تقويم

1,001 Tips for Orthodontics and its Secrets

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Senior Managing Editor: Kevork Topalian

Original edition in Spanish:
1.001 Tips en Ortodoncia y sus secretos
ISBN: 978-958-8328-02-7

English edition 2008
1,001 Tips for Orthodontics and its Secrets
ISBN 978-958-8328-46-1

English translation: Marco Grimshaw

Layout: Gregorio González

Impreso en Colombia por: D'vinni S.A.

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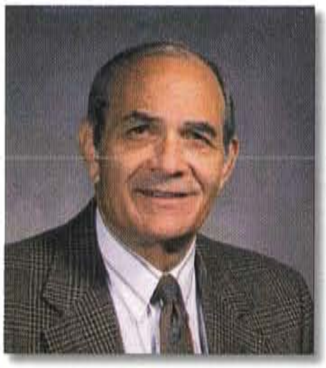

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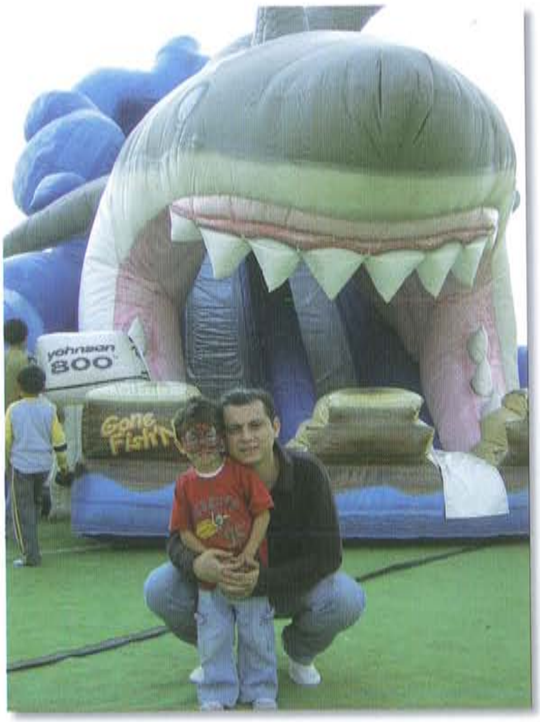
Acknowledgments

- To my wife Ericka, with all my love and caring, to my parents Ezequiel and Edith and to my brother Oscar and my sister Sonia. All of them an example to me.
- To my son Alan Mauricio, whom I love with all my heart.

Esequiel Eduardo Rodríguez Yáñez



Special Thanks to

- We profoundly thank our collaborators for the time and experience they shared with us in the creation of this book. They supplied their valuable comments and observations which gave us the chance to enhance our work.

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- To our residents, who unknowingly have been for us more of a family than an excellent work team. All of you are a very important and a fundamental part in the creation of this book. It is yours. Thank you with all our hearts.

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- To our "second home", the orthodontics department at Centro de Estudios de Ortodoncia del Bajío (CEOB), for letting us use the facilities and the unconditional support that we always have received.
- To our friends William Riaño and Rafael Cortés for the blind faith that they have always had in us.
- To Doctors Narciso Domínguez Anda, Vladimir Ramírez Montes y Francisco Fuentes Vázquez for their great ideas and bright commentaries.
- To Dr. Francisco Silvestre Sánchez, exclusive distributor of GAC, for his wise advice and support with didactic and orthodontic materials.

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Prologue

If writing a book is no easy task, to try to analyze its contents is not a bit easier, even more when one can observe there the reflection of the teachings of many individuals or read between the lines how many references the author had to consult and review in order to transmit his ideas, an amalgam of knowledge that throughout the years had been maturing. This information compilation, set in an orderly fashion, is what allows us to enjoy its lecture.

Now then, when we review books, we can come across some that we read only once and some that have become part of our reference library, those we always keep at hand for permanent consultation. In my opinion, "1,001 tips for orthodontics and its secrets" will be one of those books that upon opening will introduce us in the basic biomechanical principles that we always must keep in mind. Then, in the second chapter we can appreciate how the management of anchorage is a fundamental part of treatment, it plays a preponderant role in the different mechanics that are exposed and how we can vary the type of anchorage depending upon the necessities of each case in particular, exemplified with the different auxiliaries that allow us to obtain our objectives, from minimal anchorage to the use of mini implants for the consecution of the almost utopist absolute anchorage.

In later chapters we can relish upon the superb exposition of different techniques that will help us make decisions in the solution of different problems, from space closure, passing through the therapeutic focuses of open and closed bites, the treatment of anterior and posterior cross bites, dental and skeletal through the polemic distalization.

The different types of habits, their probable causes and the effects they can produce, and the varieties of appliances that can be used for their interception are exposed, from the well known crib to the modern trainer.

A subject not frequently mentioned in orthodontic books refers to lesions and urgency treatments that may happen during orthodontic treatment and how to manage them mechanically and therapeutically. The subject is well managed in this text and clearly orients the professional about a series of everyday problems that may be encountered and sometimes we do not have at hand the alternative of a solution.

And ending with one of the most important treatment phases in the success of any treatment, there is "Retention", where we can find different techniques from the classic Hawley to the most modern and recent retention systems.

In few words, the content of this book is an arsenal with the best secrets to lead us through and to a successful treatment; it is all written here, now its up to the reader to take advantage of this superb text.

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Preface

The book 1,001 Tips For Orthodontics and its Secrets has been written in a simple and didactic way for easy reading and understanding, ideal for the dental student, orthodontic resident or specialist. The book has a stock of more than 1,000 clinical photographs in which we explain "different methods to do the same thing" meaning that we point out many ways to close, open or uncross a bite. We include different molar distalizers, how to provide anchorage or how to close spaces; in this manner, multiple treatment options are shown for an identical problem, orthodontic or orthopedic in nature.

Our book consists of ten chapters, which we will describe briefly:

Chapter 1. Action and reaction. In an informative and straightforward approach we:

- Describe how and why teeth move orthodontically, and the effects at bone and dental levels.
- The three laws of Newton and their clinical application during orthodontic treatment.
- A simple and easy description on how to understand the physics laws that we utilize in an orthodontic treatment. The use of forces, resultant forces, coplanar forces, center of resistance, center of rotation, moment, types of dental movements and their physiology, dental equilibrium and first, second and third order bends are clearly explained.

Chapter 2. Anchorage. In this chapter we examine the different types of anchorage utilized during orthodontic treatment, such as when to use minimal, moderate, maximum or absolute anchorage, their advantages, disadvantages and recommendations for each one.

Chapter 3. Space closure in orthodontics. We present a whole array of different modalities for dental space closure, from the classical elastic chain to the use of coils, wire bends and retroligatures. We also describe the forces produced by each of these additions, in the case they can be used, the advantages, disadvantages and recommendations of each one.

Chapter 4. Deep bite. Description of the different types of deep bites and their etiology, and the possible treatment plans for correction. We mention here why and how to use a bite plane, the use of bite ramps, bypass, why should braces be bonded near the incisal edge to help correct this problem, when to use an intrusion bend or a Tip back, how to use and how can reverse curves help us to correct a deep bite, the use of in-block intrusion arch wires like the intrusion arch of Dr. Oscar Quiroz, the utility arch wire, the CIA and intrusive arches with loops. All these additions have advantages, disadvantages and recommendations, which are clearly explained.

Chapter 5. Open bite. This is one of the most difficult types of malocclusions to treat because it has a high relapse rate. As in the *deep bite* chapter, we describe the different causes and the different types of open bite, and their possible treatments. We discuss how we use in block extrusion bends or in an individual manner, the benefits of palatal plates and the advantages of using reverse curves on the maxilla and a curve on the mandible in order to close an anterior open bite; why brace bonding near the gingival margin helps us, cases in which we can use an individual or In block By-pass, the use of an inverted tip back, the treatments in which we must place cribs or reminders for tongue habits and cases that require tongue or maxillary surgery.

Chapter 6. Cross bite. In this chapter we will analyze the different methods of correction of anterior and posterior cross bites, and their etiology. We review in a meticulous manner the ideal moment to implement orthopedic appliances for the correction of a cross bite, in which we mention the Face Mask, the Modified Tandem, the mini maxillary protractor, the Camacho Badillo regulator, the Tandem Loop, the Quad Helix, the Hass and the Hyrax. We also present various orthodontic options to correct a cross bite, like the use of the forward arch wire, the lingual bonding of braces, the overlay, inverted NiTi arch wires and crossed elastics. We mention all the advantages, disadvantages and indications for these additions.

Chapter 7. Distalizers. This is one of the most controversial topics in orthodontics today because these appliances can provoke alterations in the temporomandibular joint. This type of appliances are used in cases where we want to avoid bicuspid extractions. There is an arsenal of distalizers like the CEOB-1, open coils, the Vlock distalizing technique, the GG distal spring, repellant magnets, the pendulum, pendex, distal jet, the Cetlin plate, the K-loop, the Veltri distalizer and the Belussi distalizer. We mention the facial and dental characteristics of the patients that are candidates for this therapy modality; we also cover the advantages, disadvantages and indications for each distalizer.

Chapter 8. Habits. Early detection of a habit in our patients may help us solve many problems and avoid future headaches. So, in this chapter, we propose different appliances in order to correct habits, like cribs, punchers, tridents, labial shields and trainers. Each one of these has advantages, disadvantages and indications which we mention here.

Chapter 9. Lesions and emergencies during orthodontic treatment. In this chapter we mention the possible solutions (analgesics, vibratory stimuli and laser) in order to avoid or diminish pain provoked by dental movement.
Orthodontic and orthopedic appliances tend to retain great amounts of dentobacterial plaque, which can provoke gingival problems; so we give alternatives in order to diminish this inconvenience, and in case they are present, how to eliminate them in a simple way with the use of dental pastes, tooth brushes, creams and topical gels.

Chapter 10. Retention in orthodontics. The success of an orthodontic treatment is based on retention. We cannot place the same retainer in all finished cases, that is why in this chapter we present various retainers (removable, fixed and invisible ones) and their different uses, advantages, disadvantages and indications. Among the removable retainers we mention the Hawley, the circumferential retainer, the elastic circumferential retainer, the Van der Linden retainer, the Sarhan, the spring aligner and the Coregg. Amid the esthetic retainers we will analyze the Osamu retainer, The Essix "A", Essix "C+ and the reinforced Essix. Finally we will analyze the prefabricated fixed retainers and the made-to-fit on the patient fixed retainers.

We are very proud to present this book, but what is really rewarding to us is the fact that the book was developed largely by our residents and ex residents of Centro de Estudios de Ortodoncia del Bajío (CEOB), who, thanks to their enthusiasm, brotherhood and support, have turned into a great family.

The author.

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Action and Reaction 1

Esequiel Rodríguez, Larry White, Rogelio Casasa, Adriana Natera

Introduction

In order to have success in an orthodontic treatment, two factors must be combined: a good treatment plan and excellent biomechanics. If these two objectives are fulfilled, the orthodontist will have the foundations to perform a satisfactory and efficient treatment. These biomechanical principles are contemplated within a part of Engineering called Mechanics, which describes the effect of forces on objects (teeth and bone) divided in three areas:

1. Static
2. Kinetics.
3. Materials Resistance.

Static describes the effect of forces over still objects at a constant speed (in a straight line).
Kinetics describes the behavior of objects that suffer shifting speeds (acceleration and deceleration).
And finally, Materials Resistance describes the relation between force and tension among these, allowing us to select the ideal materials in order to apply a force.[3]

The basis of orthodontic treatment consists in the clinical application of biomechanical concepts. The term Biomechanics refers to the part of Mechanics that studies movement in relation with biological systems.[11] Biomechanical principles explain the mechanisms of action of the orthodontic appliances and of the force system utilized for dental movement. Common sense use of these concepts will lead to obtain more predictable, efficient and stable treatments.[4,11,14]

The Mechanics principles and Static design are universal for all orthodontic appliances and do not change with time. When the physical principles of fixed or removable appliances are understood, it is possible then to have enough knowledge to build and place a determined appliance. Whoever gets to understand how these physics principles work, will be able to design, select and use orthodontic appliances for greater benefit of the patient.[1]

Many different designs in appliances, methods, and philosophies are used, but we use forces in all of them, without them orthodontics would not exist. [13]

Laws of Newton

In 1686, Newton presented the fundamental laws of Mechanics, their applications and results.[3] The three laws of motion are the following:

1. *The law of inertia:* Every body continues in its state of rest or uniform motion in a straight line unless it is compelled to change by the forces impressed on it (body in equilibrium).[3] A dental malposition can never resolve itself spontaneously; because of this, forces must be applied in order to obtain movement. [13] In orthodontics we can state that teeth tend to remain almost motionless, unless there is a force applied to provoke tooth displacement.[14]

2. *The law of acceleration:* The change in motion is proportional to the motive force impressed and is made in the direction of a straight line in which the force is impressed.[3] In orthodontics we can apply diverse forces with different intensities; it all depends on the tooth that we want to move.[13] Said in another way, we can affirm that teeth move in the direction of the applied force, the larger the root volume, the larger the force that has to be exerted to produce physiologic movement.[14]

3. *The law of action and reaction:* To every action there is always opposing and equal reaction.[3] The "secret" in orthodontics is to minimize or eliminate the number of secondary or collateral effects of treatment; for this to happen they must be understood and clearly identified.[13,14]

These three laws offer evident benefits to the orthodontist and the patient. If applied in a convenient manner, therapy efficiency can improve; thus, rapid and painless treatments with negligible damage to teeth and supporting tissues can be achieved with less collateral damage and more pleasing and durable results.[14]

Orthodontic appliances have a similar function as pharmaceuticals have in medicine. They both need an accurate diagnosis to be able to define an exact treatment. In medicine, the physician makes a diagnosis and then selects the proper medication to accomplish his goals. In orthodontics, the orthodontist must make his diagnosis and then select the best appliance design to reach his objectives. In pharmacology, medicines are used to act upon cells, tissues and specific organs. In orthodontics moments and forces are used to act upon cells and specific tissue that support teeth and bone. The collateral effects of medicines are unavoidable and must be well managed. Secondary effects are also produced during tooth movement and should also be recognized and managed with care. When such effects are known beforehand, precaution measures can be taken to counter these harmful effects, which in some instances can be managed to our benefit. Finally, in orthodontic appliances as in medicine the efficiency depends upon the degree of cooperation of the patient.[1,11]

What is force?

Force is an action exerted by a body (wire, coil, elastic, etc.) over another body (teeth or bone). It expresses itself as mass times acceleration (mass x acceleration) and is a vector that presents:

1. Intensity (measured in g).
2. Sense/Direction (straight or angular). The latter is included between the straight line and an axis of reference.
3. Modulus (sense or direction of the force). [13]

A force is also defined as a vector with magnitude and direction. The correct unit for force expression is the Newton (N). But in orthodontics forces are expressed normally in g. The conversion factor from g to Newtons is 1g=0.00981N, or 1N=101.937 g. [1,14]

This vector is graphically defined by an arrow, indicating the direction of the force (bucco-lingual, mesio-distal, etc.) and the line of action, (where the force is going). The force direction (from buccal to lingual, from mesial to distal, etc.) is defined by the point of the arrow. The vector also shows us the force magnitude that is proportional to the length of the body of the arrow; the point of force application is indicated by the origin or tail of the arrow. [11,14]

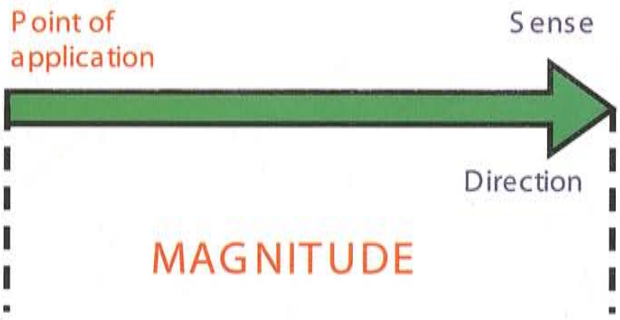


Fig. 1. The vector is used to represent force graphically.

The units employed in orthodontics are force and distance. Force is defined, as previously mentioned, as the action of a body (wire) over another body (tooth) that changes or tends to change the way the second body moves, due to a push or traction. In the metric system it is measured in g or g x mm^2, depending if it is considered shear force or force times surface unit (pressure).[3]

Sometimes we do not work in orthodontics with a single force, frequently two or more elements add up.

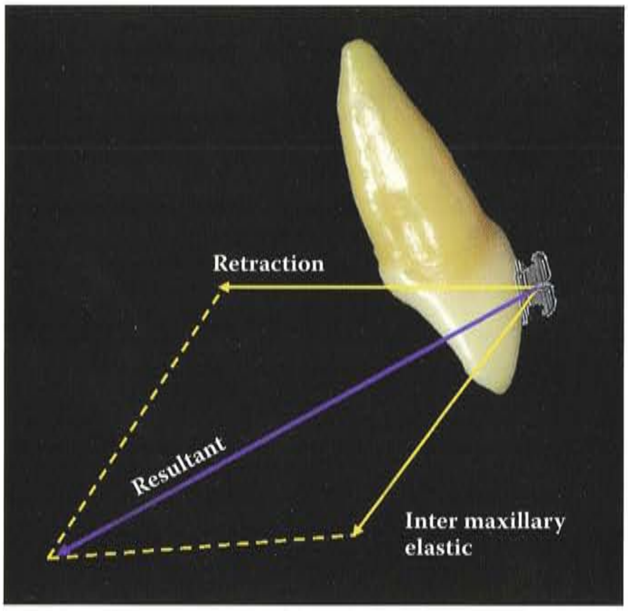


Fig. 2. In this Figure an upper central incisor is simultaneously submitted to a retraction force and to the action of a inter maxillary Class II elastic. Both forces will form both sides of the parallelogram and the diagonal line will represent the resultant of the applied forces.

In these cases we can use the Parallelogram law, which determines the resultant of two forces applied over the same point.[14]

What is the center of resistance?

The center of resistance is the point a force has to pass through in order to move an object freely in a linear manner. Said in another way, every free body has a point known as mass center, therefore, every time that the line of action of a force passes through de mass center of a free body will suffer a translation movement.[11,14]

A tooth in the mouth is not a free body because periodontal support tissue does not let it move freely. The center of resistance is equivalent to the mass center for free bodies. Any force that acts through the center of resistance of a tooth makes it translate in a bodily manner.[1,11]

The center of resistance of a tooth depends on the length and morphology of the root, the number of roots and the level of support of the alveolar bone.[11]

The center of resistance for a single root tooth with a normal level of alveolar bone is situated between the middle and cervical third part of the root, meanwhile in a multiple root tooth the center of resistance is located at one or two millimeters apical from the furcate.[11,14]

Because braces can only be bonded on the crowns of teeth, there are very few opportunities in which it is possible to apply a force that can act through the center of resistance of the tooth to produce pure dental translation (excepting power arms. Please refer to the Space Closure chapter).[1]

What is the Center of Rotation?

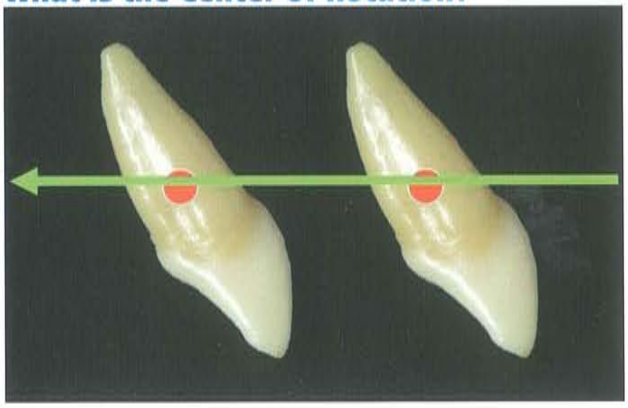


Fig.3. Any force acting through the center of resistance of a tooth will make it translate in a bodily manner.

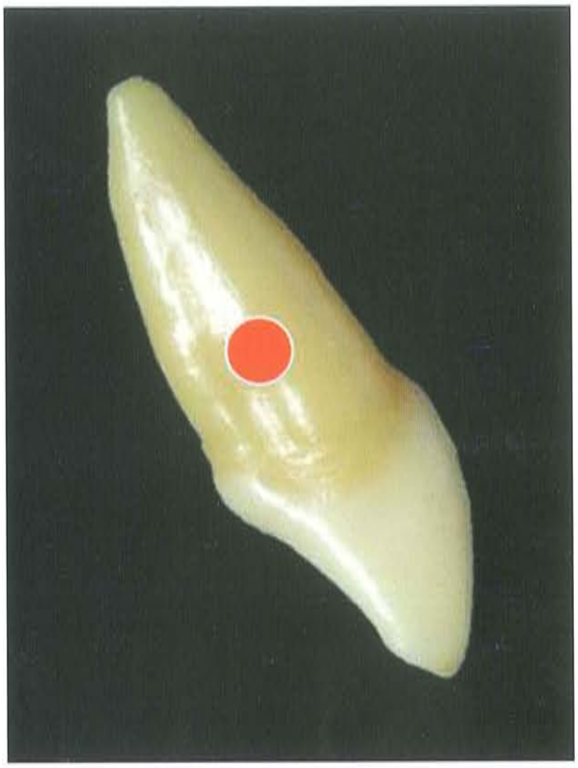


Fig. 4. Center or resistance of a single root tooth,

Fig. 5. Center of resistance of a molar

The center of rotation of a tooth is the arbitrary point located at a distance from the center of resistance on which a tooth is going to turn around if a force is applied.

The center of rotation can be very close, but it will never coincide with the center of resistance. In orthodontics, when the rotational process occurs along the larger axis of the tooth it is called rotation or first order dental movement (in-out movement).

When rotation occurs around the mesiodistal axis it is called angulation or second order dental movement (Tip).

if it happens around the buccolingual axis, it is called torque or third order movement. [1]

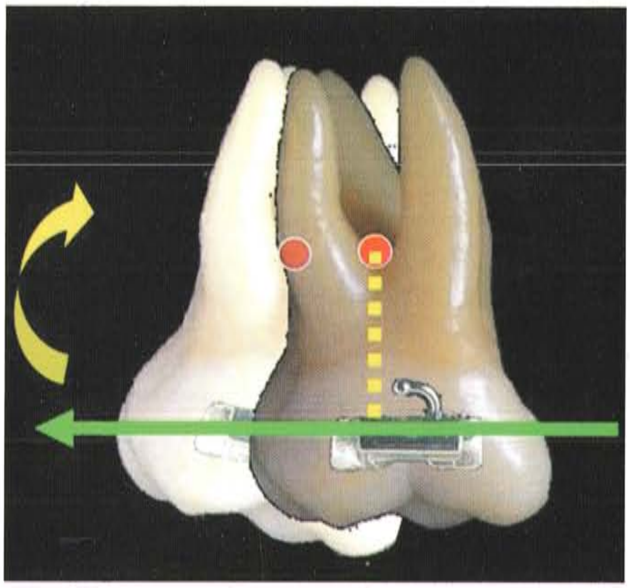


Fig. 8. Second order movement.

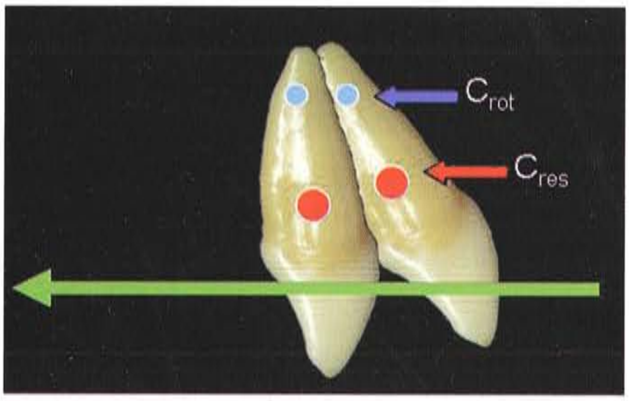


Fig. 6. Center of rotation.

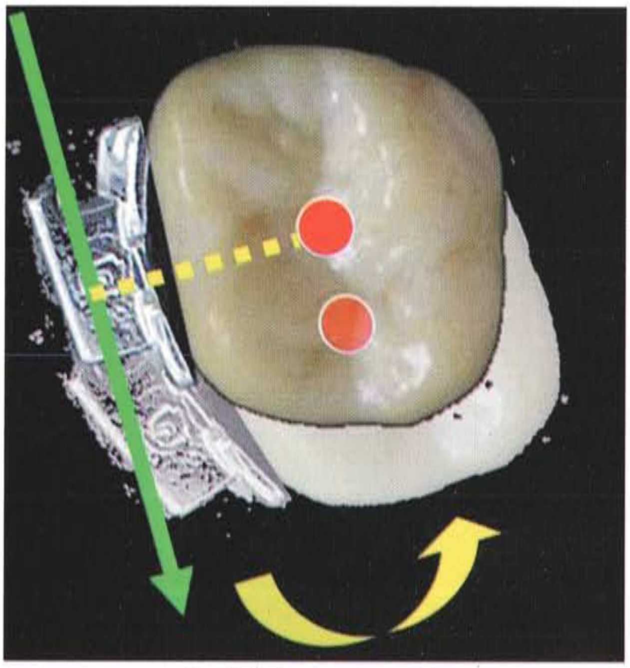


Fig. 7. First order movement.

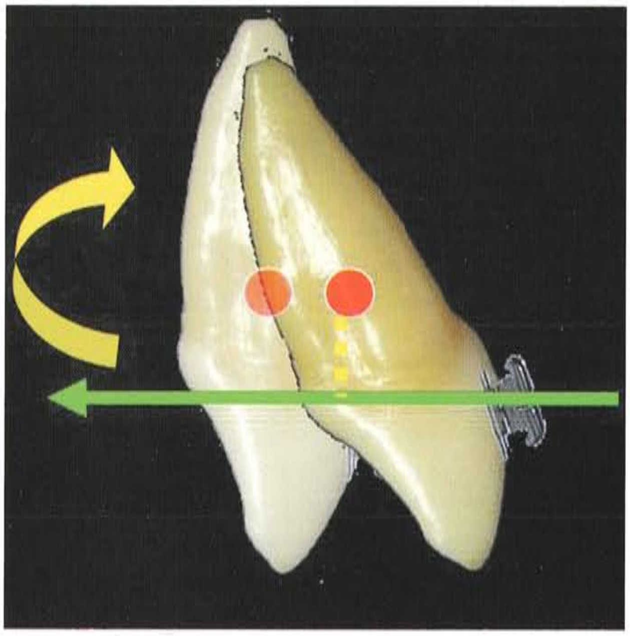


Fig. 9. Third order movement.

What is a moment?

A moment is produced when the line of action of a force passes along the center of resistance provoking a tendency to rotate; said in another way, a force applied on a brace that does not act through the center of resistance provokes the rotation of the tooth.[14] A Moment is the result of a force times distance. When a force is applied on braces and it does not pass through the center of resistance of the tooth, a distance is produced between the line of force and the center of resistance of the tooth. This distance (in a perpendicular way) is the cause of moment in the tooth, giving dental rotation as a result.(5) The measuring unit for a moment is g x mm^2 and the graphic representation is a curved arrow that in 2-dimensional diagrams can be drawn clockwise or anticlockwise.(14)

Every force that passes through the center of resistance will not produce a moment; furthermore, the body will translate without any type of rotation; the greater the distance between the center of resistance to the line of force, the greater the moment that will be produced.

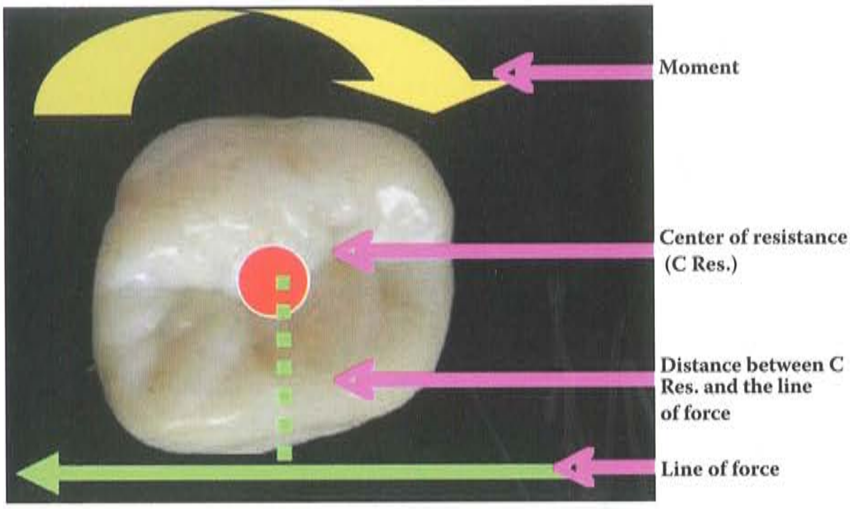


Fig. 10.

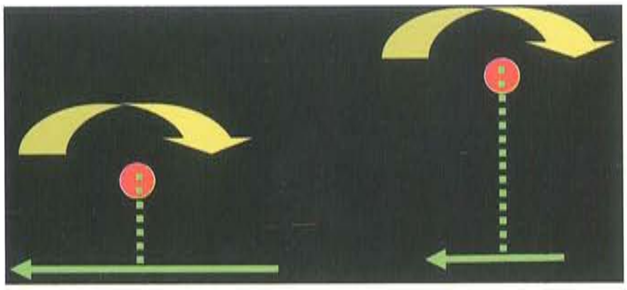


Fig. 11. Independently that the force magnitude is doubled and the distance to the center of resistance be reduced by half, or that the distance is duplicated and the magnitude of the force diminished, there will always be a tendency to produce rotation.

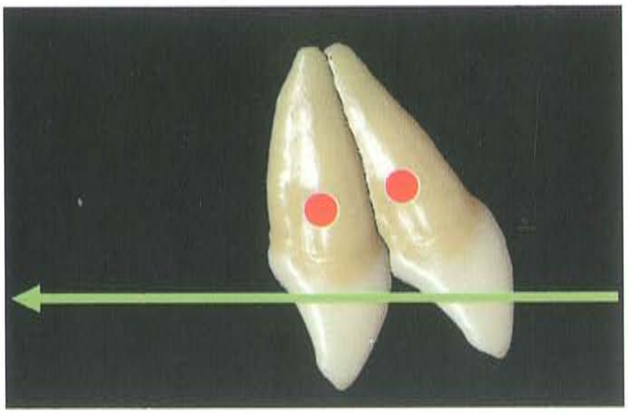


Fig. 12. When the force line passes away from the center of resistance a moment happens and the tooth tends to rotate.

Dental movement physiology

Dental movement is produced as a result of a biological response to the physiologic reaction toward forces applied by our mechanical procedures. So when we design our appliances it is very important to evaluate the forces that they will generate during treatment. (12)

Teeth are united to the maxillary bones by a peculiar type of joint, the dentoalveolar joint, different from any other present in the rest of the human body. This union is done by the periodontal insertion, represented by dental cement, periodontal ligament and alveolar bone. The periodontal ligament occupies a space of approximately 0.5 mm between the alveolar wall and the tooth cement and it is responsible for the dental joint. It is made out of collagen fibers that insert themselves in the root cement and in the alveolar bone intermingling with blood vessels, cellular elements, nerve endings and interstitial fluids.(14)

Blood vessels are responsible for the periodontal ligament nourishment, and will provide a way of access for the cells responsible of bone remodeling. Existing nerve endings will transmit pressure sensation and proprioception. Periodontal fibers and interstitial fluids will provide together, during brief time periods, an effective physiologic force dissipater and shock absorption system.(3)

When a force is applied to a tooth, it dislocates itself in the interior of the alveolar space, stretching some periodontal fibers and compressing other periodontal fibers. Simultaneously, the liquid that fills the spaces between the fibers is compressed against the bone walls provoking a hydraulic resistance to tooth movement.(3) At this moment, the load is transferred to the alveolar bone and due to its porosity, the interstitial liquid drains toward neighboring tissues, diminishing the hydraulic pressure. This way, the root gets even closer to the alveolar wall, compressing the periodontal ligament closer to the side the force was applied upon and stretching the ligaments on the opposing side. The vascular system, that occupies 50% of the periodontal space, is compressed, and makes circulation difficult on the tension and compression areas.[14]

At this moment, an inflammatory tissue response is produced increasing blood vasodilatation and promoting prostaglandin production in order to increase blood irrigation, stimulating the exit of monocytes that will fuse with one another, by doing this, multinuclear cells called osteoclasts will be originated, these are responsible for cortical alveolar resorption whenever periodontal ligament is compressed. On the side where distention of the periodontal ligament fibers is occurring, undifferentiated mesenchyma cells transform into osteoblasts and fibroblasts, which are responsible of forming bone tissue and collagen fibers respectively. When blood flow is limited, teeth do not move or they move slowly. Intense forces may limit the physiologic response and can affect the rate of dental movement.[12]

Dental movement begins two days after the force is applied. This movement stimulates osteoclasts and osteoblasts to begin the bone remodeling process with apposition on the periodontal fiber tension side and resorption on the compressed periodontal ligament side. Slowly the alveolus dislocates in the direction of the applied force, with orthodontic movement as a consequence.[14]

Brian Lee, following the works by Storey and Smith, evaluated the optimal force for canine retraction. In his study he proposed that 200 g/cm^2 of exposed root surface to movement was the optimal pressure to apply In order to obtain an efficient dental movement.[7]

Taking into consideration that force times surface unit is defined as pressure, the force applied must differ depending on the size of the root surface and the direction of the planned movement.

The mesiodistal size of the root surface is evaluated when the tooth is moving in an anteroposterior direction. The buccolingual size of the root surface is evaluated if the tooth is going to be moved in a transverse direction. When intrusion or extrusion of teeth is planned, the cross section of the root surface is evaluated.[12]

According to Ricketts, the optimal force for dental movement is 100 g/cm^2 of root surface exposed to movement (please refer to Space Closure chapter. Table of Ricketts).[12]

Types of dental movement

Dental movement can be classified in many ways:

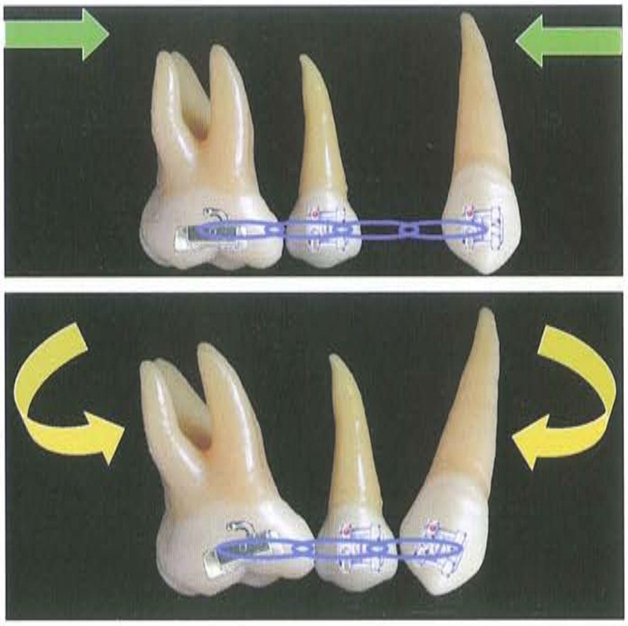
1. Inclination:
   a. Uncontroled inclination.
   b. Controlled inclination.
2. Translation.
3. Root displacement.
4. Rotation.[11]

1. **Inclination:** Is the movement in which the crown of the teeth suffers greater displacement than the root of the tooth. This can be classified according to the location of the center of resistance:

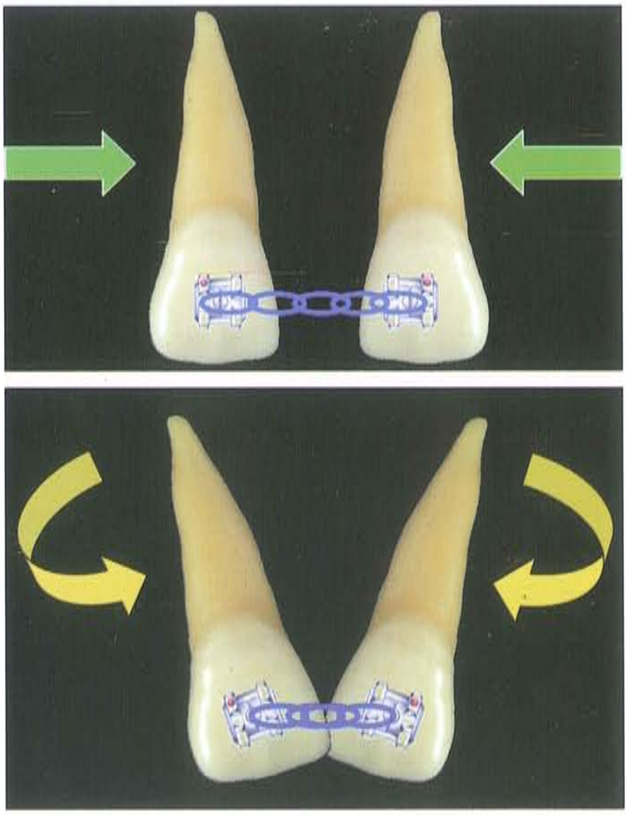
   a. **Uncontrolled inclination:** This type of inclination happens when the center of rotation is between the center of resistance and the apex of the tooth. This movement can be obtained by any orthodontist, but is usually not wanted. This uncontrolled inclination happens when we have a round arch wire in the slot of the brace and force is applied to the tooth.[3,11,14]

Fig. 13 Uncontrolled inclination.

Another way to produce uncontrolled inclination is with the use of elastomeric power chains in order to close spaces.



Figs. 14 and 15. Uncontrolled inclination during space closure. The force is placed on the crown, and because there is no other force to counter react, a moment is produced and this provokes all teeth to rotate over their center of rotation.



Figs. 16 and 17. Uncontrolled inclination of the incisors during space closure with elastomeric power chain on a round arch wire. The force is placed on the crown, and because there is no other force to counter react, a moment is produced and this provokes both teeth to rotate over their center of rotation.

When an elastomeric power chain is placed from a molar to a canine, with a round arch, the outcome is an inclination (moment) of the crowns toward the space; meanwhile the roots will become completely divergent. This happens because the force is applied on the crown, away from the center of resistance.

b. **Controlled inclination:** This is a wanted movement; it is obtained with the application of a force to move the crown, and the placement of a moment in order to control or maintain the position of the root apex. An example of this inclination is when we want to retract the anterior sector without moving the location of the tooth apex. This is obtained with rectangular arch wires. When we softly insert the wire in the slot of the brace, It counteracts (torque) part of the moment caused by the dental retraction.[3,11,14]

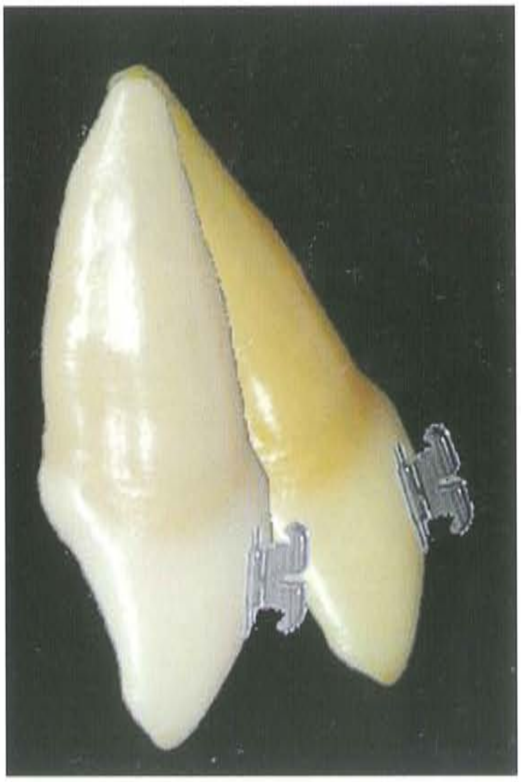


Fig. 18 Controlled inclination. The rotation center is near the apex of the tooth.

2. **Translation:** Is one of the most difficult movements in orthodontics. It is also known as in-mass or bodily movement. Happens when the crown and the dental apex are horizontally displaced. This is only possible when the line of action of a force passes through the center of resistance of the tooth. We obtain this type of movement with the use of power arms, which allow the line of action of the force to pass directly through the center of resistance.[1,3,11,14]

As it was previously mentioned, translation is one of the most difficult movements to achieve in orthodontics. This is caused by the anatomical characteristics that surround teeth that make the application of a force through the center of resistance very difficult, so pure translation is hard to obtain. Although in a high percentage of cases, each time we want to move a tooth in a bodily manner, it will not translate, instead it will tend to rotate slightly in the direction of the exerted force, because the force is away from the center of resistance of the tooth, so we will have translation and rotation of the tooth.[5]

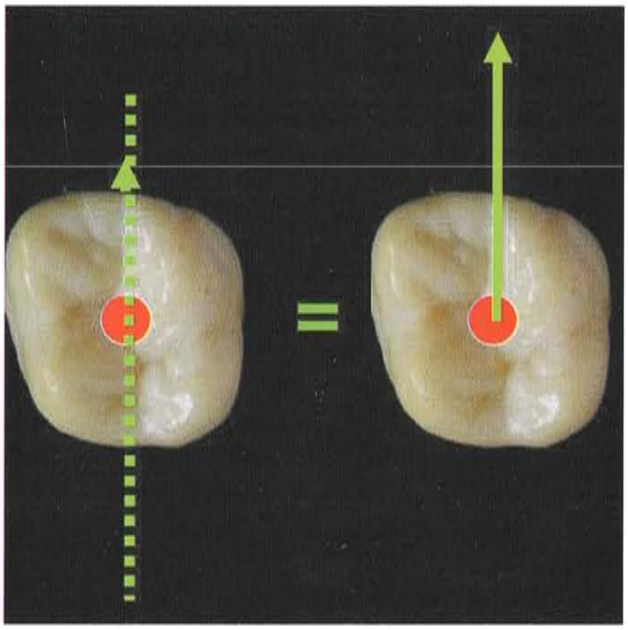
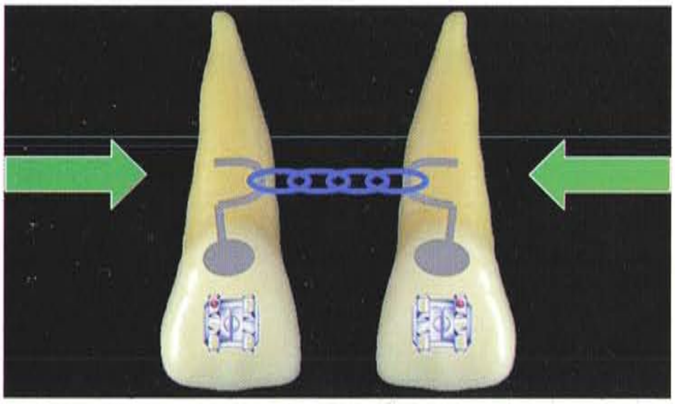
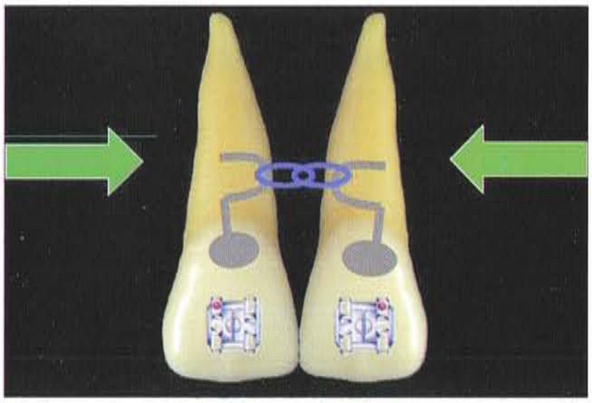
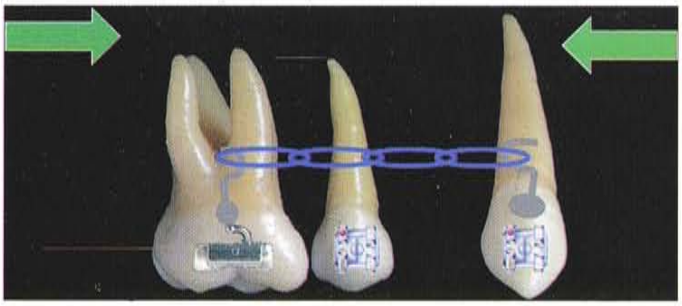


Fig. 19. When the force passes through the center of resistance of a tooth, no kind of rotation is created and translation is accomplished.[5]





Figs. 20 and 21. Space closure with power arms allows a pure translation movement, because the force is applied at the level of the center of resistance of the incisors.



Figs. 22 and 23. During space closure we can also create translation movements when the force is applied through the center of resistance of the teeth, in conjunction with rectangular arch wires that help counteract the Moment.

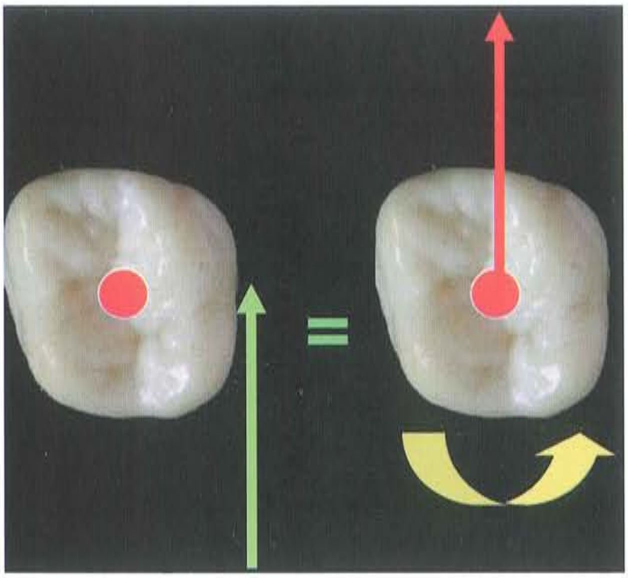


Fig. 24. All force exerted far from the center of resistance of the tooth will tend to translate and rotate the tooth.

3. **Root displacement:** In this movement a Moment and a force are applied to displace only the root, meanwhile the dental crown is not displaced. This is the best movement to alter the longitudinal axis of the tooth without altering the incisal edge of the tooth. Root displacement is commonly used to torque incisors, to upright canine roots after space closure, upright posterior teeth that are mesially inclined, etc.[3,11,14]

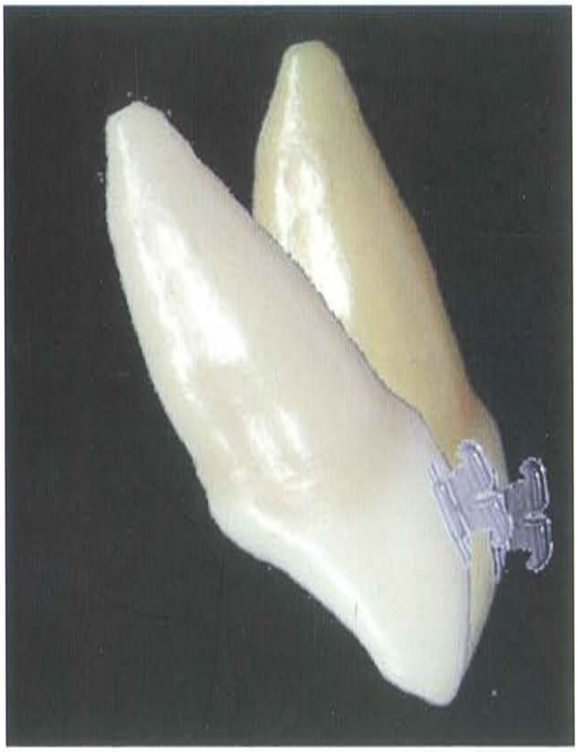


Fig. 25. Root displacement without alteration of the position of the crown (torque).

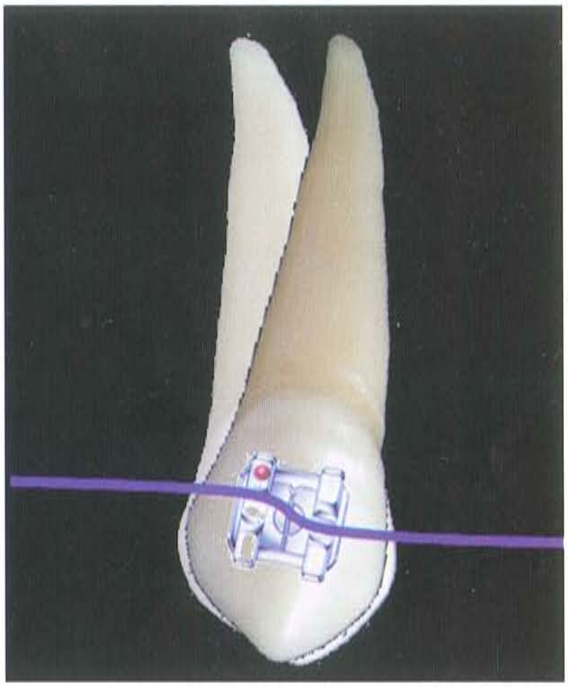


Fig. 26. Canine root uprighting after space closure.

4. **Rotation:** To make this movement a couple or coplanar forces are required, which can produce a pure rotation around the longitudinal axis of the tooth (seen from the occlusal view).[3,5,11,14]

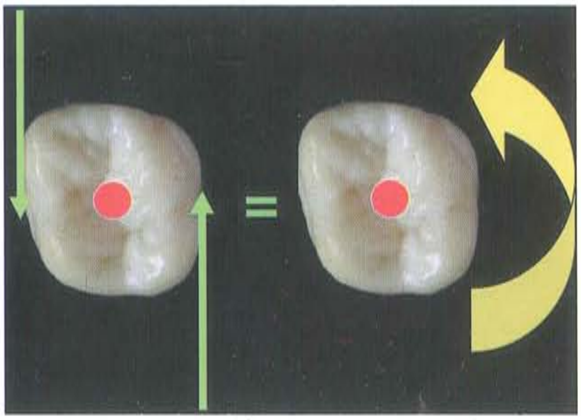


Fig. 27. Two equal forces that act upon a tooth but in opposed direction tend to produce pure rotation.

What is a couple?

A couple is defined as two parallel forces of the same magnitude but in opposite directions. This is the only force system capable of producing pure rotation of a body around its center of resistance.(14) In this case the tooth maintains its position because both forces annul each other since both lines of force act at a same distance perpendicular to the center of resistance, leaving only the pure Moment (pure rotation).(5)

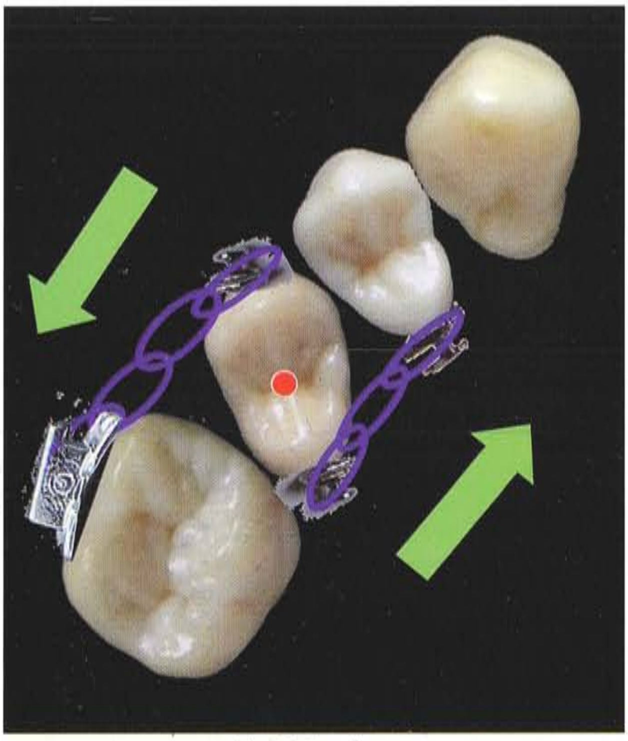


Fig. 28. Couple.

Clearly understanding the basic concepts of orthodontic biomechanics and the physiology of dental movement, we shall now analyze the different actions and reactions that can happen during the different stages of orthodontic treatment and select, apply and control in an efficient manner the force systems that will be utilized.

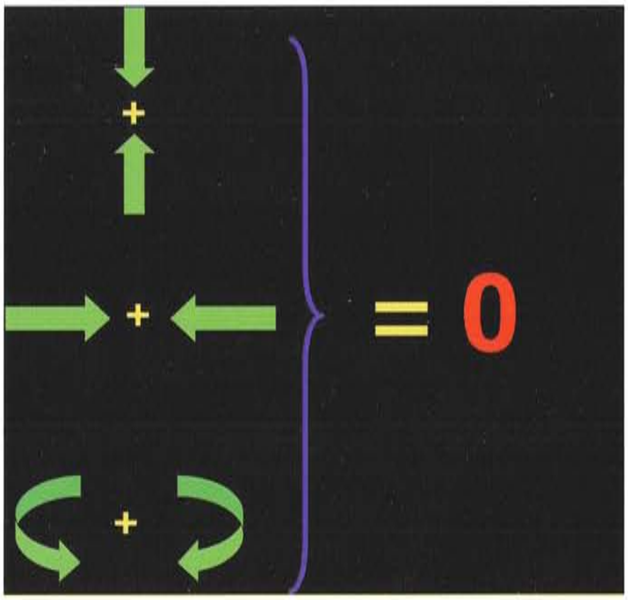


Fig. 29. Static equilibrium.

¿What is static equilibrium?

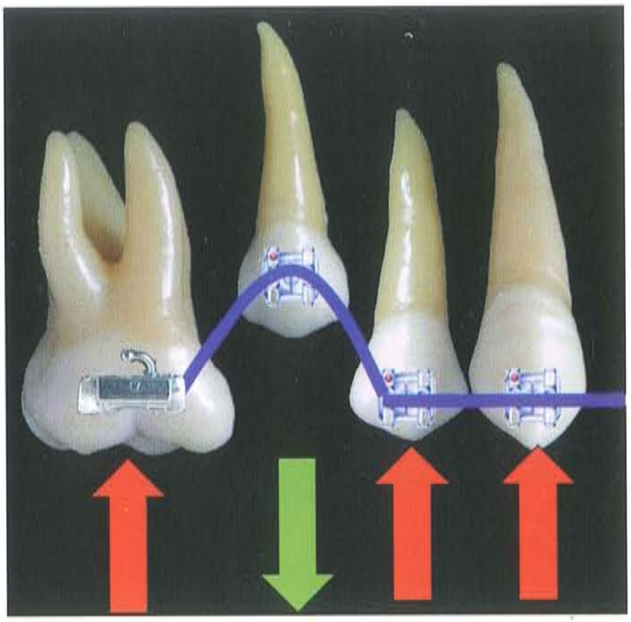
In order to have static equilibrium in an orthodontic system, three basic criteria must be met:

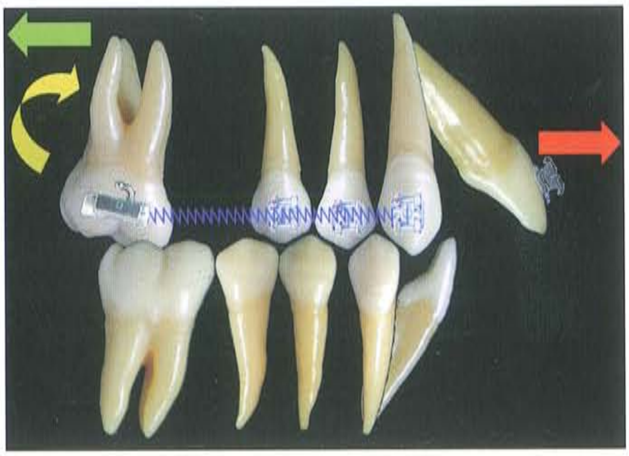
1. That the sum of all *vertical* forces that act in the system be equal to 0.
2. That the sum of all *horizontal* forces that act in the system be equal to 0.
3. That the sum of the moments that can act in any point be equal to 0. (6,11)

ACTION AND REACTION

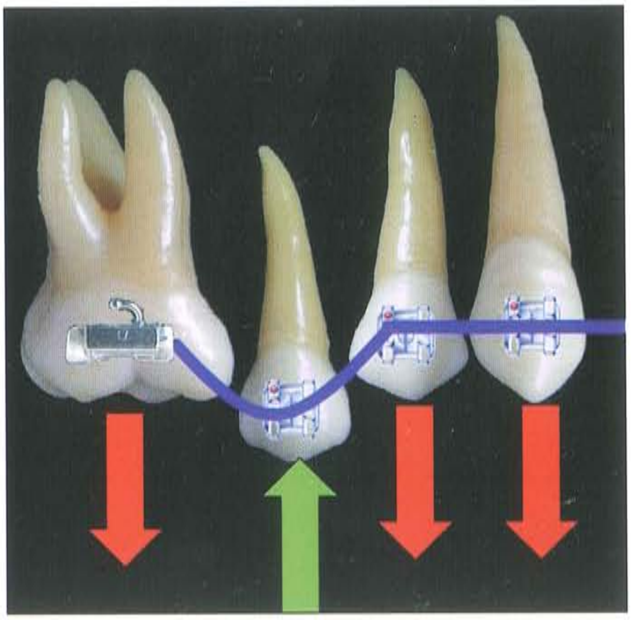
The third law of Newton applies in almost all orthodontic movements; the law of Action and Reaction, which states that to every action there is always opposing and equal reaction. Sometimes the reaction to a movement results in an unwanted movement.

Another example of the third law of Newton would be when we want to align intruded or extruded teeth, where the same force produced to make these movements will be applied on the surrounding teeth provoking a movement in opposite direction to the one we want to produce.





Figs. 30 and 31. An example of the third law of Newton (Action and Reaction) would be when we want to distalize a molar with NiTi open coils. The molar distalization is accomplished, but the same force applied backwards to distalize is applied on the buccal segment, not only provoking distalization and molar tipping, but also proclination of the buccal segment.[8]



Figs. 32 and 33. The intrusive and extrusive forces that we want to use for the correct alignment of the canines will provoke in the surrounding molar, premolars and canine forces of the same magnitude but opposing direction.

In order to determine the action of a bend, we must know where we are going to put it, this way we can identify what type of forces are going to be applied and the moments we can expect with the bends on a determined group of teeth.

The easiest way to determine the direction of a movement of a bend made on an arch wire is to put it in a passive manner in the slots of two braces, and we will observe where the arch is headed to, so that when we activate the wire, placing it in the slots, we can predict the direction of the movement to take place. [1]

In these images we can observe the direction where the arch wire is going when it is placed in the slot of the brace of the central incisor in a passive way, and what movements we can expect once the arch is activated. In this case, as soon as we insert the arch in the slot of the brace on the lateral incisor, this tooth will be intruded and the central incisor will extrude (action and reaction: third law of Newton).

In the next set of images, the same case is presented but seen from another perspective; the arch wire is passive in the slot of the lateral incisor and the bend is over the brace of the central incisor; when activated, it is going to produce the same movements, extrusion of the central incisor and intrusion of the lateral incisor.

Fig. 34. Passive bend.

Fig. 35. Bend out of mouth.

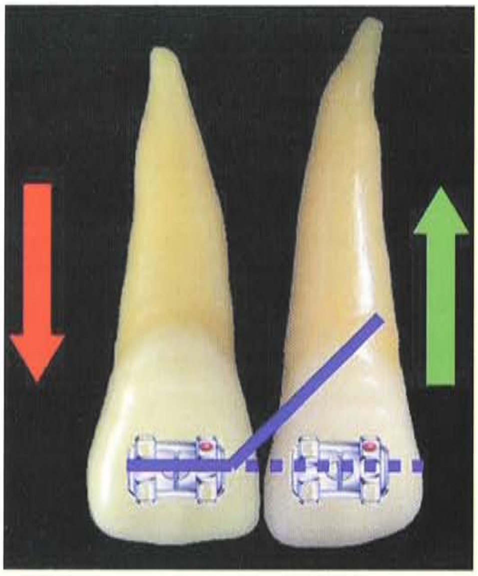


Fig. 36. Active bend.

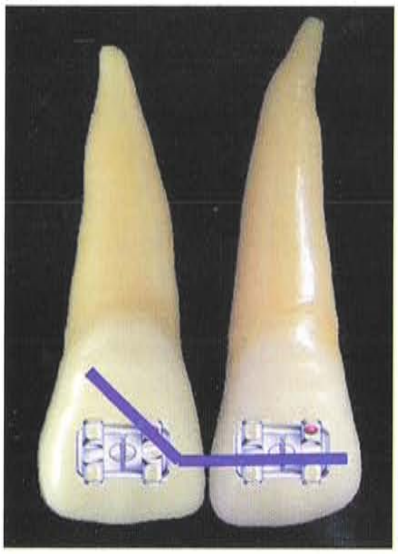


Fig. 37. Passive bend.

Fig. 38. Bend out of mouth.

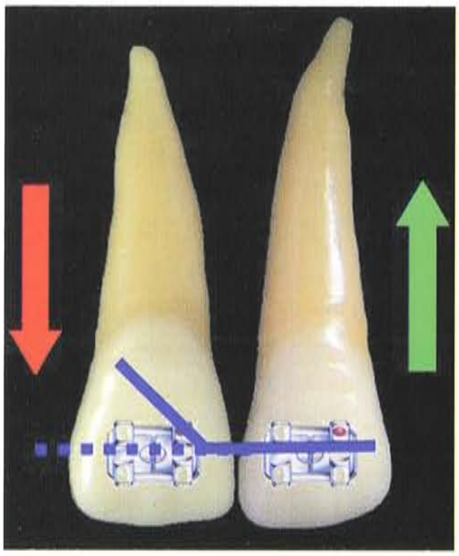


Fig. 39. Active bend.

Both examples are useful in order to predict the direction of dental movements produced by the forces of the arch wire. Now we have to know where to place the bend so we can identify over which teeth we want to place the force.

If a bend is located far from the center of the arch wire, we will have two segments, a short one and a long one, that will produce equal forces in different directions. When the short segment of the bend is inserted in the tube, the long segment will indicate us the direction of the force produced over the teeth that are going to receive this

Fig. 40. In this case, the short segment of the wire once inserted in the molar tube will indicate us that the force exerted on the incisor area is an intrusive force and extrusive in the molar area, being the molar the one with a greater Moment.

segment. In this case, what is produced is what we call force equilibrium, where equal and opposed forces with different moments take place, being the greater moment the side that receives the shorter segment of the bend. [1,4,7]

On the contrary, if the bend is located in the center of the arch wire, between both teeth, the forces that are produced cancel one another when the wire is inserted in the slot of the braces. In this case the system is in equilibrium, because the associated forces are equal and opposed and cancel each other. This type of centered bend is only going to produce equal moments that are going to oppose each other.[1,4,12]

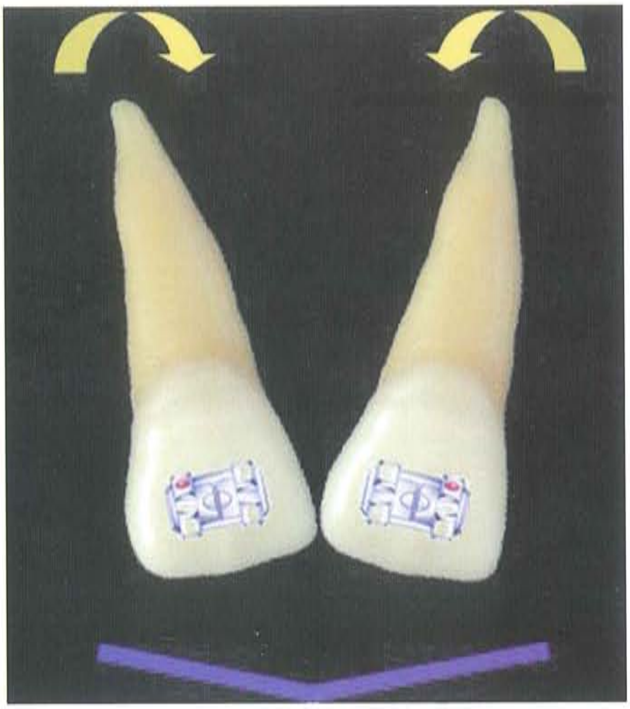


Fig. 41. This type of bend is very helpful uprighting divergent roots.

Deep bite correction with a tip back

If we utilize the tip back bend for the correction of a deep bite, it can clearly be seen that when the short segment of the bend is inserted in the molar tube, the large segment directs itself to the apical portion of the anterior zone(before being inserted in the slots of the braces of the incisors).[5] This way we know that an intrusive force will be produced on the anterior zone and an extrusive force in the posterior zone.[1,5] Another consideration that we have to mind with the placement of bends is that the short segment of the arch wire is going to represent the anchorage side, and the long segment of wire the side of no anchorage, this is due to the fact that Moment at the molar level (short part of the bend) is greater than the one that is being produced at the incisor level, making the molar much more resistant to movement.[10]

When the arch wire is activated by placing it in the slots of the incisor braces, two moments are going to be produced, one at molar level and another at the incisor level, provoking a differential torque on both teeth.

Fig. 42. Deep bite.

Fig. 43. Tip back.

Fig. 44. At the time of insertion of the tip back in the molar tube, the large segment of wire directs itself to the apical zone of the anterior segment, indicating the direction where the forces are going to be produced.

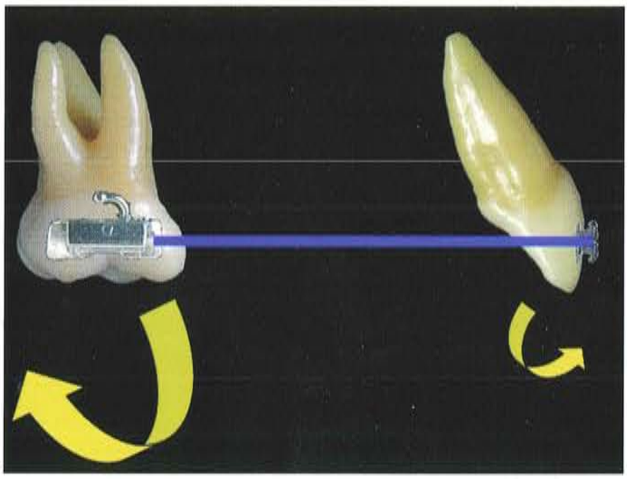


Fig. 45. Differential torque.

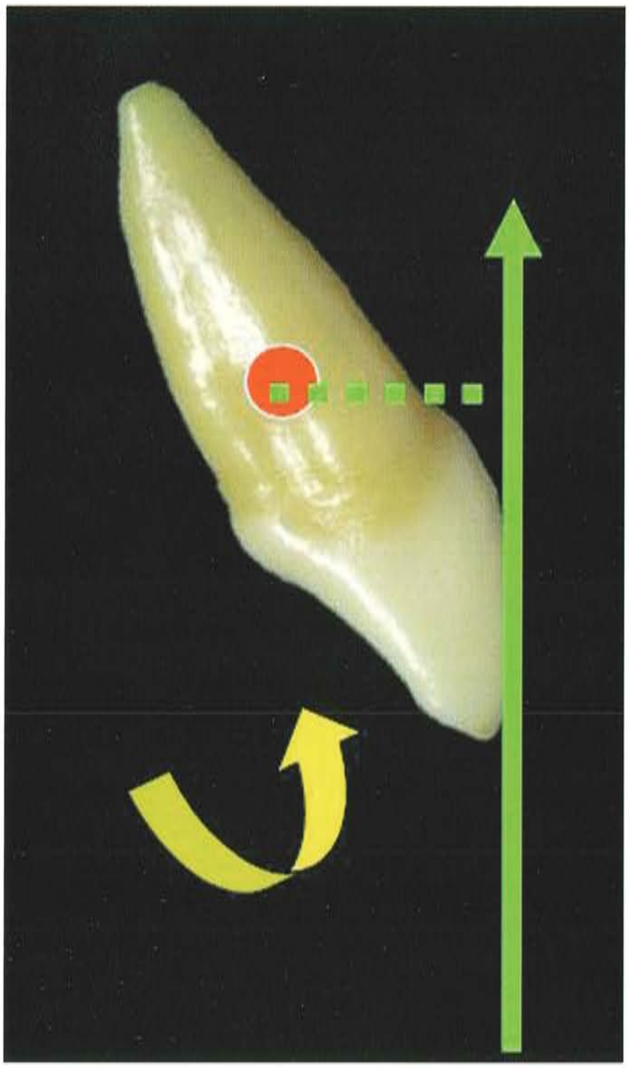


Fig. 46. The intrusive force produced by the tip back will act in a buccal manner and perpendicular to the center of resistance of the upper incisor.

A mesial root movement and a distal crown movement is going to be produced in the molars, meanwhile since the intrusive force passes buccal to the center of resistance of the incisors, the moment is going to be lower, taking the incisor to a more buccal position.[5]

Fig. 47. Tip and torque expressed in the molar and the incisor. A slight molar extrusion is produced that together with the tip back bend helps the opening of the bite and the correction of the overbite.

Fig. 49. Tip back bend.

Fig. 50. The Tip back that is inserted in the inferior molar tube is going to produce an extrusive force at molar level and an intrusive force at the incisor level.

Once tip and torque have expressed themselves completely at incisor and molar levels, the slight extrusion that is produced with the mesial angulation of the molar is going to aid in the correction of the deep bite together with the intrusion of the anterior segment.[7]

Now then we can apply this same bend in the lower arch when the deep bite is a product of the extrusion of the anteroinferior segment, and the biomechanics of the movement will be exactly the same.

Fig. 48. Deep bite due to extrusion of the anteroinferior segment.

Fig. 51. The greatest moment will occur at the molar level where the crown will tilt distally and the roots mesially. The intrusion produced in the anterior sector will provoke a slight buccal movement of the inferior incisors.

In both cases the moment that is produced in the anterior sector, product of the intrusive force, projects the incisal edges of the incisors in a buccal manner increasing the arch length and correcting the deep overbite.[11]

Action taken

1. Apically directed Tip back.

Produced reaction

1. Molar extrusion.
2. Incisor intrusion.
3. Distal inclination of the molar crowns.
4. Mesial inclination of the molar roots.
5. Buccal movement of the incisors.
6. Increase of dental arch length.
7. Posterior anchorage.

Spee curve leveling with reverse curves

When we use reverse curves to level a deep curve of Spee, we find that the intrusive forces exercised in the anterior and posterior sectors are balanced with the extrusive forces that are exercised in the premolar region.[(6)] Another effect is that the intrusive forces are going to provoke at the molar level a positive torque and a distal inclination of the crowns and a mesial movement of their roots; on the other hand the intrusive forces exercised at the incisor level will provoke a buccal movement of these (positive torque).

Fig. 52. Deep Spee curve.

Fig. 53. Inferior reverse curve.

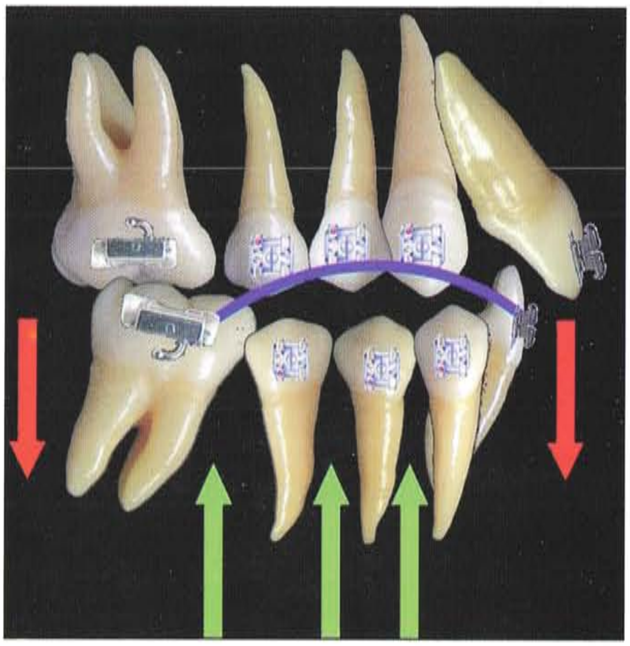


Fig. 54. The extrusive forces at the premolar level are going to be equilibrated by the intrusive forces exercised at the molar and incisor levels.

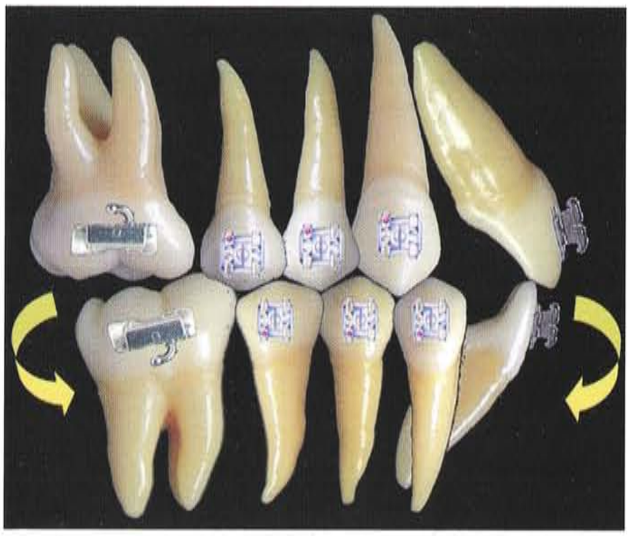


Fig. 55. The moments produced by the action of an inverse curve are evidenced at the molar level with a distal inclination of the crown and a mesial in the roots and at the incisor level with a buccal movement of them (positive torque).

Action taken

1. Use of an inverse curve in the inferior arch.

Produced reaction

1. Leveling of the deep Spee curve.
2. Overbite reduction.
3. Extrusion of the premolar sector.

4. Intrusion of the molar and the incisors.
5. Positive torque in molars and incisors.
6. Distal inclination of the crown and mesial inclination of the roots.
7. Increase in length in the lower dental arch.

Correction of a bilateral posterior open bite with reverse curves

For the correction of this problem we can also help ourselves with the use of reverse curves (Retranol, GAC). The action principle of the curves, in this case, is exactly the same one that we use for the leveling of a deep Spee curve. The reactions that are produced at molar, premolar and incisor levels are the same in the upper and lower dental arches. We simply have to know how to place the reverse curves in order to have the desired effect, that in this case is the closure of the bilateral open bite. On the contrary, if we do not place the curves correctly, far from solving the problem we can complicate it even more.

Fig. 56. Bilateral open bite.

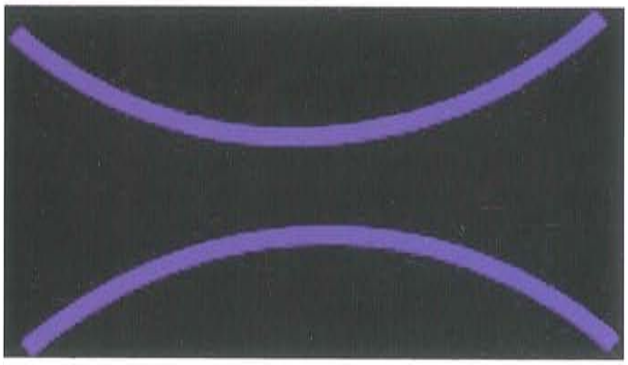


Fig. 57. Lower inverse curve and an upper curve.

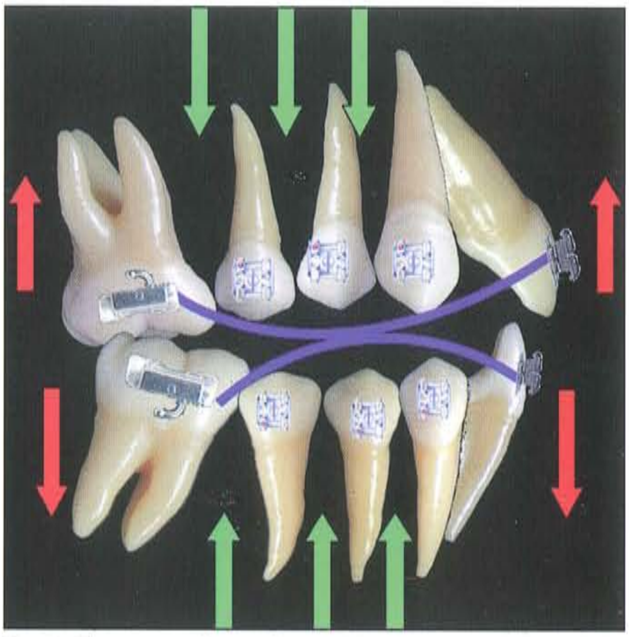


Fig. 58. The curves will provoke premolar extrusion in the upper and lower dental arches, and the intrusion of molars and incisors in both dental arches.

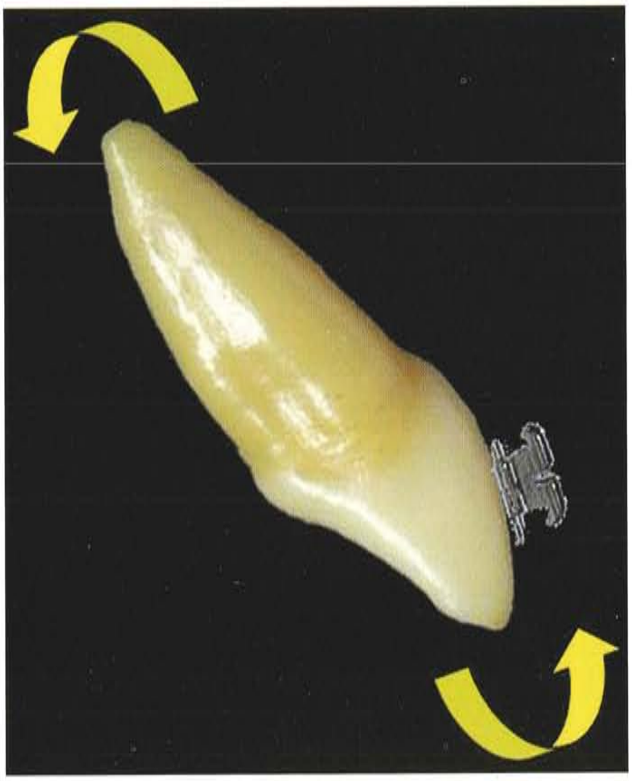
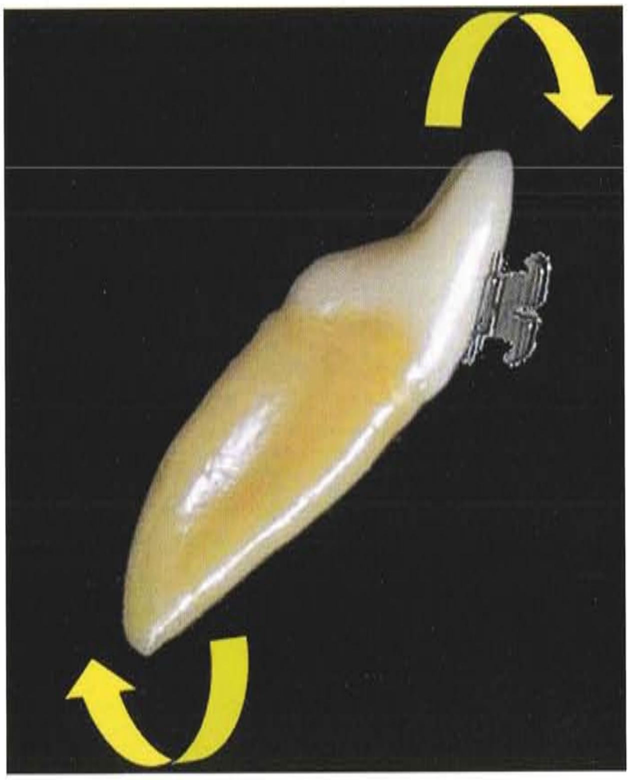
Fig. 59. Provoking the distal inclination of the molar crowns and mesial inclination of the roots, and a positive torque at the incisor level in both dental arches.

Action taken

1. Use of curves on both dental arches.

Produced reaction

1. Intrusion of upper and lower molars and incisors.

Figs. 60 and 61. Positive torque.

2. Extrusion on the upper and lower premolar sector in order to level the dental arches.
3. Increase in length in both dental arches.
4. Distal inclination of the crowns and mesial inclination of the roots in both dental arches.
5. Positive torque in molars.
6. Positive torque at upper and lower incisor level.

Correction of a deep bite with a bite plane and bilateral box elastics

The use of an anterior bite plane for the correction of an anterior deep bite is, without a doubt, a very simple, practical and stable solution for this malocclusion. With the bite plane we seek to put a top on the anterior sector producing a posterior disclusion. This way, the extrusion of molars and premolars in a passive way is stimulated or it can be accelerated with the use of bilateral box elastics. With this type of mechanotherapy, aside from the correction of the deep bite, there will also be an increase in the vertical dimension in the lower third of the face.

The bite plane should be kept in the mouth until the occlusion in the posterior sector is definitely assented.

Fig. 62. Anterior deep bite.

Action taken

1. Use of an anterior bite plane.
2. Use of intermaxillary box elastics.

Produced reaction

1. Intrusion of inferior incisors.
2. Extrusion of canines, premolars and molars due to the disclusion provoked by the bite plane.
3. Improvement of the interincisal relation.

Fig. 63. The bite plane will provoke the extrusion of the anteroinferior segment and the extrusion of the posterior sector; this can be assisted with the use of intermaxillary box elastics.

Fig. 64. Molar and premolar extrusion with the use of box elastics, a better interincisal relation is also produced.

Correction of an anterior open bite with the use of a bite block (Posterior bite block)

Anterior open bite is caused in the majority of cases by the extrusion of the posterior sector and the intrusion of the anterior sector, so in order to correct this, the intrusion of the posterior sector and the extrusion of the anterior sector are necessary. This way, we can close the anterior open bite.

The purpose of the use of the bite block is the intrusion of the posterior segment, resulting in an autorotation of the

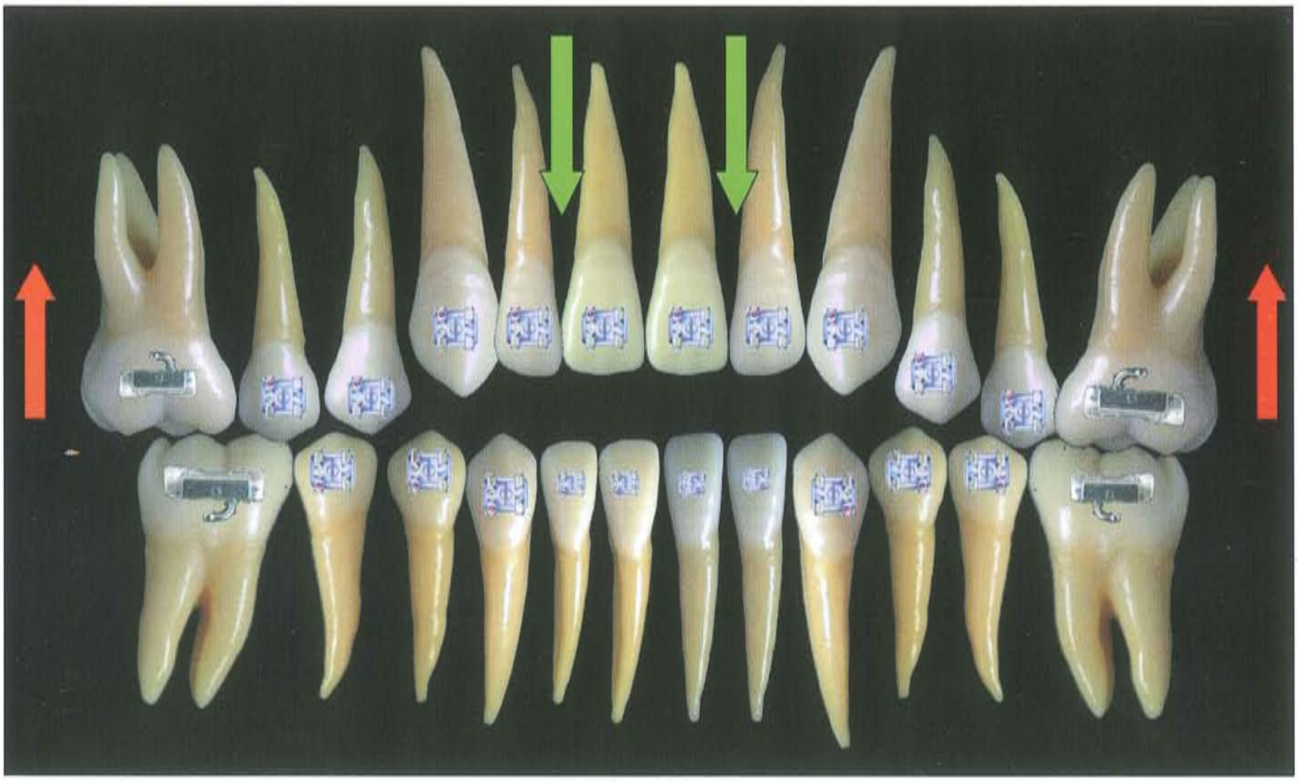


Fig. 65. Anterior open bite due to intrusion of the anterosuperior sector and extrusion of the posterosuperior sector.

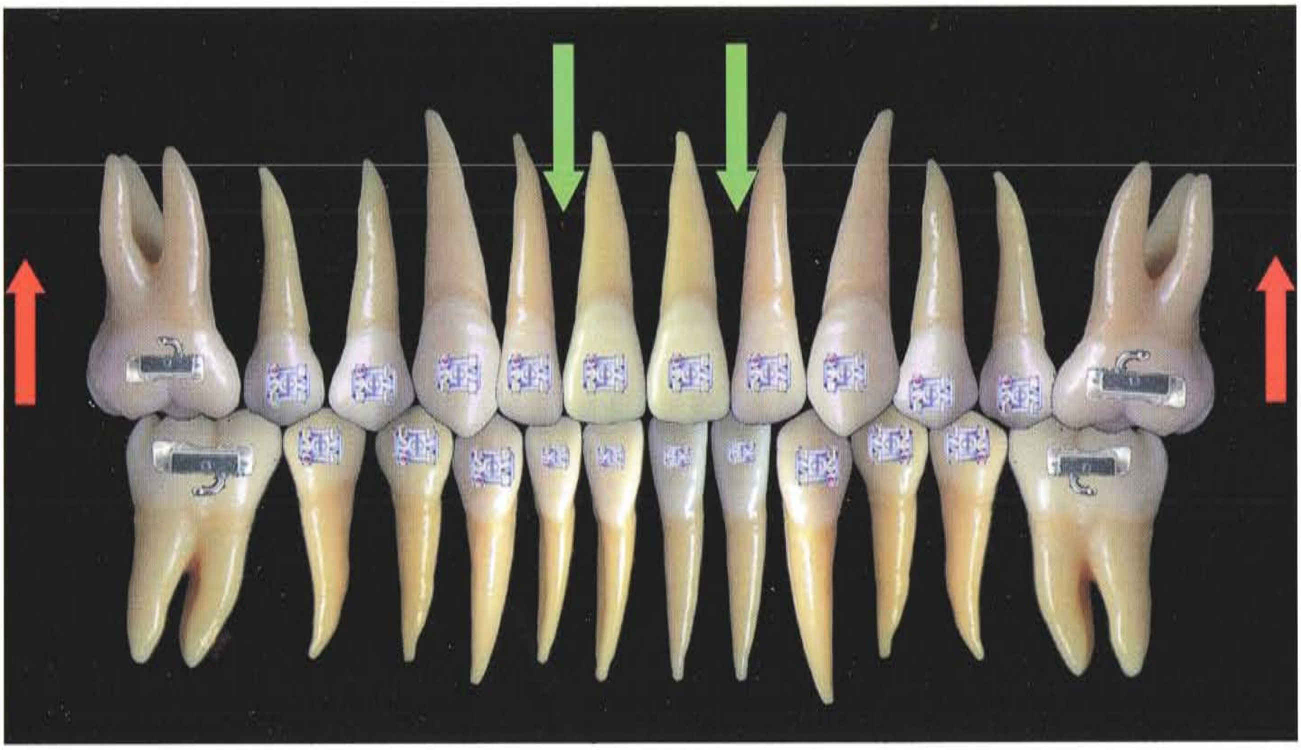


Fig. 66. In order to close the anterior open bite, the mechanics are directed toward the intrusion of the posterior sector and the extrusion of the anterior sector.

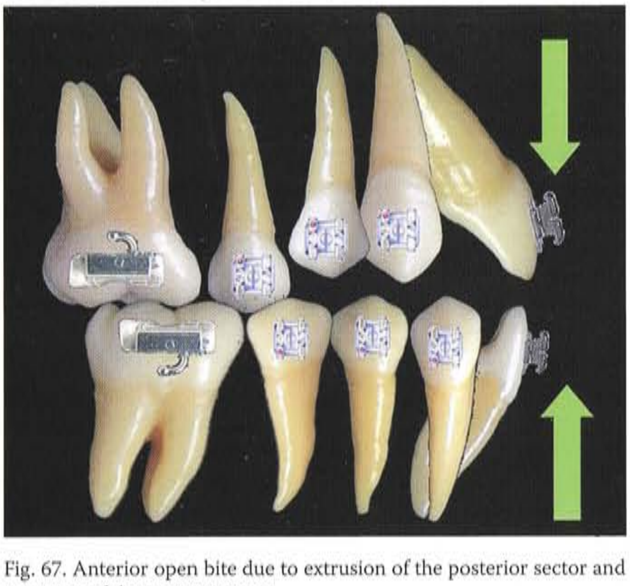


Fig. 67. Anterior open bite due to extrusion of the posterior sector and intrusion of the anterior sector.

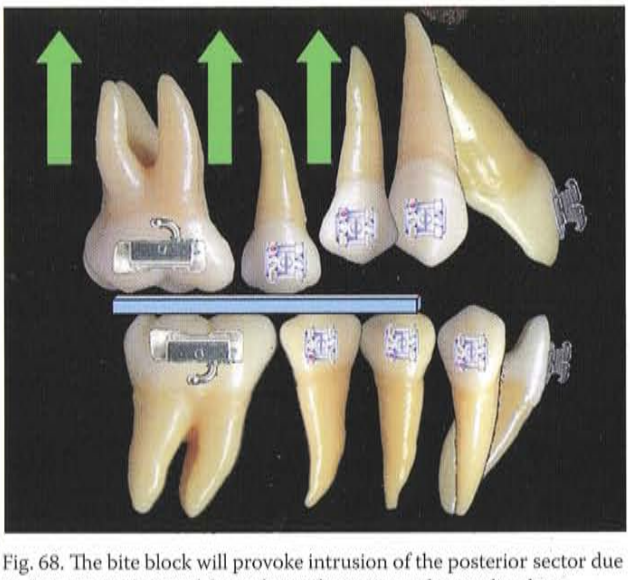


Fig. 68. The bite block will provoke intrusion of the posterior sector due to the pressure exerted from the occlusion over the acrylic plate.

mandible, producing the satisfactory closure of the open bite.[2] Posterior intrusion will be produced by the pressure of occlusion over the bite block and anterior extrusion by the lack of dental contact in this zone.

Action taken

1. Bite block placement for open bite closure.

Produced reaction

1. Molar and premolar intrusion.
2. Extrusion of the anterosuperior sector.
3. Shortening of the inferior facial height.
4. Overbite correction.
5. Mandible autorotation

For closure of the anterior bite with a bite block we can help ourselves with the use of intermaxillary elastics to facilitate bite closure.

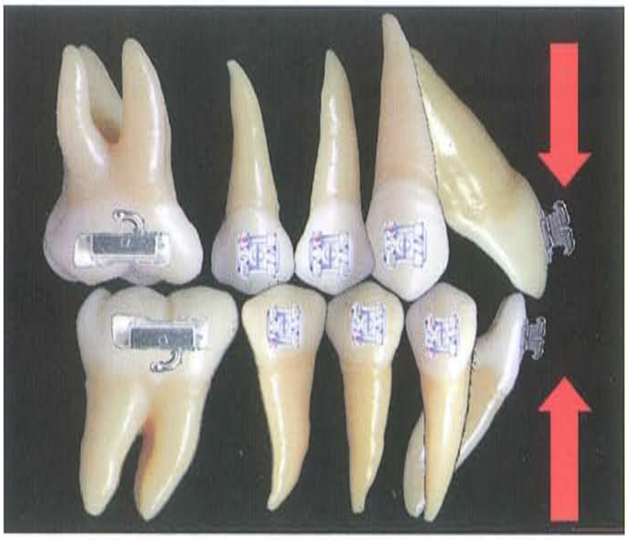


Fig. 69. Bite closure by intrusion of the posterior teeth and extrusion of anterior teeth.

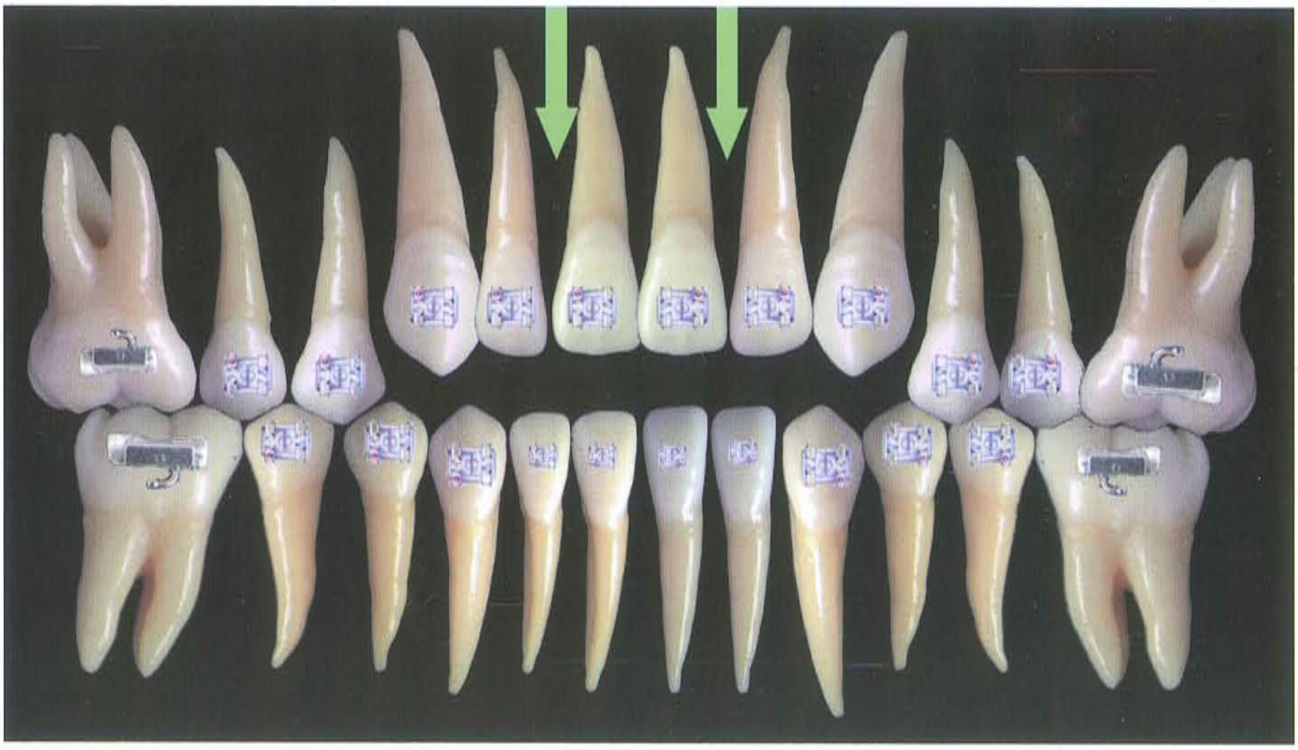


Fig. 70. Anterior open bite.

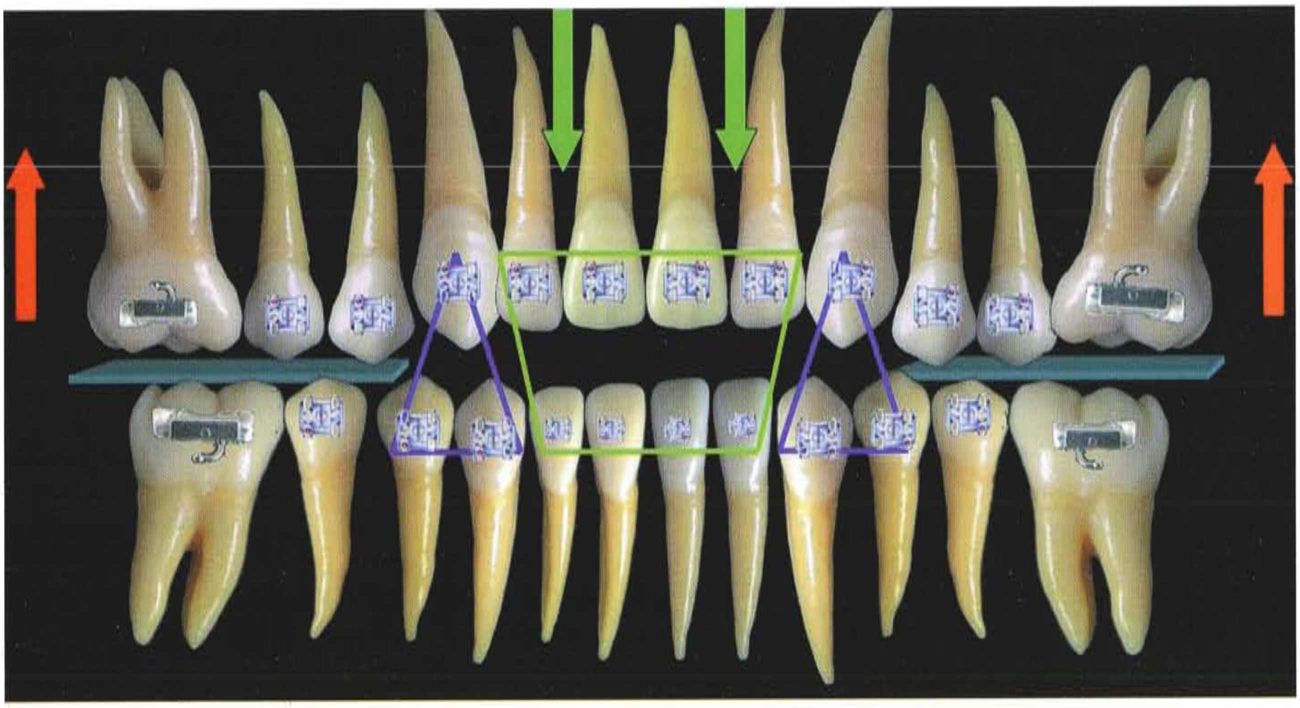


Fig. 71. Bite block use for the intrusion of the posterior sector in conjunction with the use of intermaxillary elastics for open bite closure.

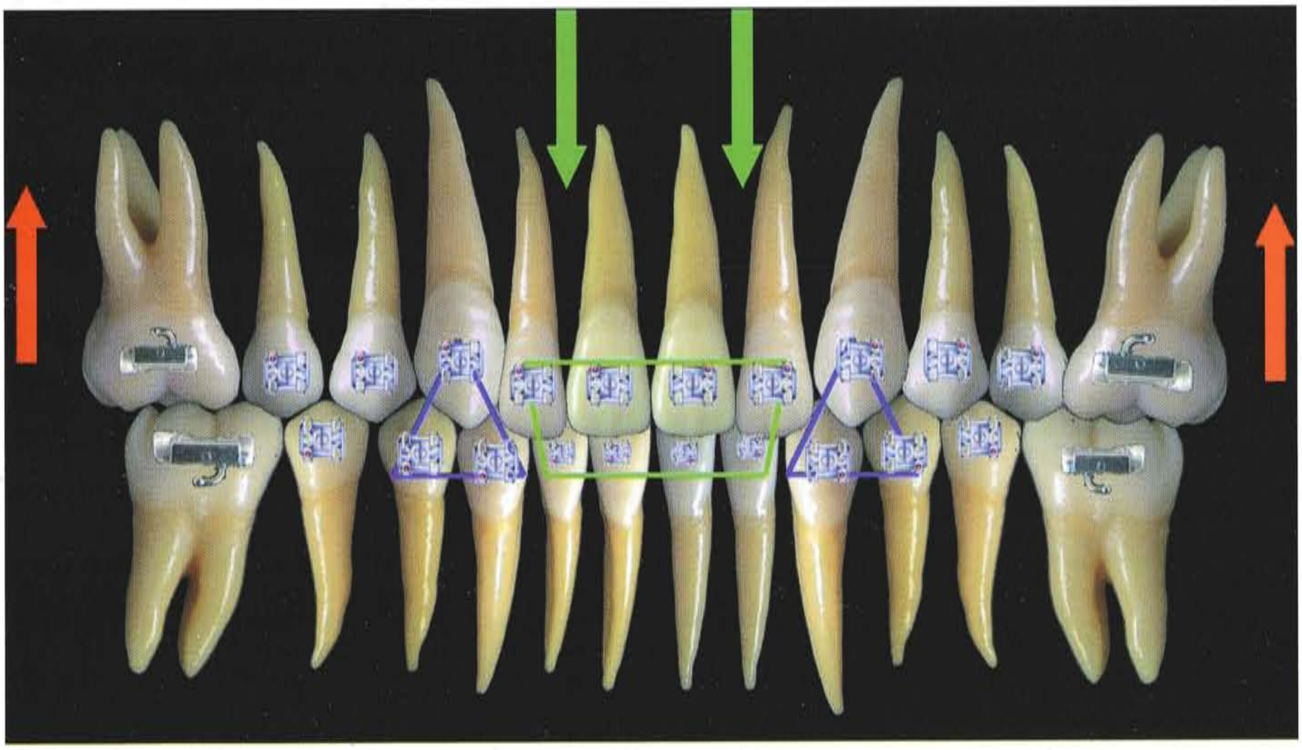


Fig. 72. Once the bite is closed, the use of intermaxillary elastics is recommended until the occlusion is well assented.

Correction of an anterior cross bite with the use of a forward arch wire

For the correction of an anterior cross bite with a forward arch wire, this should only have a dentoalveolar component, and not a skeletal one. This is because the necessary forces for the correction of an anterior cross bite of skeletal origin must be greater than the ones that can be produced by a forward arch.

The forward arch is made by doing two small stops at the entrance of the molar tubes and leaving 2 mm or 3 mm of separation between the arch wire and the slot of the anterior braces. This arch wire is not only going to produce an anterior proclination for the correction of the cross bite, but will also provoke a mild molar distalization.

Fig. 73. Anterior cross bite.

Fig. 74. Stops.

Action taken

1. Placement of a forward arch in order to correct an anterior cross bite.

Produced reaction

1. Proclination of the upper incisors.
2. Upper molar distalization.
3. Positive torque in the upper incisors.
4. Distal inclination of the crown and mesial inclination of the roots of the upper molars.
5. Posterior anchorage.
6. Reduction of the nasolabial angle.

Fig. 75. Forward arch inserted in the molar tube. The exerted forces are going to be reciprocal; they are going to procline the anterior segment and mildly distalize the molars.

Fig. 76. A corrected anterior cross bite; note the incisal proclination and the space gained by the molar distalization.

Root uprighting

In order to do this, artistic or second order bends must be made on a stainless steel arch, round or rectangular. The direction of the bends will depend upon whether the roots are divergent and convergent among themselves.

The forces exerted by this type of bends annul each other because they are of the same magnitude but have different directions, leaving only the action of the Moments that are going to make the root rotation movement.

Fig. 77. Divergent roots.

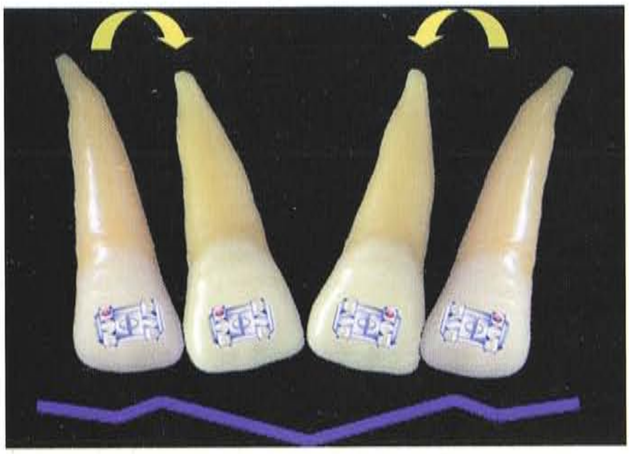


Fig. 78. "V" bends to upright roots. The forces that act when the wire is inserted in the slots annul themselves because they are of equal magnitude and opposed direction, letting only the Moments act in each root.

Fig. 79. Parallel roots.

Action taken

1. "V" second order bends to upright divergent roots.

Produced reaction

1. The forces cancel each other.
2. Root uprighting by the action of the Moments.

Diastema closure with closing loops

A diastema is defined as a space between two teeth; these can be treated with orthodontics or with cosmetic dentistry. The orthodontist must determine the cause of it before designing an appliance to correct it. Usually closing loops are going to exert their forces in a perpendicular mode to the center of resistance of the tooth, making

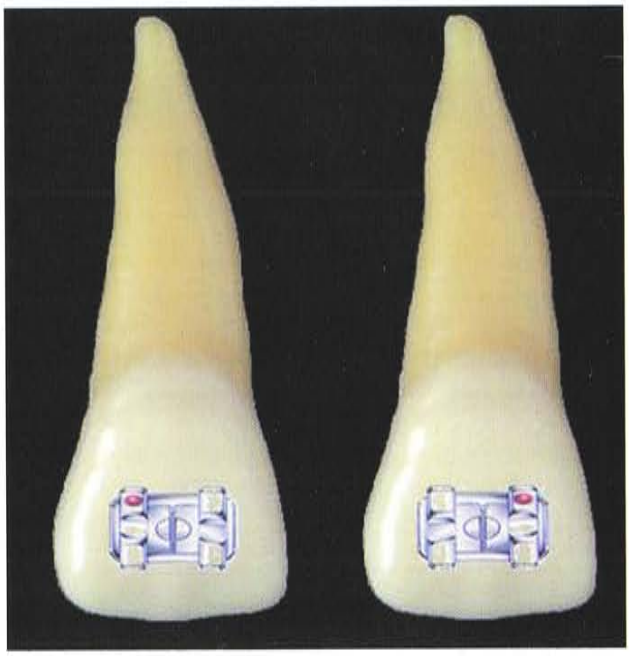


Fig. 80. Diastema between central incisors.

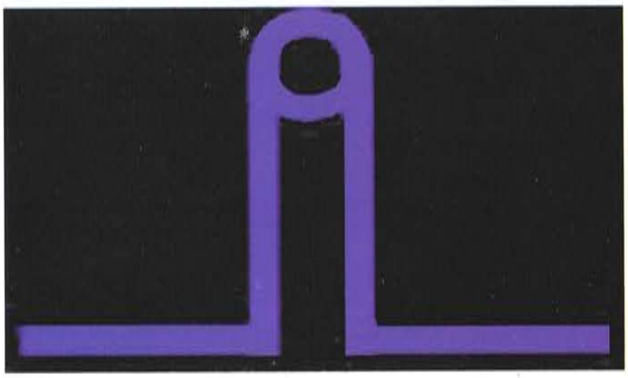


Fig. 81. Closure vertical loop.

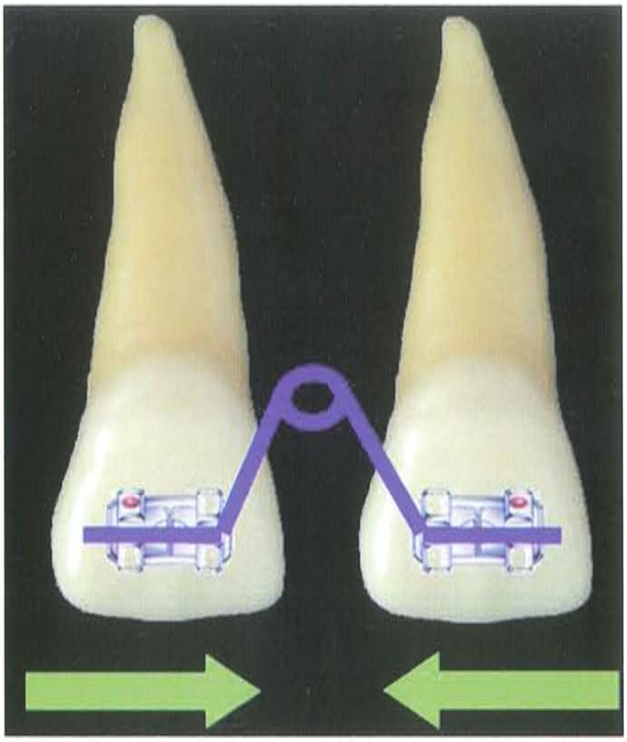


Fig. 82. Active vertical loop.

Fig. 83. Closed diastema.

these move bodily without any Moment that may make them rotate.

Produced reaction

1. Placement of a vertical closure loop for diastema correction.

Produced result

1. Closure of the diastema with a bodily movement of the root.

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Anchorage

2

Esequiel Rodríguez, Rogelio Casasa, Adriana Natera, Elías Burguera

Introduction

The success of an orthodontic treatment depends upon many factors, but without any doubt one of them is anchorage control. If we do not have the anchorage that we need, this will lead us to certain failure, so it is very important to apply all our knowledge in this subject during orthodontic treatment.

Anchorage can be defined as the resistance to movement that teeth show upon the application of a force. Another way to define anchorage would be the distance in millimeters teeth have to be displaced in order to close an extraction site.[4,19,28]

In order to understand the importance of anchorage use, first we must review the mechanics of dental movement. The third law of Newton states: "To every action there is always opposing and equal reaction." In orthodontics this means that when a force is used to move a group of teeth in a certain direction, there will always be an equal force in an opposing direction, this is why anchorage selection is so important; also important is the selection of the teeth in which we want to limit its movement, because this reciprocal force may induce the displacement of the anchored teeth.[3,19]

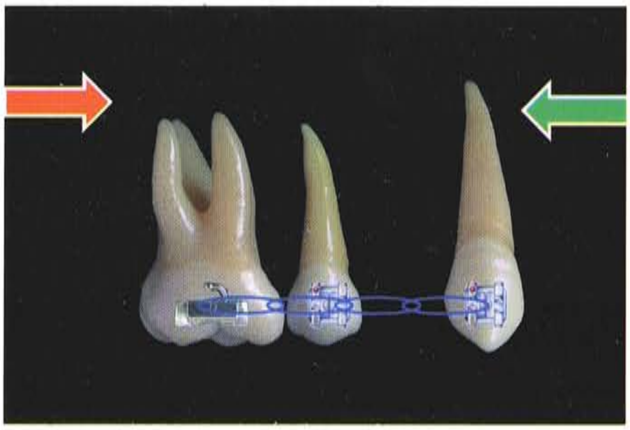


Fig. 1. When we try to retract the canine to the extraction site with power chain, an equal magnitude force will be exerted in the opposing direction upon the molar.

Orthodontic anchorage diminishes or limits the movement of the anchored teeth, but does not immobilize them. The concept that a group of teeth can maintain themselves immobile while another group can be displaced during the application of a force is controversial, therefore anchored teeth must not be considered static. In fact, one of the main advantages in the use of the appliances is the displacement control of anchored teeth.

Within the various anatomical structures we can rely on in order to improve anchorage control we find teeth, the hard palate, alveolar bone, the occipital bone and the nape of the neck.[28]

If anchorage was not well designed or if we did not choose the right type for the case, a mesial displacement of the anchored teeth will occur and the overjet will increase.[19] This is known as loss of anchorage; if it is excessive, canines will not retract enough and there will not be enough space to obtain good incisor alignment.

Indications for anchorage placement [7]

1. There must be good bone support and no dental mobility. We can check the degree of periodontal health of the teeth that will be used for anchorage support with a Panorex x-ray.

Fig. 2.

2. We need healthy teeth with no caries and well adjusted restorations on which to cement anchorage.

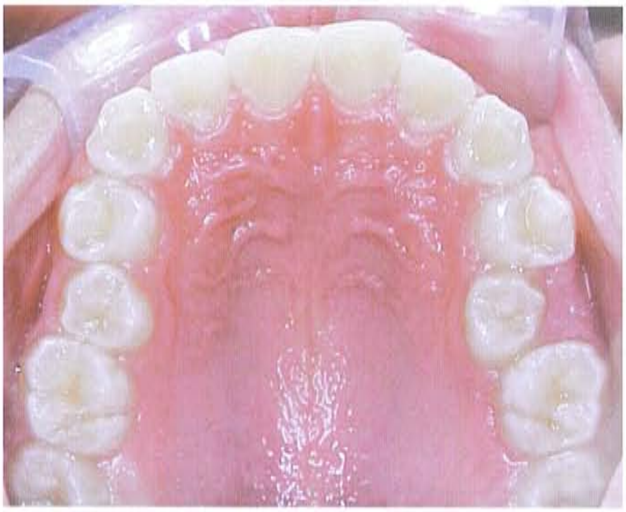


Fig. 3. Caries free teeth with no maladapted restorations.

3. We must determine the amount of dental overcrowding, this way we can define the type of anchorage accordingly with the space needed. The greater the misalignment, the more anchorage will be needed.

Fig. 4. Severe overcrowding.

4. Profile type. The type of anchorage to be used will be determined by the dental overcrowding and the profile of the patient.

Fig. 5. Concave proFile.

Factors to consider determining the type of anchorage

1. The angulations and position of the anterosuperior and anteroinferior teeth. Usually, in cases where there is biprotrusiveness or excessive proclination of

Fig. 6. Anterosuperior proclination.

the anterosuperior teeth, a total control of anchorage will be necessary. This way we can take complete advantage of the extraction spaces.

2. The mandibular plane angle (high or low). The inclination of this angle may be modified with different extra-oral anchorage appliances (High Pull, Head Gear, and Face Bow).

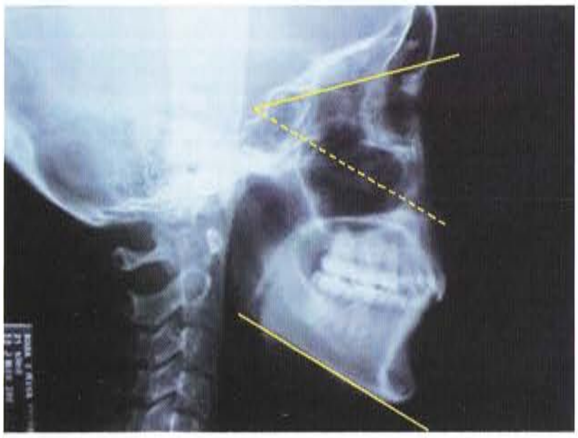


Fig. 7. Mandibular plane angle.

3. Spee curve depth.

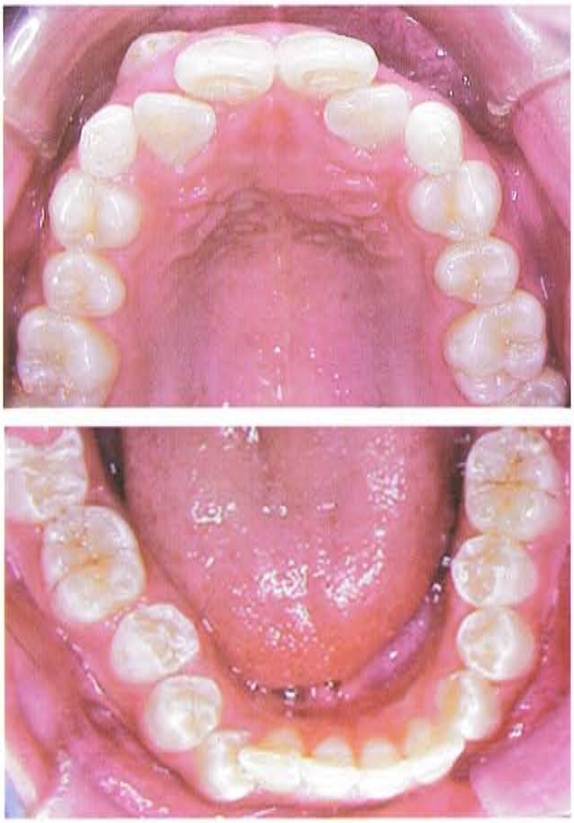
Fig. 8. Deep Spee curve.

4. Age of the patient. Depending on this we must take the growth factor of the patient into consideration for anchorage type selection.[27]

5. Patient profile. In biprotrusive type patients we will need very good posterior anchorage in order to modify this type of profile.

Fig. 9. Patient proFile.

6. Anterior and posterior dental overcrowding discrepancy. Usually, for a greater degree of overcrowding, a greater degree of anchorage will be needed.



Figs. 10 and 11. Maximum and moderate dental overcrowding.

7. Size and form of the root. The wider the area covered by the root, higher resistance to movement the tooth will have. This is the reason why teeth with small roots, like the lower incisors, will respond faster to movement, compared with the first molars, which will need a greater force in order to be displaced. Teeth that present great resistance to movement have an elevated anchorage value; meanwhile, those that move easily have a low anchorage value. This is known as Dental Anchorage.

The recommended forces for anteroposterior movements, according to Ricketts, are as follow:

- Upper central incisor.......................... 50 grams.
- Upper lateral incisor............................40 grams.
- Upper canine...75 grams.
- First upper premolar............................75 grams.
- Second upper premolar.......................55 grams.
- First upper molar............................... 120 grams.
- Lower central incisor.......................... 25 grams.

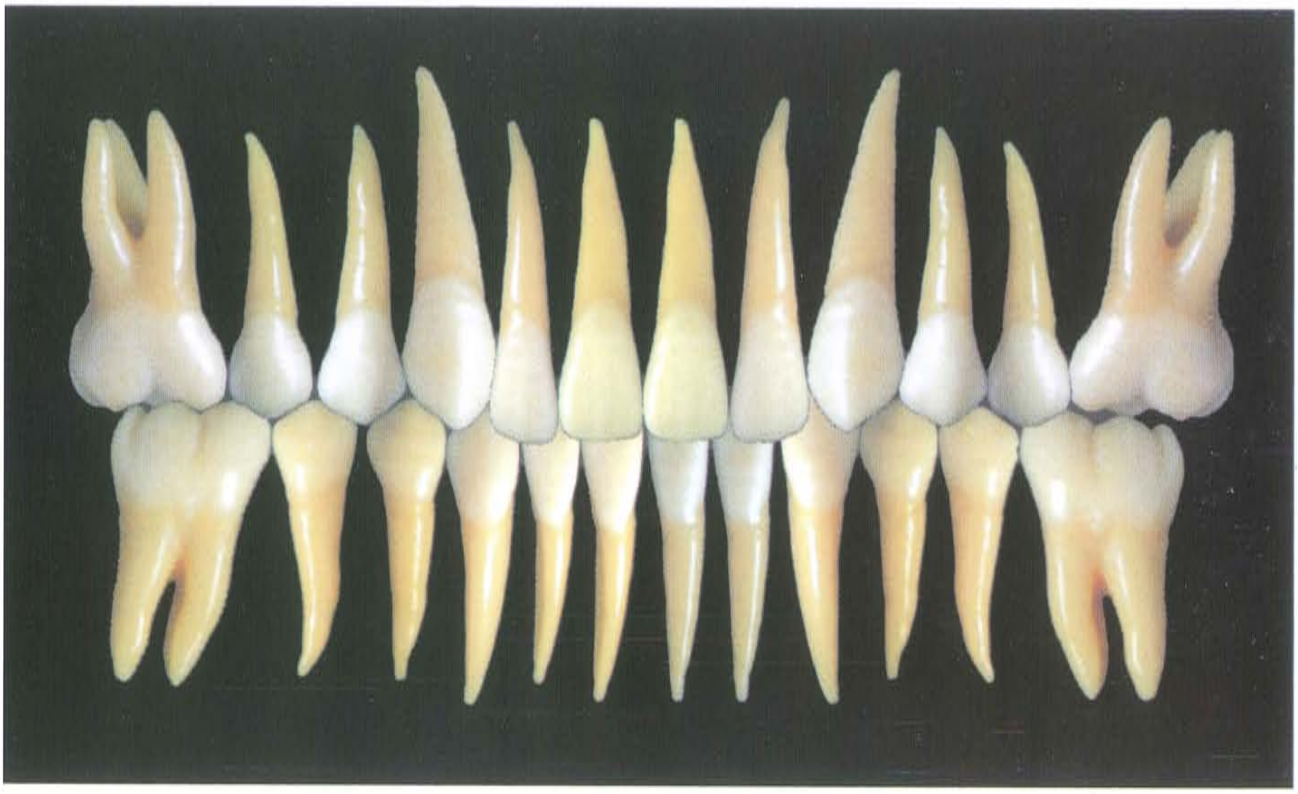


Fig. 12. Root size and form.

The necessary force to move a tooth is related to the root area and the quantity of movement permitted: this is called "affronted root surface", described by Dr. Ricketts. He mentioned that the optimal force for tooth movement is 100 g/cm^2 and that the teeth with the highest anchorage quantity are the first superior molars, and the teeth with the least anchorage are the central and lateral incisors.[23] The optimal force is the one that produces dental movement without collateral adverse effects (root resoption).

- Lower lateral incisor.............................25 grams.
- Lower canine..75 grams.
- First lower premolar.............................60 grams.
- Second lower premolar........................60 grams.
- First lower molar................................110 grams.

8. Surrounding bone characteristics. When teeth are located within trabecular bone, they pose less resistance to move. But, when they are located in cortical bone,

their anchorage quantity increases because this bone is denser, laminated and much more compact, with a very limited blood supply. Blood supply is the key factor in dental movement because the physiologic resorption process and the osseous apposition are delayed, so dental movement is slower.[23] For this motive it is convenient that at the moment of retracting the canines we give a vestibular torque to the molar roots in order to anchor them in the cortical bone, and in this manner we can limit its mesial movement. This is known as Cortical Anchorage. [8,23]

10. Patient facial muscles. Brachyfacial patients (short faces) have more muscle tone than dolichofacial patients (long faces); these have weak and hypotonic facial muscles.[5,9] In these patients teeth present less resistance to orthodontic movement. [9, 20, 27] This is called Muscular Anchorage.

Once we have considered all these factors we can establish the amount and type of anchorage necessary to accomplish our treatment objectives.

Fig. 13. Brachyfacial patient.

Fig. 14. Dolicofacial patient.

9. Amount of allowed movement. Teeth will move toward places where they encounter less resistance (toward extraction sites); because of this, they incline toward the direction of the applied force. But if this inclination is avoided and we force the tooth to move bodily, then the force needed must be stronger, because teeth that are moved bodily present greater resistance than teeth that are free to incline. In the same manner, teeth that are submitted to torque and tip bends present more displacement resistance.

Tips to increase the amount of anchorage in the upper and lower dental arch

1. Use of the tip back bends in the wire arch. These bends are made in the wire arch mesial to the tube of the molar at 45° from the occlusal plane (toward the gingiva), preventing the mesial inclination of the molars and making them more resistant to displacement.

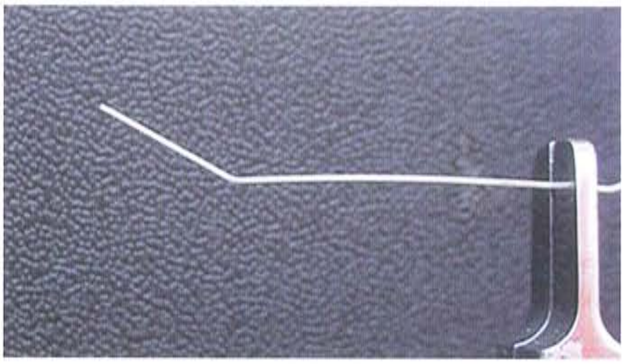


Fig. 15. 45° tip back bend.

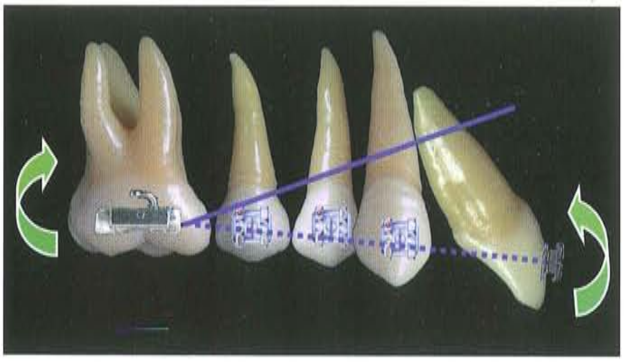


Fig. 16. Inactive tip back bend. The arrows indicate where the crowns and roots of the molar and incisors will move once the wire becomes active.

Fig. 17. Once activated, the wire is going to produce intrusion of the incisors, and the roots of the molar will mesially incline making it more resistant to movement.

2. Torque force utilization. The use of pre-torque arch wires will increase the anchorage of the incisors against buccal force.

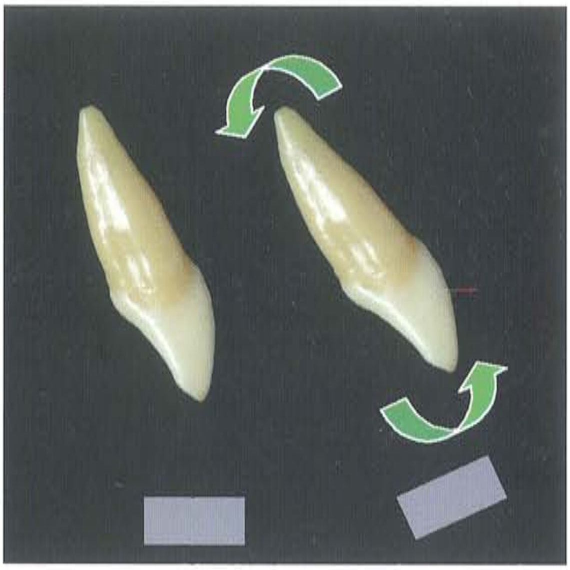


Fig. 18. Positive torque in anterosuperior teeth.

3. Use of intermaxillary elastics. These allow teeth from a dental arch to function as anchorage and produce a differential movement of the antagonist teeth; for example Class II, Class III or Delta elastics.

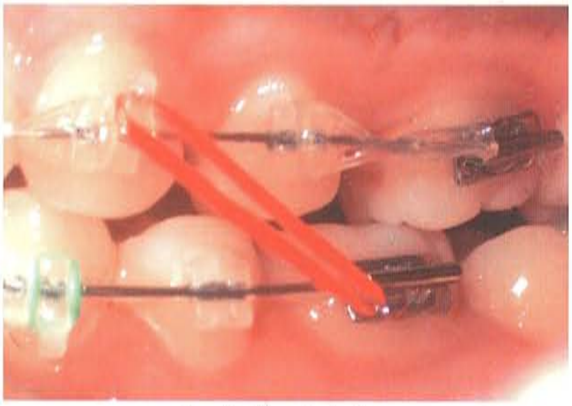


Fig. 19. Class II elastics.

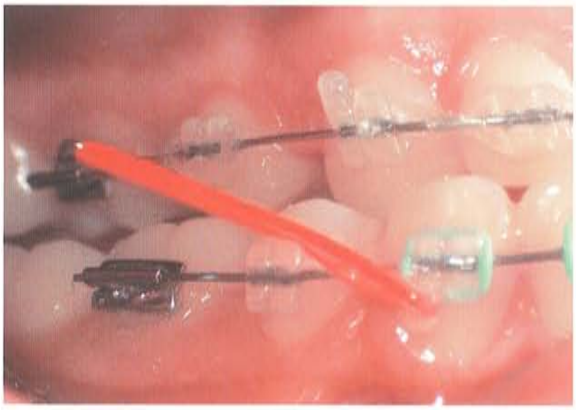


Fig. 20. Class III elastics.

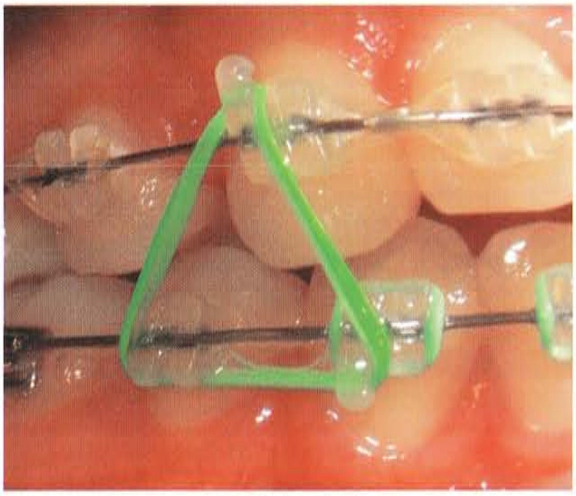


Fig. 21. Delta elastics.

Tips to reinforce posterosuperior anchorage

1. Incorporate a greater number of teeth to the anchorage unit so that the root area will increase.[3] For example, a chromosome arch or a 4-band transpalatine arch.

Fig. 22. Chromosome arch over plaster model.

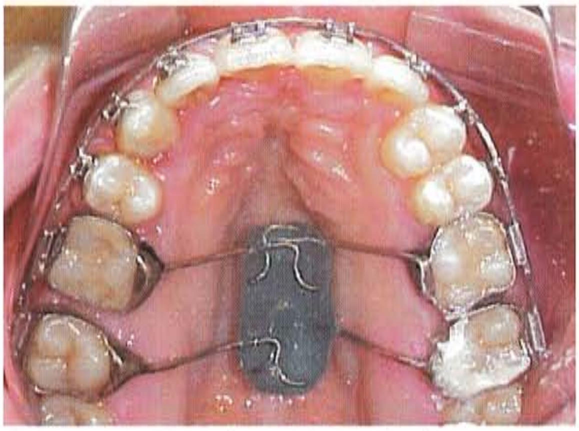
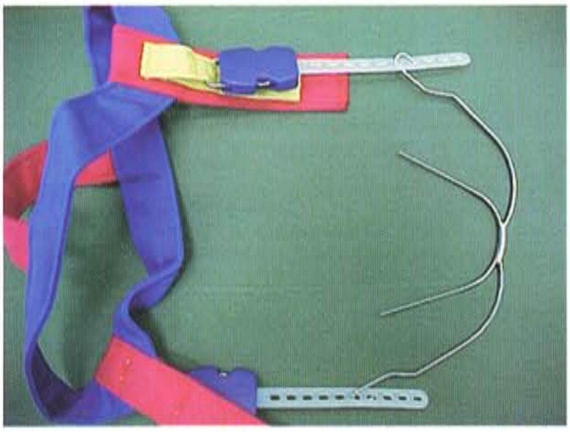


Fig. 23. Transpalatine arch with 4 bands.

2. Use extra oral forces directed backwards, with a face bow (that applies the force directly to the first upper molars) or with a cap with "J" hooks (that apply force directly on the anterior teeth while being retracted).[3]



Figs. 24 and 25. High Pull.

3. Cement a transpalatine arch or a Nance button to the first upper molars.

Fig. 26. Transpalatine arch soldered to the molar bands.

Fig. 27. Removable Nance button with lingual sheath on molars.

4. Use an upper removable retainer. These circumferential or Hawley type retainers can have acrylic teeth added for space maintenance, this way we can avoid teeth mesial drifting or "domino effect". They are indicated in cases that present multiple tooth loss, unilaterally and bilaterally. With the aid of these retainers, patients recuperate their chewing, swallowing and phonetic abilities as well as esthetics. (14)

5. Group several posterior teeth to form an anchorage unit. (3)

Fig. 30. Posterior teeth grouping for cuspid retraction.

6. Use segmented arches for anterior teeth retraction. This lessens friction during retraction and space closure (Burstone T). (3)

Fig. 31. Sectioned Burstone T for anterior teeth retraction.

Figs. 28 and 29.

7. Apply mesial root inclination to posterior-superior teeth. With this inclination bodily movement of the molar lessens during anterior segment retraction. [3]

Fig. 32. Mesial inclination of the roots of the upper molar.

8. Distally incline the crowns of the upper canines at the moment of retraction. This is done in order to lessen the loss of anchorage of the posterior segment. Later on, the canine roots must be uprighted.

9. Place a lingual arch as lower anchorage, while forces with Class II elastics are applied.

10. Place an osseointegrated implant as absolute anchorage. [3]

Fig. 33. Osseointegrated implant placed in the retromolar zone as absolute anchorage.

11. Another reinforcement option in posterior anchorage control during space closure consists in "separate canine retraction" (in extraction cases). Some orthodontists prefer this technique because they consider it preserves the posterior teeth position. It is considered that "separate canine retraction" lessens the load upon the posterior anchorage. [3]

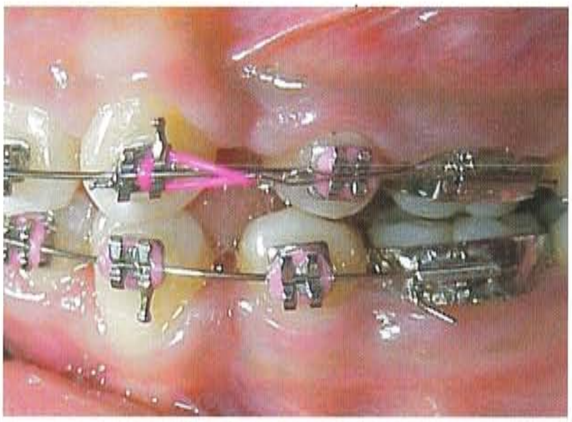


Fig. 34. Separate canine retraction.

Tips to reinforce anteroinferior anchorage [3]

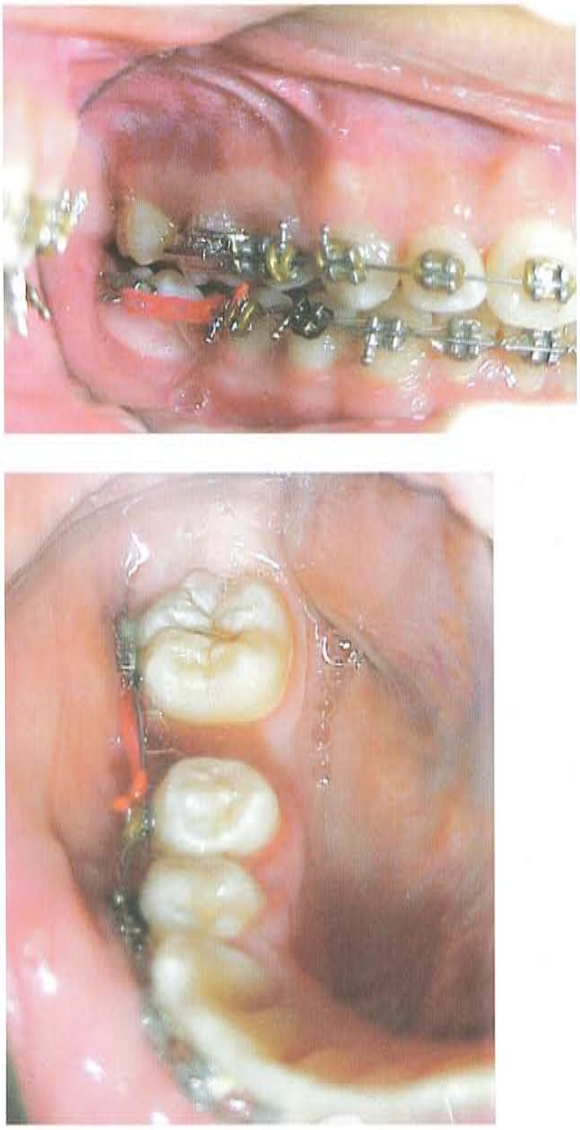
1. The use of extra oral forces directed forward. Elastics that stretch from posterior teeth to a face bar of a facemask exert these forces. The anchorage points would be in this case the forehead and the chin. This type of anchorage is indicated in maxillary traction cases and it is also called Geniomolar Anchorage.

Fig. 35. Petit-type face mask.

2. Lingual arch fixed to the lower molar bands.

Fig. 36. Lingual arch soldered to molar bands.

3. Group several anteroinferior teeth like an anchorage unit, while a posterior tooth is being pulled.



Figs. 37 and 38.

4. Use segmented arch mechanics for posterior teeth traction (Burstone T).

Fig. 39. Burstone T.

5. Apply lingual torque to lower incisor roots.

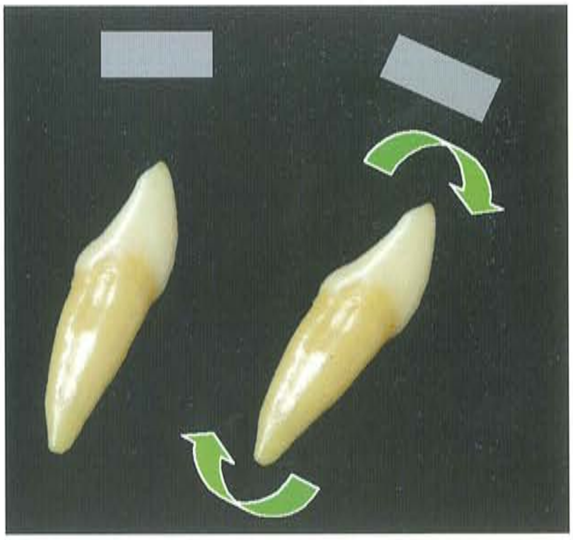


Fig. 40. Positive torque in anteroinferior teeth.

6. Mesially incline the crowns of posterior teeth during their traction; this is done to ease the mesial movement of posterior teeth during space closure. Upright the posterior teeth roots subsequently.
7. Use a transpalatine arch as anchorage while applying forces with Class III elastics.
8. Place osseointegrated anchorage auxiliaries distal to the lower molars so they can act as intrabuccal absolute anchorage. (3)

Undesired movement control during the space closure phase

Because the space closure objectives are reached with canine and incisor retraction, a careful evaluation of the negative results during this phase is convenient. This way we can evaluate the three types of undesired movements that can happen during treatment:

1. Palatomesial rotation of the molars. Due to the mechanical force that acts upon the molars during space closure, these teeth tend to turn in a mesial direction. The effect of this rotation is observed clinically when the mesiobuccal molar cusp falls into a Class II molar relation. This can be reestablished correcting the molar rotation in a distal direction. (3)

Fig. 41. Palatomesial molar rotation.

In order to avoid this palatomesial molar movement during canine retraction, a Toe-In bend in the arch wire is convenient. This way, the undesired molar movement that is produced by the force exerted by the power chain, closed coil or retro ligature is counteracted, and it will also serve as a minimal type of anchorage.

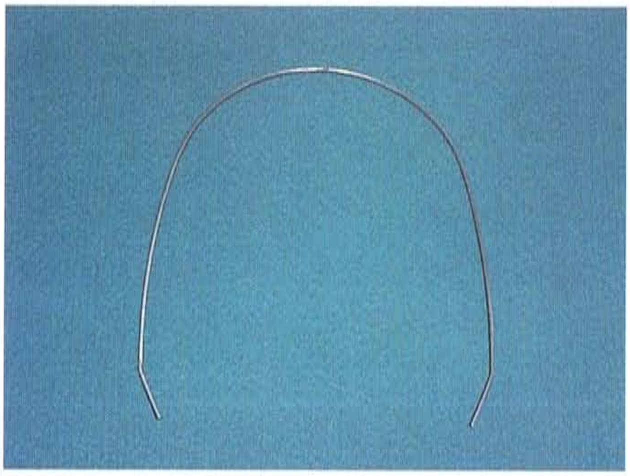


Fig. 42. Toe-In.

2. Molar and canine crown inclination toward the extraction site. (3)

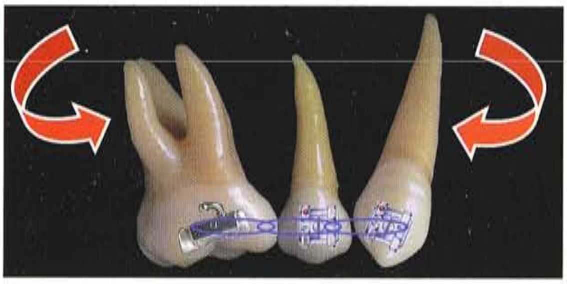


Fig. 43. Canine and molar inclination toward extraction site.

In order to avoid this undesired movement, a rectangular steel arch wire soldered to a chromosome arch and cemented to the molars is used; this arch will give us excellent anchorage and will help us while moving the canines in a bodily fashion due to the use of parallel forces.

Fig. 44. Chromosome arch

3. Excessive lingual or palatine inclination of the incisors.(3)

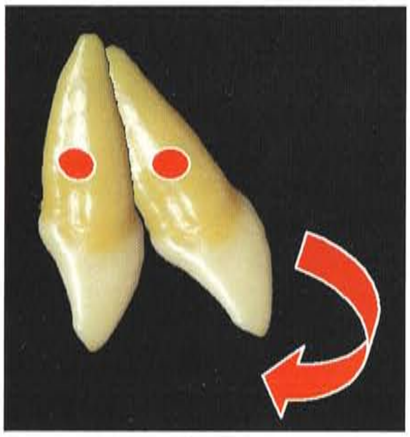


Fig. 45. Excessive palatine inclination of the incisors.

To avoid the unwanted movement of the incisor, the use of rectangular pre-torqued wires from canine to canine is recommended, or we can place individual torque bends on each tooth. We can also lace the anterior teeth with 0.012" steel ligature wire.

Anchorage control

Whenever the orthodontic objective is clear from the beginning, determining the time and type of anchorage is easy. Anchorage control is complicated; this is why we must have a balance between the applied forces and the anchored teeth. If we contemplate tooth extractions, it is indispensable to consider the amount of space that is going to be available, and the anchorage combinations that will be needed to limit dental displacement. In some cases, all the space obtained from the dental extractions will be used for the alignment of the remaining teeth, and in some other cases only part of that space will be required.(3)

When orthodontic treatment has been decided, we must take into consideration all the problems that can arise from biomechanics and must know the anchor value of each tooth (dental anchorage).

The complications in anchorage control can be easily managed, if we:

- Have a clear idea how the final occlusion will turn out.
- Be aware of the undesired movements that can appear between appointments and their immediate correction.
- Have knowledge of the biomechanical principles in which orthodontic appliances function. (10,18,19,24)

Types of anchorage

In this chapter we will study the different types of intraoral anchorage, which can be classified in diverse manners; however, a very simple and understandable classification will be presented. Intraoral anchorage can be divided in four big groups:

1. Minimal Anchorage.
2. Moderate Anchorage.
3. Maximum or Severe Anchorage.
4. Absolut Anchorage.

1. MINIMAL ANCHORAGE

When we place this type of anchorage in molars, they migrate in a mesial direction up to 70% of the space, giving us 30% of anchorage; minimal anchorage is also helpful in anchoring the anterior segment. According to Nanda this type of anchorage is called C Anchorage or "non-critical -anchorage", where 75% of space closure is obtained by mesial displacement of posterior teeth. We elaborate this type of anchorage in the arch wire (stops, tip back, arch wire tie back, toe-in, toe-out, in-bend, out-bend) or with accessory elements (retro-ligature, intermaxillary elastics, lip bumper) or a combination of both.(19,24)

Types of Minimal Anchorage:

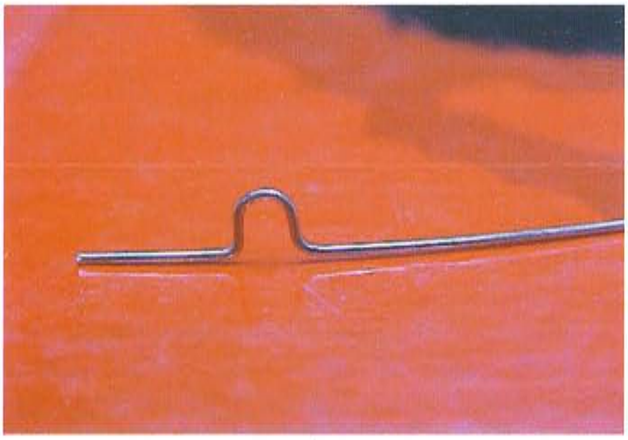
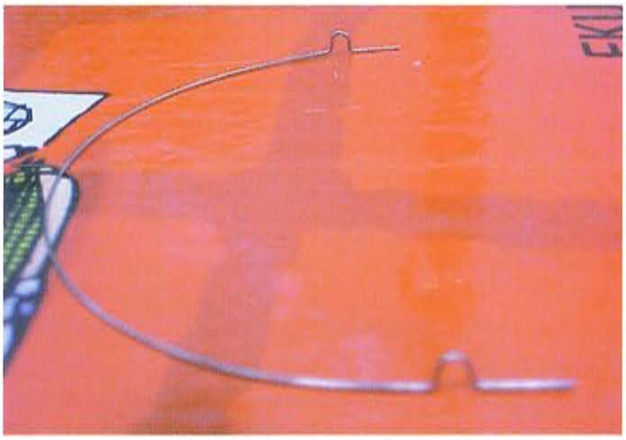
1. Stops.
2. Tip back.
3. Arch wire tie back.
4. Toe-in, Toe-Out.
5. Retro-ligature.
6. Intermaxillary elastics.
7. Lip Bumper.

a) Stops

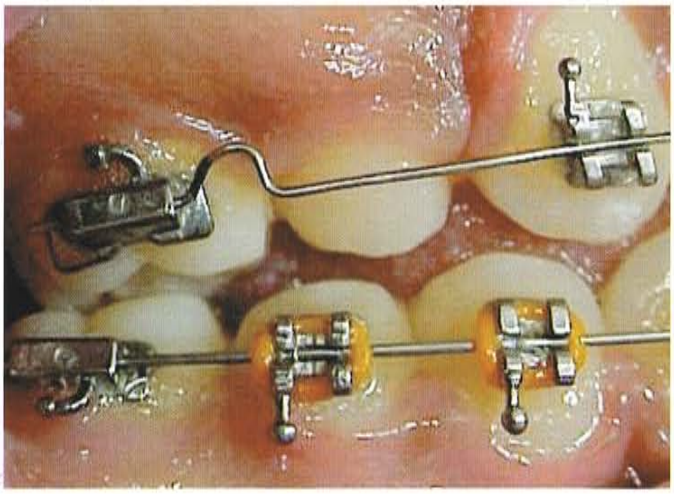
This type of minimal anchorage is done in the arch wire, can be round (0.020") or rectangular (0.017"x 0.025") stainless steel. The stops are made at the mesial portion of the molar tubes in a passive manner, this means that the arch wire must be inside all the slots.(22)

Advantages

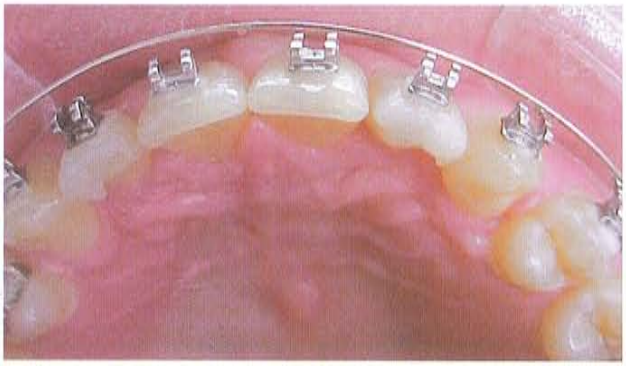
1. It is very economic.
2. Fast and easy to make.
3. Tip and torque of molars can be controlled if the arch wire is rectangular.
4. No patient cooperation dependence.
5. Because it is a minimal anchorage appliance, the quantity of anchorage loss can be controlled for each case.
6. It is a multipurpose anchorage appliance since it can be used solely as minimal anchorage (placing the arch wire in all the slots of the braces) or to correct an anterior cross bite (placing the arch wire separated 2 or 3 mm from the slot), provoking the proclination of the anterior sector and molar distalization (forward arch).

Figs. 46 and 47. Stops outside the mouth.

Figs. 48-51. Stops in mouth.



Figs. 52 and 53. Forward arches

Disadvantages

1. The stop of the loop must be placed gingivally, because if it is placed occlusally can make contact with the antagonist tubes and braces and provoke their debonding.
2. It can provoke localized gingival inflammation localized between the premolar and molar, due to food accumulation.
3. A strict appointment control is imperative since it is a minimal anchorage appliance, and too much anchorage may be lost.

Recommendations

1. It is very advisable to make the loop of the stop as high as the gingival margin of the posterior sector, because if we do not do so, gingival laceration can occur.
2. If we put an active arch wire (forward arch) to correct an anterior cross bite, the activations must be made in a paused manner (no more than 2 mm between the arch and the slot), otherwise the wire would be too forced and the buccal braces may debond.
3. It can be used in combination with other types of anchorage.

b) Tip back

The main objective of this bend is to provide minimal anchorage. It is made at the end of the wire arch. The bend is done round (0.020") or rectangular (0.017" x 0.025") at 45° toward the gingival margin producing a tip or molar angulation.[25]

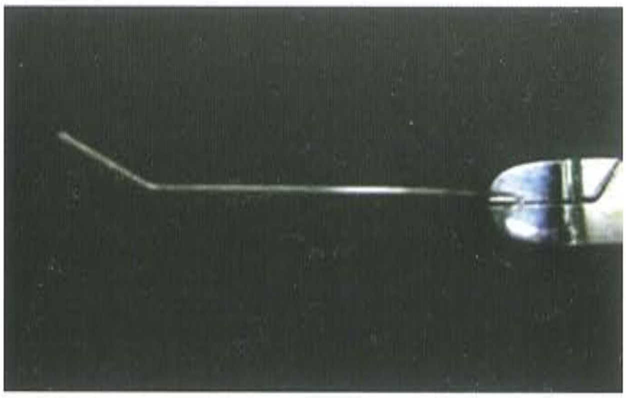


Fig. 54. The Tip back is done at 45° toward the gingival margin at the end of the wire arch.

Advantages

1. Fast and easy to make.
2. No patient cooperation dependence.
3. Distal crown inclination and mesial root inclination in molars make them more resistant to mesial movement.
4. It is cheap.

Disadvantages

1. May provoke an anterior open bite due to the intrusion of the anterosuperior segment.
2. May provoke TMJ alterations due to premature contacts that can develop after molar inclination.

Recommendations

1. Do not use it in patients with open bite.
2. In case of pain in the TMJ due to premature contact points, remove the wire immediately.
3. This type of anchorage can be used in conjunction with another one in deep bite cases. At the moment of placement of the wire in the molar tubes (with the Tip Back bend), the anterior segment of the arch wire tends to displace itself gingivally producing an intrusive force in the anterior sector.

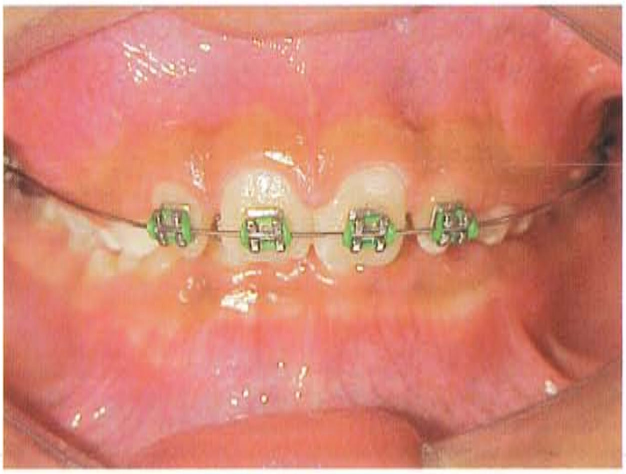


Fig. 57. Active Tip back in mouth.

Figs. 55 and 56. Passive Tip back in mouth.

c) Arch wire tie back

The tie back is a type of minimal anchorage made directly on the arch wire. This is done by bending the arch 45° gingivally at the end of the molar tube; in order to do this it necessary to let the arch wire 5 mm in excess from the distal end of the molar tube. This can be used in the initial stage of treatment (during alignment and leveling with NiTi or stainless steel wires) or in the space closure phase for anchorage control. Also helps to "stall" the anterior segment from the distal part of the tube and prevent proclination in the anterior segment.[16]

We have to bear in mind that before we tie back the NiTi arch wire we must flame the ends. This way it will lose its resilience and will be bent with precision.[16]

Advantages

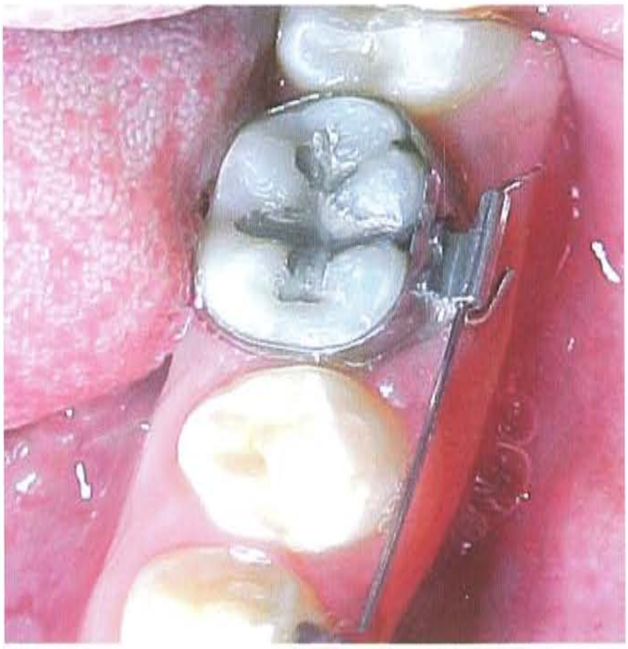
1. We do not depend on patient cooperation.
2. It is done directly on the arch wire.
3. Cheap and easy to do.
4. Helps prevent the mesial movement of anterior teeth in the aligning, leveling and space closure treatment phases.

Disadvantages

1. If the bend is not made correctly, lacerations and ulcers can occur in the oral mucosa.
2. We could debond the molar tube if we were not careful enough when making the bend.
3. More than necessary anchorage loss if we do not have a strict appointment control.

Recommendations

1. The tie back of the lower arch wire is recommended in Class III patients with the use of Class III elastics, in order to prevent proclination of the anteroinferior segment.
2. The tie back of the upper arch wire is recommended in Class II patients with the use of Class II elastics, in order to prevent proclination of the anterosuperior segment.
3. In cases where we want more dental arch length during the leveling and alignment treatment phase, the tie back must be done 1 or 2 mm behind the end of the molar tube.



Figs. 58 and 59. In order to tie back the arch wire, we must leave about 5 mm in excess from the end of the molar tube, and then bend 45° toward the gingiva.

Fig. 60. Arch wire stress relief.

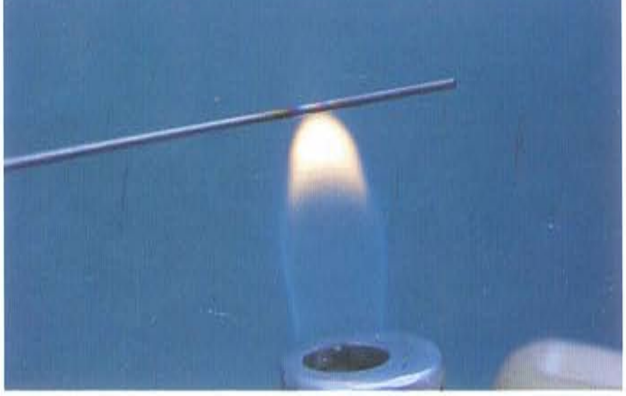


Fig. 61. NiTi wire arch f laming.

4. We must maintain the tie back in the wire during the alignment and leveling phase in those cases that require anteroposterior incisor control.
5. During the space closure phase with double key loops (DKL), the activation is done tying back the arch immediately behind the molar tube.

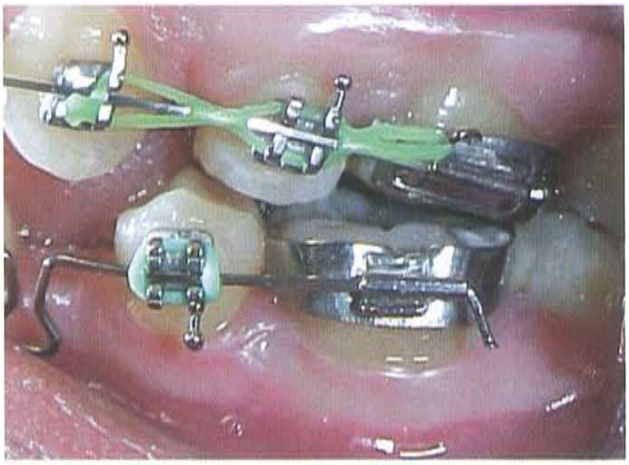


Fig. 62. Arch wire tie back during space closure phase with double key loops (DKL).

d) Toe-in / Toe-out

These first-order bends anchor molars in a palatodistal position (Toe-in) or buccomesial position (Toe-out), and are indicated to correct or prevent molar rotation as a consequence of intraoral or extra oral traction. They are usually done in round (0.018" or 0.020") or rectangular (0.017" x 0.025") wire, making a 20° or 30° palatine or lingual-wise (Toe-in) or buccally (Toe-out) at the end of the arch wire (at the entrance of the molar tube). [25]

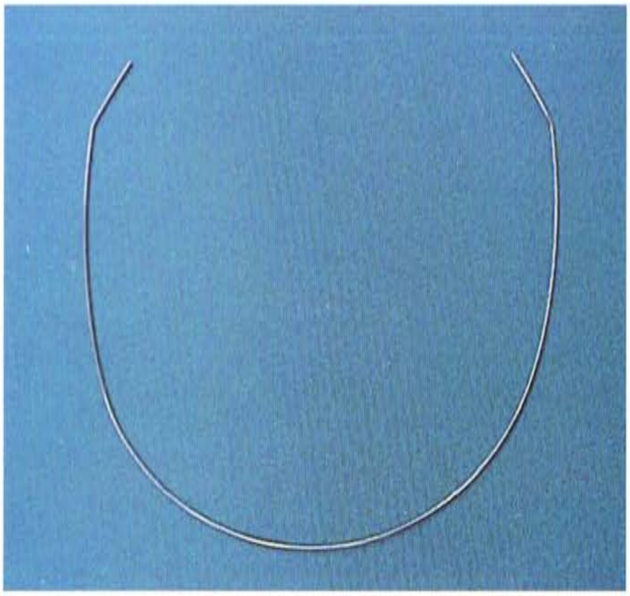


Fig. 63. Toe-In.

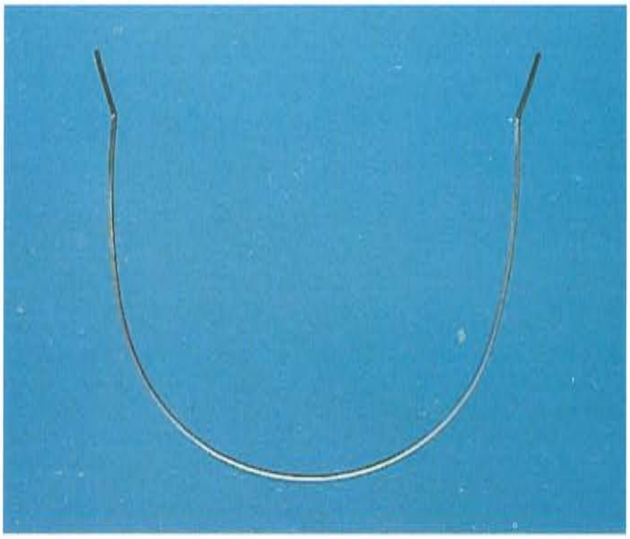


Fig. 64. Toe-Out.

Advantages

1. They are done in the arch wire.
2. They are cheap and easy to make.
3. The Toe-in bend prevents palatomesial molar rotation.
4. The Toe-out bend prevents buccodistal molar rotation.
5. They are multipurpose anchorage elements because can correct and prevent rotations or increase dental arch length.

Disadvantages

1. The patient can refer pain at molar level when the arch is placed in the molar tubes while the molars begin to rotate.
2. It can provoke TMJ disorders due to premature contact points that can appear during molar inclination.
3. We can debond the molar tube if we are not careful enough when inserting the wire.

Recommendation

1. Once the spaces are closed we must take the bend off so we can align the molar again and close the space that may have opened; this type of anchorage can increase arch length momentarily.

e) Retroligatures

The initial indication for retroligatures was to prevent canine proclination, but we have observed that retroligatures are the most effective minimal anchorage for the anterior sector.

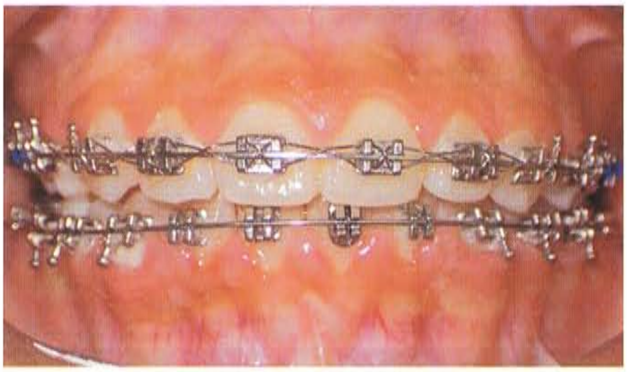


Fig. 65. Double 8 ligature over the wire.

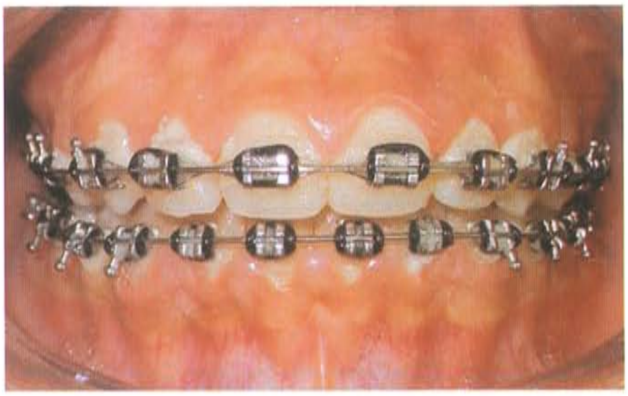


Fig. 66. Double 8 ligature under the wire.

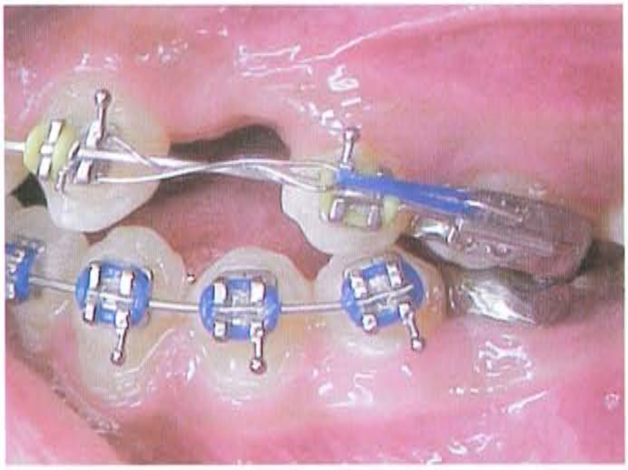


Fig. 67. Retroligatures are effective not only as anchorage but also for canine retraction.

Retroligaturures are made with metal wire 0.010"-0.012" diameter, laced between braces (ligature in 8) or both between and inside the brace (double 8 ligatures); they can be placed over or under the arch wire, with a Matthew needle holder or a ligature pencil. [16]

Advantages

1. It is the main method to maintain anterior anchorage during the alignment and leveling phase of treatment.
2. Economic and easy to do.
3. It minimizes canine anterior inclination during their retraction phase.
4. Not only does it serve as minimal anchorage, but it can also be used for canine retraction.
5. When retroligatures are used, there is posterior anchorage loss, but there is substantial anchorage gain in the anterior segment (2.5 mm per quadrant Approx.)

Disadvantages

1. It is not always accepted by the patient because of the "metal smile effect".
2. It favors food retention so it may cause gingivitis.

Recommendations

1. Indicated in premolar extraction cases but also in non-extraction cases where there is a local menace to anchorage control.
2. They are passive elements and they must not be laced to the point of producing tissue ischemia.
3. The initial purpose of retroligatures was to prevent anterior canine inclination, but it has been observed that they are an effective method of canine distalization with no undesired inclinations.
4. Retroligatures in combination with distal bends (Tip-back, Toe-in, etc.) are a effective support to anterior anchorage during the leveling and alignment phase and in space closure.[16]
5. With retroligatures the main point is that the greater the number of teeth bound as an anchorage unit, the more resistant to retraction movement they become.

f) Intermaxillary elastics

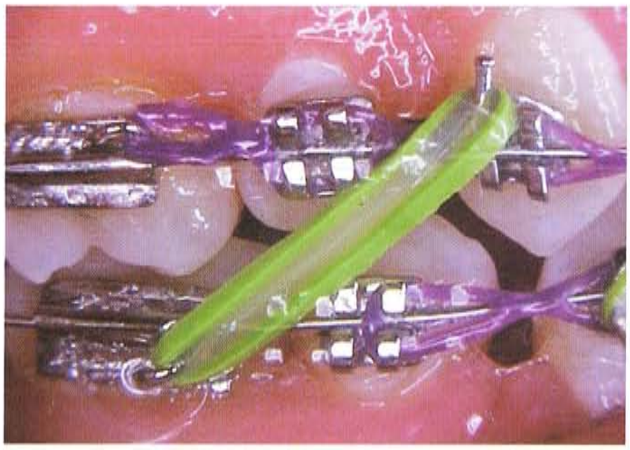
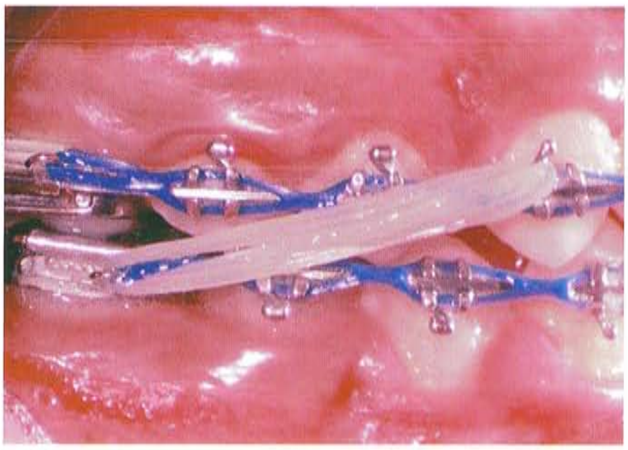
Class II, III and delta elastics represent minimal anchorage that limit the protrusion of the anterosuperior or anteroinferior segments. They can get upper and lower teeth closer together and are a frequent way to obtain differential dental movement. The direction of the elastic defines their force vector and the terminology to describe it.

Class II elastics connect maxillary anterior teeth with posterior mandible teeth.[24]

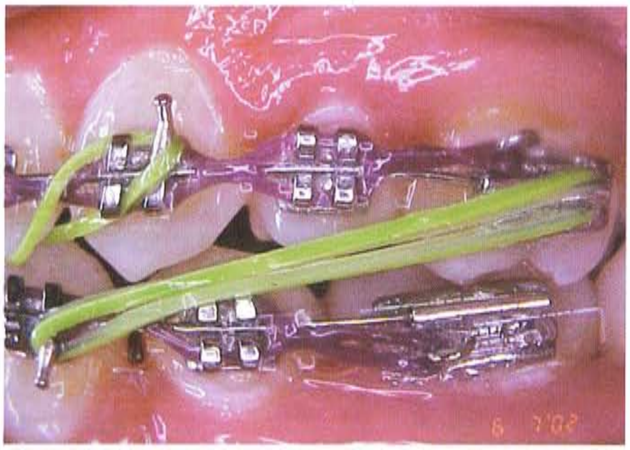
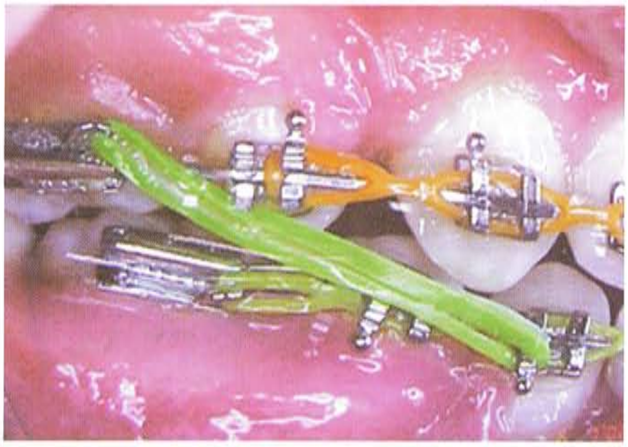
Class II elastics are placed from anterosuperior to posteroinferior teeth.

Delta or "Delta locks" are usually used to interdigit the occlusion, but they are also used as anchorage in order to maintain Class I canine relation in cases where spaces to close still exist.

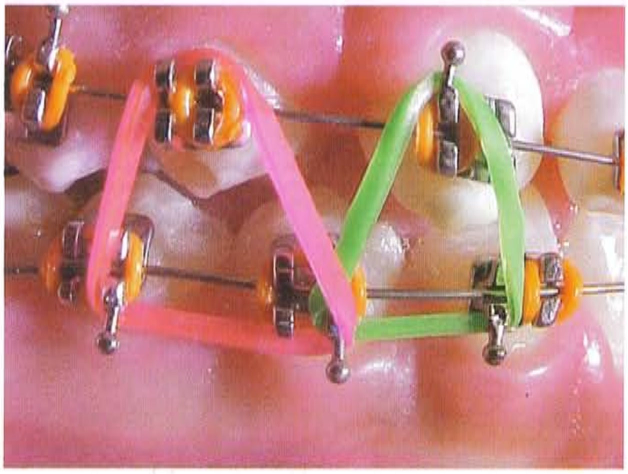
Different elastic diameters (1/8", 3/16", 1/4" or 5/16") may be used and the force can vary from 2 Oz, 4 Oz to 6 Oz.

Figs. 68 and 69. Class II elastics.

Figs. 70 and 71. Class III elastics.

Figs. 72 and 73. Delta elastics.

Advantages

1. 1. They are cheap.
2. Easily placed by the patient.
3. Not only can they be used as minimal anchorage but they can also produce anteroposterior changes.
4. Class II elastics limit the anterosuperior segment protrusion, procline the anteroinferior sector and impulse mandible anterior displacement.
5. Class III elastics procline the anterosuperior segment and retrocline the anteroinferior segment. [24]

6. Delta elastics are ideal for the maintenance of Class I canine relation during the space closure phase.
7. Vertical dimension control.[24]

Disadvantages

1. Effectiveness depends 100% on patient compliance.
2. Pain is the main cause of patient non-compliance.[24]
3. They deteriorate and loose elasticity.
4. Prolonged use can cause TMJ pain.
5. May over-extrude anterior or posterior teeth according to the vector used.
6. Odor after 24 hours of continuous use.

Recommendations

1. Use of these elastics is recommended with a heavy stainless steel wire in order to avoid extrusion of the posterior and anterior segments.
2. In order to avoid extrusion and mesial movement of the posterior teeth, a lingual or transpalatine arch must be placed.
3. Intermaxillary elastics can be used in a favorable manner while extruding the molars in a controlled fashion and anteroposterior problems are corrected.
4. We must instruct the patient to wear them all day and night.

g) Lip bumper

This appliance works inhibiting the force exerted by the lips on the anterior teeth (in those patients that have very tense perioral muscles) acting like a bumper, allowing growth of the maxilla or the mandible. Depending on where it is placed, their action is similar to the labial shields of the Frankel appliance. Labial shields are appliances that are placed in the first molar tubes or can be welded; they have an acrylic shield that covers all the anterior buccal area. They are made from 0.036" stainless steel wire or can be purchased in a wide range of sizes. According to Anthony Viazis, in order to have greater anchorage the acrylic shield should be placed 5 mm to 7 mm from the buccal aspect of the incisors and according to James McNamara it should be separated 2 or 3 mm from the buccal aspect of the incisors, and be at the cement-enamel junction level.[17,28,29]

Advantages

1. Lip bumpers can maximize anchorage and gain length in the lower arch maintaining muscular tension away from teeth; this allows a passive arch expansion in

Fig. 76. The lip bumper is a removable appliance that is inserted in the tubes of the First molar bands.

Figs. 74 and 75. Lip Bumper. The buccal shield must be placed at the cement-enamel junction level and separated 5 mm from the buccal aspect of the lower incisors.

an anterior and lateral way, gaining dental arch length.
2. Promotes transversal changes that vary from 2 to 2.8 mm at canine level, 2.5 to 4 mm at first premolar level and 2 to 5.5 mm at the first molar level.
3. These shields depend upon lip pressure (100 to 300 g) to produce distal molar movement or to prevent mesial molar movement. According to Viazis, when lip bumpers are placed on first lower molars, these incline distally 1.5 mm per quadrant (3 mm per maxilla) and they can up right to 8°.
4. Because of the distal movement in molars, these bumpers can diminish or eliminate an anterior deep bite.
5. They annul the action of the buccinator muscle over the dental arch. (29)
6. They aid in leeway space conservation.
7. Buccal seal is rehabilitated.

Disadvantages

1. Bands can dislodge from the molars and ulcerate the oral mucosa.
2. We depend on patient compliance when the appliance is removable.
3. Some patients do not like the change in facial appearance once the appliance is placed.
4. Because of its distalizing effect, an anterior open bite may develop.
5. Preferably, do not place fixed appliances in the lower dental arch while the bumper is in use.

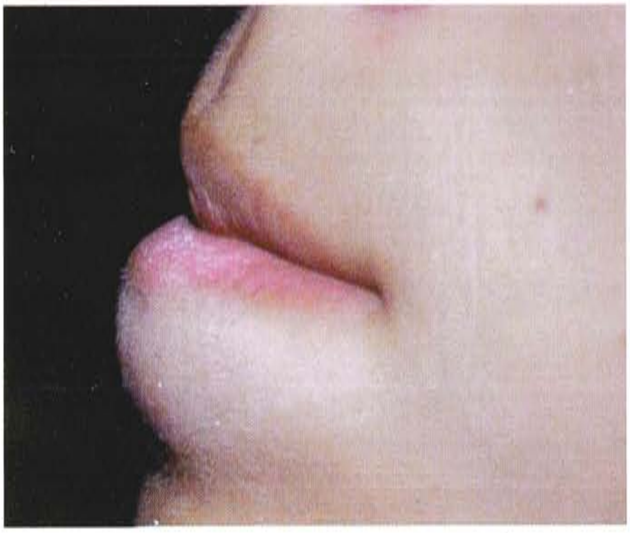


Fig. 77. Facial appearance of a patient with the bumper in place.

Recommendations

1. Depending on the level of placement we can expect certain movements:
   a. If it is placed in the marginal gum level, it will upright the molar.
   b. If it is placed at a middle level or at the cement-enamel union level, it will allow a distal molar movement and a buccal displacement of the lower incisors (1.4 mm).
   c. If the lip bumper is placed under the cement-enamel union level, the molar will distalize without inferior incisor proclination.(13)
2. As the lower dental arch expands spontaneously, the treatment outcome tends to be more stable.
3. The use of a Schwarz appliance with the lip bumper is recommended, so the expansion develops in a controlled manner and we can obtain a more stable outcome.
4. The lip shield must be used continuously between 6 to 18 months, this way we can reeducate the stimuli of the neuromuscular system that cause the perioral muscles to compress the lower dental arch.

2. MODERATE ANCHORAGE

This type of anchorage gives us 50% of mesial molar migration and 50% of anchorage. It is also called reciprocal anchorage. According to Nanda this anchorage is denominated B Anchorage, where space closure is relatively symmetrical, with the same displacement for anterior and posterior teeth during space closure. These appliances are made with 0.036" round stainless steel, and are soldered to molar bands or go inserted in sheath boxes attached to the molar bands, or bonded directly to the tooth. Among the moderate anchorage appliances we can mention the Nance button, the Viaro Nance, transpalatine arch, lingual arch0 etc. (19,24)

Types of moderate anchorage:
1. Nance Button.
2. Transpalatine Arch (TPA).
3. Viaro Nance.
4. Lingual Arch.

a) Nance Button

This is one of the most used anchorage appliances today, being the anchorage of choice in cases with prior upper molar distalization. The Nance button includes a small

Figs. 78 and 79. Fixed Nance Button soldered to upper molar bands.

Fig. 80. Fixed Nance Button soldered to upper molar bands.

acrylic dab the size of a coin (about 1cm diameter). It reclines against the hard palate mucosa, at the palatine ridges level. It is made out of 0.036" round stainless steel wire with rests in the molars and on the hard palate through the acrylic dab. This appliance can be bonded on the molars or soldered to the molar bands (fixed anchorage) or inserted in sheath boxes attached to the molars (removable anchorage).[3,5]

Figs. 81 and 82. Removable Nance Button inserted in lingual sheaths on the molar bands.

Advantages

1. This anchorage leans on the hard palate in order to resist mesial molar migration during the anterior retraction phase.[3]
2. Cheap and easy to make.
3. Can be used in the mixed dentition in cases of premature tooth loss to preserve leeway space, as in the permanent dentition as anchorage maintaining the space of the extraction site.[29]
4. Maintains dental arch length.

Disadvantages

1. Can ulcer the hard palate due to the fact that the acrylic dab can retain food particles or to the excessive anterior retraction force that may impinge it against the palate.

Fig. 83.

2. The appliance can dislodge if it is removable.
3. Laboratory time consuming.
4. Not always well tolerated by the patient because of the food entrapment under the acrylic dab.
5. The bigger the dab, the greater the anchorage, but there will also be more food entrapment.
6. In cases where the button is directly bonded to the molars, it can loosen due to the force of the occlusion.

Recommendations

1. Short use periods in order to avoid ulcers.
2. Polish well both sides of the acrylic dab at the moment of fabrication. This will lessen food retention.
3. Not recommended for patients with bad oral hygiene. In this case it is best to apply other anchorage appliances.
4. Leave the dab borders as rounded as possible so it will not impinge itself in the palate.
5. The bonded Nance button helps maintain periodontal integrity, more so in patients with periodontal problems.
6. Remove the Nance button in a monthly basis if it is removable, this will enhance hygiene in the patient.
7. In case it is fixed, instruct the patients to use a syringe with a solution of water and Clorhexidine Gluconate under pressure to avoid gum irritation or ulcer formation.
8. It may be placed at premolar level while upper molar distalization is taking place with NiTi open coils.

b) Transpalatine Arch (TPA).

Dr. Robert A. Goshgarian introduced this arch in 1972. It crosses the palate joining as one unit both first molars; it is effective as a moderate anchorage appliance forming an anchorage unit that resists mesial molar movement and mesial rotational lingual root tendency. It is one of the most simple moderate anchorage appliances to make and the most used by the majority of orthodontists.[12,17,24,29]

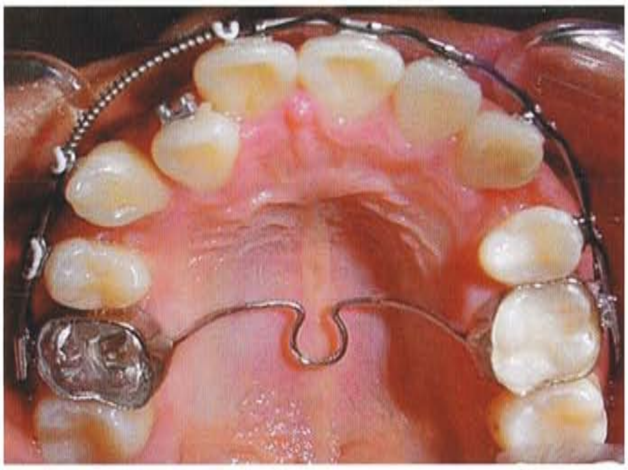


Fig. 84. Transpalatine arch.

We must take an impression with bands adapted on the first upper molars in order to fabricate one, then we pour plaster in the impression with the bands placed in it; then we can proceed to bend the 0.036" stainless steel wire and form the transpalatine arch, leaving a 1 or 2 mm separation between the wire and the palatine mucosa.[29]

Fig. 85. The transpalatine arch must be separated 1 or 2 mm from the palatine mucosa in order to avoid its impingement.

The transpalatine arch can be fixed, soldered to the first molar bands or directly bonded on the palatine aspect of the molar. It can also be removable being inserted in lingual sheaths soldered on to the molar band itself.[1,14]

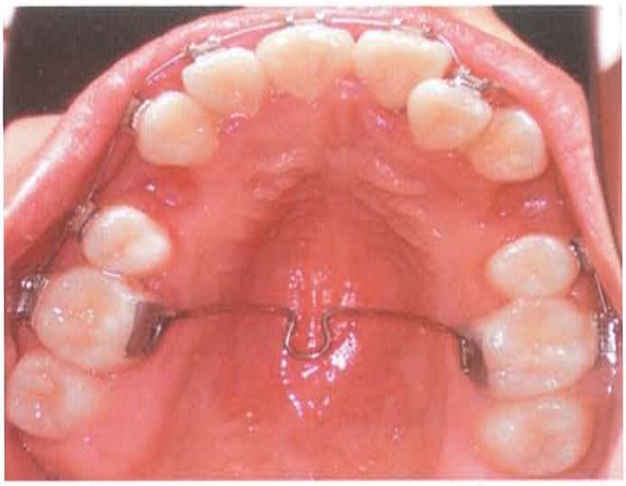


Fig. 86. Fixed transpalatine arch bonded on the palatine aspect of the first upper molars.

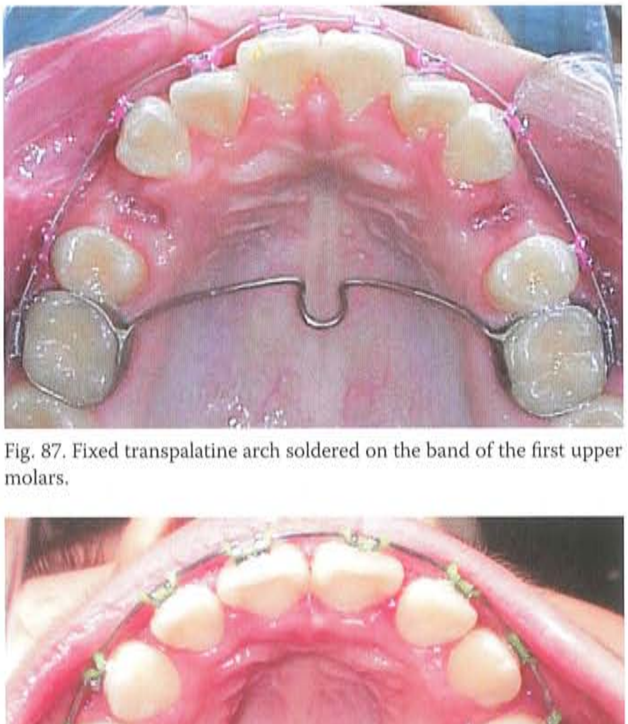


Fig. 87. Fixed transpalatine arch soldered on the band of the first upper molars.

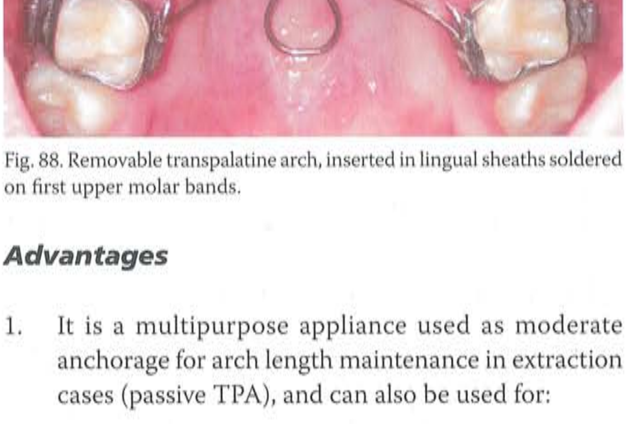


Fig. 88. Removable transpalatine arch, inserted in lingual sheaths soldered on first upper molar bands.

Advantages

1. It is a multipurpose appliance used as moderate anchorage for arch length maintenance in extraction cases (passive TPA), and can also be used for:
   a. Molar mesial rotation. Sometimes a Class II molar relation can be due to a simple mesial molar rotation. Counteracting this rotation corrects the molar relation 1 to 2 mm (active TPA).
   b. Unilateral molar distalization (active TPA).
   c. Helps in the maintenance of leeway space in case of premature primary tooth loss (passive TPA).
   d. If the omega is closed, the transpalatine dimension can be reduced.
   e. If the omega is opened can produce palatine expansion.
   f. It can apply torque to the roots of the molars (only when the TPA is soldered to the bands) bending the arch at the point where solder and band meet.
   g. If we add a palatal plate, can produce upper molar intrusion due to the force that the tongue exerts on the plate.

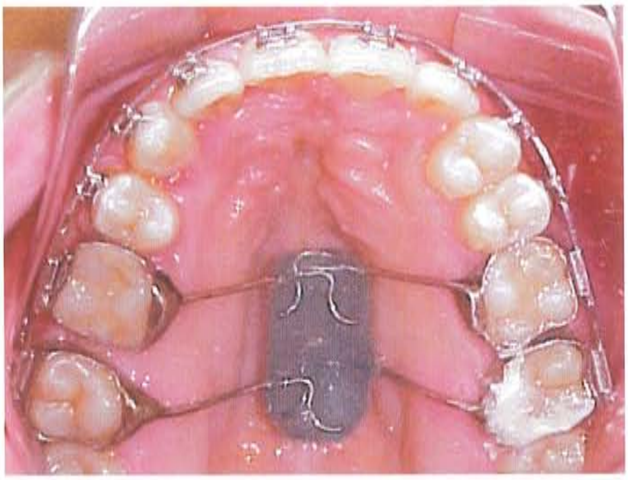


Fig. 89. Double transpalatine arch with palatine plate.

2. The fixed transpalatine arch is easier to fabricate and stiffer.
3. The removable TPA can be easily disengaged without decementing the bands. [12]
4. The bonded transpalatine arch reduces chair time because there is no need for molar separators for band adaptation.[26]

Disadvantages

1. This moderate anchorage appliance is not always accepted by the patient.
2. Consumes a lot of laboratory time.
3. If the transpalatine is soldered, the intraoral activation is difficult.
4. The appliance can dislodge if it is removable.

5. If the arch is left more than 2 mm separated from the palatine mucosa, can produce tongue lacerations in a short period of time.

Fig. 90. Lesion in the dorsum of the tounge caused by the transpalatine arch.

6. If the TPA is too close to the palate tissue can impinge into the palatine mucosa and must be excised for its removal.

Recommendations

1. This type of anchorage is very useful when a power chain is used with a continuous arch wire, but in cases where a maximum anchorage is needed, the transpalatine arch must be combined with an extra oral traction device.
2. The use of the bonded TPA is recommended because it promotes periodontal health and is easier to clean.
3. It can be used as anchorage at premolar level in conjunction with Class II elastics while molar distalization with NiTi open coils takes place.
4. Being such a versatile appliance, an arm can be added (of variable longitude) for cases that present unilateral or bilateral collapse in the superior dental arch. This arch is called a Porter Arch.[12]

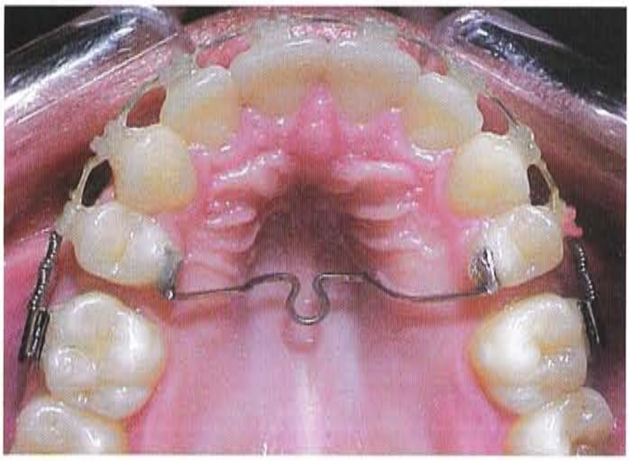


Fig. 91. Direct adhesion TPA used as anchorage at premolar level while distalizing upper molars.

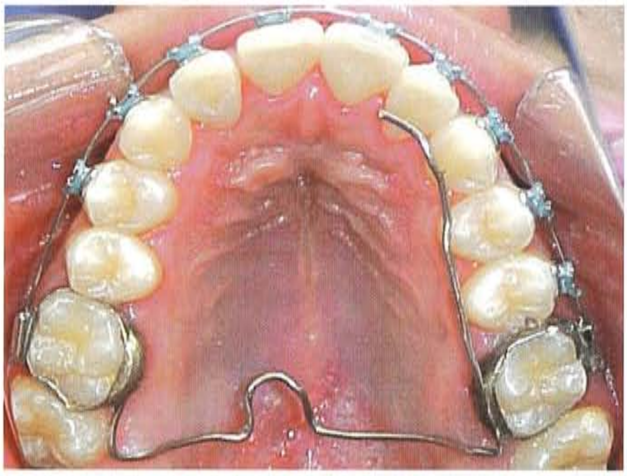


Fig. 92. TPA with a unilateral arm to uncross the bite.

c) Viaro Nance

This type of moderate anchorage is a modification of the Nance Button made by Dr. Victor Avalos Rodríguez, orthodontist graduated from Centro de Estudios de Ortodoncia del Bajío (CEOB) in Irapuato, Guanajuato, México. It is made with 0.036" TMA wire and it has two helixes, which must be activated once a month to distalize molars. This wire must be inserted in the lingual sheaths soldered to the upper molar bands, which makes it a removable anchorage.[6,24]

Fig. 93. Viaro Nance on work model.

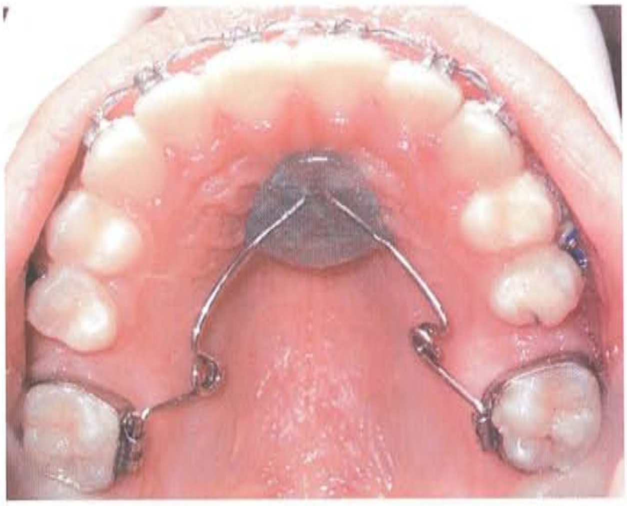


Fig. 94. Viaro Nance in mouth.

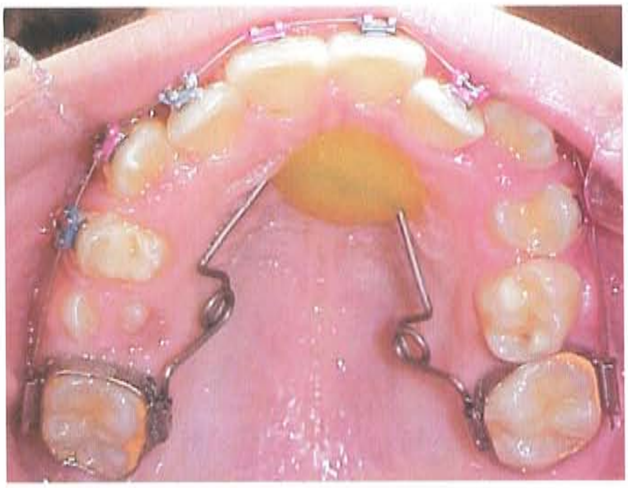


Fig. 95. Viaro Nance in mouth.

Fig. 96. Viaro Nance in mouth three months after cementation.

Advantages

1. The Viaro Nance is a double purpose anchorage appliance because it can be used as a moderate anchorage device for molars and can also distalize upper molars.
2. Cheap an easy to make.
3. Being a removable anchorage appliance, hygiene is easy.
4. Tends to distalize 1 to 1.5 mm monthly.

Disadvantages

1. May cause pain due to molar distalization.
2. The appliance may be lost because it is removable.
3. Laboratory time consuming.
4. If we leave the edges of the acrylic dab too sharp, the appliance may impinge itself in the palatine mucosa.

Recommendations

1. At the moment of insertion in the mouth, the TMA arms must be activated at 90° in order to distalize.
2. Activations will be done on a monthly basis.
3. Once the molars are distalized, leave the appliance in the mouth as anchorage during the anterosuperior sector retraction.

d) Lingual Arch

The lingual arch is a moderate anchorage appliance that is widely used for dental arch length maintenance; it is relatively rigid and diminishes mesial molar movement during canine, premolar and anterior segment retraction.

This appliance may be fixed (soldered to the inferior molar bands or bonded directly on the molars) or removable (inserted in lingual sheaths soldered to the inferior molar bands). The lingual arch is made from 0.036" stainless steel round wire and it extends from molar to molar near the lingual aspect of the inferior teeth. If it is used as a leeway space maintainer, it must rest near the cingulum of the inferior teeth; if used as anchorage for the retraction of the anterior segment, then it must be separated 3 or 4 mm from the cingulum. It has two adjustment omegas that allow the orthodontist to shorten, lengthen, rise or lower the wire.[3,17]

Advantages

Fig. 97. Fixed lingual arch soldered to the bands of the first lower molars.

Fig. 98. Removable lingual arch inserted in lingual sheaths on the bands of the first lower molars.

Fig. 99. Removable lingual arch inserted in lingual sheaths on the bands of the first lower molars.

1. It is a multifunctional appliance that can be used as moderate anchorage in extraction cases, and has other uses:
   a. Helps to maintain leeway space in case of premature primary tooth loss. [29]
   b. Intermolar distance control.
   c. Molar rotation.
   d. Platform for auxiliary elements.
   e. Lower incisor forward inclination.
   f. Lower molar distal movement.
2. Cheap and easy to make.
3. With the advancement of orthodontic adhesives (sixth and seventh generation), now we can bond directly anchorage appliances to the molars. This reduces chair and lab time.

Disadvantages

Fig. 100. Direct bond lingual arch.

1. The arch can impinge itself in the oral mucosa if the omegas are not separated 1 or 2 mm from the mucosa.
2. Laboratory time consuming.
3. The appliance can dislodge if it is removable.

Recommendations

1. The omegas of the lingual arch must be placed away from the oral mucosa so they do not impinge into the mucosa. If this happens, we must remove it for at least a week to let the mucosa heal.
2. The lingual arch can be made according to the case at hand, meaning that in those cases that we want traction of the posterior sector the arch can be made from premolar to premolar or premolar to contralateral molar, in conjunction with Class II elastics.

Fig. 101. Lingual arch impingement.

Fig. 102. Lingual arch made from molar to premolar in order to pull the second molar to the extraction site.

3. We recommend the use of the bonded lingual arch because it is easier to clean.

3. SEVERE OR MAXIMUM ANCHORAGE

In this type of anchorage molars migrate mesially 30% of the space, and give us 70% of anchorage. According to Nanda this anchorage is called A Anchorage; he describes this category as the critical maintenance of the position of the anterior teeth, where 75% or more space will be needed for retraction.[19,24] We find the Chromosome arch, the transpalance and the TPA combined with an extra oral appliance in this anchorage category.

Maximum anchorage is used when we have severe overcrowding or when we need an important facial change, like in bi-protrusive or Class II division I patients.

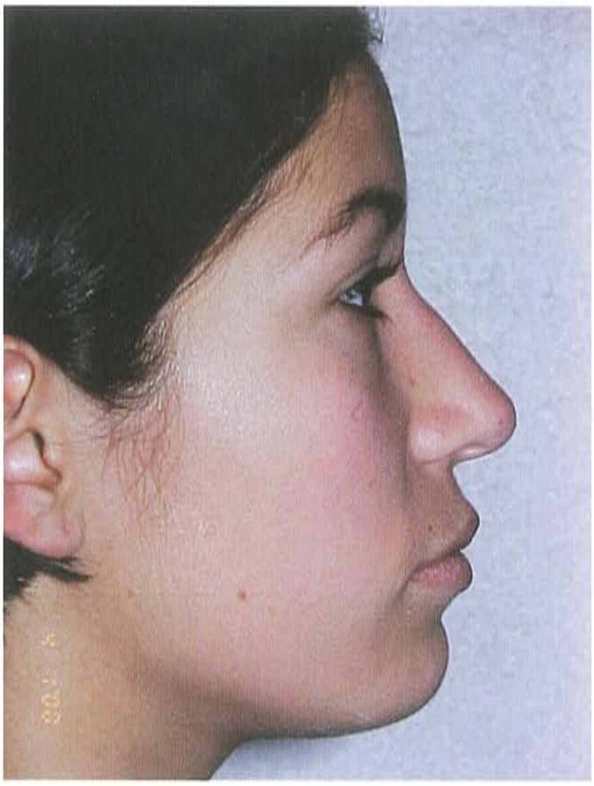


Fig. 103. Bi-protrusive patient for whom maximum anchorage will be needed.

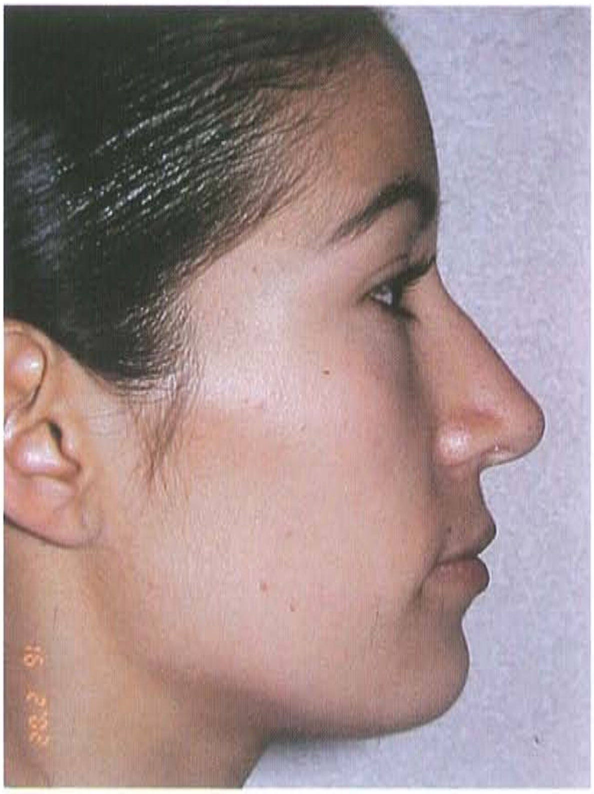


Fig. 104. Facial change produced after extractions and orthodontic therapy in which a maximum anchorage appliance was required.

Types of severe or maximum anchorage:

1. Chromosome arch.
2. Transpalanance.

a) Chromosome Arch

This appliance, designed by Dr. Esequiel Eduardo Rodríguez Yáñez, has the advantage that it is very versatile and provides excellent posterior segment control. It is made with 0.036" round stainless steel wire in an "X" manner and it is cemented to all four superior molars. It has two distal palatine bends (one on each side) to aid during canine and anterior segment retraction, making space closure faster and diminishing unwanted cuspid angulations. Indicated in severe dental overcrowding cases that need a facial change.(6)

Chromosome Arch elaboration

We need 0.036" round stainless steel wire, about 5 cm of it. This wire is bent with hollow chop pliers and adapted to the palatine vault.

Fig. 105. Wire bending with the hollow chop plier in the middle of the wire.

Fig. 106. After the bend is done, the wire is adapted to the palatine vault.

Then this wire is adapted to fit around the second molars, and the distal bends are done. These bends are made as close as possible to the center of resistance of the molars. This is the posterior part of the chromosome arch.

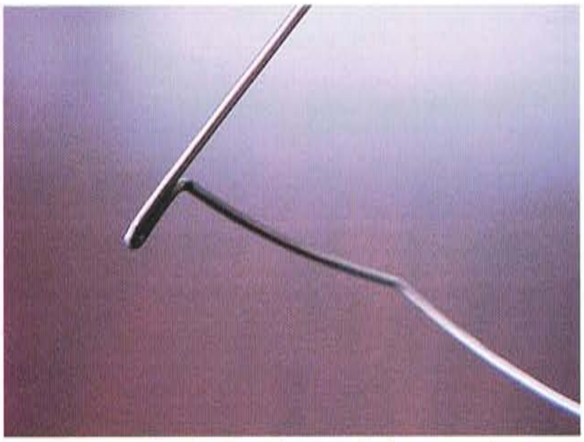
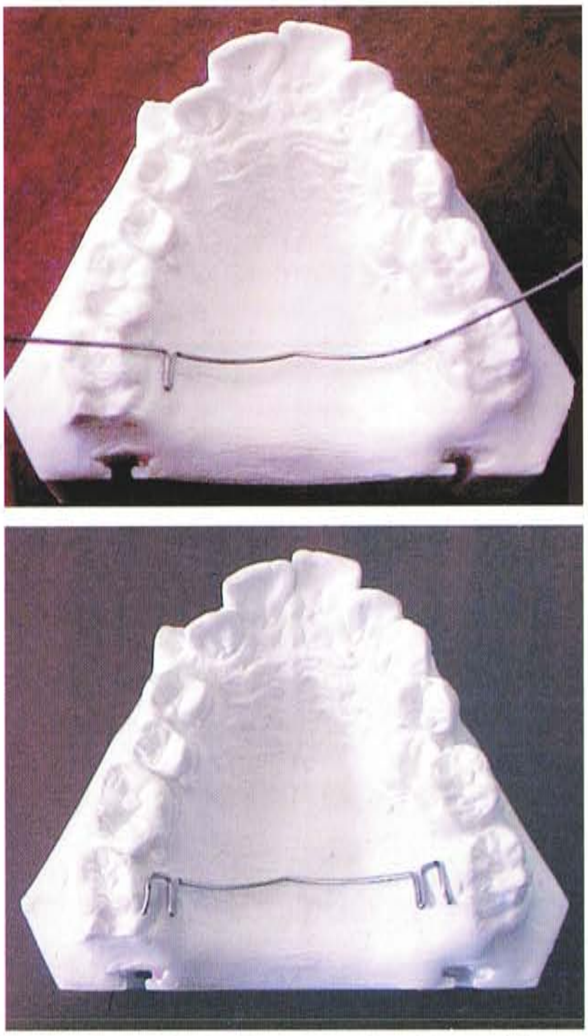
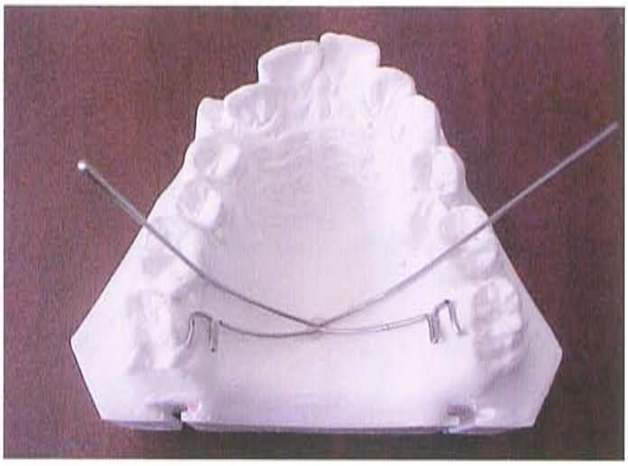


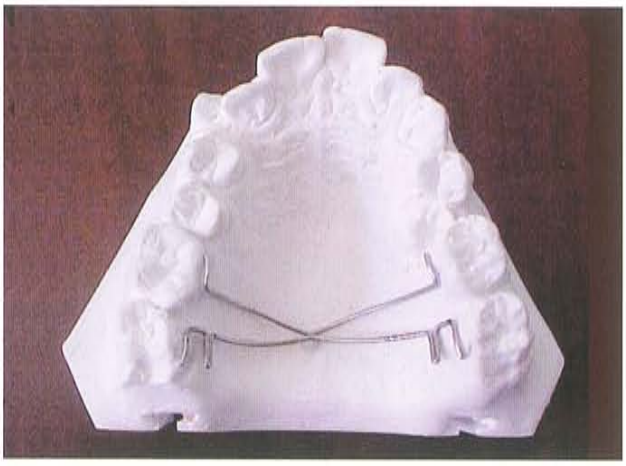
Fig. 107. Once adapted to the palatine vault, the center of resistance of the molars is marked and the distal bends are made.



Figs. 108 and 109. The distal bends are made and the end of the wire is adapted to the palatine aspect of the second molars.

With another wire of the same gauge and length as the first one, we proceed to make a second arch. This is bent in the same way as the first one and will be adapted to the first upper molars.





Figs. 110 and 111. A second wire is bent in the middle and the ends are adapted to the palatine aspects of the first upper molars. These two wires are placed together in the middle with wax and then bound together with solder.

Fig. 112. Direct bond chromosome arch on work model.

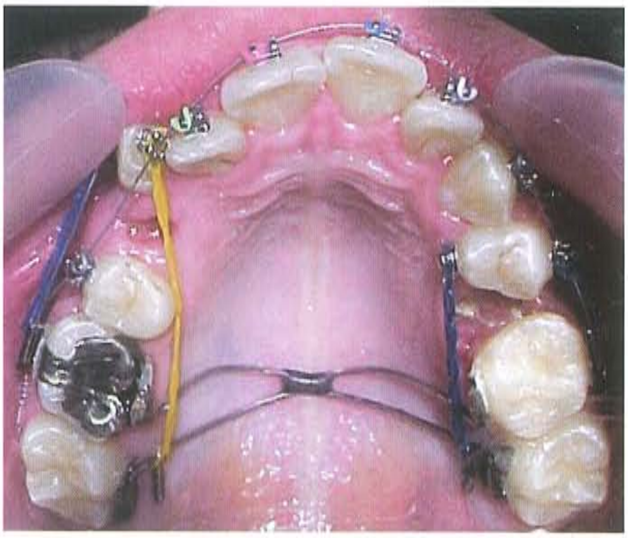


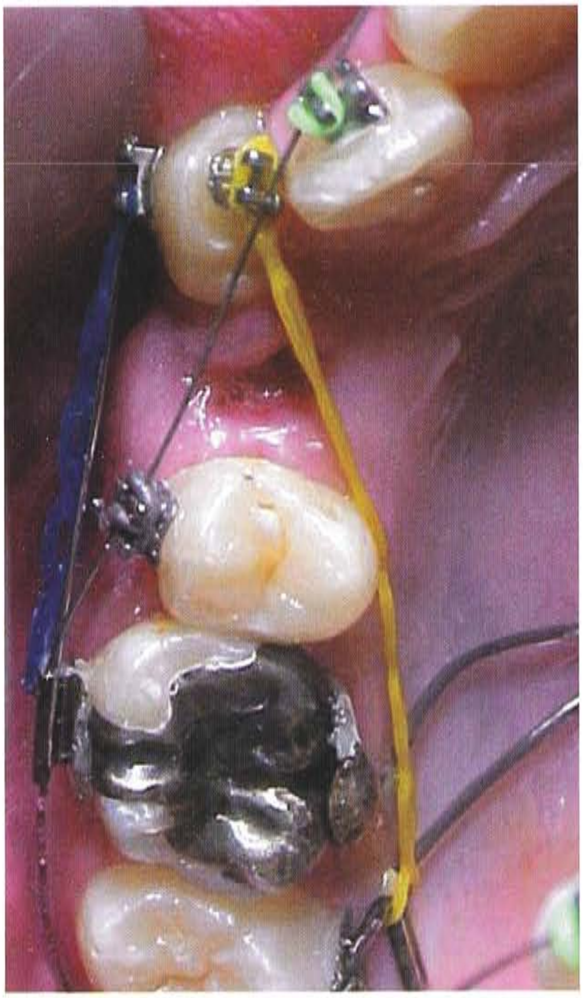
Fig. 113. Chromosome arch in mouth.

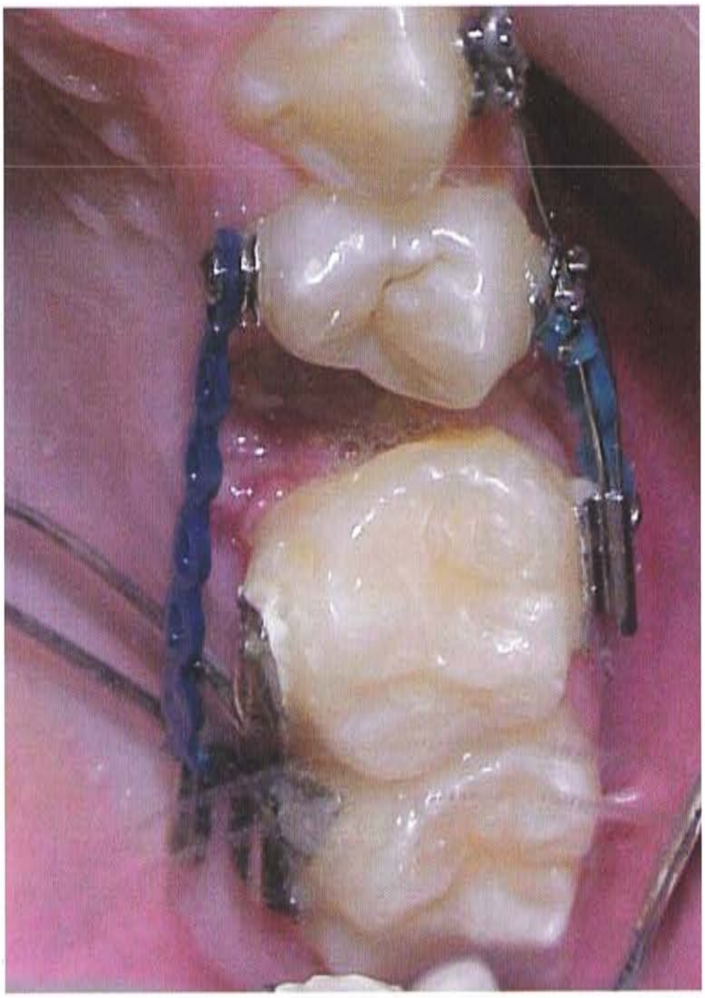
This arch can be soldered to the bands of the four upper molars or we can weld four steel mesh pads on the wire ends and bond it directly on the molars.

Once the Chromosome arch is bonded to the molars, we can bond buttons on the palatine aspect of the teeth that are going to be pulled back.

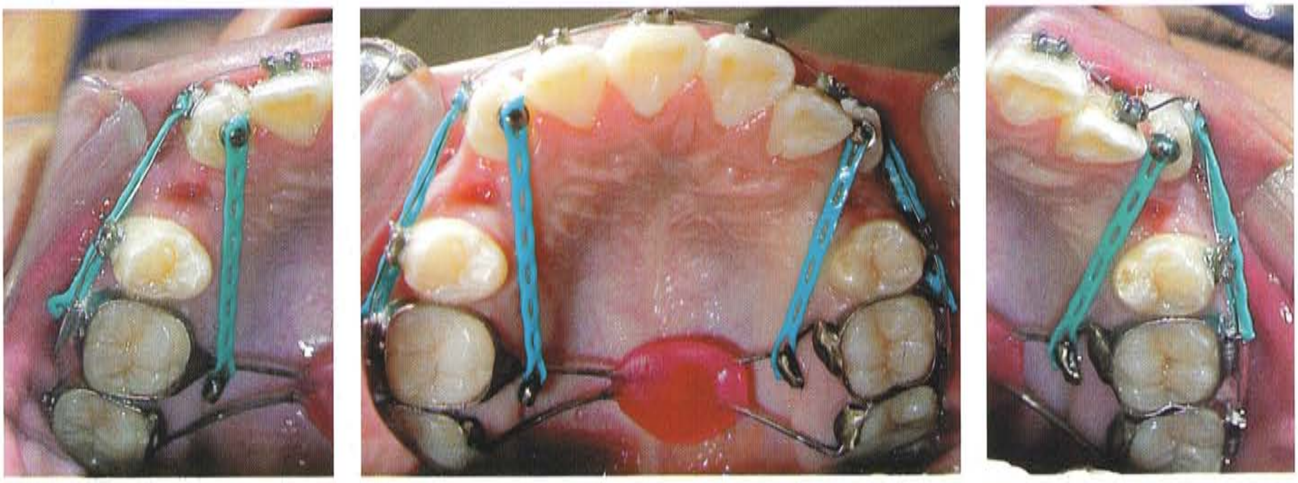
Advantages

1. Excellent maximum anchorage appliance that includes a greater number of teeth to the anchorage unit.
2. It is a double purpose appliance; besides serving as an anchorage appliance it helps in the traction of the teeth to the extraction sites through the parallel forces exerted by the power chain stretched from the distal bends to the bonded buttons on the teeth to be pulled, facilitating the overcrowding correction in less time.
3. In open bite cases a palatine plate can be placed separated from the palatal vault (approximately 2 to 3 mm) for molar intrusion and to provoke mandibular autorotation.





Figs. 114 and 115. Chromosome arch cemented, now we need to bond buttons on the palatine aspect of the teeth that are going to be pulled back, and this way we will have two parallel traction forces.



Figs. 116-118. Chromosome arch with palatal plate for molar intrusion and bite closure.

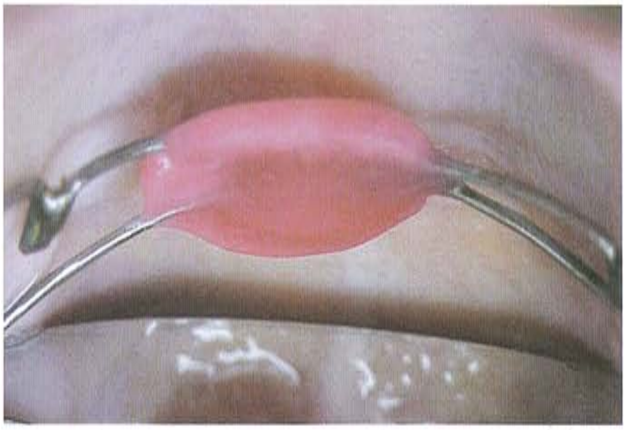


Fig. 119. The palatal plate must be separated 2 to 3 mm from the palatal vault in order to produce posterior sector intrusion through the force exerted by the tongue.

Fig. 120. Two months after the placement of the chromosome arch the correct alignment of the canines in the extraction sites has taken place.

4. The retraction movement is done in a more bodily fashion, with no undesired rotations and less time.

Fig. 121. Chromosome arch in mouth.

5. In cases where the second molar has not completely erupted, the anchorage will be supported on first molars and premolars.

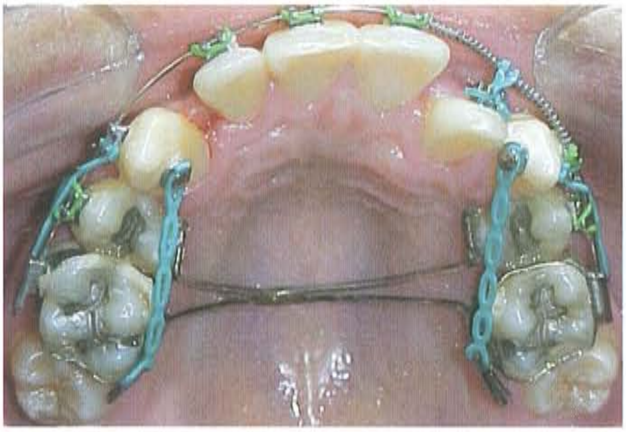


Fig. 122. Chromosome arch 20 days after placement.

6. It is cheap and easy to make.
7. The chromosome arch can be soldered to the molar bands or directly bonded to the molars.
8. Provides greater control of the posterior sector.

Disadvantages

1. Time consuming fabrication.
2. Not always well tolerated by the patient.

Recommendations

1. Once placed in the mouth, dental traction can start in the initial leveling and alignment phases.
2. We can combine the use of power chain on the palatal side and closed NiTi coils on the buccal side for dental traction.
3. The removable version is not recommended because the necessary traction force applied over the teeth may dislodge the appliance from the lingual sheaths.
4. We recommend the direct bonded version of the appliance because it is easier to clean.

b) Transpalanance

Transpalanance is the fusion of the transpalatine arch with the Nance Button. This anchorage is used, as the chromosome Arch, in cases of dental overcrowding and facial change as an objective. It is a good maximum anchorage option for the upper maxilla, where the Nance button has an acrylic dab reclined on the anterior, superior and medial region of the palate; the transpalatine arch, the dentally supported part of the appliance, is made with 0.036" round stainless steel wire.[5]

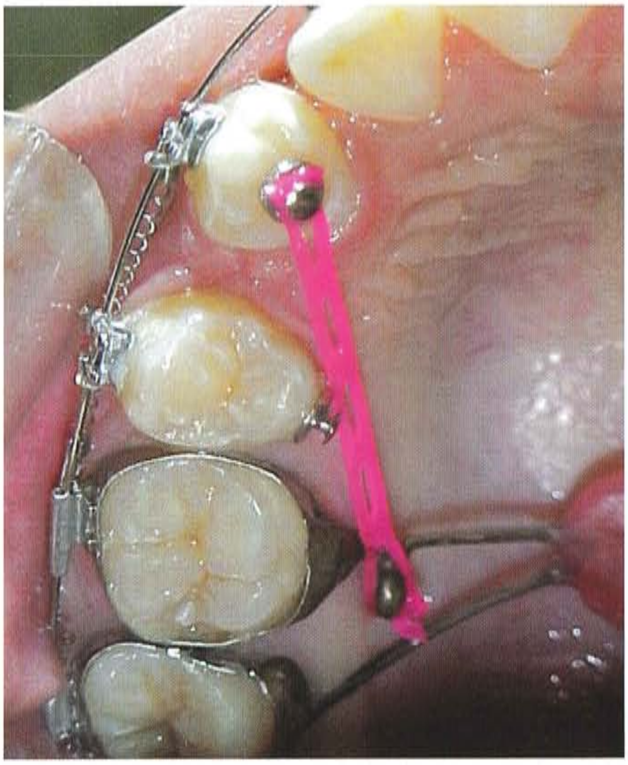
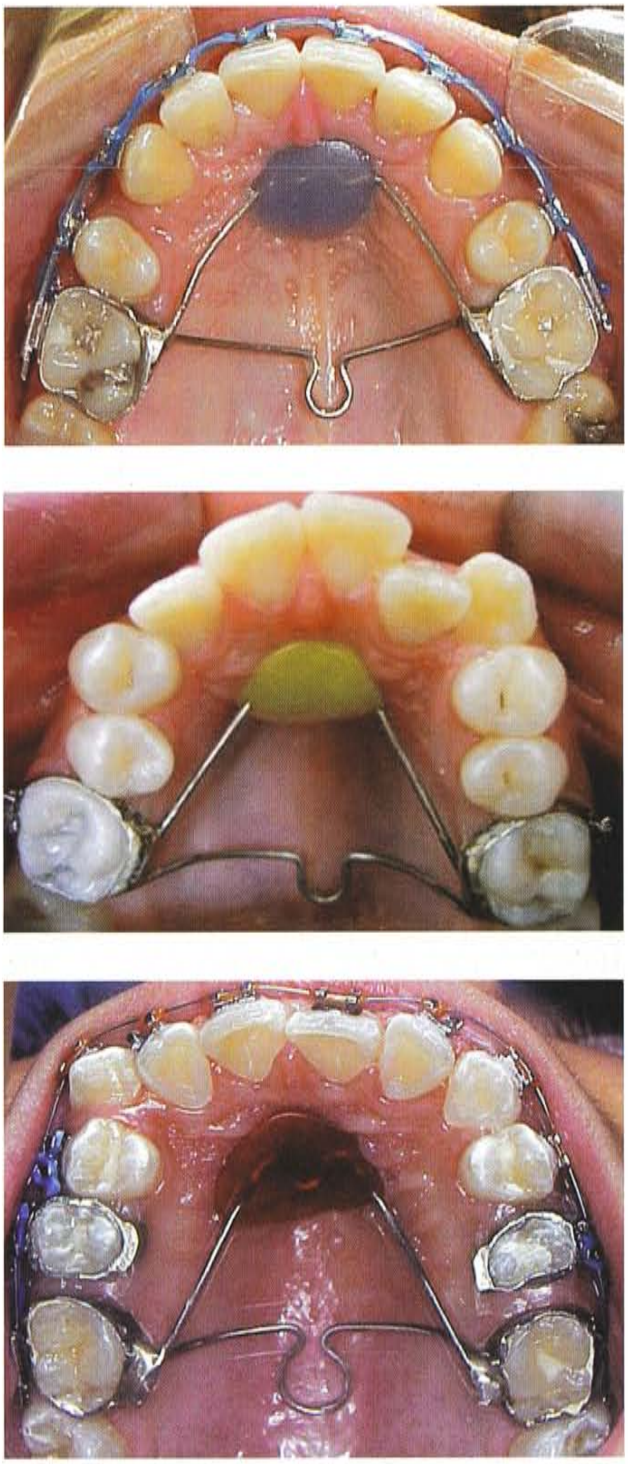


Fig. 123. Auxiliaries in combination for dental traction; NiTi closed coil on the buccal side and power chain on the palatine side.



Figs. 124-126. The transpalanance is the combination of a transpalatine arch and a Nance Button.

Advantages

1. This anchorage helps resist molar mesial migration during anterior retraction.[3]
2. Preserves dental arch length.[29]
3. It is cheap and easy to make.

Disadvantages

1. Impingement of the Nance button in the palatal mucosa.
2. Consumes laboratory time.

Recommendation

1. The use of this appliance is recommended when a facial change is needed.
2. The acrylic dab must be very polished on both sides in order to avoid food accumulation.
3. The edges of the Nance button must be rounded in order to avoid impingement of the button in the palatal mucosa and must be separated 2 or 3 mm from the palate vault.
4. In case of impingement take the button off and prescribe mouthwash with clorhexidine gluconate to the patient.

4. ABSOLUTE ANCHORAGE

In this type of anchorage mesial migration is avoided conserving 100% of the extraction site space. In the last years, titanium micro implants have been used in orthodontic treatment in order to provide absolute anchorage without patient compliance. These mini screws are small enough to be placed in different areas of the alveolar bone.[20,21,24]

Special characteristics of the mini implant placement site

1. There must be enough bone depth to place the screw to an adequate depth (at least 2.5 to 3 mm wide), this way we can protect the roots and adjacent anatomical structures like the maxillary sinus or the inferior dental nerve.
2. We must evaluate the density and transversal thickness of the bone crest and discard any root pathology process that should be attended before the implant placement.[20]

Implant characteristics

They generally have an endosseous screw section and a trans-mucose neck; they have a cylindrical form with a diameter of 2 to 3 mm, and the length varies among 7 mm, 9 mm, 11 mm, and 14 mm, with an external band 2 mm long. Some mini implants present an internal and external spot to facilitate ligation. These screws can withstand 850 N/mm^2 of force[11,15]

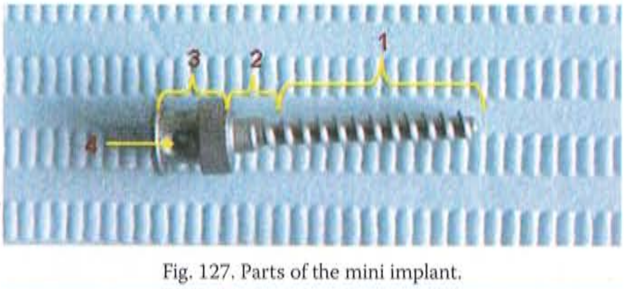


Fig. 127. Parts of the mini implant.

Fig. 128. Titanium mini implant of 14 mm in length.

Mini implant placement steps

1) Local anesthesia by blockage of the maxillary superior-posterior nerve, on both sides.

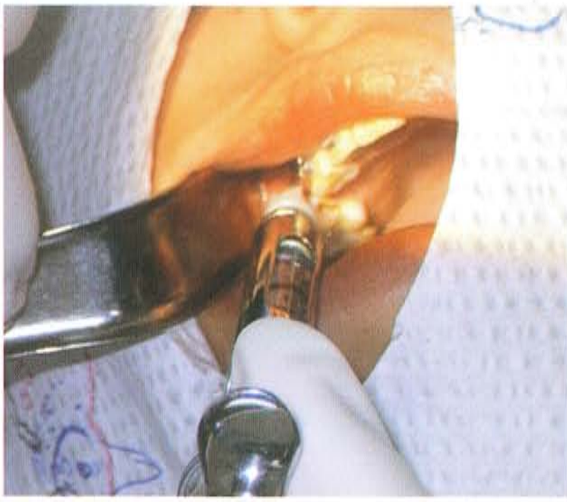


Fig. 129. Blockage of the maxillary superior-posterior nerve.

2) Small surgical incision in the buccal fold near the superior second molars.
3) Bone perforation with low speed hand piece and drill for the sequential widening of the orifice.

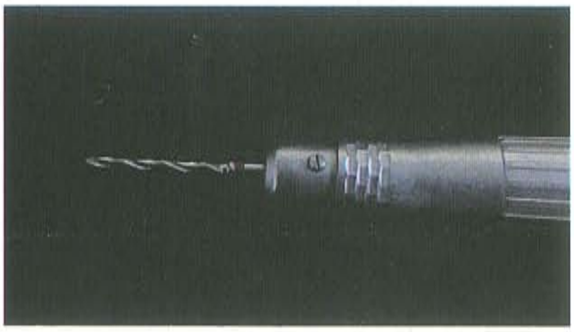


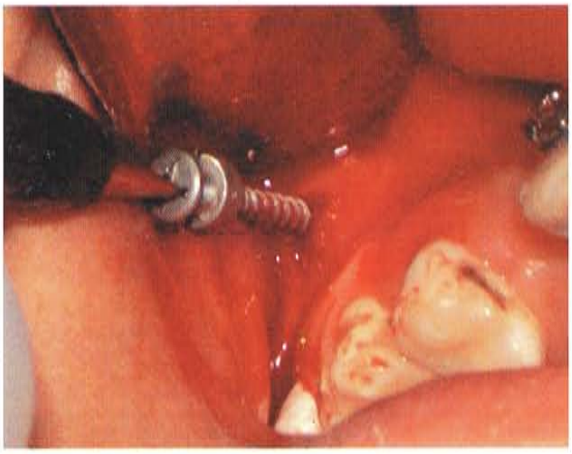
Fig. 130. Drill.

Fig. 131. Bone perforation where the implant is going to be inserted.

4) Cervical cone formation in order to receive the mini implant.

Fig. 132. Once the opening is done the field is ready to receive the mini implant.

5) Initial introduction of the screw with the screwdriver.



Figs. 133 and 134. The mini screw is tightened until the transmucose neck reaches the bone.

6) Ligature wire placed in order to avoid screw invagination.

Fig. 135. The ligature wire is inserted in the internal spot of the screw in order to avoid screw invagination.

Once the surgery is done, schedule an appointment for a week later and place power chains (from the mini implants to the mesial aspect of the canines) in order to begin the traction of the anterior sector.

Figs. 136 and 137. Anterior section traction with power chain.

7) We must take X-rays at 6-month intervals to see that everything is in order.

Fig. 138. We must take X-rays every 6 months to verify that the implant is still in the original placement site.

Advantages

1. Mini implants offer the best anchorage.
2. They require minimal patient cooperation.
3. Less treatment time required for anterosuperior sector retraction.
4. Overall treatment time reduction.
5. Less surgical instruments needed.[21]
6. Allows alignment and retraction of the anterior sector.
7. Helps the correction of shifts along the medial line.
8. Allows space closure of edentulous posterior spaces in order to avoid prosthetics.[21,22]

Disadvantages

1. Represents an extra expense that the patient has to pay.
2. Its use has certain counter indications, such as:
   a) Acute infectious processes.
   b) Uncontrolled diabetic patients.
   c) Patients who smoke, because nicotine inhibits osseointegration.
   d) Persistent periodontal disease.[2,22]
3. Not always accepted by the patient because of the surgery involved.

Recommendations

1. The use of mini implants is recommended only in patients that have excellent oral hygiene; those who do not are at risk of developing periimplantitis.[2]
2. A complete medical history is essential.[2]
3. Once the implant is removed, we must tell the patient to continue with the good oral hygiene program complemented with a Clorhexidine based mouthwash in order to prevent infection of the implant site.

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Space Closure in Orthodontics

3

Esequiel Rodríguez, Rogelio Casasa, Adriana Natera, Elías Burguera

Introduction

Orthodontic movement is the response to force applied on teeth through braces, wires, elastics, modules, elastic bands, coils, etc.[20] The process occurs in this manner: when a force is applied on the tooth, it moves inside the alveolar socket, this provokes the stretching of some periodontal fibers and the compression of other fibers. At the same time the interstitial liquid of the fibers is also compressed against the osseous walls. As the liquid slowly drains out of the alveolus, it also exerts hydraulic resistance against the dental movement. Periodontal fibers and interstitial liquid act in conjunction, against the forces applied on the tooth, making it return to its original position. It is a paradox, but bone is the most malleable tissue of the human body, adapting to the forces that act upon it. It reacts by depositing osseous tissue in the areas exposed to traction forces and to resorb osseous tissue in areas where pressure is exerted. Orthodontic movement is only possible because of this malleability. This way, the root gets even closer to the alveolar wall, compressing the periodontal ligament on the side where the force is applied and stretching the fibers on the opposite side. Osteoclasts are responsible for cortical alveolar resorption where ligament compression occurs. In the phase where ligament distension occurs, osteoblasts and fibroblasts, the cells that form bone tissue and collagen fibers, are present. Clinically, this period is characterized by moderate tooth pain submitted to pressure but without movement. Around two days after the force application, osteoclasts and osteoblasts initiate the remodeling process. Slowly the alveolus dislocates in the direction of the applied force, with the subsequent orthodontic movement.[23]

Burstone defines optimal force as the one that provides a rapid dental movement, with no patient discomfort and no tissue damage (no bone loss or root resorption), being this the most physiologic orthodontic force.[23]Many investigators (Storey, Smith, Brian Lee, Ricketts, among others) evaluated the optimal necessary force for dental movement; this was obtained by measuring the root surface exposed to movement, the so called affronted root surface. Because pressure is defined as force times surface unit, the applied force must vary depending on the size of the root surface involved and the direction of the proposed movement.[19] Brian Lee proposed 200 g/cm^2 as the optimal pressure for efficient movement, half of what Brian Lee had put forward. According to studies made by Iwasaki, 60 g of force produce a distal canine movement of an average of 1.23 mm per month.[16, 19]

Ricketts clinically showed that intrusion of the inferior incisors with utility arches is efficiently done applying 15 to 20 g per tooth or 60 to 80 g for the four lower incisors; upper incisors have a root surface transversal section that is almost double in size compared to the lower incisors, so the force required for intrusion is double compared to the force required for the lower incisors, approximately to 160 g for all four upper incisors or 40 g per tooth.

The recommended forces for dental movement, according to Ricketts, are shown next page.[16, 19]

Periodontal fibers and interstitial liquid form together a shock absorbing and physiologic force dissipating system during occlusal function and orthodontic movement. When there is a rise in the orthodontic force, the periodontal ligament will present zones with excessive pressure. In these zones, more often on the compression side, blood circulation slows or shuts down, and degeneration or necrosis of the periodontal fibers sets in. This phenomenon is known as hyalinization (aseptic necrosis). The greater the number of hyalinization areas present, the slower the orthodontic movement will be, therefore the greater the force is, the slower dental movement will be. Histologically speaking, during hyalinization we will observe periodontal tissue necrosis in the compression zone, blood vessel obliteration, a diminished blood supply and anoxia (lack of oxygen) in the conjunctive tissue. Clinically we can affirm that heavy forces are pathological and they cause

Ricketts' Table			
	Anteroposterior movements.	Transverse movements	Intrusive and extrusive movements.
Upper central incisor	50 grams	70 grams	40 grams
Upper lateral incisor	40 grams	65 grams	30 grams
Upper canine	75 grams	70 grams	45 grams
Upper first premolar	75 grams	50 grams	30 grams
Upper second premolar	55 grams	50 grams	30 grams
Upper first molar	120 grams	135 grams	80 grams
Upper second molar	——	105 grams	70 grams
Lower central incisor	25 grams	50 grams	20 grams
Lower lateral incisor	25 grams	50 grams	20 grams
Lower canine	75 grams	70 grams	35 grams
Lower first premolar	60 grams	60 grams	30 grams
Inferior second premolar	60 grams	60 grams	30 grams
Lower first molar	110 grams	105 grams	85 grams
Lower second molar		95 grams	75 grams

pain, dental mobility, pulpitis, root resorption and alveolar crest alterations.(3,23)

Orthodontic movement in young patients presents less osseous resorption due to the great cellular element proliferation in the periodontal ligament and the bundles of fibers are thinner and flexible, in contrast with much older patients. Younger patients present less tissue reaction to orthodontic forces (around 2 or 3 days), in contrast with the 8 or 10 days needed for cellular proliferation in an adult, which makes adult orthodontic movement slower. Patients with heavy complexion present reduced medullar spaces and denser cortical bone, they present a higher tendency of hyalinization and consequently a higher degree of difficulty to move teeth. Patients with hyperparathyroidism produce more osteoclasts with the subsequent bone resorption. In the same way, sexual hormones (estrogen or testosterone), when in surplus, have an effect over bone alterations. Storey, in 1954 found erratic tooth movement related to menstrual cycle phases in young adolescents.(3,23)

When we determine the need to extract teeth in an orthodontic treatment we must consider some factors like dental overcrowding, anchorage, canine and incisor axial inclination, midline discrepancies, vertical dimension, facial and dental esthetics, dental health, plus the main motive why the patient seeks consultation with an orthodontist. Space closure in orthodontic treatment can be done with two types of mechanics:

1. **Sectional or segmented mechanics,** that consist in closure loops that are made on a sectioned arch. Teeth move by activation of the loop of the wire that can be designed to deliver a low load-deflection relation and a controlled moment-force relation (Burstone "T" loop).
2. **Sliding mechanics,** in which braces slide either on an arch wire or the wire slides on braces and tubes. One of the main factors to differentiate between the two mechanics is friction; space closure in segmented mechanics is frictionless while sliding mechanics involves friction.(16).

Orthodontic friction is produced while braces slide upon the arch wire. In order to move a tooth we must apply a force (elastics, wires, ligatures, coils, etc.) in such magnitude as to overcome friction, this way beginning dental movement. The level of friction depends on several factors, including the type of brace and arch wire used. Stainless steel braces slide with relative ease over stainless steel arch wires and not so well on wires that contain certain percentage of titanium (beta-titanium or nickel-titanium) that present a rough surface and generate more friction; furthermore, a ceramic brace has a rough surface that also increases friction. The combination of ceramic braces and stainless steel arch wires produces a great deal of friction. Adding sliding mechanics for space closure will result in a high friction coefficient and more root resorption. Recent studies have demonstrated that self- ligating braces have the lowest friction coefficient.[12,16]

Some believe that we lose less posterior anchorage utilizing space closure in two phases (canine retraction first with subsequent incisor retraction) rather than with in-mass six anterior teeth retraction; but this may not be valid for all cases. In-mass space closure can reduce treatment time significantly because it is done in only one phase.[16]

The ideal force system used for space closure must meet certain characteristics, which are:

- Provide optimal forces for tooth movement.
- Must be comfortable and hygienic to the patient.
- Must require minimal chair time.
- Must require minimal patient cooperation.
- Must be inexpensive.

According to Burstone, canine retraction mechanics can be described by three principle characteristics:

1. The moment applied on the canine brace.
2. The main arch wire deflection.
3. The maximum force that the arch can withstand without permanent deformation.[9,27]

The final result of space closure must include aligned and upright teeth with parallel roots. This implies that dental movement almost always requires certain degree of in-mass translation and also root displacement.[16]

In this chapter we analyze four suggested ways to accomplish space closure:

1. Elastics.
2. Coils.
3. Loops.
4. Retroligature.

1. ELASTICS

a) Elastic chains

Elastic chains are made with polymers of synthetic rubber with great deformation capacity. Manufacturers make these elastics with urethane, thus producing light and constant forces with greater deformation capacity. These chains have an active lifetime of 60 days once installed in the mouth. This is because the molecular structure (molecular chain) is folded while the chain is inactive, but when the chain is extended the molecules unfold in a lineal and orderly fashion. The exposition to ozone and ultraviolet radiation breaks up the unsaturated double ligatures at molecular level, which results in flexibility reduction and less traction resistance. This is why manufacturers add antioxidants and ozone inhibitors that reduce these effects.[10,16]

Elastics absorb water and saliva in the mouth, which deforms permanently and destroys the chain at molecular level. These also swell and stain due to the fluids and bacteria present in saliva that fill in empty spaces of the rubber matrix. Saliva, chewing, plaque and mouth temperature have influence in the degradation rate of the force of the chain.[4-6]

The force of the elastomeric chain tends to degrade with time. Hershey and Reynolds showed a 60% force loss after four weeks; 50 % of the force loss took place the first day of use. Wong observed a loss of force of 50-70% after the first 24 hours, when the chain was kept in water at 37°.[16] In 2003 the Eastman Dental Hospital and the Queen Mary Hospital in London published a comparative study between power chain and closed NiTi coils. They compared the force and amount of space closure in millimeters

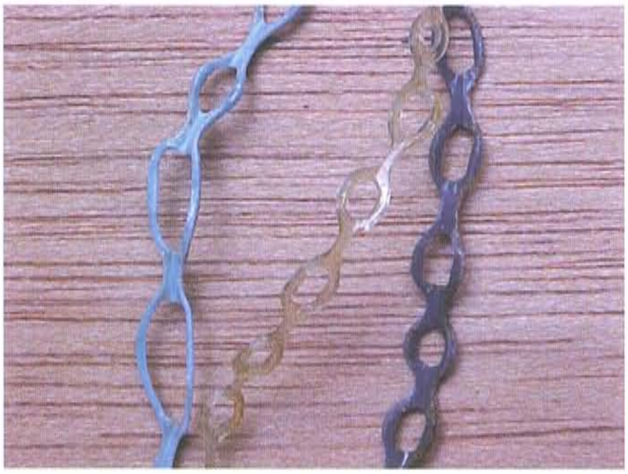
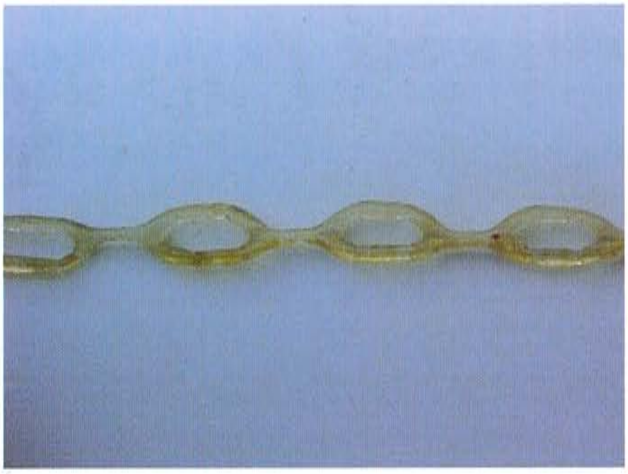


Fig. 1. Stained and deformed chains after 30 days use.



Figs. 2 and 3. Stained and deformed chains after 30 days use.

Figs. 4 and 5. New and used power chains (one month use).

between these two devices. They demonstrated that the force maintained during space closure between the chain and the closed coil was very similar; furthermore, the amount of closure of the extraction site in millimeters was very similar and there was no statistical difference. They demonstrated that the initial force of power chain was approximately 209 g while closed coils have 300 g. After a week, chains can lose almost 50% of their initial force and closed coils lose rapidly their initial force after 6 weeks of use. Weekly space closure done with the power chain was 0.21 mm and with the closed coil was 0.26 mm. Therefore, there is no significant statistical difference between these two space closure methods.[17]

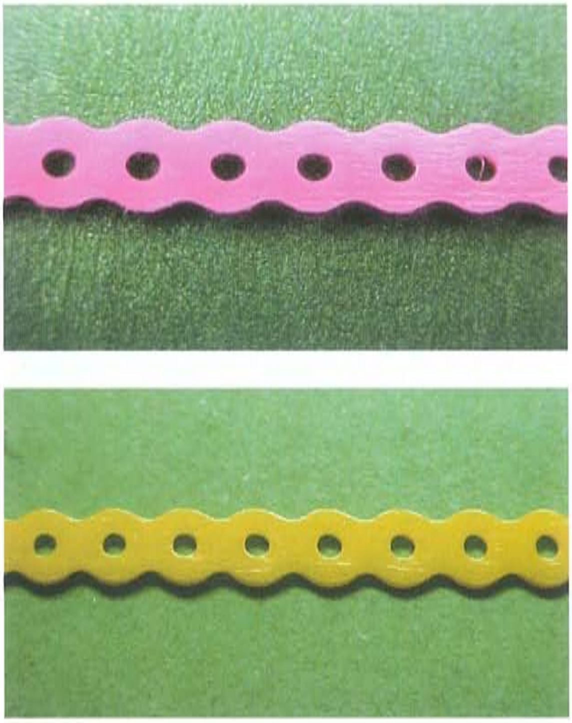
The use of power chain in big gap space closure is not recommended due to problems related with the force level. For example, chains placed from molar to molar initially exert 400 g of force in the upper dental arch and 350 g in the lower dental arch. In a premolar extraction case the chain will stretch excessively upon the extraction sites; this provokes adjacent teeth rotation. If the chain is not stretched, the spaces will not close.[2,13]

Fig. 6. Space closure with power chain.

Power chain is useful for closing one or two small spaces at the end of a treatment and to avoid space reopening in advanced treatment phases.[2,13]

According to the distance between the center of the eyelets (interlink distance), chains are divided in four types:

1. **Closed or continuous chain.** Recommended for lower incisor space closure. This chain has an interlink distance of 3 mm. Closed chains generally provide higher initial force and retain more remnant force than long chains. Bell recommends stretching the elastics three times its length in order to obtain the desired force level.



Figs. 7 and 8. Closed chain.

2. **Short chain.** Recommended for inferior dental arch space closure. The interlink distance is 3.5 mm.

Figs. 9-11. Short chains.

3. **Long chain.** Recommended for upper dental arch space closure. The interlink space is 4 mm.

Fig. 12. Long chain

4. **Extra long chain.** It has an interlink distance of 4.5 mm and the advantage of having less holes where food can lodge into, resulting in less caries and periodontal problems.[4-6, 31,35]

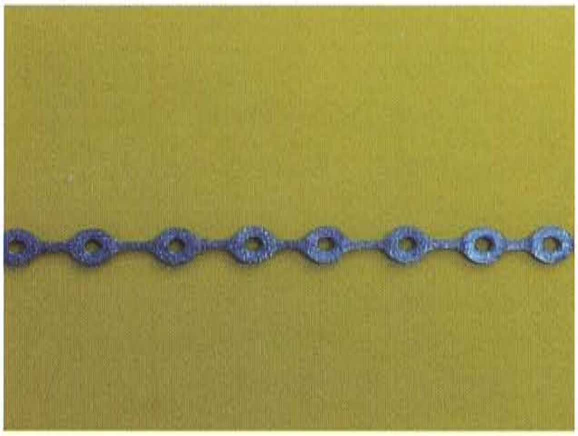
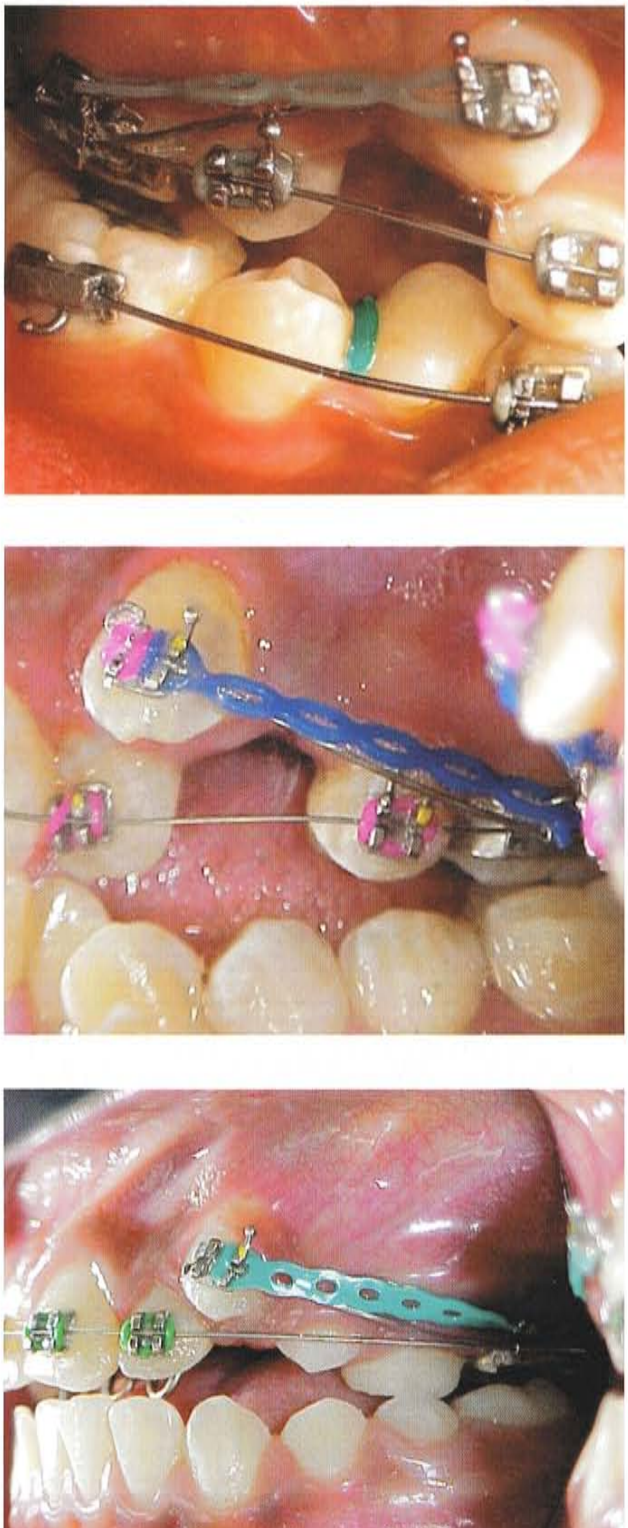


Fig. 13. Extra long chain.

I. Space closure with elastic chain on sectioned arches

The use of elastic chains during orthodontic treatment is very common. They are usually used for space closure, but they are also very effective rotating and intruding teeth. Elastomeric chains must be used with caution because there is the risk of exerting excessive force and creating new problems.

In cases of anterior overcrowding with canines out of the alveolar bone, the way to align, level and close spaces at the same time is using one continuous arch wire and two sectional ones; the sectioned arches may be round or rectangular and are placed from molar to canine (one on the left and one on the right side). These arches will



Figs. 14-16. Canine traction with segmented arches and power chain.

serve as "rails" to move the canines to the extraction sites, then we can place an elastic chain from the molar to the canine and begin its retraction. At the same time we place a NiTi principle arch wire (from molar to molar) to begin the alignment and leveling phase of the treatment.

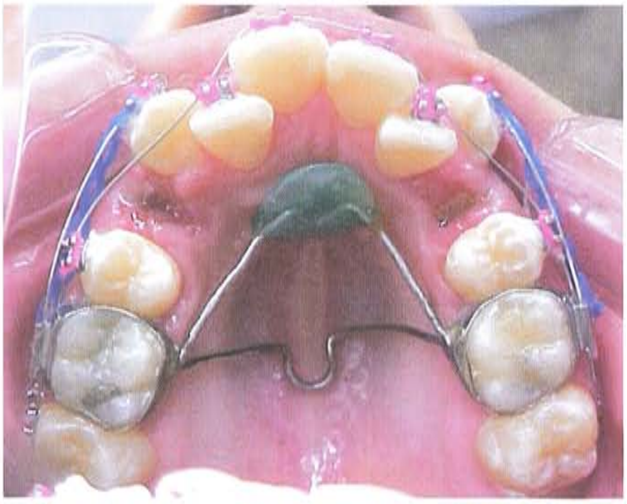


Fig. 17. Occlusal view.

Fig. 18. Anterior view.

Advantages

1. We level, align and close spaces at the same time.
2. Treatment time is reduced.
3. Lateral incisor intrusion is avoided while alignment is taking place.
4. Anterior sector proclination diminishes.
5. In this case, power chain can be substituted by closed coil.

Disadvantages

1. If the power chain exerts excessive force, it will provoke undesired canine crown tip.
2. The power chain can impinge itself in the gum.
3. The chain can lose elasticity.

Recommendations

1. Use heavy sectional arches to diminish undesired canine tip.
2. Closed coils or elastic chain can be used.
3. Change the chains every 3 weeks.
4. Tie back the sectioned arch on the mesial aspect of the brace; this will keep the arch in the brace.
5. Place the chain from the hook of the molar to the distal wings of the canine brace, this will diminish rotation. Place elastomeric or wire ligature on the mesial wings of the brace.
6. Place molar anchorage.

II. Space closure with a molar to molar chain

Basically, molar to molar chain is useful for:

- Space closure.
- Anchorage loss.
- Alveolar bone colapser.
- Anterior segment reclinement.
- To deepen the anterior bite.

Chain placed from molar to molar exerts initially 400 g in the upper dental arch and 350 g in the lower dental arch, gradually the force diminishes.[2,13]

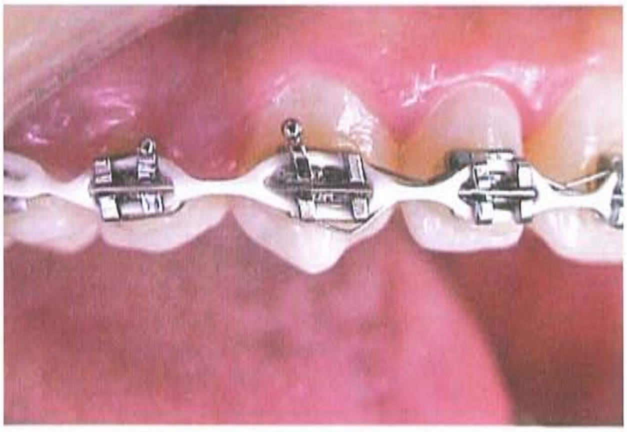
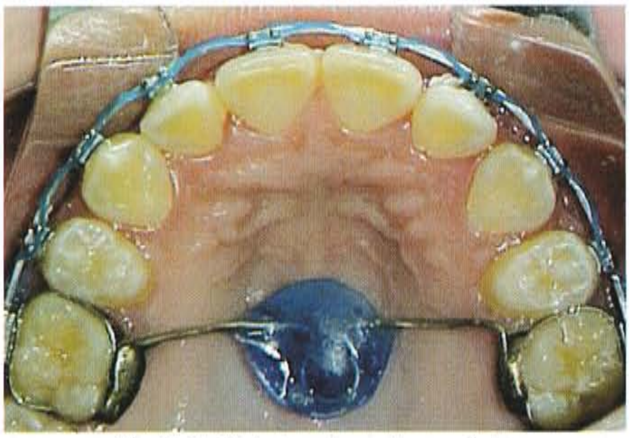


Fig. 19. Molar to molar continuous chain.



Figs. 21-22. Molar to molar continuous chain.

Advantages

1. Easy to remove and place on.
2. Approximately 1mm of space closure per month.
3. Can be used as anchorage when placed from molar to molar.
4. An anterior open bite can be closed using a chain from molar to molar.

Disadvantages

1. The average elastic life of the chain is 20 days. From that time on the force and elasticity diminish.
2. Some chain colors pigment more than others.
3. Can produce an undesired molar tip.
4. Can rupture and cause undesired tooth movements.

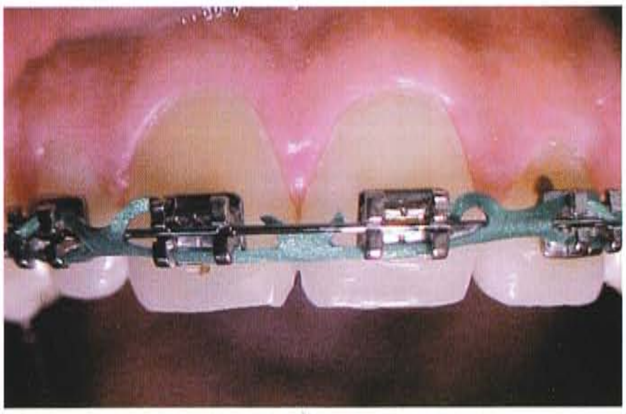
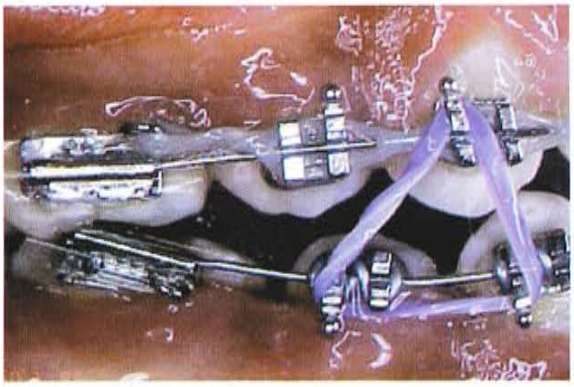
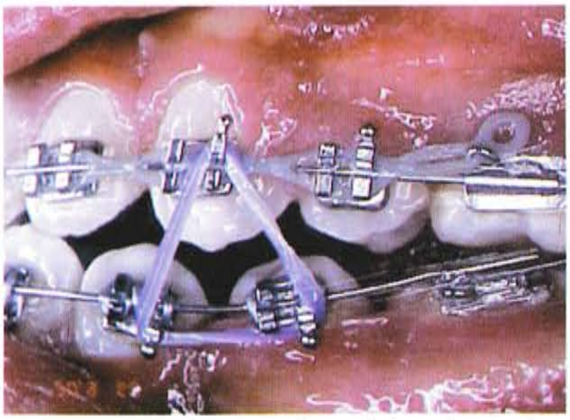


Fig. 23. Ruptured chain.

Recommendations

1. In order to avoid unwanted torque or to deepen the Spee curve (roller coaster effect), place a heavy arch wire during space closure with elastomeric chain.





Figs. 24 and 25. Roller coaster effect in the lower dental arch.

2. Be cautious placing molar to molar chain in deep bite patients.
3. Use molar anchorage, especially in cases that require a facial change.
4. Do not apply too much pressure during chain placement, because we may debond some braces.
5. Replace the chain every 21 days.

III. Space closure with open coil and chains

We can close extraction sites or diastemas combining two forces: a traction force and a pushing force; for example, a chain in combination with a NiTi open coil. By adding these forces, dental movement is quicker.

Advantages

1. Space closure is at about 1.5 to 2 mm per month.
2. Being a greater force for dental movement, treatment time shortens.

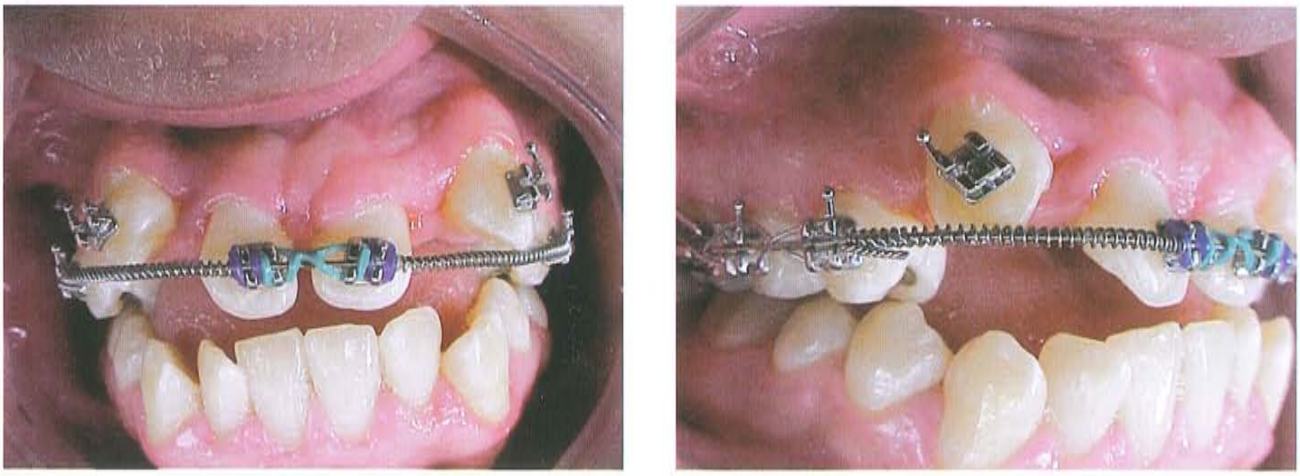
Disadvantages

1. Undesired crown tip.
2. Being a fast movement, it can cause more root resorption.
3. Chain loses elasticity over time.

Recommendations

1. Use heavy arch wires during space closure.
2. Anchor teeth on which the coil is going to lean on. This will diminish their distal or mesial movement.

Figs. 26 and 27. Chain and open coil.



Figs. 28 and 29. Chain and coils two months later.

3. Avoid this type of movement in teeth with periodontal problems or short roots.
4. Change coils and chains every three weeks.

IV. Space closure with parallel forces

This is done with two simultaneous forces (buccal and lingual). We must place additional buttons, braces or lingual accessories in order to apply a simultaneous force in the lingual aspect of the tooth as well as on the buccal side.

Fig. 30. Canine retraction with parallel chains.

The chain can be combined with a NiTi closed coil.

Advantages

1. Dental movement is fast.
2. Treatment time is reduced.
3. We have two parallel and simultaneous forces.
4. Collateral effects as tip and rotation are diminished.
5. Closed coils can substitute Chains.

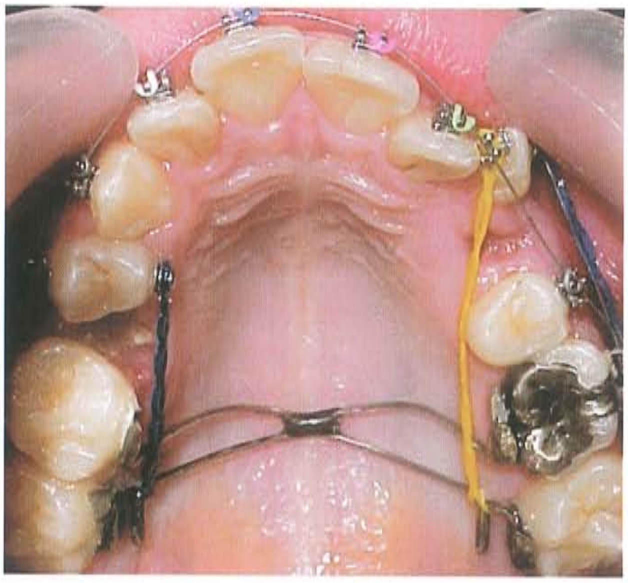
Fig. 31. Two weeks after.

Disadvantages

1. Greater risk of root resorption.
2. Food retention on the chain may provoke gingivitis.

Recommendations

1. Determine the amount of space required, and then decide on the anchorage needed for the case.
2. Place anchorage with palatine auxiliaries, like the Chromosome arch.
3. Do not use this combination of forces on teeth with short roots or periodontal problems.
4. Replace the chain every three weeks.



Figs. 32 and 33. Canine retraction with parallel chains and maximum anchorage (Chromosome arch).

Fig. 34 . Space closure with closed coil and parallel chain.

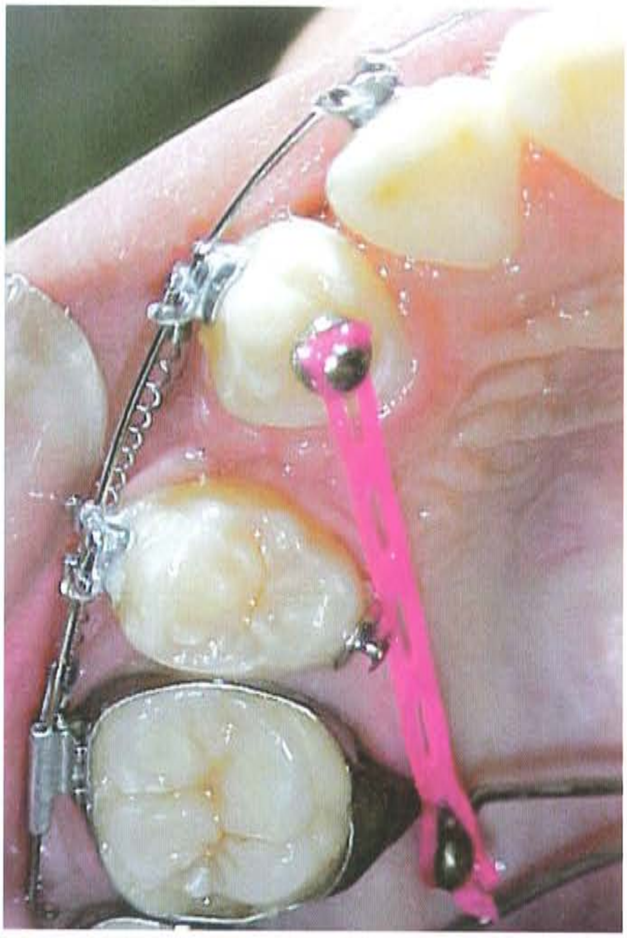


Fig. 35. Space closure with closed coil and parallel chain.

V. Space closure with power arms

Power arms are simple appliances that are easy to use, and are generally used for canine retraction and anterior diastema closure. The movement applied by the power arms is going to be determined by its length and root measurements. The biomechanics consists in getting these arms as close as possible to the center of resistance so that rapid and stable space closure takes place (bodily movement).

They are made by tackle welding a "C" form rectangular arch (on the gingival aspect) over a direct bond button. They are bonded on the gingival area of the dental crown and the force is applied through a power chain, an open coil or a 6 ounce elastic.[7,28]

Figs. 36 and 37. Power arms on canines.

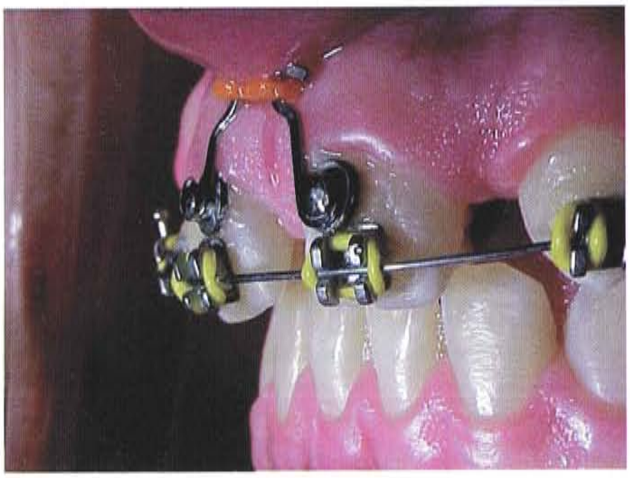


Fig. 38. Power arms on central incisors.

Fig. 39. Diastema closure with power arms.

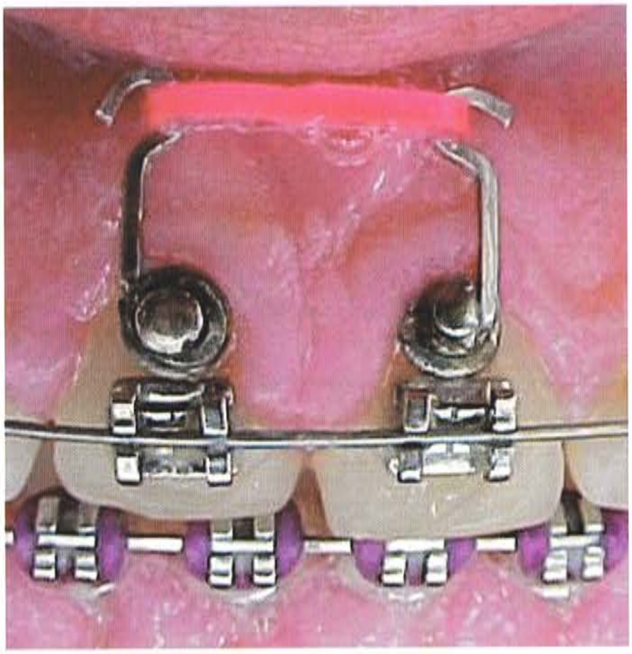


Fig. 40. One month latter.

Advantages

1. Produces a bodily movement.
2. Reduced undesired tip because teeth are tractioned near the center of resistance.
3. Fast dental movement.

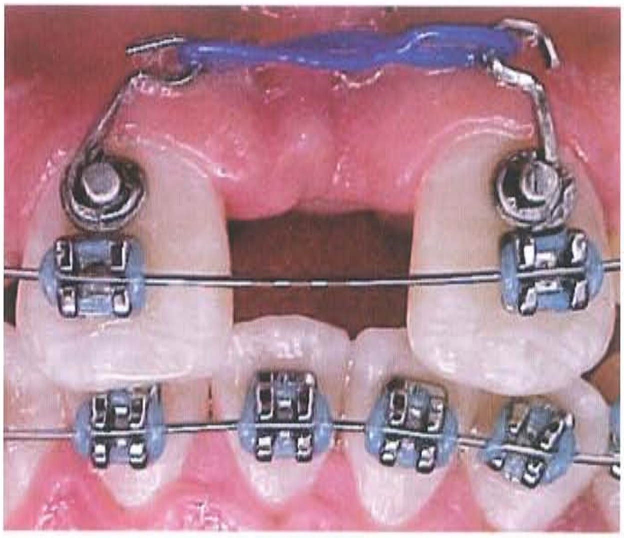


Fig. 41. Diastema closure with power arms.

Fig. 42. After two months.

Disadvantages

1. Because of their length, they can provoke gingival inflammation or can impinge in the gum of the patient.
2. Laboratory time has to be spent in its elaboration.
3. The power arm can give off from the button and not produce any movement.

Recommendations

1. Take a Panorex or a periapical x-ray before making the power arm to establish the center of resistance of the tooth and to determine the length of the arm.

Fig. 43. After three months.

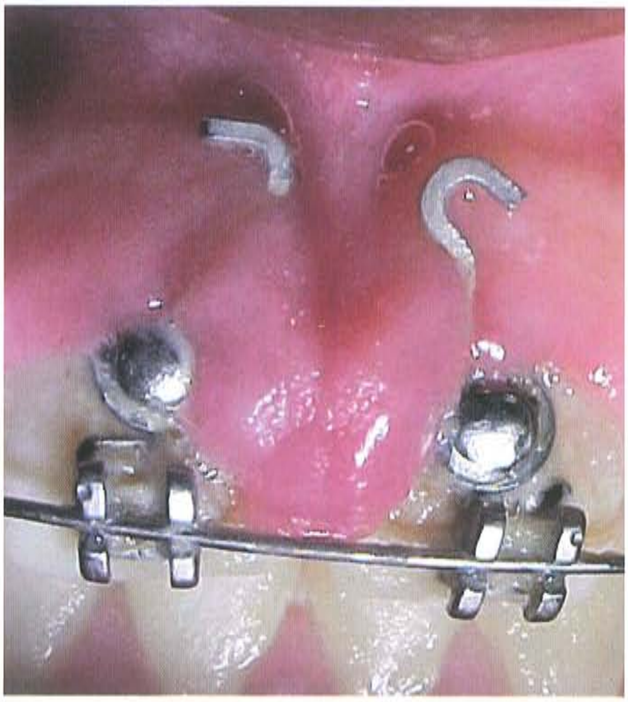
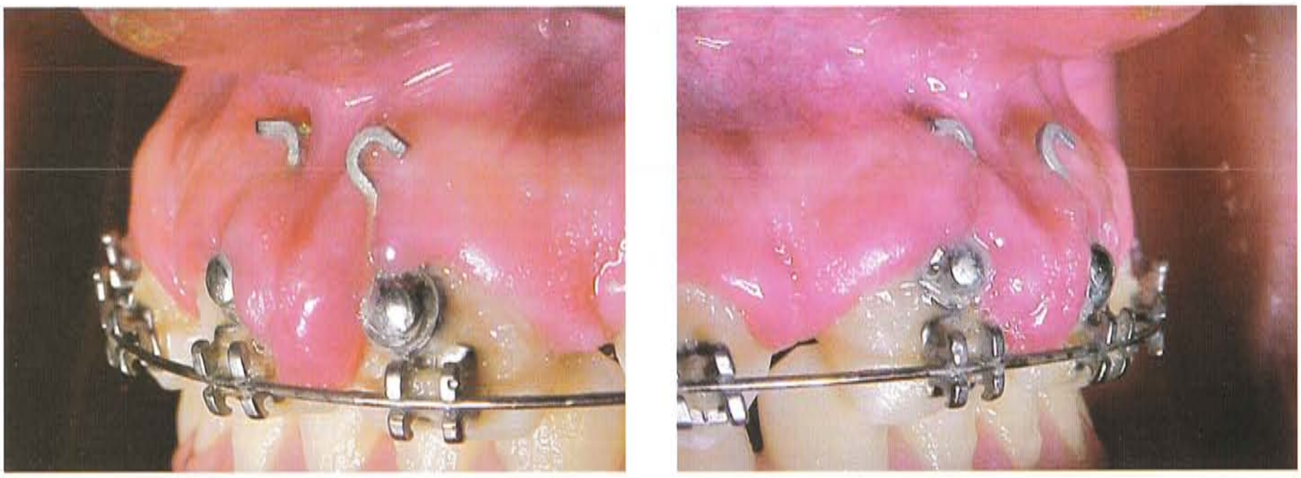


Fig. 44. Impinged arms.

2. We can use inter brace forces in order to speed up the space closure.
3. If black triangles are formed after space closure is accomplished, some enamel stripping may be convenient.
4. Send the patient to a periodontist for a frenectomy after space closure.



Figs. 45-46. Impinged arms.

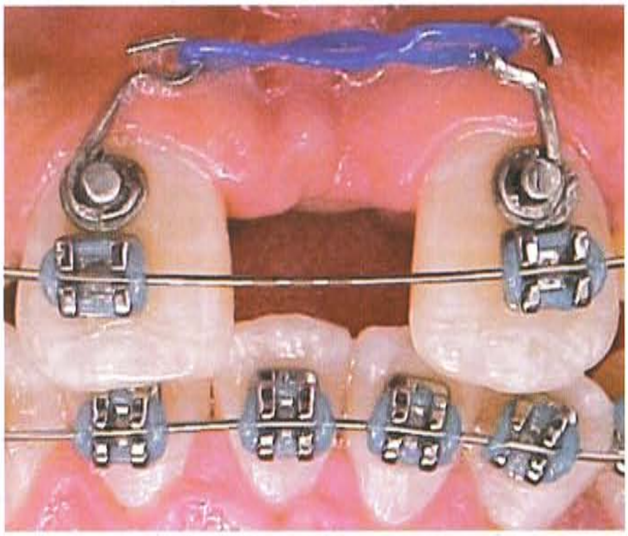


Fig. 47. Loose right power arm.

VI. Space Closure with intermaxillary elastics

Elastics present the following properties:

1. No distortion beyond elasticity limit.
2. They are physically homogenous.
3. They are isotropic (deliver force in any direction).

In general terms, elastics return to their original dimensions immediately after great distortion; these elastics can be made out of natural rubber, latex or synthetic rubber polymers (rubber, butylpolypropene, ethilpropilane or silicon).

Elastics` advantages

- They are placed and removed by the patient.
- They are discarded after use.
- Do not need to be activated by the orthodontist.
- Can be changed two or three times a day.

Elastics` disadvantages:

- They deteriorate and lose elasticity.
- They absorb humidity.
- After 24 hours in the mouth they begin to produce bad odor.
- The exerted forces are unpredictable if their prescription is not well explained and controlled.
- The force is not constant and depends on patient compliance.
- Elastics can be misplaced.
- Patient motivation needed.

Intraoral elastic packages contain 50 or 100 elastics; the force can be light, medium, heavy or super heavy (depending on the diameter and thickness of the elastic). The elastic force is measured in ounces (1 Oz = 28.34 g) and the packages containing the elastics are marked with a color, letter or animal, etc. (depending on the trademark) to distinguish the force of the elastic enclosed in the package.

Force		**Diameter**
Light	1.8 Oz	3 mm = 1/8"
Medium	2.7 Oz	4 mm = 3/16"
Heavy	4 Oz	6 mm = 1/4"
Super Heavy	6 Oz	8 mm = 5/16"
	1.8 Oz	10 mm = 3/8"
	2.7 Oz	12 mm = 1/2"
	4.0 Oz	14 mm = 9/16"
	6.0 Oz	16 mm = 5/8"
		18 mm = 11/16"

Usually the prescribed force is obtained when the elastic is stretched three times its diameter.[20]

Retention is initiated after active treatment This is very important and we must keep in mind that selecting the wrong retainers, or if the patient does not fully cooperate, this can translate into total treatment failure.

We can expect more rebound in the extraction sites in cases treated with extractions. This problem can be corrected with a thermoplastic retainer (mouth guard) in combination with intra-maxillary elastics. The guard is done with 0.060" acetate and it is sectioned at the extraction site level; then buttons are bonded for the use of space closure elastics.

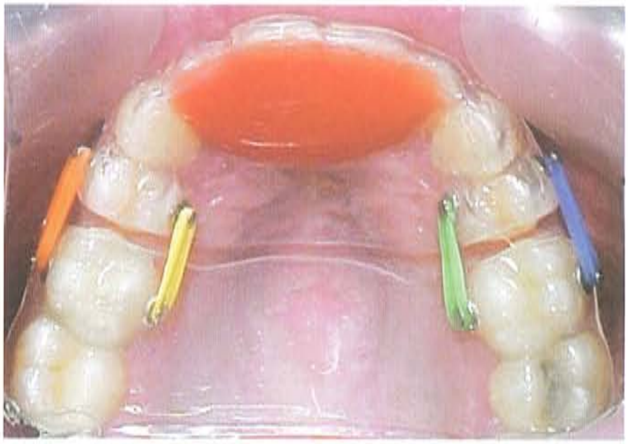


Fig. 48. Rebound in the premolar zone.

Figs. 49-52. Sectioned acetate at the premolar level with buttons and space closure elastics.

Advantages

1. Quick and easy to make.
2. Elastics are placed and withdrawn easily.
3. It is comfortable and very esthetic.
4. In-block space closure.
5. Minimal tip and torque alteration.

Disadvantages

1. We depend 100% upon patient compliance.
2. Space closure is slow (0.5 mm per month).
3. If the guard is not well adapted, it can dislodge while elastics are being placed.
4. It opens the bite.

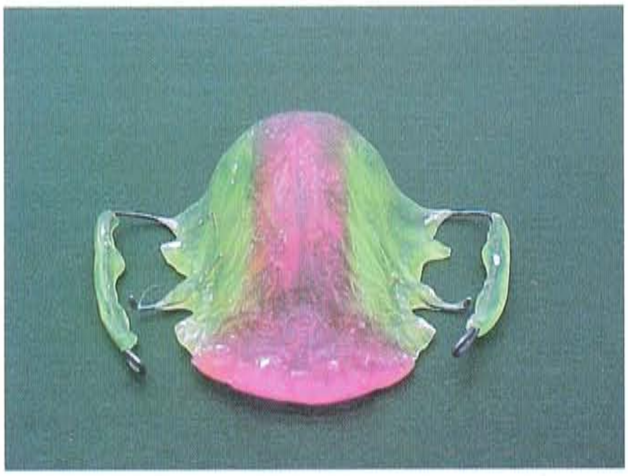
Recommendations

1. The guard must be used all day and night.
2. Change the elastics every 24 hours.
3. The elastics must be 1/8" in diameter.
4. The force must range around 4 Oz to 6 Oz.
5. The elastics must stretch 3 times their diameter.
6. In case the appliance dislodges itself while the elastics are placed, it must be relined with acrylic to improve the fit.
7. Elastics can be placed crossed in order to speed up the space closure.

Fig. 53.

8. The use of buttons elevates the cost of the retainer.
9. In case TMJ symptoms suddenly appear immediately suspend space closure.

In cases that present rebound at the anterior sector due to dental proclination, we will observe diastemas on the upper or lower incisors. These spaces can be eliminated with a Hawley or circumferential retainer. A modification of the circumferential retainer would be cutting the buccal arch and placing an elastic as a substitute.



Figs. 54 and 55. Sectioned buccal arch.

Advantages

1. Easy to make.
2. The retainer and the elastics are easy to remove.

Disadvantages

1. We depend upon patient cooperation.
2. No tip or torque control.

Figs. 56-58. Elastic on the anterior section.

3. Space closure is slow (0.5 mm per month).
4. If the retainer is not well adjusted, it can dislodge during elastic placement.

Recommendations

1. The elastic must pass through the middle of the teeth, or undesired movements will occur.
2. The retainer must be used all day and all night.
3. The elastics must be changed every 24 hours.
4. The elastics must be size 3/16" or ¼".
5. The force exerted by the elastics must range between 4 Oz To 6 Oz.
6. The elastics must stretch 3 times their diameter.
7. In case the appliance dislodges itself while the elastics are placed, it must be relined with acrylic to improve the fit.
8. The removal of acrylic on the palatine aspect of the retainer allows incisor retro-inclining.

2. CLOSED COIL SPRINGS

Since the 30's decade many materials have been used to manufacture closed and open coil springs (stainless steel or chrome-cobalt alloy), today nickel titanium alloy is the material of choice.[20,36]These springs are very resilient, meaning that while they are being deformed they accumulate a lot of energy that is then liberated as light and long term orthodontic force. This way coils exert physiologic loads, that translate in accelerated dental movement and they act for longer periods of time, so they do not have to be changed that often. About biocompatibility, some authors believe that NiTi is as compatible as stainless steel; some say that NiTi is more prone to corrosion. Super elastic coils, compared to stainless steel, store more energy because they are more resilient.[18,23]

Stainless steel coils provide elevated initial force, which can cause discomfort in some patients, but this force rapidly dissipates with dental movement. These coils are not so resilient and tend to deform after use.[13]

The variables that affect the force level produced by the coils are: the caliber of the arch wire, the alloy, the size of the spiral, the length and magnitude of the coil activation. The less contact between the coil and the arch wire, the faster space closure and dental movement will be.[26,28]

Rudge and Mair compared the space closure index using elastic chain and NiTi closed coil. They analyzed dental movement in 17 subjects, all cases involved four first premolar extractions and straight wire braces slot 0.022". The arch wires were stainless steel 0.019"' x 0.025" and were placed at least a month before space closure initiated. The closed coils were medium force (150 g). They found that the space closure index was higher and more constant with the NiTi coils than with the elastic chain. NiTi coils closed approximately 1.20 mm per month in comparison with 0.75 mm with the elastic chain. They also found that closed coil deliver more constant force than elastic chains.[13]

In 1992, Angolkar and cols. examined the force degradation in stainless steel, chrome-cobalt and NiTi closed coil conserved in a saliva substitute at 370° C (all coils had a 0.030" inner diameter). In their results, they found that after 24 hours the percentage of force loss for stainless steel coil was 17%, 10% for Cr-Co and 3% for NiTi coil.[25]

There are two types of closed coils in the market, with one and two stainless steel eyelets. The eyelets are soldered to the coil with a laser and this makes placement on tubes and brace hooks easier. They are comfortable to wear because there are no sharp edges that may lacerate the oral mucosa. The length of inactive closed coil is 3 mm (this measure does not include the eyelets) and can be stretched up to 15 mm without deformation or force change. The forces range from 25 g to 300 g depending on the manufacturer.

Figs. 59 and 60. 150 g closed coil.

GAC has 3 force levels: soft (100 g, yellow eyelet); medium (150g, blue eyelet) and heavy (200g, red eyelet).[24,26,29,32]

Figs. 61-63. Space closure with 200 g closed coil.

Advantages

1. NiTi closed coils close spaces faster in comparison with elastic chain (almost double the rate).
2. There is no need to change the NiTi coils every three or four weeks, as recommended for elastic chain. This minimizes the need for individual dental movement monitoring so we can focus in more important aspects as anchorage control, overbite and overjet control, skeletal and facial profile management.
3. They are easy to place and to take off.
4. They maintain a constant force.
5. They do not keep foul odors.

Disadvantages

1. The high cost of the coil.
2. In occasions the coil can entrap food and nip the oral mucosa.

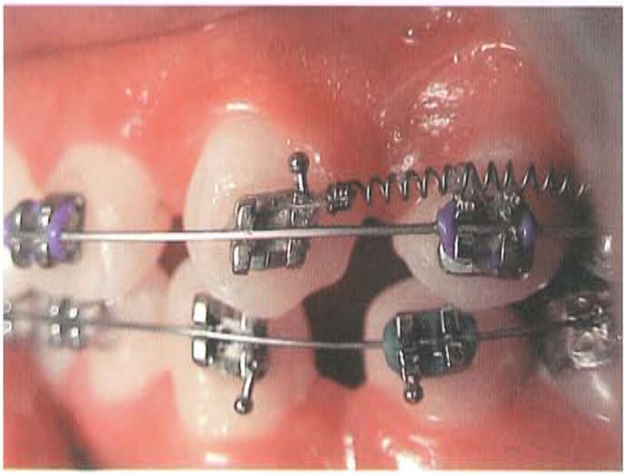
Recommendations

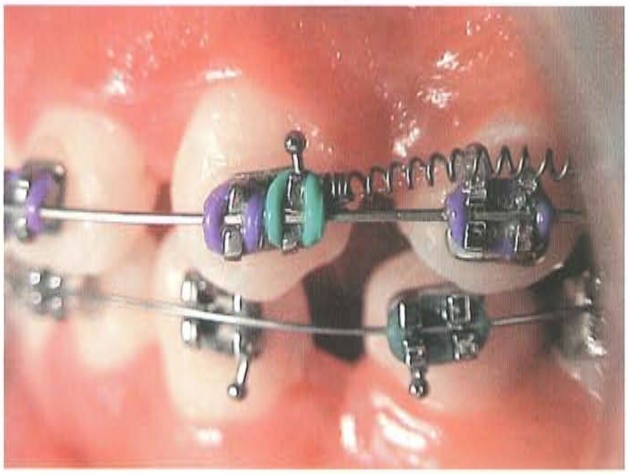
1. We recommend the use of bigger inner diameter coils, because the force is more constant and movement is faster (Bell, 1951).
2. They are ideal for large space closure.
3. The placement of a heavy gauge arch wire will diminish undesired canine tip.
4. Use 150 g to 200g coils.
5. Place the eyelet of the coil at the distal wings of the canine and wire ligature or elastomeric tie on the mesial wings. This will diminish undesired canine rotation.
6. Because it is a violent movement, we must be careful placing this appliance on a tooth with short roots.

a) Space closure with open and closed coils

Another way to close extraction sites or diastemas is with the combination of two forces: a traction and a pushing force; for example, a closed NiTi coil with an open NiTi

Figs. 66 and 67. Closed and open coils.





Figs. 64 and 65. Elastomeric tie on the mesial wings of the canine.

coil. With the sum of these forces, dental movement is faster.

Advantages

1. Spaces close approximately 2 to 2.5 mm per month.
2. Because it is a violent movement treatment time diminishes.

Disadvantages

1. Undesired tooth crown tip.
2. Because it is a violent and rapid movement, the possibility of root resorption increases.

Recommendations

1. Place a large gauge arch wire during space closure.
2. Anchor with wire ligature the teeth on which the open coil will lie on, this will diminish their movement.
3. Do not place this force combination on teeth with short roots or periodontal problems.
4. Augment the length of the open coil every 21 days.
5. Place the eyelet of the coil at the distal wings of the canine and wire ligature or elastomeric tie on the mesial wings. This will diminish undesired canine rotation.
6. Because it is a violent movement, we must be careful placing this appliance on a tooth with short roots.

3. SPACE CLOSURE LOOPS

This orthodontic space closure technique has been used since 1940. A loop is a spring or spiral made on an arch wire and its objective is to move teeth in an individual or collective manner. Loops must exert continuous but controlled force, with a safety margin that auto limits its function after some time and should not permanently damage teeth or supporting tissues.[22,30]

A base and two vertical or longitudinal arms constitute loops.

a) **The base** can have a straight or curved form.
b) **The arms.** The arm extension determines the magnitude of the force that is exerted by the loop; the larger the loop, the less force is exerted. The height oscillates between five and seven millimeters. A two millimeter increase in height diminishes the force 50%. A limitation of the height of the loop is the depth of the buccal fold, because we can lesion the fold if the loop is too high.[22]

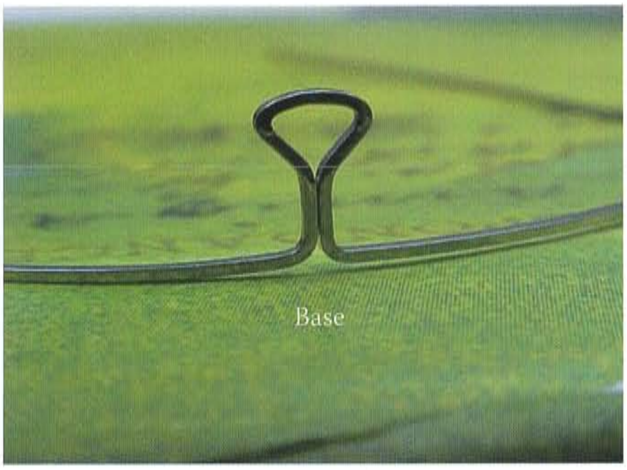


Fig. 68

The criteria used for loop fabrication is based upon two vectors: a horizontal and a vertical one, and from these vectors the different designs are made.

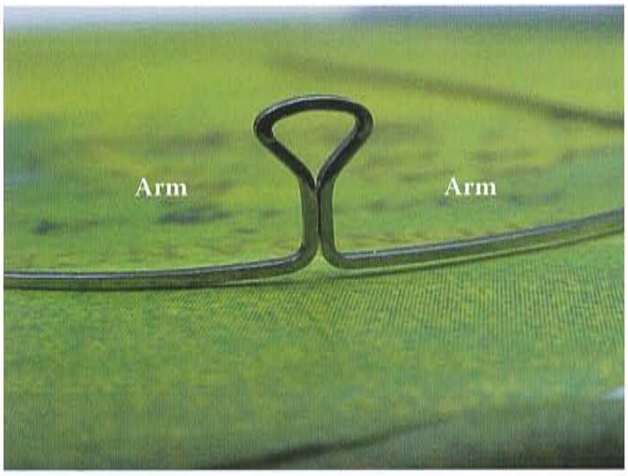


Fig. 69

Loops are divided in horizontal, vertical or mixed loops, and may be open or closed.

Horizontal loops have a mechanical action expressed in a vertical plane, they are ideal for mesiodistal movement (space closure).[8,22]

Vertical loops have a mechanical action expressed in the horizontal plane, they are ideal for intrusive and extrusive movements.[8,22]

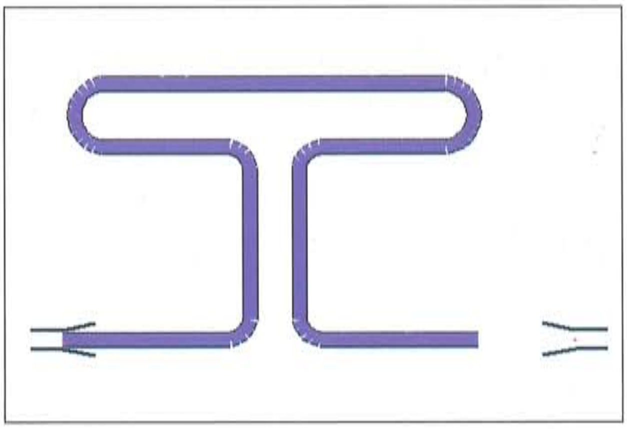


Fig. 70. Passive "T" loop.

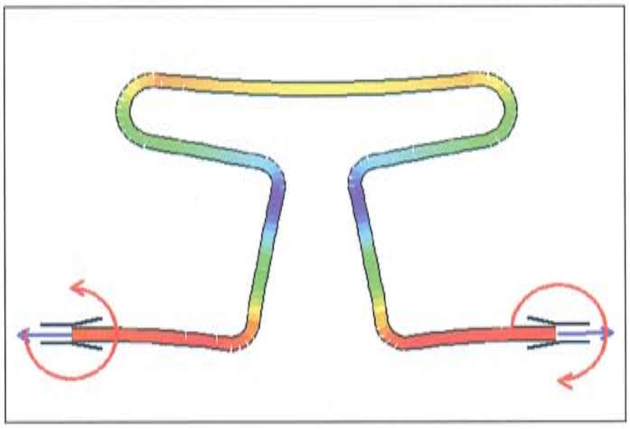


Fig. 71. Active "T"" loop.

Closed loops have the same moment and force proportion than equally designed open loops. Closed loops reduce the down slide of the load/deflection curve and need less force activation.

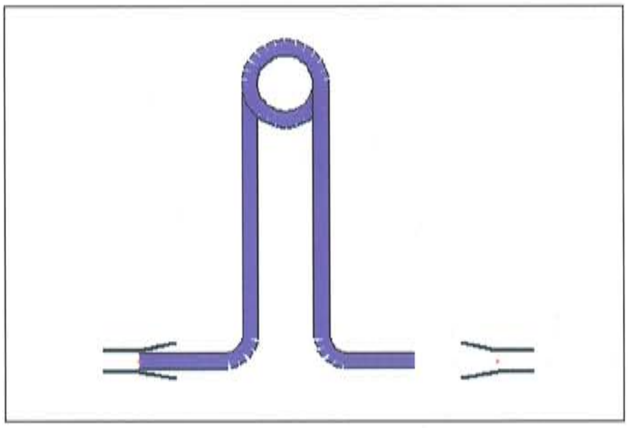


Fig. 72. Passive "I" loop.

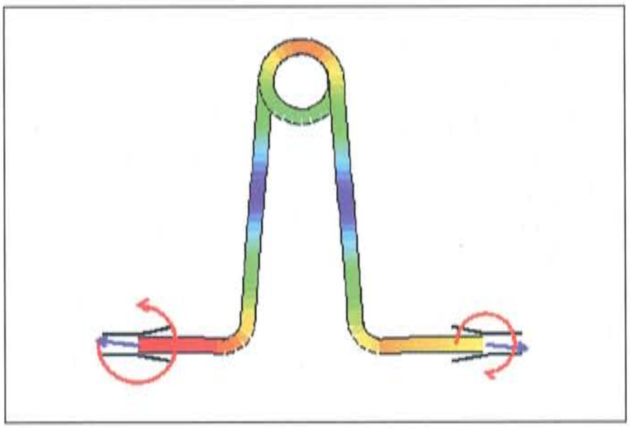


Fig. 73. Active "I" loop.

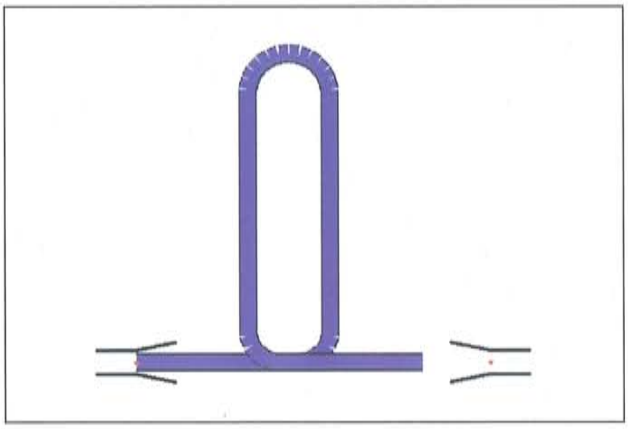


Fig. 74. Passive closed vertical loop.

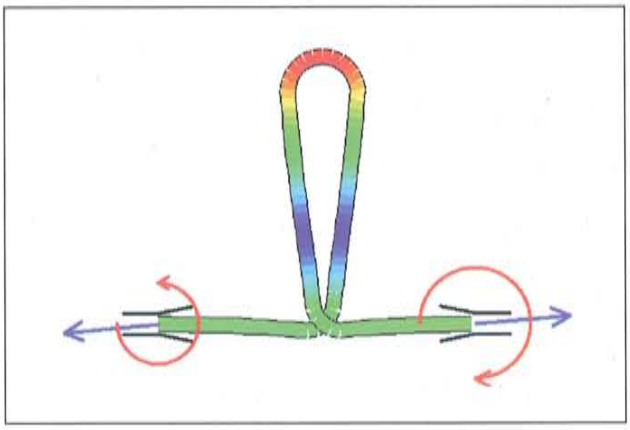


Fig. 75. Active vertical closed loop.

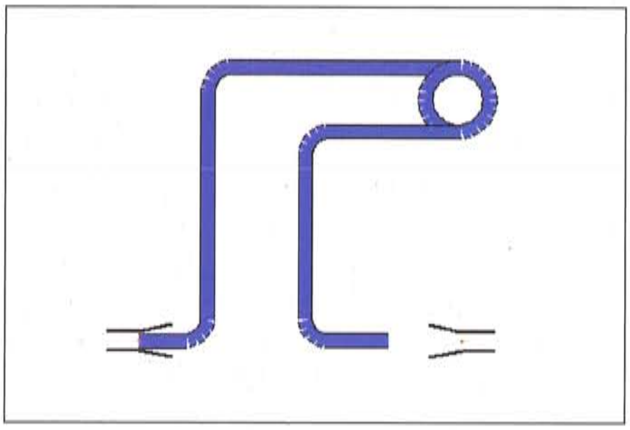


Fig. 76. Passive open horizontal loop.

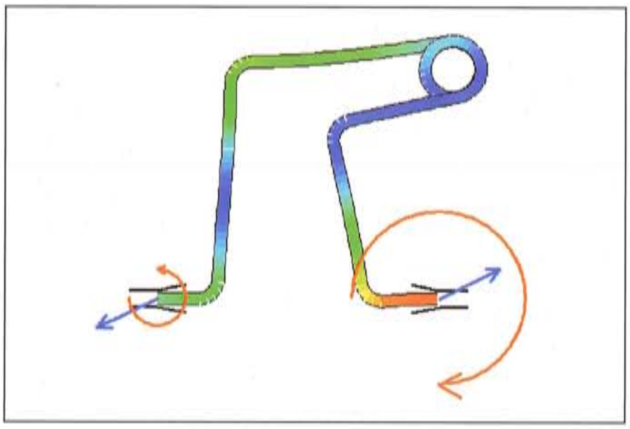


Fig. 77. Active open horizontal loop.

The force exerted by a 0.017 x 0.025 stainless steel loop seven millimeters high is approximately 250 g.

When we want more flexibility and less force, we can extend the loop and add spirals or helixes.[3]

Activation temporarily deforms the loops allowing them to behave as springs or as very elastic elements. We must try to maintain the same moment and force proportion when we activate and deactivate the loop, in order to control dental movement and to avoid inclination and secondary effects.[8,22]

The loops of closure arch wires make them flexible, but they exert an intense closure force upon extraction sites. So, with this type of mechanics, during space closure, we need extra control of inclination, tip and rotation. In order to obtain this, bends are added for each tooth. In advanced treatment phases these bends can be added or eliminated selectively. This space closure method has many disadvantages: we need a lot of time for wire bending and the forces are elevated; sliding mechanics is not so effective and the activation range is limited.[2, 13,34]

There are many loops designed for space closure and retrusion of the anterior sector, of which we can mention:

- The open "I" loop.
- The closed "I" loop.
- The closed helicoid "I" loop.
- Ricketts loop.
- Bull or Keyhole loop.
- The "T" loop.
- The segmented "T" loop.
- The utility retraction loop.
- The DKL (Double Key Loops).

Loop principles

- **Principle 1.** Loops function better when activation "closes them" instead of "opening them". Because these are elastic alloys (TMA), they always tend to recuperate their initial shape, so they have a greater tendency to recuperate their initial shape if activation closes them instead of opening them. In this manner, closed loops close spaces better, and open loops open spaces better.

- **Principle 2.** Loops function better when their form is perpendicular to the movement they must perform. This way vertical loops perform horizontal movements better (mesiodistal movements for example), and horizontal loops perform vertical movements better (intrusion/extrusion movements for example).

Principle 3. The more wire a loop has, less force it will exert. Loops with helixes have more wire length, and because the force exerted by a wire is inversely proportional to the cube of its length, the force exerted by the wire over the teeth is less.[8]

a) Open "I" loop

This vertical loop is 7 mm high and is made on the arch wire. Generally located between the canine and the lateral incisor.

- **Principle 1.** This loop must be opened to be active, so it does not comply with this principle.
- **Principle 2.** This is a vertical loop that closes spaces well, but it lacks a horizontal element, so it has no vertical control.
- **Principle 3.** This loop has a short wire length, so it can exert intense force.[8]

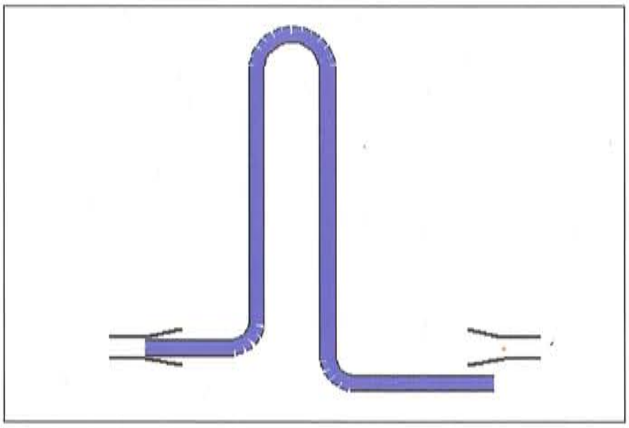


Fig. 80. Passive loop.

b) Closed "I" loop

Vertical loop, 7 mm high, made on the arch wire, the arms inter-cross, and generally is located between the lateral incisor and the canine.

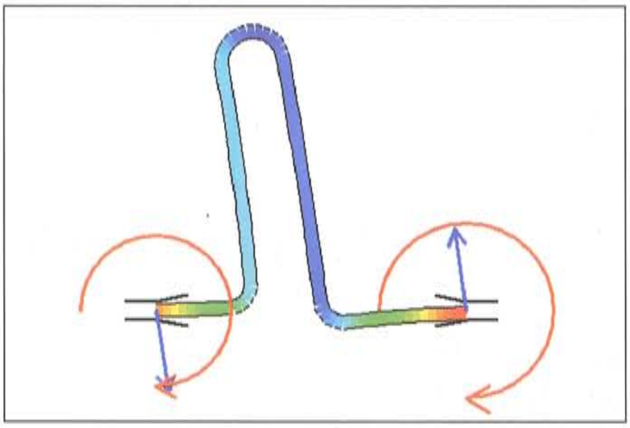
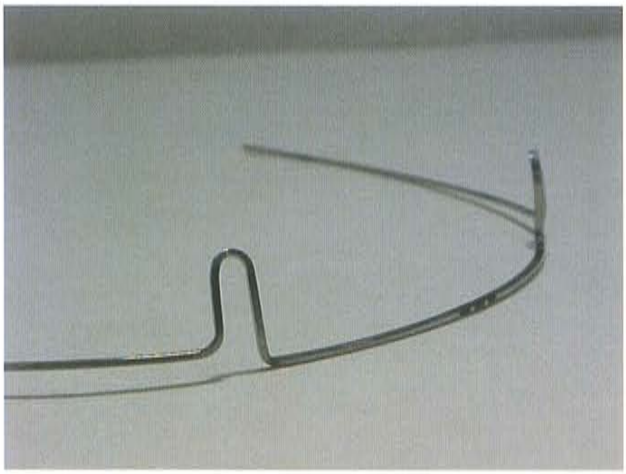


Fig. 81. Active loop.



Figs. 78 and 79. Open "I" loop with an extrusion bend.

- **Principle 1**. This loop activates by being closed, so it complies with the principle.
- **Principle 2.** It is a vertical loop that closes spaces well, but not having a horizontal component, it does not have vertical control.
- **Principle 3.** This loop has a short wire length, so it can exert intense force.[8]

c) Closed helicoid "I" loop

Vertical loop 7 mm high, the arms Inter cross and at the gingival end form a circular loop. Made in the arch wire usually between the lateral incisor and the canine.

Fig. 82. Closed loop.

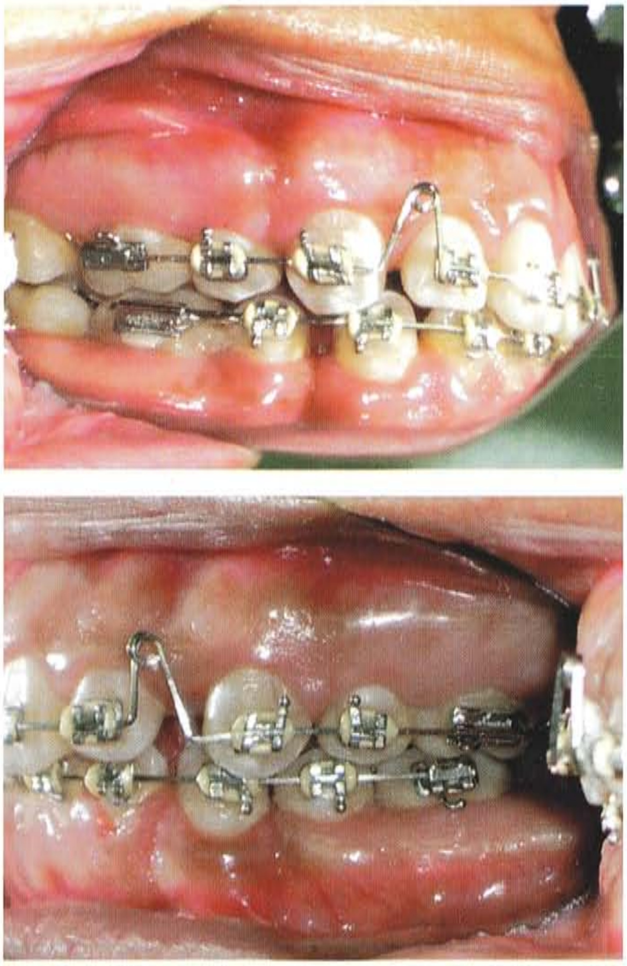
- **Principle 1.** This loop activates closing it so it complies with this principle.
- **Principle 2.** A vertical loop that closes spaces well, but not having a horizontal component, it does not have vertical control.
- **Principle 3.** This loop has an average wire length so the force it exerts is of medium intensity.[8]

Fig. 83 and 84. Passive loops.

d) Ricketts' loop

This loop has two circular loops and two closed helicoid "I" loops.

- **Principle 1.** This loop activates by being closed, so it does comply with this principle.



Figs. 85 and 86. Active loops.

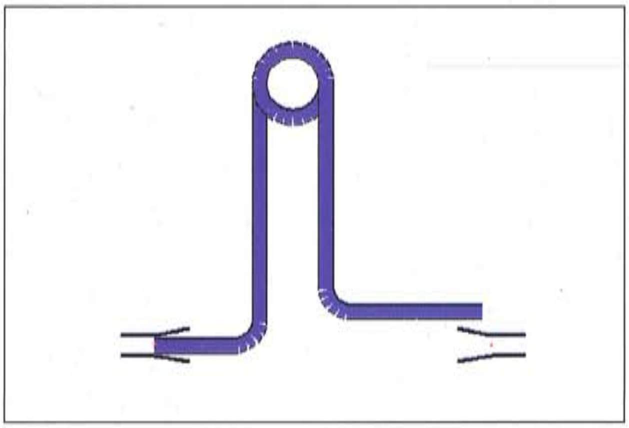


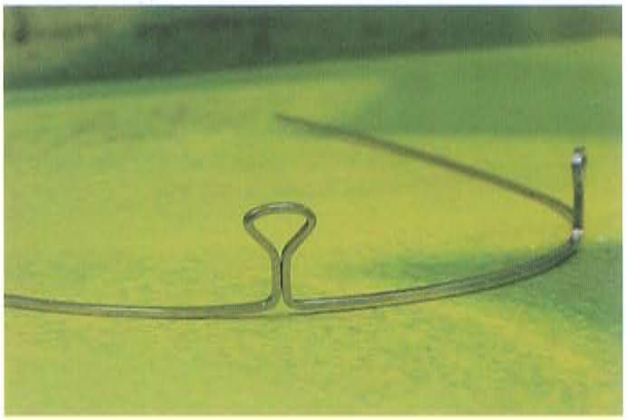
Fig. 87. Passive loop.

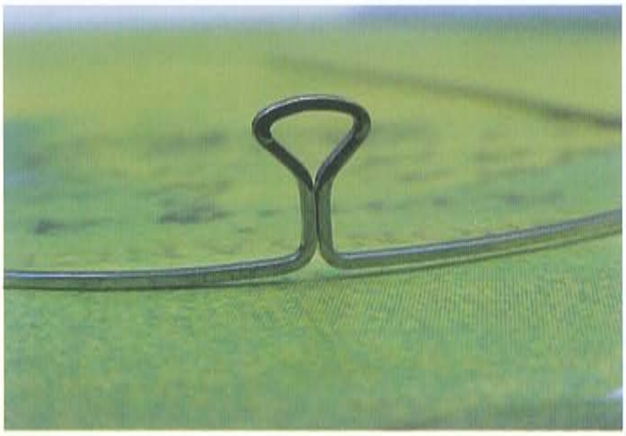
- **Principle 2.** Vertical loop that closes spaces well, but not having a horizontal component, it lacks vertical control.
- **Principle 3.** This loop has a longer wire length so the force intensity is light it is complicated to bend.[8]

e) Bull or Keyhole loop

Vertical loop 7 mm high, the longitudinal arms touch one another and at the gingival end, and forms an open circle that looks like a "keyhole"; done on the arch wire, generally between the lateral incisor and the canine.

- **Principle 1.** This loop activates by being opened so it does not comply with this principle.
- **Principle 2.** A vertical loop that closes spaces well, but not having horizontal component, it lacks vertical control.
- **Principle 3.** This loop has a short wire length, so it can exert intense force.[8]

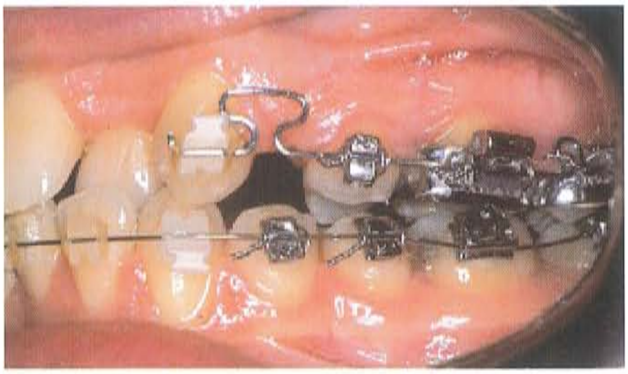


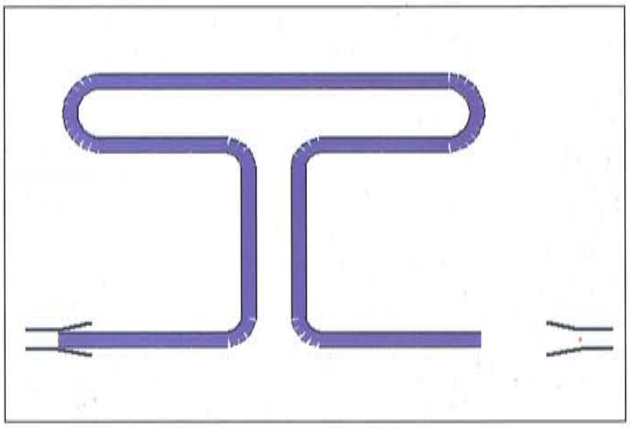


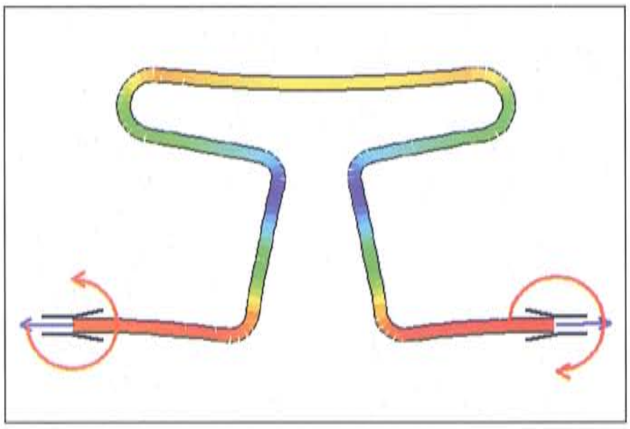
Figs. 88 and 89. Keyhole loop.

f) "T" loop

Mixed vertical and horizontal loop 7 mm high, done on the arch wire and usually located between the lateral incisor and the canine or between the canine and the premolar. In TMA arches the "T" loop can be activated 3 mm behind the molar tube, exerting forces ranging between 250 and 300 g.[16]







Figs. 90-92.

- **Principle 1.** This loop activates by being opened so it does not comply with this principle.
- **Principle 2.** A vertical and horizontal loop, it closes spaces well, and having a horizontal component it has vertical and torque control. It allows activation of the horizontal portion of the "T" so we can have more or less vertical control.
- **Principle 3.** This loop has an average wire length, so the force it exerts is of medium intensity.[8]

g) Segmented "T" loop

The segmented arch technique, as developed by Burstone and cols. at the University of Connecticut, uses spring loops type "T" that are going to help us to retract the anterior or posterior segments or to obtain symmetric closure. One of the fundamental principles is the segmented approach that consists in treating the anterior and posterior segments as if each of them were a big tooth. Each segment must be prepared for space closure placing rectangular arch wires in the slots of the braces. The posterior sector can be anchored with a Chromosome Arch, a Transpalatine Arch, a Nance Button, a Viaro Nance, a lingual, etc. This segmented loop is made with rectangular 0.017" x 0.025" TMA wire, which exerts an intrusive force of 63 g that can be transmitted to the cuspid or to the anterior sector. At the extraction site a segmented "T" is placed, the distal portion is inserted in the auxiliary molar tube and the mesial portion in the canine brace.[15,16,20]

Fig. 93 Segmented "T" loop.

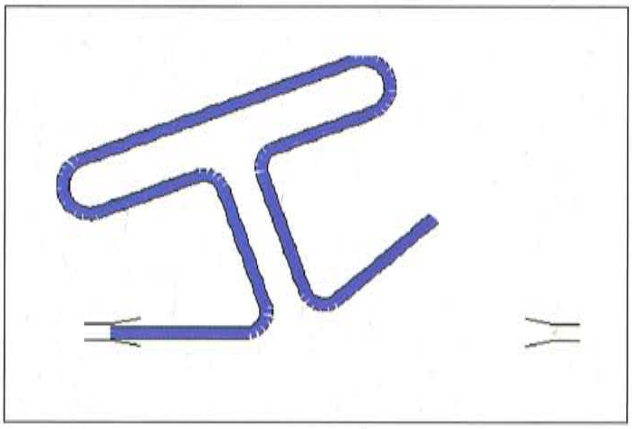


Fig. 94. "T" Segmented passive loop.

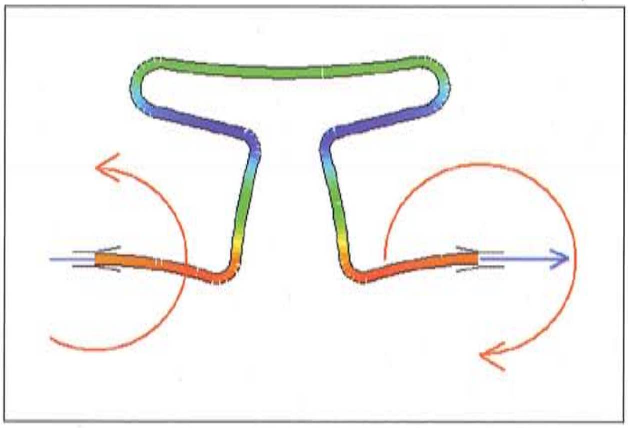


Fig. 95. Segmented "T" active loop.

h) Utility retraction arch wire

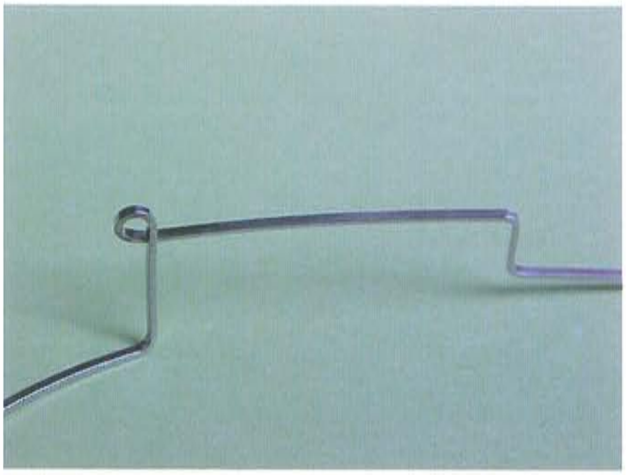
There are several types of utility arch wires, being the retraction type the most widely used. This type of arch wire can be used in the mixed or permanent dentition for intrusion or retraction of the four incisors; it is generally used during the last phases of treatment.

In premolar extraction cases, in which canines have been retracted, a space distal to the lateral incisor opens. In non-extraction cases, generally a similar but smaller space opens distal to the lateral incisors due to molar and premolar rotation, like treatment mechanics of a Class II. This space can be closed with a utility arch wire (retracting the upper incisors).This arch also gives us the necessary intrusion that usually must precede anterior dental retraction.

The retraction utility arch is usually used in the maxilla, but it can be used on the mandible, for example in cases with dentoalveolar anterior cross bite, in which inferior incisors are flared and spaced. There are two modes of activation:

1. The extension of the utility arch that protrudes from the distal aspect of the molar band is pulled back with a Weingardt plier 3 to 5 mm and it is cinched back. The distal extension must not harm the oral mucosa.

2. The second mode is to place a bend in an angle directed occlusally in the buccal segment in order to produce intrusion.[14]



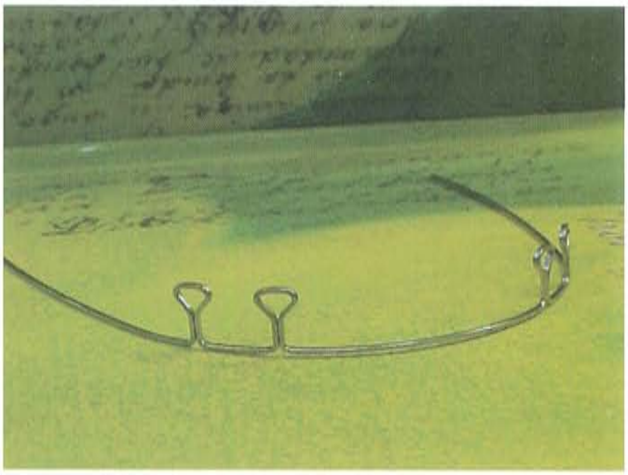
Figs. 96 and 97. Utility arch.

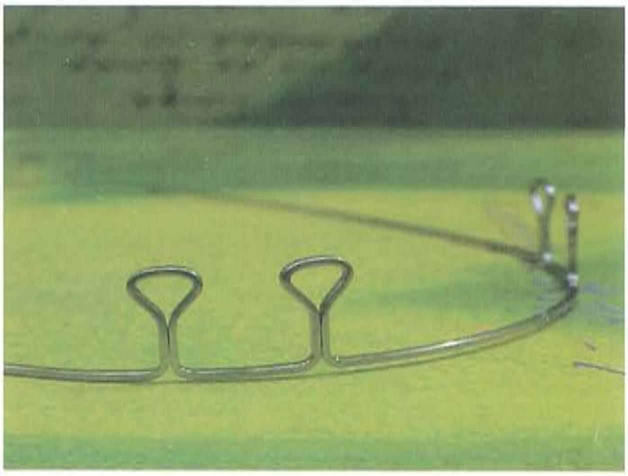
i) DKL (double key loops) arch

Mixed vertical and horizontal loop 7 mm high that resembles a champagne bottle.

- **Principle 1.** This loop activates by being opened so it does not comply with this principle.
- **Principle 2.** A vertical and horizontal loop, it closes spaces well, and having a horizontal component it has vertical and torque control. It allows activation of the horizontal portion of the loop so we can have more or less vertical control.
- **Principle 3.** This loop has an average wire length, so the force it exerts is of medium intensity. The sharp bends of this loop may fracture, and some portions of the wire may have zones with altered elasticity.[8]

This is a steel wire with two loops on each side of the wire and is used for sagittal movements of the anterior or posterior sectors in order to close extraction sites. It performs a broad range of movements with good control of the dental groups involved. DKL preformed arches of different calibers of stainless steel or TMA are available or they can be manually conformed. On each side, near the canines, it has two loops that resemble key eyelets. When this arch is installed, the loops must be equidistant mesially and distally to the brace of each canine.[11]





Figs. 98 and 99. DKL arch.

We can find preformed DKL arches in the market in various dimensions that are adequate for different dental arches. The numerical scale is in millimeters, and measures the distance between both mesial loops with a two millimeters difference between sizes.

Scale: 22 mm, 24 mm, 26 mm, 28 mm, 30 mm, 32 mm, 34 mm, 36 mm, 38 mm, 40 mm, 42 mm, 44 mm, 46 mm.

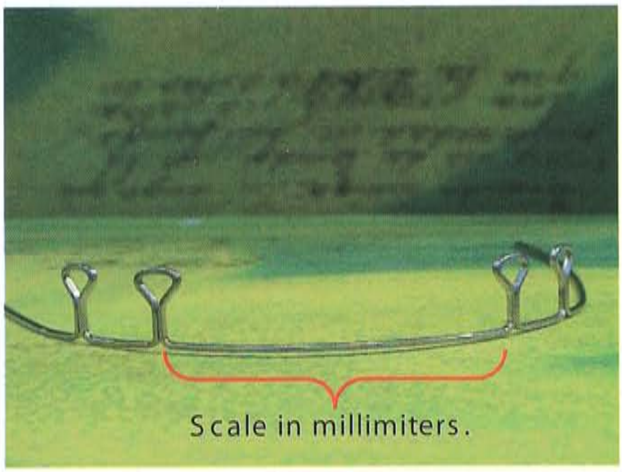


Fig. 100.

The loops have 8 mm of separation between them; the wire in between is inserted in the slot of the brace leaving approximately two millimeters on each side of the brace. In some occasions due to DKL size standardization, the equidistance between the brace and the loop is not possible, in those cases, we must have the precaution to choose an arch in which the mesial loop remains separated at least two millimeters from the brace of the canine in order to allow the activation.(11)

Due to these characteristics, it is indispensable for the use of the DKL that the anterior sector from canine to canine to be diastema free. Sometimes it may be necessary to unite the 6 anterior teeth with continuous rigid ligature in order to maintain the contact points. If small diastemas develop continuous elastic chain must be used to close them before installing the arch; at this moment, the dental arch is divided in three sectors: two posterior and one anterior and in between them the extraction sites. In general the anterior group is formed by incisors and canines and includes the first canines in second premolar extraction cases.(11)

In order to place a DKL arch, the dental arches must be perfectly prepared for arch installation. The previous arch sequence must have left the teeth aligned and with torque fully expressed on each tooth. This previous sequence with rectangular arches must reach a caliber similar to the DKL in order to allow not only an easy insertion but also perfect sliding of the arch in the slots of the braces. This is an indispensable requisite in order to maintain good movement control of the dental groups involved.(11)

Before we install the DKL arches, we must define the direction and the magnitude of the required movements: retraction of the anterior sector, mesial movement of the posterior sector or a combination of both movements. According to these, not only arch modifications will be made, but also the appropriate way to activate the arch will be selected so space closure can go according to our treatment plan. When the DKL is activated, the anterior key exerts a retrusion force on the anterior sector and a mesialization force on the cuspid; the second key exerts a distalizing force on the canine and a mesializing force on the posterior sector. Both forces applied on the canine are

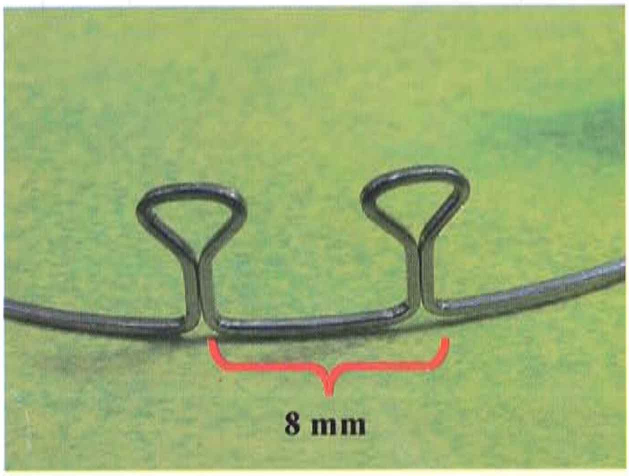


Fig. 101.

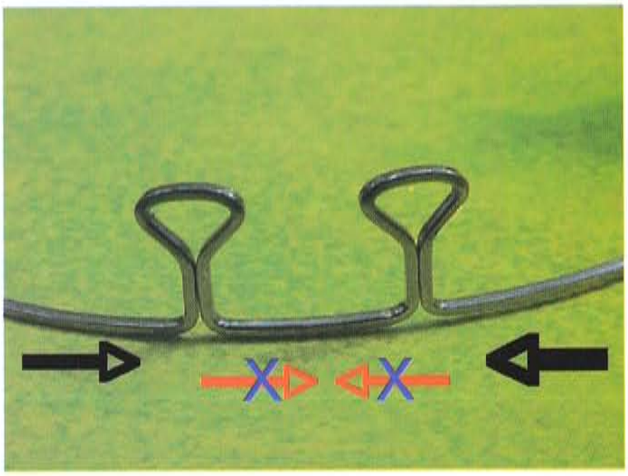


Fig. 102.

of the same intensity and in inverse direction, therefore they annul each other. The force exerted on the cuspid is zero, the 300 g should translate in a mesial movement of the posterior sector (anchorage loss), but in reality this does not occur, because if we add up the resistance force of the first and second molars (364 g), these are greater than the mesializing force of the key. Because of this, the retrusion force is of 64 g.[1, 11]

Activation

Because this arch has four closure loops incorporated, it can behave as a spring or in some cases the loops will remain passive and these will be used as anchorage elements for ligatures or elastic chains in case these become the active elements. In the first case, activation is made by opening the loops, pulling and cinching back the arch at the end of the molar tubes or with wire ligature tied from the molar hook to the distal loop provoking its opening.[11]

When the DKL is used as an anchorage device, the active element is added to it (elastic chain, ligature, etc.).

DKL activation

The DKL arch can be used for space closure under two different mechanical concepts:

1. Use as a spring.
2. Use of the arch as an anchorage element for auxiliary additions.[11]

1. Use of the arch as a spring

This space closure manner is based on the activation of the arch by opening the loops and producing a closure force while the arch returns to its original form. This activation can take place in two ways:

A. **Activation by distal traction of the arch.**
B. **Activation with retroligature.**

A. **Activation by distal traction of the arch:** this is done opening the loops by pulling the arch from behind the molar tube, provoking the loop aperture that must not surpass 1 mm; the maneuver is completed by cinching the arch behind the molar tube and this way we maintain this activation.[11]

Figs. 103 and 104. DKL cinch back.

The response to activation (arch cinching) is manifested in two time periods; in the first period a crown retro-inclination occurs at the canine and incisor level. In the second period incisor and canine torque are recuperated. We must prolong the time between activations so this recuperation can occur.[11]

Teeth with orthodontic treatment have a periodontal widening that can absorb the tension accumulated in the loops, provoking rapid loop closure; this must not be interpreted as the desired dental movement. The resorption and apposition process needs the persistence of the stimuli on the periodontium. The zones that first absorb the activation forces of the DKL are the palatine or lingual portion of the alveolar socket of the incisors and the distal portion of the alveolar socket of the canine, resulting in retro-inclination of these teeth. In the canine, this uprighting inclines mesially and inciselly the slot of the brace, guiding the arch in this direction and incrementing the arching of the Spee curve with intrusion of the lateral section and the extrusion of the anterior sector. This tends to create a posterior open bite and an anterior deep bite. On the other hand, due to the magnitude of its root surface, the canine will be the tooth that will take more time to recover its correct inclination.[11]

The appropriate period between activations must oscillate between 6 and 8 weeks. Before each activation we must observe clinically if it is the right time to do it. We must bear in mind two references:

- The DKL arch must not have any occlusal curving.
- The cuspid must have its correct inclination.

When the indicated time has passed, if we observe a curvature or if the canine is distally inclined, the arch should not be activated again. We must wait until both situations normalize. If the activations are too often, the second phase of the movement of the incisors will not occur, meaning that incisor torque and correct canine inclination will not be accomplished.[11]

B. Activation with retroligature: another way to activate this arch is with a wire ligature that spans from the hook of the buccal tube on the molar band to the distal loop of the DKL arch wire. The loops are opened with a Weingardt plier and this activation is consolidated with the ligature wire; do not bend the end of the wire behind the molar. The main difference between these two activation modes is the position assumed by the anterior portion of the arch. The traction exerted by the ligature in the distogingival angle of the distal loop provokes a gingival inclination of the anterior sector of the DKL with the increment of positive torque. [11]

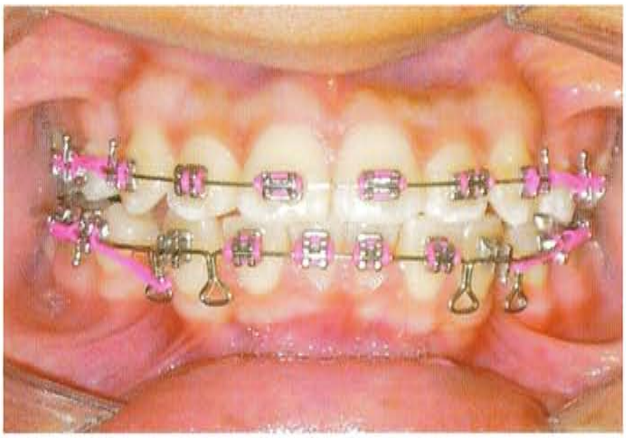
This has many advantages:

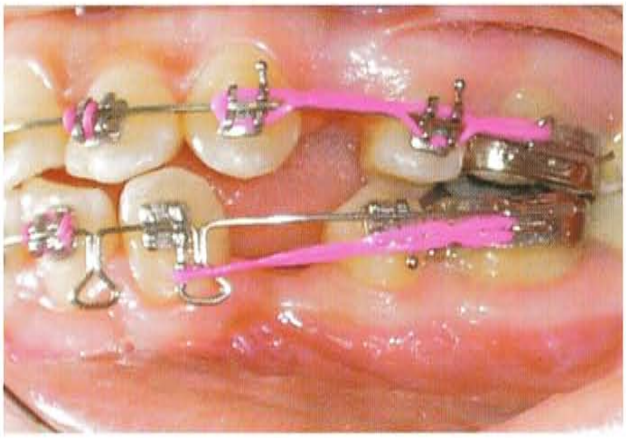
- Improved torque recovery of the upper incisors.
- It avoids anterior sector extrusion.
- Moves the canine distally minimizing the crown retro inclining effect.
- Reduces the intrusion effect on the lateral sector and, associated to the anterior intrusive movement, maintains the occlusal plane leveled eliminating forward and aft movements.

When a lot of dental retraction is needed, the activation with retro ligature is more appropriate.

2. *Use of the arch as anchorage for auxiliary elements*

This is used in special cases in which we want posterior sector migration (anchorage loss). In this case the DKL arch must remain passive with the loops closed. The distal loops will be used as anchorage for the auxiliary elements, and from these loops the auxiliary elements will apply the force to the teeth of the posterior sector that we want to move.[11]





Figs. 105 and 106. Loops as anchorage for space closure using elastic chains.

DKL arch modifications for retraction without torque: the management of the DKL has a variant when the retraction movement must be accomplished without torque, movement is seldom planned for the upper dental arch, but on the contrary, apt for the inferior dental arch in which the retraction movement of the anterior sector must be planned with minimal or nil torque expression due to the anatomical characteristics of the alveolar ridge of this sector. To accomplish this we must wear off the arch in the anterior sector so we can eliminate the edges and this way diminish torque. Despite this, the manner and frequency of activation are the same for both cases with the objective to avoid secondary effects derived from the deepening of the Spee curve.[11]

DKL modifications in order to allow mesial migration of the posterior sectors: in cases where the treatment plan indicates that the posterior sectors must be mesialized, and especially in those where retrusion of the incisors is necessary, the DKL arch must not express negative torque because anchorage would increase. This is done by wearing off the arch wire on the distal portions of the loops, and this way the sharp edges of the wire will disappear and with this the negative torque expression and friction will be reduced. This activation will be made from the first molar. Another modification can be made for the same purpose we must place a positive torque (around 15 degrees), in the posterior sectors of the arch (turn the braces 180 degrees). This will place the molar roots onto trabecular bone. When an important inferior molar mesial movement is going to be done it is convenient to reinforce the inferior incisor anchorage. A higher caliber DKL arch can be used to increase anterior torque, like a 0.021" x 0.025" DKL arch. In this case the wearing off will be done on the edges of the posterior segment of the arch; giving positive torque is not convenient because using a higher caliber wire increases friction and will make mesial molar migration more difficult. [11]

Most frecuent mistakes in retrusion mechanics

Activation errors. These are always made by excesses; in the opening of the loops of the arch or in the frequency of the activations. Both provoke very marked retroclination of the anterior sector and greater resistance to torque recovery. As a result of this, a total loss of control of tooth movement occurs. The adverse effects are difficult to solve and prolong treatment time, because the occlusal planes would have to be leveled again and sometimes this is obtained by opening spaces in the dental arch again. The activation of a DKL arch provokes in a first time period a distal canine inclination and a retroclination of the incisors, at the second time period incisor torque and canine upright position is regained. These different types of movement made by the DKL require a prolonged time to manifest. The orthodontist must be cautious with the amount of activations of the loops of the DKL, which must be very moderate in order to avoid a distal canine crown inclination that would affect the anterior part of the dental arch provoking extrusion of the incisors. For this reason, activation must not surpass 1 mm in each loop. On the other hand, the frequent activation of the DKL wire will not allow the canine to regain its normal inclination and will retard the recovery of the incisor torque. This over activation provokes an increase of the overbite due to incisor extrusion. Furthermore, we must decide which the best time to do the activation, observing the aspect of the dental arch. A new activation can be done if good canine inclination is observed and if there is no evidence of a concave occlusal arch (deep Spee curve). In normal conditions, activations can be made every 6 or 8 weeks.[11]

Synchronization errors during space closure: when both dental arches are being retracted it must be in a coordinated manner. Two of the main objectives of orthodontic mechanotherapy are a normal overjet and a Class I canine relation; sometimes this last objective forces us to work on one dental arch, and when the canine Class I relation is obtained we can activate both DKL arches.

If we retroincline the inferior incisors excessively and we do not take good care of the overjet, upper retrusion may not accomplish the objectives of normalizing the overjet and obtaining a canine Class I. For this reason, in four extraction cases the closure sequence would be, in a coordinated manner, to close the two anterior sectors first and later mesialize the posterior sectors in two phases, first the lower arch till completed and then the upper arch. This way, we finalize first the space closure in the inferior arch, maintaining the spaces in the upper arch that must be closed mesializing the molars. This maneuver is done with ease and poses no risk to the canine relation because the upper incisors will be consolidated in their sagittal position. These upper spaces allow incisor retrusion in case we must compensate any maladjustment in the anterior sector relation. Due to these anchorage differences between the dental arches in both sectors, it is logical to think that if we pretended to migrate mesially simultaneously in both dental arches, the most frequent complication observed would be a total space closure in a Class II relation with an increased overjet.[11]

Error in anterior vertical control: sometimes we can alternate our mechanotherapy sequence and retrude the upper arch without solving before any vertical problem of the inferior and superior incisors. This may place the inferior incisors in contact with the cingulum of the upper incisors, not allowing their retrusion and increasing anterior anchorage; impeding this situation prevents the obtention of canine Class I relation and provokes posterior anchorage control in the upper dental arch.[11]

Use of a wrong sized DKL: the appearance of diastemas in the anterior sector is produced by the use of a wrong sized DKL. If a bigger than needed arch is used, the mesial loop will lean on the cuspid braces. During activation only the distal loop will open, but the mesial loop, although it does not open, will receive the tension of the activation and the distal arm of the mesial loop will exert pressure on the canine braces, which will distalize in an isolated way. This will provoke diastemas between the lateral incisors and the canines. (11)

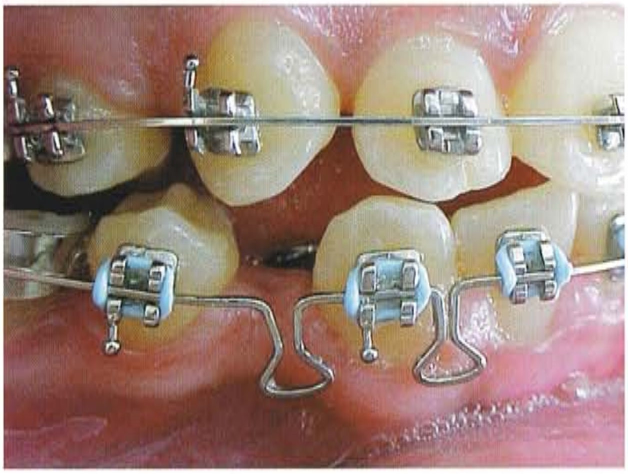


Fig. 107. Mesial pressure over the canine brace.

When to use a two or four-loop arch?

The simple arch (two loops) and the double key loop arch (DKL) were designed for space closure.

Simple arches are used in cases in which we first want to distalize canines first (with closed coils or with power chain) with a force that does not surpass 350 g and later on retrude the four incisors by opening the loops (no more than 1mm). These are also recommended when we need posterior maximum anchorage.

The DKL arches are used when we want to close extraction sites in one single stride, retruding in-block the six anterior teeth with posterior anchorage loss, or, if we need maximum anterior anchorage and posterior anchorage loss, the loops are activated more than 1 mm.(1)

TMA or stainless steel DKL arches?

The basic operation of this arch is that upon activation, the loops open and these tend to close again, closing the spaces.

These arches were first made out of stainless steel, but with the rise of new alloys in orthodontics like Nickel-Titanium and TMA, manufacturers had the alternative to use these materials to fabricate these arches.

Steel is an alloy made out of 75% austenitic steel, 18% chrome, 8% nickel and less than 0.20% of carbon. Its principle characteristics are high stiffness, low elastic memory, less accumulated energy, low friction level, moderate elastic module, it is easy to bend and has low cost. The energy saved in a steel wire is less than the energy in a TMA wire. This is why these wires exert high forces that dissipate in short periods of time.

TMA is composed of 77.8% titanium, 11.3% of molibdenium, 6.6% zirconia and 4.3% of tin. It has a lesser elasticity modulus than steel and approximately the double than NiTi, greater recoverability, less force production, high friction level; it is difficult to bend and of higher cost.

Dr. Alfredo Bass and cols. made a study in 2005 comparing the mechanical properties of steel and TMA two and four loop arches. The results are as follow:

- Steel is harder, therefore, we need to apply more load to open the loops than in TMA wire.
- The simple and DKL steel loops have a saturation curve and a change in its flexibility modulus, which can lead to intrinsic deformation, altering its load distribution. This can happen around 250 g.
- Instead, the simple and DKL TMA arches comply with the Hooke law (deformation is directly proportional to the load) showing greater linearity level between 200 and 500 g (recommended load). Steel conserves linearity until 200 g.
- A 1 mm activation of the loop of a TMA arch exerts 300 g of force and stainless steel 500g of force.
- One of the disadvantages of TMA is the difficulty to manage anterior torque during retraction.

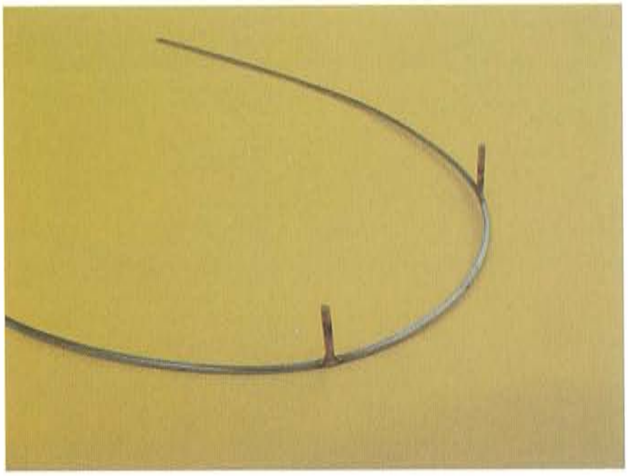
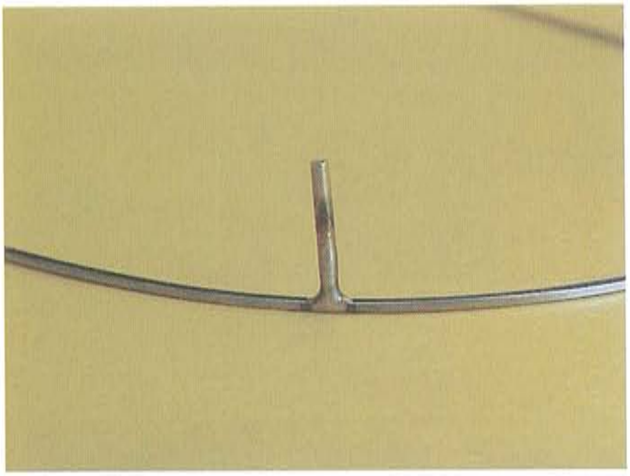
In synthesis, the use of TMA simple and DKL loop arches for space closure is recommended.(1)

4. RETROLIGATURES (LACE BACKS)

In 1990 a method for space closure that employs sliding mechanics was described. In 1989, Robinson demonstrated that molars mesialized 1.76 mm with retro ligatures, but incisors moved distally 1 mm. In cases where no retroligature was used, molars mesialized 1.53 mm and the incisors 1.4mm, meaning that the anterior segment proclined. So, when retro ligatures are employed, posterior anchorage is lost, but we gain anchorage in the anterior segment (2.5mm per quadrant).

Drs. McLaughlin, Bennett and Trevisi (MBT) suggest the use of stainless steel 0.019" x 0.025" arch wires in a 0.022" spot, because the arches of this dimension provide good overbite control and allow posterior sector sliding. Overbite and torque are not well controlled with smaller arches. Bigger arches limit posterior sector sliding. These arches have 0.7" soldered brass hooks. These hooks are placed with 36 mm or 38 mm of separation between them in the upper arch and with 26 mm in the lower arch. This measurement is taken following the curvature of the arch. The 26 mm measurement in the lower arch is valid for the majority of cases but in the upper arch individual variability is greater due to the variations in the size of the upper lateral incisors. Therefore, we must have a great inventory with different distances between hooks.[2,13]

According to the MBT technique, there are three ways to close spaces:

Figs. 108 and 109. MBT arches with brass hooks.


Figs. 110 and 111. The brass hook is bended to facilitate elastic and ligature insertion.

a) Active distal ligature type 1 (distal elastomeric ligature).
b) Active distal ligature type 2 (mesial elastomeric ligature).
c) Active distal ligature with NiTi coils.

Active distal ligatures type 1 and 2 are simple, economic and reliable. Placement is easy and have little complications. These active distal ligatures use an elastomeric ligature that is stretched upon activation. This exerts a force between 50 and 100 g if the elastomeric ligature is stretched before placement, in case it is not stretched before placement the force can oscillate between 200 to 300 g more. The force exerted by the elastomeric ligature varies according to the type of elastic ligature used, how much was it stretched before placement and how much we stretch it while placing it.[2,13]

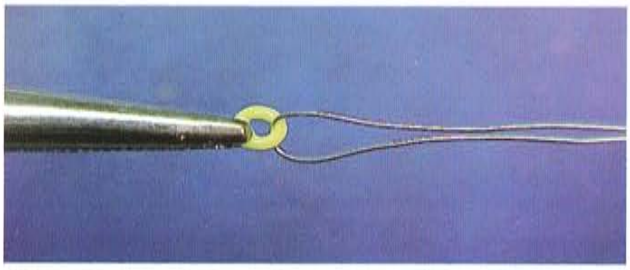


Fig. 112. Passive ligature.

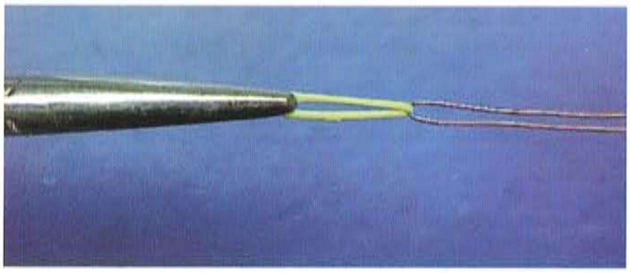
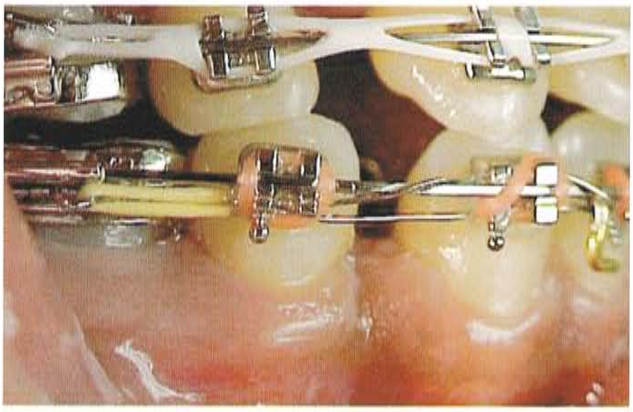
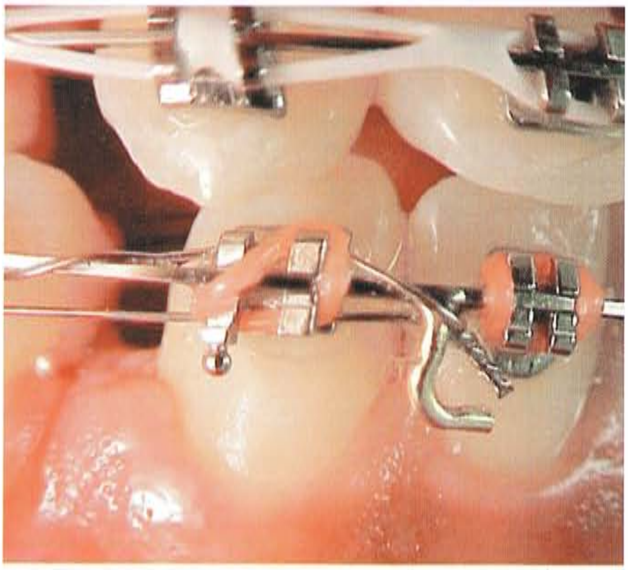


Fig. 113. Active ligature.

a) Active distal ligature type 1 (distal elastic ligature): The 0.019" x 0.025" steel wire is placed on the braces with metallic or elastomeric ligature. We hitch the elastic ligature on the hook of the first or second molar. We use a 0.010" steel ligature. We pass an end of the ligature under the arch. This increases the stability of the distal active elastomeric ligature and helps maintain the elastomeric ligature away from the gingival tissues.[2,13]





Figs. 114-116. Type 1 Laceback.

b) Active distal ligature type 2 (mesial elastomeric ligature): the principle is the same as in the type 1 ligature, but the elastomeric ligature is hitched to the hook soldered to the arch. The arch is a 0.019" x 0.015" stainless steel wire and we place elastomeric ligatures except on the bicuspids. We hitch a 0.010" steel ligature to the hook of the first or second molar and after turning on itself a few times we hitch the other end to an elastomeric ligature that is hitched to the hook of the arch. Finally we place an elastomeric ligature on the brace of the bicuspid covering the arch and the active distal ligature. With both types of ligature the elastomeric ligature stretches double its original size. The ligature can be reactivated every 4 to 6 weeks. If hygiene is not good, the elastomeric ligatures can deteriorate and must be changed in every appointment. In some cases, at the end of space closure, it may be useful to use two elastomeric ligatures or complement the active distal ligature with an elastic chain of 10 or 12 links from molar to molar.[2,13]

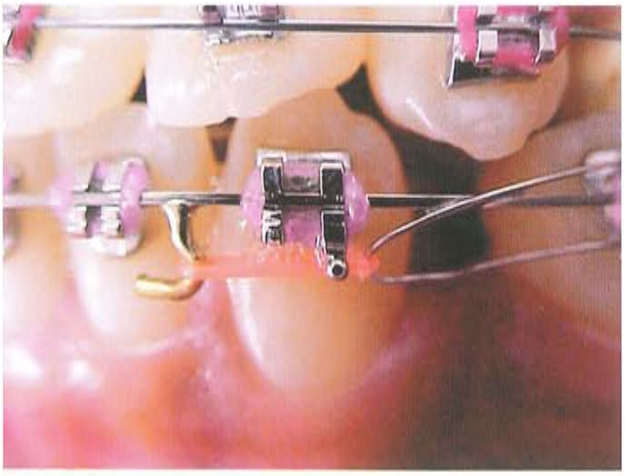
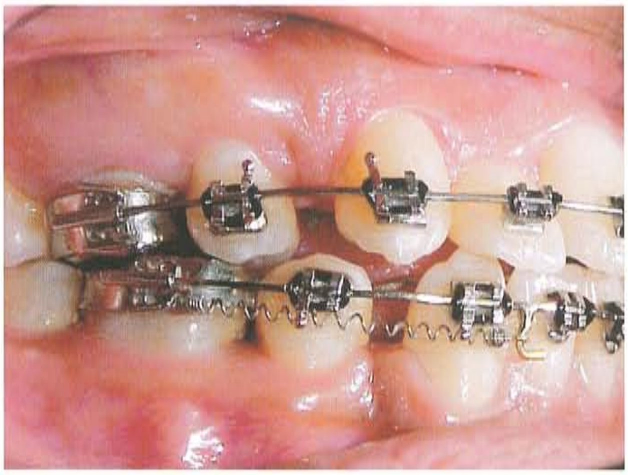


Fig. 117. Type 2 lace back.

c) **NiTi coils:** if the sites to close are too large or if appointment compliance is difficult, NiTi coils can be used instead of elastomeric ligatures. Samuel and cols. recommend the application of 150 g as the optimal force for space closure. They found that 150 g coils are more effective than 100 g coils, but not as effective as 200 g coils. This work confirms prior findings that NiTi coils close spaces better than elastomeric ligatures. Natrass & cols. have confirmed that the force of elastomeric ligatures declines rapidly after 24 hours and that temperature and the environment have an effect on this process. This loss of force does not happen in the same way as in NiTi coils. Despite scientific evidence that favors NiTi coils, many orthodontists still use power chain for space closure in the majority of cases. If space closure is too fast, incisor torque can be lost and may take months to recuperate after the spaces are closed. Elastic chain is easy to use, economical, and functions well in the majority of cases. Even thouhg NiTi coils can close spaces without being replaced during periodic appointments, this is a relative advantage, because during space closure we must take off the arches and check them out and cut off the excess wire in every appointment if necessary.[2,13]



Figs. 118 and 119. 150 g closed coil.

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Deep Bite

4

Esequiel Rodríguez, Rogelio Casasa, Adriana Natera,
Francisco Gaitán, Víctor García, Carlos Coutiño, José Luis Mozqueda

Introduction

The influence of mandible growth in the development of deep bite before, during and after orthodontic treatment has been the object of numerous investigations for more than 40 years.(16)

The definition of deep bite, according to Graber, refers to a state of increased vertical overbite in which the dimension between the incisal margins of the upper and lower teeth is excessive. This dental projection is denominated overbite and the norm is 2 mm. Chaconas considers it in percentages and mentions that a normal overbite exists when close to 20% of the buccal surface of the lower incisors is covered by the upper incisors.(11,15)

Deep bite predisposes the patient to periodontal disease due to the overcharge of occlusal forces, excessive tension, trauma, functional problems (limitation in lateral movements) and bruxism. Due to the excessive depth of the bite, functional problems that affect the temporal, masseter and lateral pterigoyd muscles occur, and by consequence, the condyle goes backwards and upwards in the articular fossa (vertical growth) due to the lingual eruption of the central incisors, which forces the mandible and the condyles to go backwards far away from central relation. Therefore these patients are susceptible to TMJ pathology.(11,15,16)

Facial characteristics of deep bite patients may be the following:

1. Brachicephalic face.
2. Skeletal Class II tendency.
3. Concave profile.
4. Short vertical dimension and lower third of the face.
5. Diminished occlusal plane.
6. Hypodivergent growth tendency.
7. Mandible retrognatia.(11,15)

Dental characteristics of deep bite patients may be the following:

1. The skeletal base of the mandible canine region is significantly narrower than the corresponding skeletal base of the upper maxilla.
2. The upper dental arch is well developed and sometimes there is an excess of posterioanterior growth, the anterior zone may be sometimes smaller.
3. The lower dental arch is morphologically normal and has characteristic signs of crowding and lingualization of the lower incisors.
4. Regularly we can observe a noticeable retroclination of the upper and lower incisors.
5. Regularly the mandibular teeth are in a distal position in relation with the maxillary teeth (Angle Class II).
6. Increased overbite (the upper teeth cover a great portion of the lower teeth and in some occasions totally).
7. Gingival hyperplasia in the lower teeth.
8. Regularly, deep bites are associated with an excessive eruption of the upper incisors.(11,15,16)

Types of deep bite

- Congenital deep bite (skeletal and dentoalveolar).
- Acquired deep bite.

Two subtypes of congenital deep bite have been described:

1. **Skeletal deep bite**, characterized by a horizontal growth factor. The anterior facial height is reduced; especially the lower third of the face, meanwhile the posterior facial height is excessive.(16) When the anterior facial height is lesser than the posterior facial height the maxillary bases converge and the result is a deep bite of skeletal origin. The alterations of the transversal width can also cause a skeletal deep bite because we can have a wide maxilla and a narrow mandible. The profile of the patients tends to

be concave with a prominent chin eminence with labial retrusion.[11,15] In general, these patients have a diminished inferior facial third, their growth is horizontal or hypodivergent. Other characteristics that are present are a brachicephalic facial type, increased muscle tone, a square face and perfect lip closure. The diagnosis of this alteration with x-rays and cephalometric radiographs will determine if the discrepancy or alterations are at bone or teeth levels and if the problem lies in the maxilla, in the mandible or both.[11,15,16]

2. **Dentoalveolar deep bite** is characterized by molar infraclusion and/or incisor overeruption.

Deep bite produced by molar infraclusion presents the following characteristics:

a) The molars have erupted partially.
b) The inter occlusal space is ample.
c) The tongue occupies a lateral position.
d) The distances between the basal planes of both maxillas and the occlusal plane are short.[16]

The deep bite produced by the over eruption of the incisors presents the following characteristics:

a) The incisor edges of the incisors exceed the occlusal plane.
b) The molars have erupted completely.
c) The Spee curve is excessive.
d) The inter occlusal space is reduced.[16]

Due to the hypodivergent growth, the incisors are compressed by the muscles of the lips and their hyper tonicity is going to provoke retroclination of the crowns of the incisors producing a deep bite. Of this functional influence and the consequential deviation of the dental eruptive pattern, the rest of the occlusal anomalies will develop, like retroclination, deep bite, mesialization of the buccal segments and overcrowding.

While the molars erupt, the anterior deep bite does not allow lateral movements of the mandible and the child becomes a vertical chewer. Aperture and closure movements that act like functional stimuli for the growth of the anterior maxillary alveolar apophysis are limited and inhibit mandible development. Anterior deep bites in the primary dentition are very frequent, but they are rarely treated. They can be associated with the presence of Class II malocclusions in development. The decisions of treatment are generally postponed until the mixed dentition.

The indications for such treatment in the primary dentition include: lower incisor impact on the palatal mucosa, excessive wear and headaches.[11,15,16]

Strong posterior mastication worsens the bite because it puts posterior teeth in infraclusion. Normally the inferior incisors present a marked retroclination due to blockage by the upper incisors and extrude until they touch the palatal mucosa. In occasions the overbite is so severe that the lower incisors are totally covered by the upper teeth. This excessive overbite may produce trauma in the lower buccal mucosa and in the palatine mucosa of the upper maxilla. Deep bite is a typical clinical sign of Class II division 2 malocclusions.[11,15]

Acquired deep bite can be caused by the following factors:

1. The lateral posture of the tongue.
2. The premature loss of deciduous molars or permanent posterior molars.
3. Wear of the occlusal surface or dental abrasion.

Possible treatment options to open deep bites

Deep bite can be localized in the dentoalveolar or skeletal zone, and treatment will always depend on the affected zone.

The correction of dentoalveolar deep bite can be obtained by intrusion of the anterior teeth, extrusion of posterior teeth, a combination of both, posterior teeth uprighting and increasing the inclination of the anterior teeth.[11,15,16]

Anterior teeth intrusion may be indicated in patients that show too much upper gum (gummy smile), or if they have too much dental mass in the four anterosuperior teeth, a great interlip gap or a steep mandibular plane.

Intrusive movements are very violent and may cause root resorption. But Gottlieb showed that using 15-20 g of force per incisor there is no measurable root shortening or visible apical resorption.[11,15]

Extrusion of the posterior teeth may be the treatment of choice in patients in which we want to increase inferior facial height, improve facial convexity or if we want to open the mandibular plane.[23]

There is great controversy surrounding the effects of premolar extraction in vertical dimension. Viazis considers extractions of premolar counterproductive in patients with deep bite because the rest of the teeth would move lingually and the bite would deepen more.[22]

Deep bite, apart from producing occlusal irregularities, may intervene in the seating and/or increase of problems in the TMJ. For this, orthodontists have tried for some years to reduce the depth of deep bites using different mechanisms from the use of extra oral appliances (feared by the patients because of its anti esthetic effects), till the most recent elements described in the literature product of clinical investigation with basis in bioengineering applied to the design of elements for dental movement control. Studies in Physics and Biomechanics have given us designs of arches and passive and active elements that are more efficient and plural.[12]

The options that we will review in this chapter for the opening of the anterior bite are as follows:

- Anterior bite plane.
- Anterior bite plane with intermaxillary elastics.
- Bite ramps.
- Bypass.
- Incisal brace placement.
- Intrusion bend.
- Tip back.
- Reverse curve arch.
- Intrusion arch of Dr Oscar Quirós.
- Utility arch.
- CIA.
- Intrusive arch with loops.
- Face bow.

Anterior bite plane

With this additment the occlusal plane will open with the help of the anteroinferior teeth, which will contact the acrylic plate provoking a separation or posterior disclusion, facilitating the passive or forced eruption of molars and premolars, which will open the anterior bite.[4,11,15]

Hemley, in 1938 affirmed that the bite plane slows the growth of the anterior alveolar process; meanwhile the posterior alveolar process continues growing. He also found that of 22 patients that used the bite plane, only one showed inferior incisor intrusion. Strang says that the bite plane induces molar extrusion but does not have an intrusive effect on the anterior segment. Sleichter studied the vertical changes of molars and incisors, and found that the height of the molar region increased while the anterior region had a minimal change.[16,20]

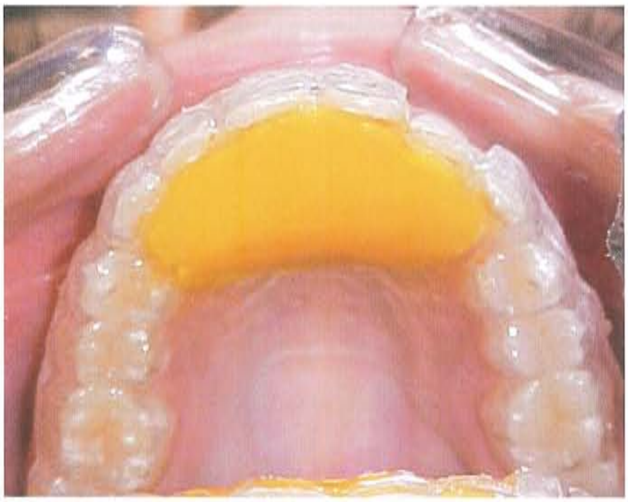
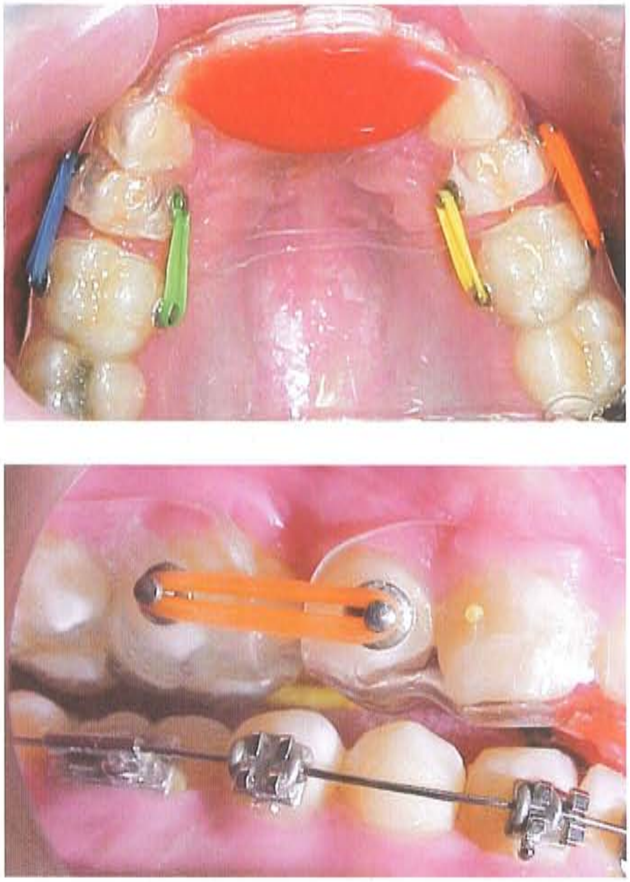


Fig. 1 Acrylic bite plane over an acetate.



Figs. 2 and 3. The bite plane helps us provoke a posterior disclusion and correct easily minor relapses.

Figs. 4 and 5. Bite plane in Hawley retainer. This will produce a passive posterior segment extrusion provoking mandible autorotation correcting the deep bite.

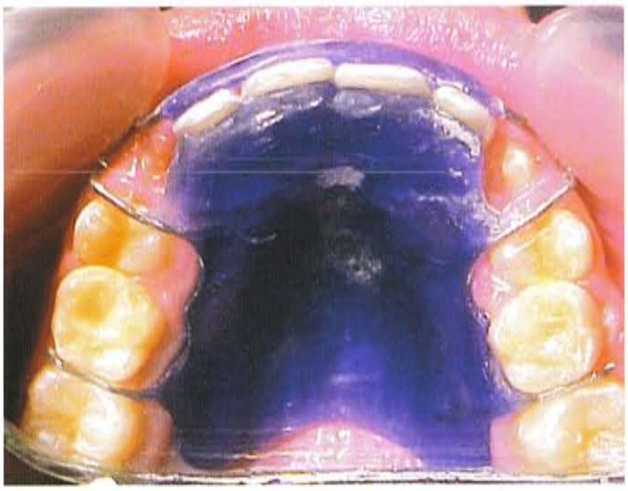


Fig. 6. Patient with a Hawley plate with a bite plane in the mixed dentition.

Before placing an anterior bite plane we must evaluate the type of malocclusion of the patient and its cephalometric characteristics (that determine the growth direction of the mandible). For example, if the mandible rotation tendency is forward and upward (hypodivergent), the use of the bite plane will favor change of growth direction, and at the same time will facilitate the opening of the bite. In turn, in patients with a mandibular tendency to rotate downward and backward (hyperdivergent) with an increased facial lower third, the use of an anterior bite plane is contraindicated.

If the patient is in the mixed dentition, the anterior bite plane will assist the extrusion of the posterior segment, maintaining contact with the lower incisors, so these will not extrude, leveling the Spee curve, opening the bite and increasing the facial lower third.[16,20]

Advantages

1. Easy to make.
2. Promotes mandibular rotation that will tend to open the bite.
3. Increases vertical dimension and the lower third of the face.
4. Deprograms mandibular muscles.
5. Diminishes the depth of the Spee curve.

Disadvantages

1. Must invest laboratory time.
2. Not very comfortable for the patient.
3. We depend upon patient cooperation because it is removable.
4. The passive extrusion of the posterior segment is slow, so the bite plane must be used for at least 6 to 8 months. For each millimeter of posterior extrusion the anterior bite will open 2 or 3 mm (scissor effect).

Recommendations

1. The time of use of this appliance is 6 to 8 months; in this time frame, a passive extrusion of the posteroinferior sector should be obtained.
2. If it is used as retention (Hawley or Essix with a bite plane), posterior stripping must be preformed to allow passive extrusion of molars and premolars.
3. The thickness of the acrylic of the bite plane must be enough to provoke a 1mm to 3mm posterior open bite. Due to this passive extrusion we will provoke

an anterior open bite of +3mm because of the scissor effect.

4. When the incisor retroclination and the deep bite are corrected, the mandible will move forward, simplifying the orthodontic correction of the distoclusion.

Anterior bite plane with intermaxillary elastics

Patients with permanent dentition and deep bite, deep Spee curve and anterior rotation of the mandible, can be treated with a combination of fixed and removable appliances (braces and intermaxillary elastics). With the use of intermaxillary elastics we can force an over eruption of the posterior teeth, this way we can level the Spee curve, increase the height of the inferior third of the face and we can lessen the depth of the anterior bite. It is important to make these procedures with rectangular wires in the braces in order to avoid brace rotation around the wire, which can happen with round wires, because this rotation may lingually incline the premolars.

The results obtained with this technique are generally very stable, the facial height and the depth of the bite are usually well maintained.[13]

Fig. 7. Patient with anterior deep bite due to intrusion of the posteroinferior segment.

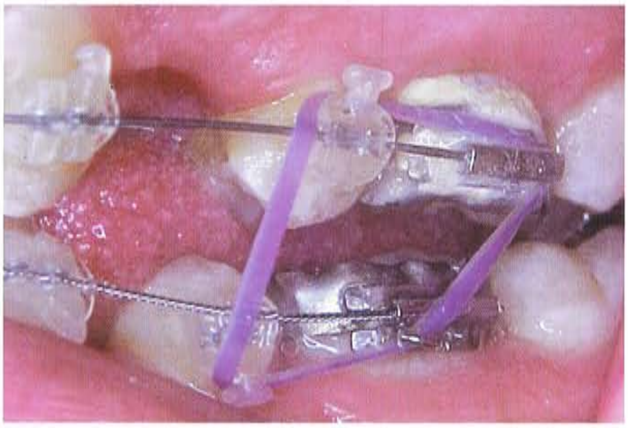
Figs. 8 and 9. Fixed bite plane in mouth.

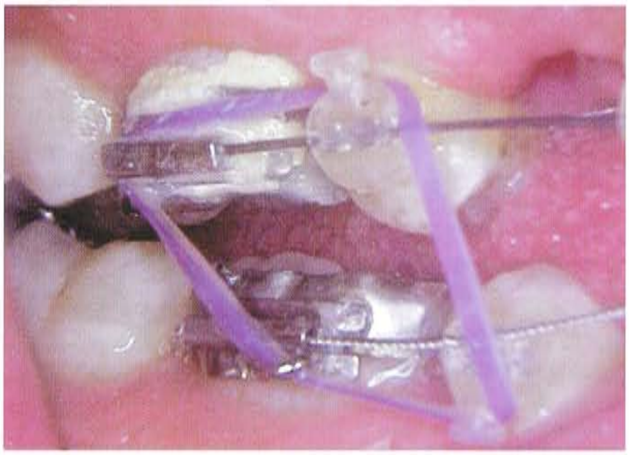
Fig. 10. Posterior disclusion.

Advantages

1. The extrusion of the posterior segment is fast.
2. The correction of the anterior deep bite is done in little time.
3. Provokes a mandibular rotation that tends to open the bite.
4. Increases vertical dimension an the lower third of the face.
5. Deprograms the mandibular muscles.
6. Diminishes the depth of the Spee.

Fig. 11. Bonded braces in both arches.





Figs. 12 and 13. Molar and premolar forced extrusion with the use of box elastics.

Disadvantages

1. We depend upon patient compliance for the use of the intermaxillary elastics.
2. Swallowing and speech become difficult for the patient.
3. Food tends to accumulate under the bite plane.
4. Orthodontic pain in the posterior segment.

Recommendations

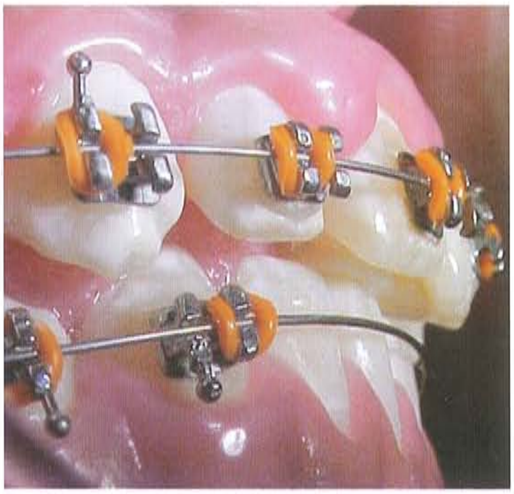
1. The thickness of the acrylic of the bite plane must be enough to provoke a 1mm to 3 mm posterior open bite. Due to this passive extrusion we will provoke an anterior open bite of +3 mm because of the scissor effect.
2. We must remove the bite plane every two months to clean it.
3. In case the bite plane provokes a lesion in the palatine mucosa, we must instruct the patient to use mouth washes with monohydrated sodium perborate or 0.12% clorhexidine gluconate or iodine antiseptics (see chapter of lesions and urgencies during orthodontic treatment).
4. Use rectangular wire arches (sectioned arches preferably) in order to avoid the lingualization or palatinization of the posterior segment.
5. Use 6.5 Oz of force elastics.
6. The elastics must be changed every 24 hours.
7. Perform stripping in the posterior segment to facilitate extrusion.
8. Tell the patient to chew gum with the intermaxillary elastics in place. This will accelerate the extrusion of the posterior segment.

Bite ramps

Bite ramps (GAC) are very resistant additaments made of a flexible resin, which are bonded on the palatine aspects of the upper incisors in order to provoke a posterior disclusion. Soon after they are placed, intermaxillary elastics are used to interdigit the posterior bite with the consequential aperture of the anterior bite. ORMCO makes the turbo bite, made of metal; we prefer the resin bite ramps because they do not wear off the enamel of the lower incisors as metal bite ramps do. A way to substitute the bite ramps is to place on the palatal aspect of the upper incisors block out resin or conventional resin stops. Like an acrylic bite plane, these bite ramps will increase the facial height, open the posterior bite and deprogram the mandible muscles. (2,3,8,13)

Advantages

1. Bonding is fast and easy.
2. They are more comfortable than bite planes.
3. They are hygienic.



Figs. 14 and 15 Bite ramps bonded to the upper central incisors.

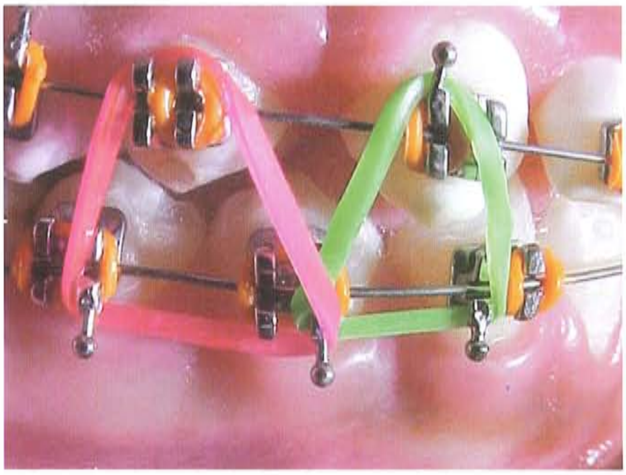


Fig. 16. Use of delta elastics for posterior bite closure and to open the anterior bite.

Fig. 18. Posterior disclusion waiting for eruption sequence.

Fig. 17. Bite ramps on upper central incisors.

4. Provoke mandibular rotation that tends to open the bite.
5. Increase vertical dimension and the inferior facial third.
6. Deprogram the mandibular muscles.
7. The depth of the Spee curve is diminished.

Disadvantages

1. Bite ramps can be easily dislodged due to the forces of mastication.
2. Sometimes swallowing is difficult.

Recommendations

1. Bond the bite ramps on the cingulum of the upper incisors.
2. Use heavy rectangular arch wires to avoid posterior sector lingualization.
3. Use 6.5 Oz force elastics.
4. The elastics must be changed every 24 hours.
5. Perform posterior segment stripping to facilitate extrusion.
6. Tell the patient to chew gum with the intermaxillary elastics in place. This will accelerate the extrusion of the posterior segment.

Individual bypass

This form of intrusion is very simple and fast. We just have to place a brace or a button to the tooth that we want to intrude and pass an elastic wire (NiTi or TMA) on the incisal portion of the tooth. This will intrude the tooth.

Fig. 19. Extruded lateral.

Advantages

1. The bypass provokes an intrusive movement immediately.
2. The intrusive movement is 2 mm per month.
3. We do not depend upon patient compliance.
4. We can produce individual or in block intrusion.

Disadvantages

1. There is no tip or torque control of the tooth.
2. Teeth with intrusive bypass tend to incline buccally.

Fig. 20. Bypass on the lateral.

Fig. 21. One month later.

3. Because it is a violent movement, it provokes periodontal inflammation and pain.

Recommendations

1. Make the by-pass with elastic wires like NiTi or TMA.
2. The diameter of the arches can range from 0.012" to 0.020".
3. After dental intrusion, we must give tip and torque to the tooth.
4. We must lace the teeth adjacent to the bypass.
5. After dental intrusion, all arches must have an intrusion bend or we must change the position of the brace in order to place a straight wire and facilitate horizontal movements if necessary.

Incisal brace bonding

In cases of deep bite due to anterior segment extrusion, we can "play around" with the bonding of the braces. This consists in bonding the anterior braces 0.5 mm to 1mm toward the incisal edge (central incisor at 3 mm or 3.5 mm and the lateral incisor at 2.5 mm or 3 mm) and the posterior braces gingivally; this will provoke an intrusion of the anterior segment and extrusion of the posterior segment, with the sub sequential opening of the bite.[17]

Fig. 22. Deep bite due to anterior teeth extrusion.

Fig. 23. Incisal brace bonding.

Fig. 24. Nine months later.

Fig. 25. Treatment initiation.

Fig. 26. Upper braces bonded near the incisal edge.

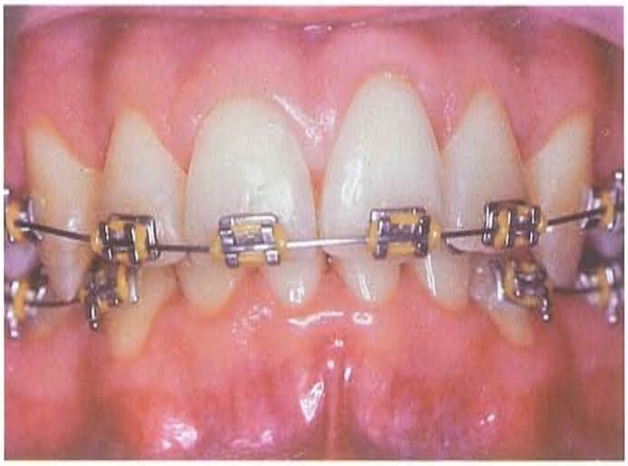


Fig. 27. Inferior braces bonded near the incisal edge.

Fig. 28. End of treatment.

Advantages

1. We do not depend upon patient compliance.
2. We can completely open the bite with a round arch sequence.

Disadvantages

1. Braces are far away from the center of resistance, so there is less control of the movement.
2. Anterior teeth tend to move buccally.
3. Loss of anterior teeth torque.
4. Detailing becomes difficult.

Recommendations

1. Wait 2 to 3 months to bond the braces in the lower dental arch.
2. Cinch back the arch wires; this will diminish proclination of the anterior segment.
3. Place negative torque on the anterior teeth at the end of treatment.
4. Tie together the posterior teeth as anchorage.
5. Place delta elastics as anchorage (upper canine-lower canine-lower premolar).
6. The patient must have excellent periodontal health.

Intrusion or second order bend

This bend is done in round or rectangular arch wires. It is used to intrude a tooth or a group of teeth in order to open the bite. It is made with Tweed pliers or with a step plier of 0.5 mm or 1 mm. Depending of this measurement will be the amount of dental intrusion in millimeters. The intrusive movement will take about 1 or 2 months to complete.[17,22]

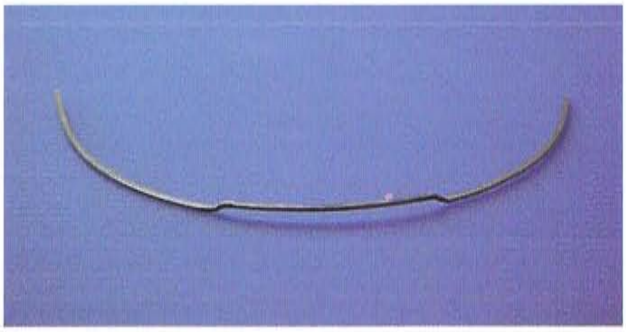


Fig. 29. Intrusion bend.

Fig. 30. Passive intrusion bend.

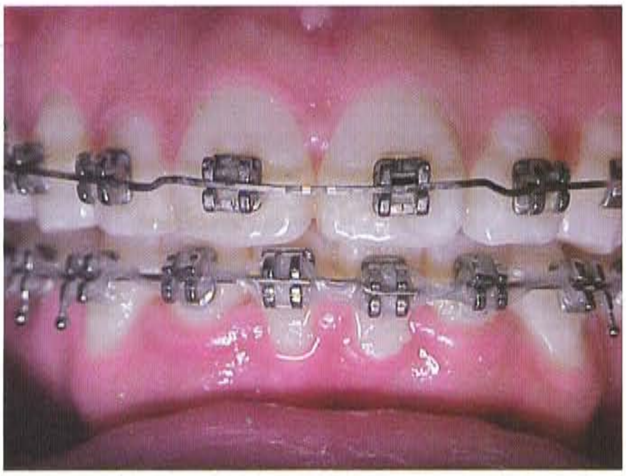


Fig. 31. Active intrusion bend.

Advantages

1. We do not depend on patient compliance.
2. Intrusion is fast.
3. Dental intrusion is stable.

Disadvantages

1. May cause pain, because this movement compresses the nerves and blood vessels localized in the dental apex.
2. The necessary intrusive force would be between 30 g to 40 g for upper incisors and 20 g for lower incisors (please refer to Chapter 3).
3. Gingival inflammation.
4. If the step of the bend is too marked, we risk debonding the brace of the tooth to be intruded.
5. The horizontal movement of the tooth is limited by the bend.
6. After dental intrusion, all arches that we place must have an intrusion bend, or we must change the position of the brace in order to place a straight wire and facilitate horizontal movements if necessary.

Recommendations

1. It must be placed after leveling and alignment are completed.
2. Increment the bend 0.5 mm to 1 mm per month for a less violent intrusion movement.
3. Leave the arch wire with this bend 2 to 4 months for stability and to lessen rebound.
4. A fixed retainer in the tooth where the bend was made is advisable.
5. When this bend is done in the anteroinferior teeth it is recommendable to add negative torque to the roots of the incisors in order to avoid contact between the roots and the cortical bone of the symphysis.
6. Lace together the teeth adjacent to the intrusion bend.[17]

Fig. 32 Tied adjacent teeth.

Tip back

This is a second order bend that is made on round (0.020") or rectangular (0.017" x 0.025") stainless steel arches, 45° gingivally orientated, that produces a tip or molar angulation movement (please refer to Space Closure) and an intrusive movement of the anterior sector. This bend will produce a total force of 100 g to 125 g, necessary enough to intrude the six anterior teeth.[17,22]

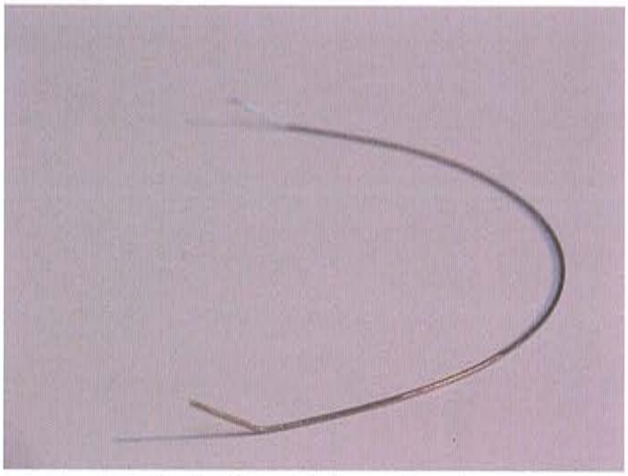


Fig. 33. Upper tip back out of mouth.

Fig. 34. Passive tip back

Fig. 35. Active tip back.

Advantages

1. Easy to make.
2. Economic.
3. We do not depend upon patient compliance.
4. No need for laboratory.
5. It is going to produce intrusion of the anterior segment and minimal molar anchorage.

Disadvantages

1. Distal angulation of the molars.
2. May provoke TMJ alterations due to the contact points that may derive from the molar inclinations.
3. Intrusion is slow.

Recommendations

1. Take off the arch wire immediately if TMJ pain develops.
2. The intrusive force produced ranges between 15 g to 20 g per tooth.
3. The intrusive force will pass through the center of resistance of the six anterior teeth, so the moment will be lesse in these teeth and the intrusive moment is purer.

Use of a reverse curve in the lower arch and a curve in the upper arch

The reverse curve or anti Spee curve is an arch that has been amply used in orthodontics for Spee curve leveling in deep bite patients. Generally, the presence of a deep spee curve is derived from the extrusion of the anterior sector; this happens when the inferior incisors, during their eruptive phase, do not find their antagonist and erupt until they contact the palatine mucosa; for this reason, the anterosuperior sector elongates inducing a deep bite.

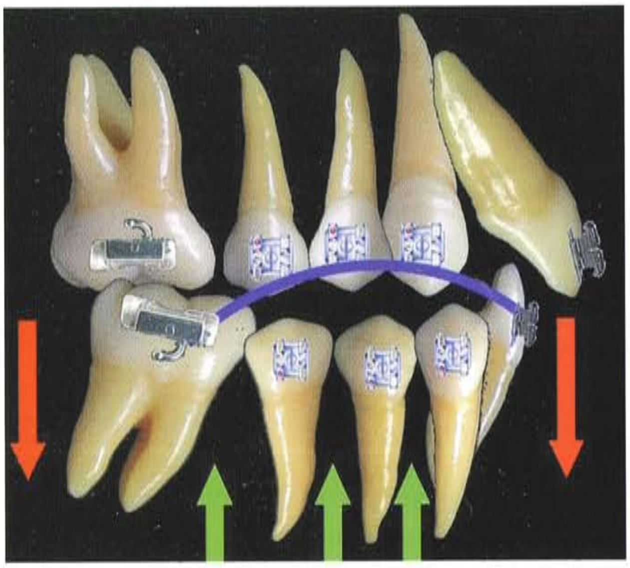
With the development of alloys, super elastic arches appeared in the form of a reverse curve or anti Spee curves (NiTi or TMA), round and rectangular (each one with advantages and disadvantages). In the sagittal sense, the reverse curve arches have three clearly defined zones:

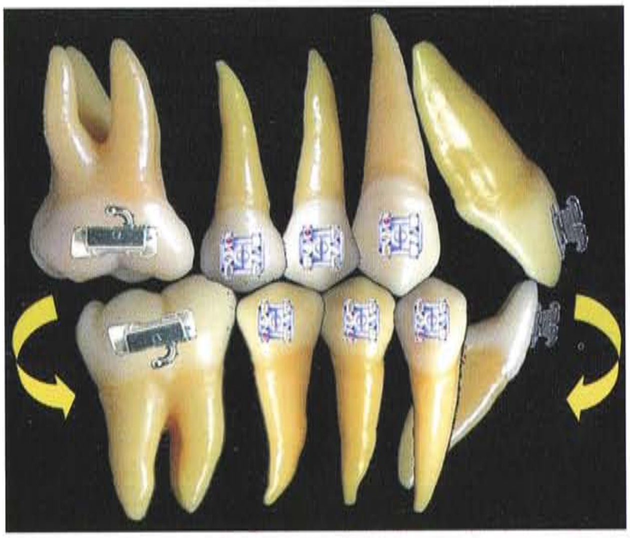
1. The anterior zone, that acts upon the incisor group.
2. The middle sector, upon the premolars.
3. The posterior sector, on the molars.

These super elastic arches generate various effects at the same time:

1. Inclination (proclination) and intrusion of the anterior sector.
2. Extrusion of the lateral sectors.
3. Distal inclination of the molars.[6,14]

In order to correct a deep bite with anti Spee arches, Dr J. Gregoret recommends to preform them (stainless steel arches) and incorporate a negative torque, which will place the teeth apexes in trabecular bone in the anterior segment and upon the buccal cortical of the posterior segment. This effect provokes a negative torque increase at premolar and molar levels increasing their anchorage (cortical anchorage). Increasing the posterior sector an-





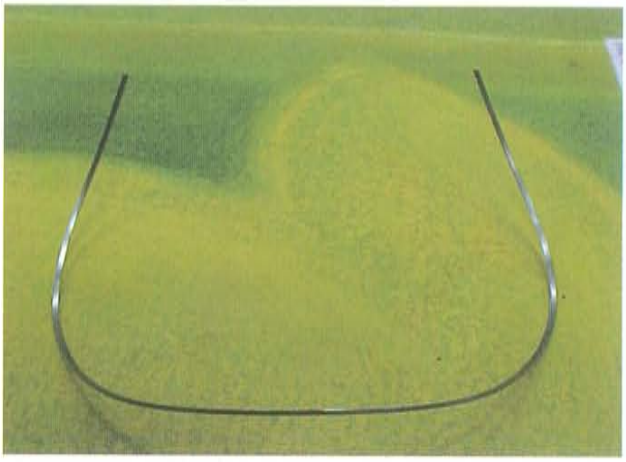
Figs. 36 and 37. Effects of the reverse curves in the lower arch.

chorage will augment the effect of the arch on the anterior sector and this way we can intrude the incisors without proclining them.

Dr Gregoret says that round reverse curve arches will produce:

1. An anterior sector intrusion and proclination with no root control.
2. In the lateral sector an extrusion force will be produced, its magnitude will depend upon the type of muscles of the patient. The premolar roots will upright, lose torque, and as a result premature contacts will appear and anchorage will be lost in this sector.
3. The crowns of the molars will incline distally and the roots mesially. Like in the premolars, uprighting, expansion and loss of torque will occur.
4. He recommends this type of arch in patients with brachyfacial patterns in which we want incisor proclination without any fear of losing anchorage.[6]

In case both anterior segments present extrusion, we can "play" with the anti Spee arches. In the upper arch we will place a curved arch and in the mandible a reverse curve. This will provoke intrusion in both anterior segments, and this will open the anterior bite. [6]



Figs. 38-49. Curved arch for the upper dental arch.

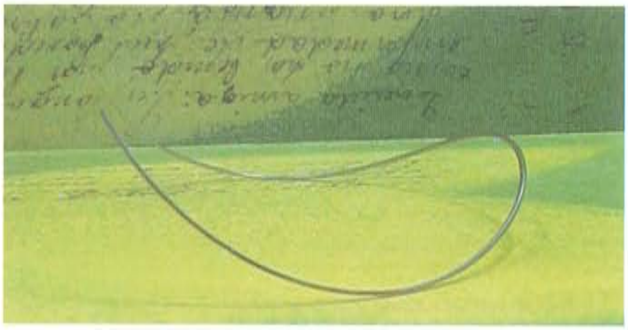
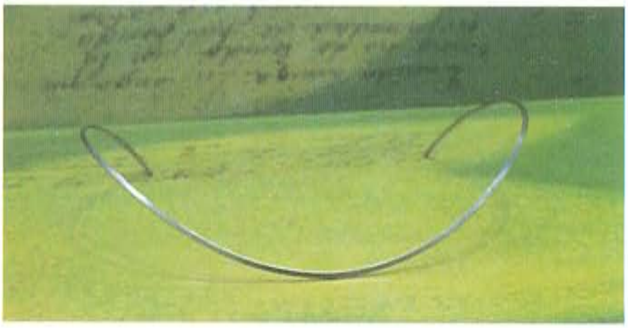
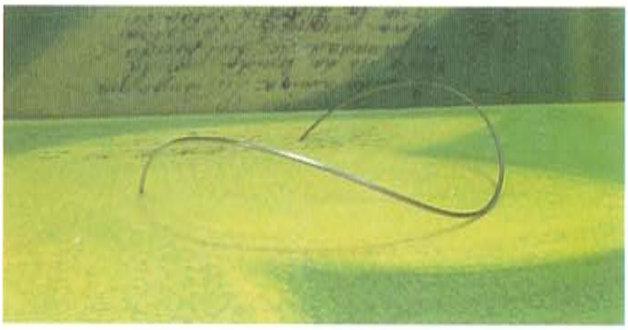


Fig. 40. Curved arch for the upper dental arch.





Figs. 41-43. Arch in reverse curve for the lower dental arch.

Advantages

1. We do not depend on patient compliance in order to open the anterior bite.

2. The bite opens rapidly because the arches exert 300 to 400 g continuously.
3. The intrusion of the anterior segment is slow, so the patient experiences no pain

Disadvantages

1. Distal molar angulation.
2. Possible TMJ alterations due to molar contact points.
3. Positive torque effect in the anterior and posterior segments.
4. Posterior anchorage diminishes.
5. Incisor proclination.

Recommendations

1. Use as anchorage an upper transpalatine arch and a lower lingual arch. This will decrease molar positive torque and distal inclination.
2. We can place the anterior braces 0.5 mm toward the incisal edge; this will accelerate the intrusion of the anterior segment.
3. In case the patient does not have a deep Spee curve, lace the posterior segment with 0.010"or 0.012" stainless steel wire.

The intrusion arch of Quirós

In deep bite cases due to anterior teeth over-eruption, anterior bite planes are not recommended because they produce mandibular rotation and an increase of the lower third of the face; the intrusion of the upper incisors would be the best option. To achieve this we can use reverse curves, intrusive bends and arches with intrusive loops.

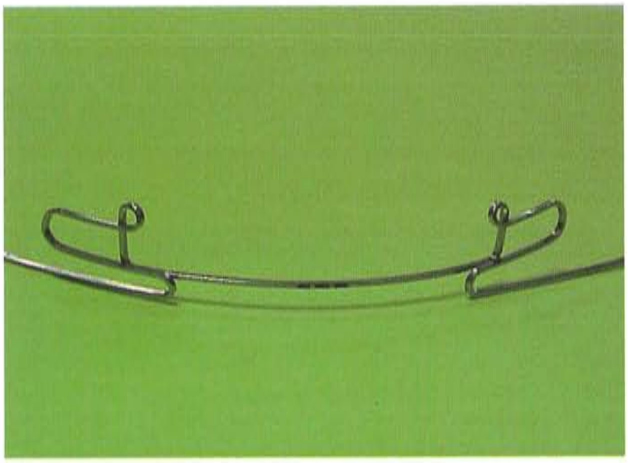
The presence of deep bites is one of the problems that we encounter frequently, to which we apply all our knowledge, but sometimes the resources we posses are inefficient. Not many arches with loops can help us achieve an effective intrusion of the anterior teeth, and the existing ones generally wear off before achieving their objective. The intrusion arch of Dr. Oscar Quirós is an excellent option for anterior segment intrusion.

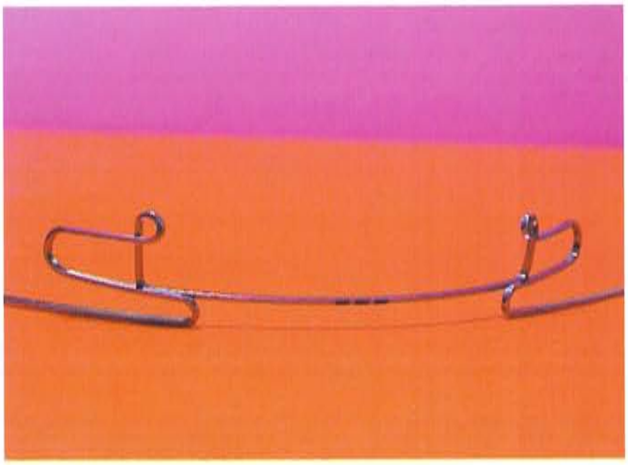
For its fabrication, preform stainless steel 0.017" x 0.025" rectangular arches or 0.016" x 0.022" TMA rectangular arches can be used. We recommend a tweed plier or a plier that does not mark acute bends.[13]

The arch is made with the anterior segment placed more gingivally than the posterior segment of the arch, this will make the intrusion of the anterior teeth possible; the difference in levels will be established by the amount of intrusion needed, 3 mm is an acceptable measure. Due to its design it acts like a very elastic spring that will physiologically intrude the anterior teeth, painlessly and without adverse effects upon teeth and support tissue. [13]

Steps for construction of the Quirós intrusion arch:

1. Mark the wire between the lateral and the cuspid.
2. First make the initial bend and then the helicoidal bend.
3. Then make the intrusion loops.
4. Make the same operation on the other side, try on and then ligate it conventionally.

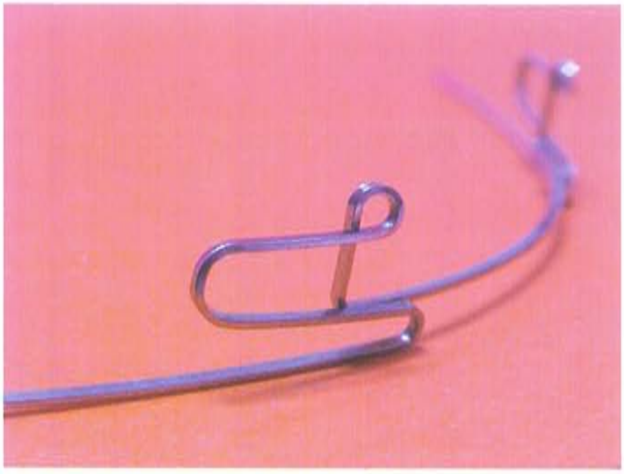


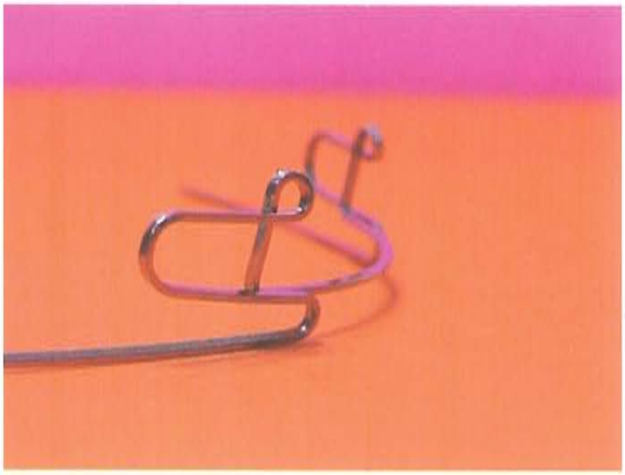


Figs. 44 and 45. Frontal view of the intrusion arch of Dr. Oscar Quirós. The anterior segment of the arch is gingivally oriented 3 mm in order to provoke the intrusion of this segment.

The arch can also retract the anterior teeth once the required intrusion is obtained, with the advantage that, due to the loops that are integrated in the arch while the wire is activated for the anterior segment, retraction forces are exerted that maintain torque on the teeth to be retracted, which is favorable when we are reducing the dental overjet.[13]

In occasions, during retraction, we can have an adverse effect on the canine that can tend to extrude; but this is easy to correct in a short period of time, placing an arch with a bridged bend with a loop over the canine and a segment of elastic chain.[13]





Figs. 46 and 47. Lateral view of the intrusion arch of Dr. Oscar Quirós.

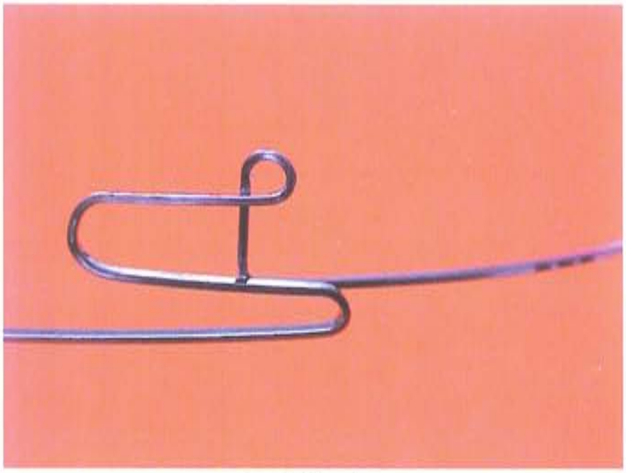


Fig. 48. Right loop

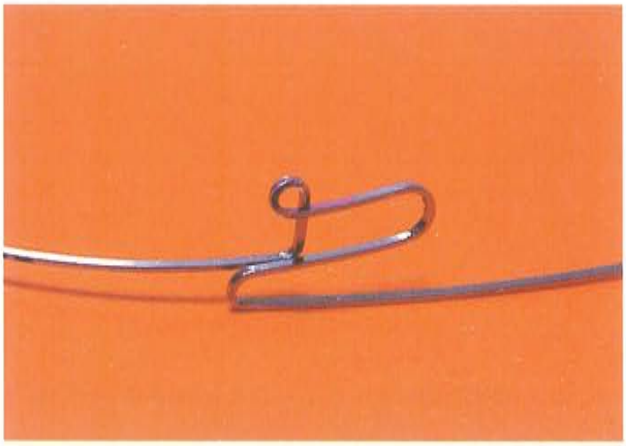


Fig. 49. Left loop.

Advantages

1. This arch produces bodily intrusion of the anterior sector.
2. Due to its intrusion loops, the intrusive movement is smooth.
3. Root resorption is diminished.
4. Minimal tooth pain.
5. It is a multipurpose arch, because is useful for intrusion and space closure in the anterior segment.

Disadvantages

1. The elaboration is time consuming.
2. The elaboration requires dexterity.
3. The loops can impinge if they are not separated from the buccal mucosa.
4. After the use of this intrusion arch the placement of a straight wire is difficult.

Recommendations

1. For use in patients with periodontal problems.
2. For use in patients with short roots.
3. The recommended intrusion step is 3 mm.
4. Make the arch with TMA wire.

Utility arch

Conventional techniques use a sequence of round wires to level deep Spee curves. Sometimes reverse Spee curves are incorporated in order to power their effect. The response to this procedure is the extrusion of the lower bicuspids, molar uprighting and forward inclination of the incisors. This incisor inclination puts the roots in intimate contact with the lingual cortex of the symphysis, which makes intrusion difficult, and also provokes a mesial movement of the roots of the molars. These collateral effects manifest more in patients with weak muscles, like in dolichofacial patients, in which we must implement Spee curve leveling mechanics that do not compromise the occlusal plane in the posterior sector, in order to avoid bite opening and an increase of the inferior third of the face.[6]

By the end of the 50's, Ricketts tried to counteract the secondary effects mentioned before with the use of the utility arch. This is based in the principle that the dental arches are constituted in different sectors; each has its own anatomical, functional and esthetic characteristics. Ricketts divides the lower dental arch in five sectors: incisors, canines, premolars, first molars and second molars.[7, 9,14]

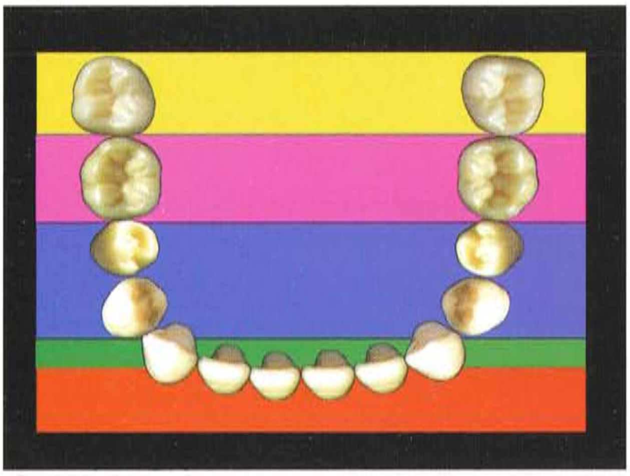


Fig. 50. Sectors of the lower dental arch.

Mono-radicular teeth that have incisal edges that allow them to cut, constitute the incisor group, they also play an important esthetic and phonetic part.

Molars are multi radicular with an occlusal surface that plays a different masticatory function from the incisor group, and have a null esthetic function.

The canines, with a different anatomy and function, have an intermediate position between the incisors and premolars, and are placed in the curve of the dental arches. Speaking about trabecular bone volume and proximity to the cortical bone, all these sectors are placed in totally different zones of the maxilla and the mandible. If we add to all this the different muscular environments, it is understandable that, given the different characteristics of each sector, individualizing the mechanics applied in each sector makes the overall mechanics of this arch very efficient.

In order to avoid the negative effects produced by the reverse curve arch, that lengthens treatment time, we recommend the use of the utility arch, which really is a multisectional appliance because it works independently and simultaneously on the molars and the incisor sector. This procedure is very effective leveling deep curves, obtaining incisor intrusion in brief periods without negative effects.[6,7,9,14]

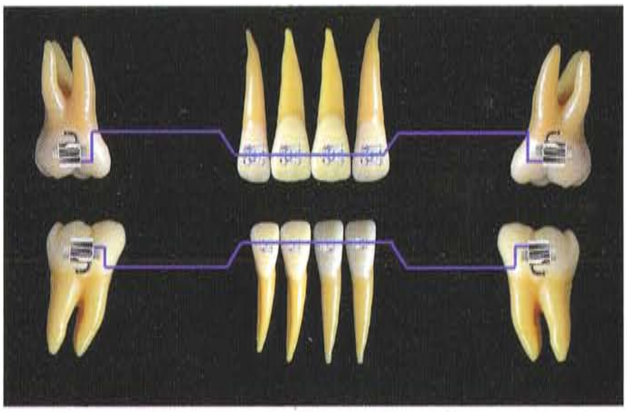


Fig. 51. Upper and lower utility arches.

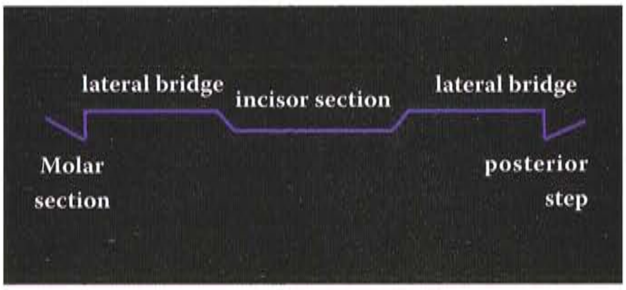


Fig. 52. Parts of the utility arch.

Being an arch that works in three sectors at the same time, we must consider that any activation done will have action-reaction effects, which must be neutralized in order to obtain only wanted movements.[6,14]

Intrusive action of the lower utility arch

1. A 45° tip back is done to the terminal segments that are inserted in the molar tubes. This is the intrusion activation.[6,14]

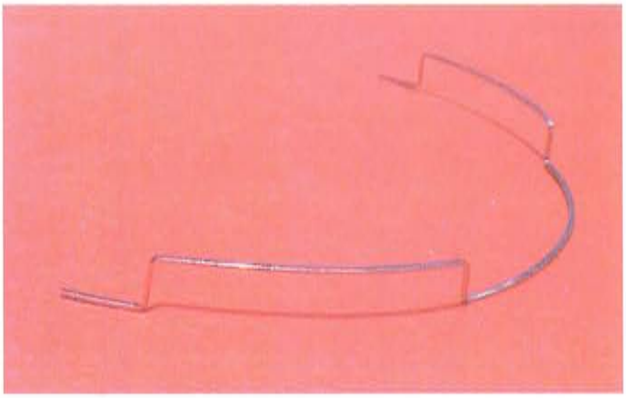


Fig. 53. Passive upper utility arch.

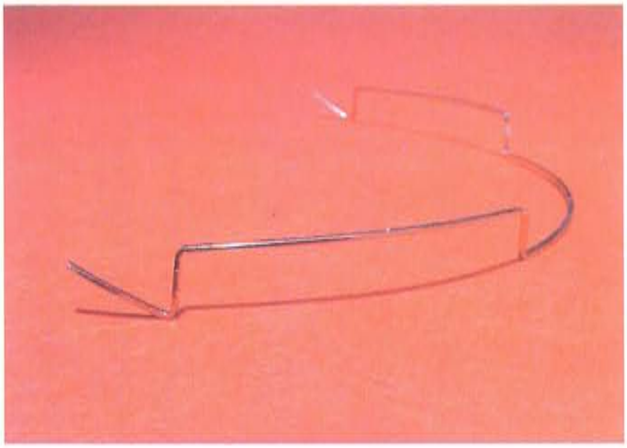


Fig. 54. Active upper utility arch.

Fig. 55. Active utility arch in mouth.

2. A negative torque of aproximatly 10° to 15° is induced in the incisor sector. This torque is placed to separate the apexes from the lingual cortical and to situate them in trabecular bone in order to accomplish the intrusion movement. The arch loses its intrusion capacity because of the contact of the apexes with the lingual cortical and only a buccal movement will occur, so this arch will not serve its purpose. This radicle-buccal torque activation is essential for the intrusion movement.[6,14]

Intrusion activation of the upper utility arch

The tip back activation will be done as in the lower arch and the negative torque will not be necessary in the upper utility arch.[6,14]

With the tip back bend done in the molars, the anterior sector of the utility arch is gingivally located about 10 mm from the slot of the inferior braces and 16 mm to 18 mm from the slot of the upper braces. With this activation an intrusive force of approximately 80 g to 100 g in the lower incisors and 140 g in the upper incisors is generated. These values respond to the application of 100 g of force for every cm^2 of root surface considering that the surface that opposes the dental intrusion movement is the transversal surface of the root of the incisors (please refer to Space Closure in Orthodontics, chapter 3).[6,14]

Dr Gregoret recommends the placement of sectioned arches for stability in the premolar and molar sectors while the intrusion of the anterior sector is taking place. They do not have any type of activation, are totally passive and can be made of the same caliber as the utility arch or slightly bigger.

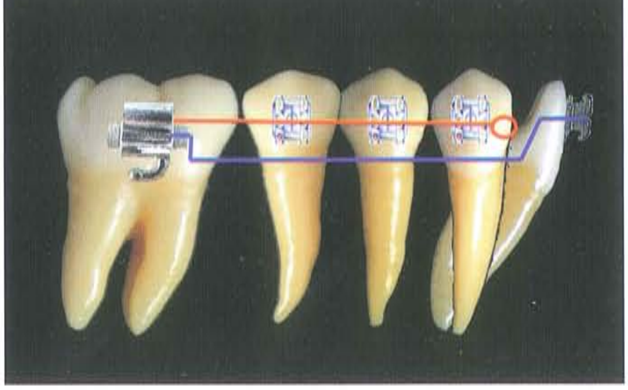


Fig. 56. Stabilizing the sectioned arch.

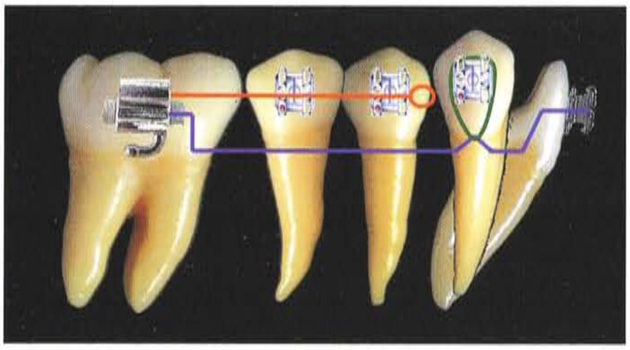
Parting from this, the anterior sector can be intruded without a negative response from the molars. Without this anchorage reinforcement, they would incline distally with the following alteration of the occlusal plane and the possible creation of a fulcrum as a consequence of the contact points of the mesial cusps.(6)

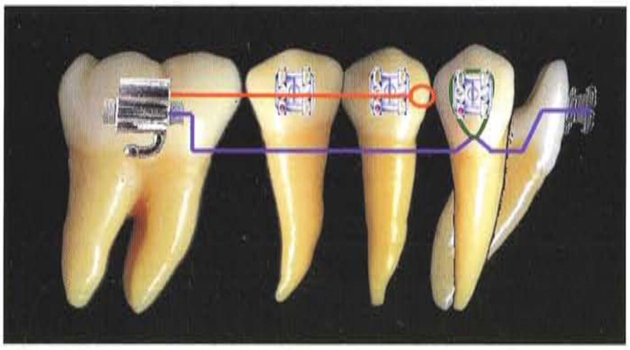
Intrusion sequence in the permanent dentition

Canine intrusion

Once the intrusion objectives in the incisor sector are met, the canine intrusion is next, and the procedure is as follows:

1. Make a "V" bend on the lateral bridges of the utility arch at the canine level. This bend must not generate any activation.
2. A ligature is placed from the canine brace to the "V" bend of the lateral bridge, and this is tensed. After adjusting the ligatures on both canines, the anterior sector is ligated.(6,14)
3. Once the canine intrusion is accomplished we take off the ligatures and we place a 0.016" superelastic wire or a higher caliber wire for re-leveling, without taking the utility arch off, remaining two wires in the anterior sector (wire over wire). The objective is to re-level the whole dental arch without losing the anterior intrusion.(6)
4. Once re-leveling is obtained we remove both arches and we continue the sequence of continuous arches.





Figs. 57 and 58. Canine intrusion with ligature.

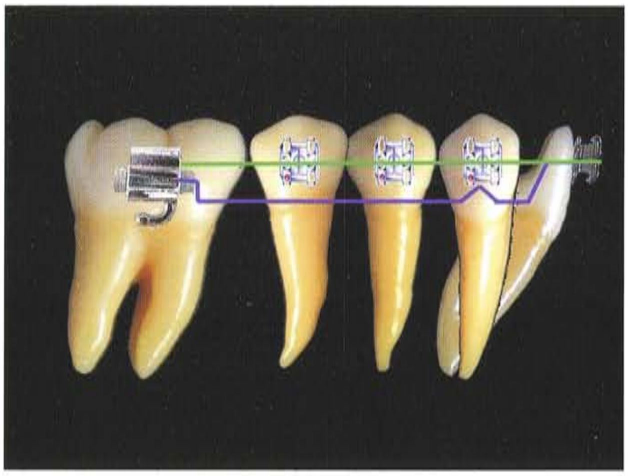


Fig. 59. Leveled arch.

Advantages

1. It produces light and constant movements.
2. We do not depend upon patient compliance.
3. It produces controlled intrusion movement.
4. It produces pure intrusion, because the intrusive force passes through the center of resistance of the tooth.

Disadvantages

1. The elaboration consumes some time.
2. If the arch is not well constructed, it can impinge in the buccal surface of the premolars.
3. The intrusive movements can debond the anterior braces.
4. Undesired molar inclination.
5. May provoke TMJ alterations due to the contact points that can result from the molar inclination.

Recommendations

1. Anchor the upper molars with a transpalatine and the lower molars with a lingual arch to diminish their inclination.
2. Immediately remove the arch if the patient refers pain in the TMJ.
3. Place negative torque in the anterior sector.

CIA (Connecticut Intrusion Arch)

The correction of a deep bite (deep overbite) can be accomplished with the intrusion of the anterior sector, the extrusion of the posterior sector or a combination of both. This decision must be based in the ideal position of the upper incisor, considering the lip-teeth relation (nasolabial angle) and the vertical dimension of the lower third of the face.[10,23,24]

There are many ways to intrude the anterior segment; Begg, Ricketts and Burstone employ the same principle: the molar tip back bend. The wire materials used for intrusion with these techniques are diverse, but they all recognize the need to employ a continuous light force.[10]

Nickel Titanium alloys (NiTi) are a good option to produce these continuous and light forces. These alloys have high memory and a low load-deflection ratio that translates into less wire activation appointments.[10]

The Connecticut Intrusion Arch (CIA) is more commonly used for intrusion of the anterior teeth, but it has other uses, including molar tip back for Class II correction, for anchorage preparation of the posterior segment, correction of minor anterior open bites, occlusal plane leveling and detailing.

The CIA is manufactured and distributed by Orto Organizers and made out of NiTi wire. There are two available arch sizes: 0.016" x 0.022" and 0.017" x 0.025". The upper and lower have an anterior dimension of 34 mm and 28 mm respectively.[10,23,24]

In the majority of cases the CIA is not placed in the slots of the anterior braces. In the anterior segment, a sectional rectangular arch is placed in the slots from lateral to lateral.

Fig. 60. Passive CIA with sectional anterior arch.

Over this wire the anterior segment of the CIA arch wire is ligated to the sectional wire. This is the reason why the use of triple tubes in the upper molars and the use of double tubes in the lower molars are recommended. [10,23]

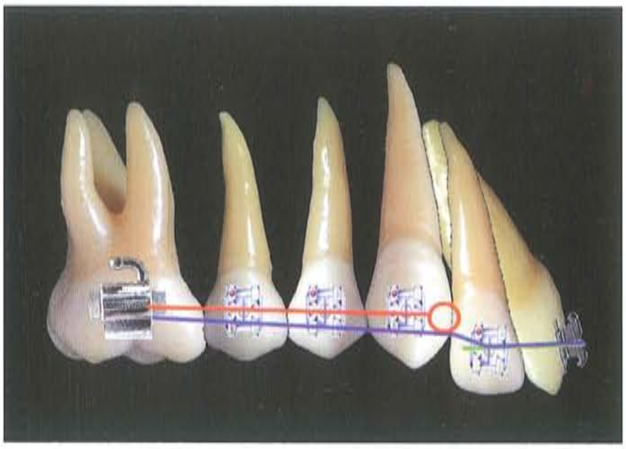


Fig. 61. Active CIA with a sectional stabilization wire and a sectional anterior wire.

The CIA exerts an intrusive force of 40 g to 60 g due to the "V" bend placed mesial to the molar tube. With this arch we can achieve pure intrusion, because the intrusion force is directed apically through the center of resistance of the tooth, producing 1mm of intrusion in 6 weeks.[10]

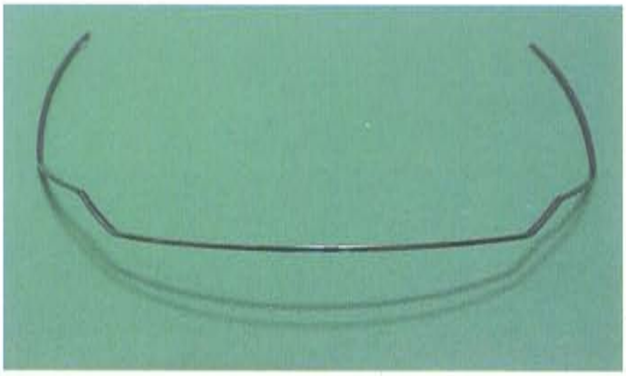


Fig. 62. Frontal view of the CIA.

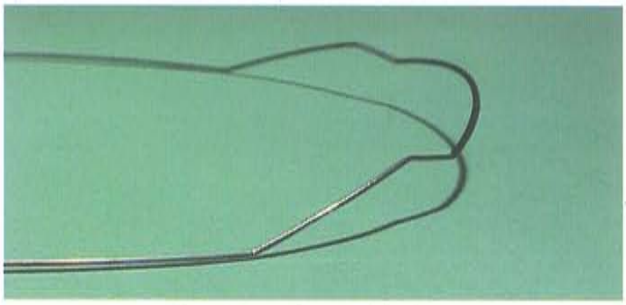


Fig. 63. Lateral view of the CIA.

Fig. 64. Frontal view of the CIA.

Fig. 65. Lateral view of the CIA

Advantages

1. It produces pure intrusion, because the intrusive force is applied very close to the center of resistance of the tooth.
2. Intrusion is fast with continuous and light movements.
3. Root resorption is diminished.
4. Provokes minimal discomfort to the patient.
5. It is a multipurpose arch.
6. We do not depend upon patient compliance.

Disadvantages

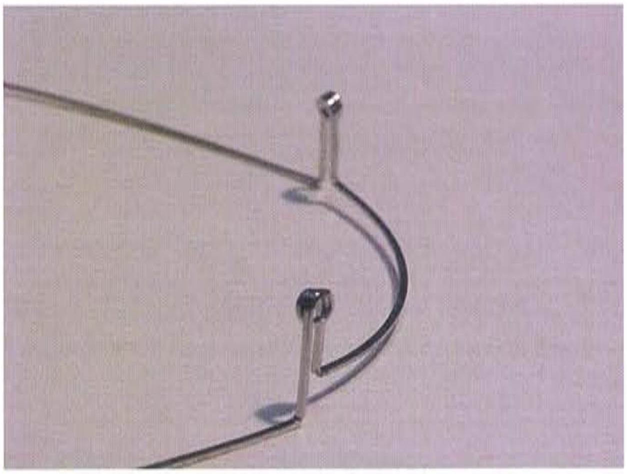
1. The posterior section can impinge in the buccal mucosa of the premolars.
2. The intrusive force may debond the anterior braces.
3. Distal angulation of the molars.
4. It may provoke TMJ alterations due to the contact points that can result from the molar inclination.

Recommendations

1. Immediately remove the arch if the patient refers pain in the TMJ.
2. Place a transpalatine arch on the molars to preserve the intermolar width.
3. Place a cervical face bow to diminish undesired molar movements.

Intrusion arch with loops

The intrusion is done with a vertical loop of 5 mm to 7 mm high, that has a circular loop in the gingival end. This is done on the arch wire (steel or TMA) and is located, generally, between the lateral and the canine. It has an anterior intrusion step of 3 mm to 5 mm (please refer to Space Closure in Orthodontics, chapter 3).



Figs. 66 and 67. intrusion loops.

Fig. 68. Passive intrusion loop.

Fig. 69. Active intrusion loop.

Advantages

1. It produces controlled intrusion.
2. Comfortable for the patient.
3. Due to the loop, the intrusive movements are light and constant (20 g per tooth).
4. Intrusion takes about 2 to 3 months.

Disadvantages

1. Takes time to manufacture and to adjust.
2. After this arch has been used, all the subsequent arches must have an intrusive bend.
3. The loop may impinge in the mucosa if it is not correctly conformed.
4. Gingival inflammation of the anterior sector frequently appears with the use of this arch due to the intrusive force exerted.

Recommendations

1. Lace or anchor the posterior segment with wire ligature.
2. Make the bends in rectangular wire to have more control.
3. The loop must be separated 2 mm to 3 mm from the anterior sector gum.
4. The loop must be made as close to the center of resistance of the tooth as possible.
5. Place negative torque to the anteroinferior sector.
6. Activate the arch wire every two months.

Face bow

Cervical traction has also been called low traction or KHG (Kloehn) and has the following characteristics:

1. The line of force action passes 25° to 30° bellow the occlusal plane.
2. The force components are the extrusion and distalizing vectors.
3. The extra oral support is the pad that is placed in the back of the neck at the third cervical vertebrae level.[21]

Fig. 70. Cervical pad.

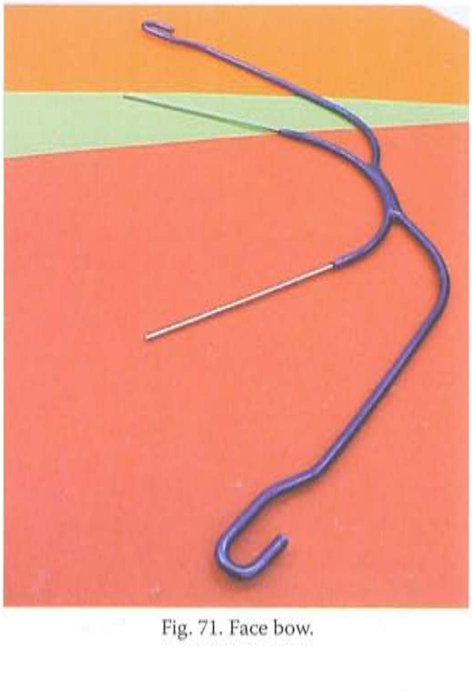


Fig. 71. Face bow.

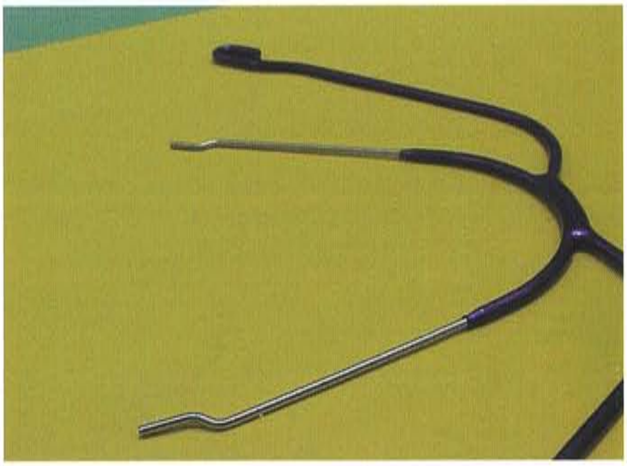
Fig. 72. Face bow.

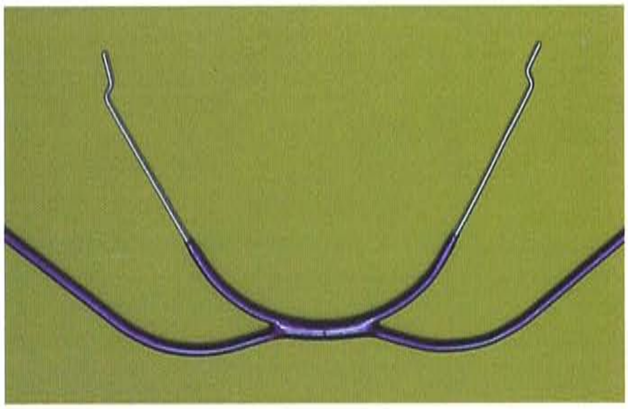
This type of extra oral appliance is indicated in Class II division 1 and 2 malocclusions with brachifacial patterns, with a horizontal growth tendency and a very strong muscular pattern. The correction is favored by the distalization and the predominantly molar extrusion or depression of the palatine plane, and consequently, mandibular rotation. The osseous profile improves, there is an increment of the anterior facial height due to the molar extrusion, the anterior overbite is corrected and maxillary protrusion is reduced.

This appliance works correcting the deep bite through the extrusion and distalization of the upper molars.[1, 18, 21]

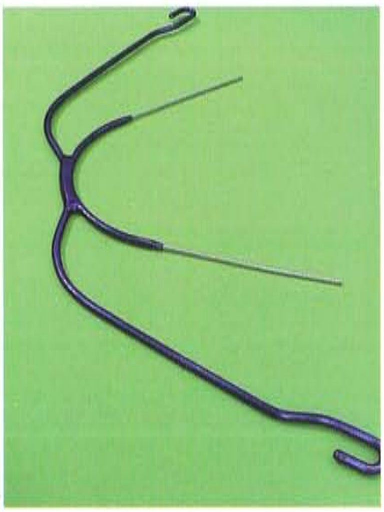
The facial bow is composed by an external bow (facial) and an internal bow (buccal), joined together in the middle anterior portion.

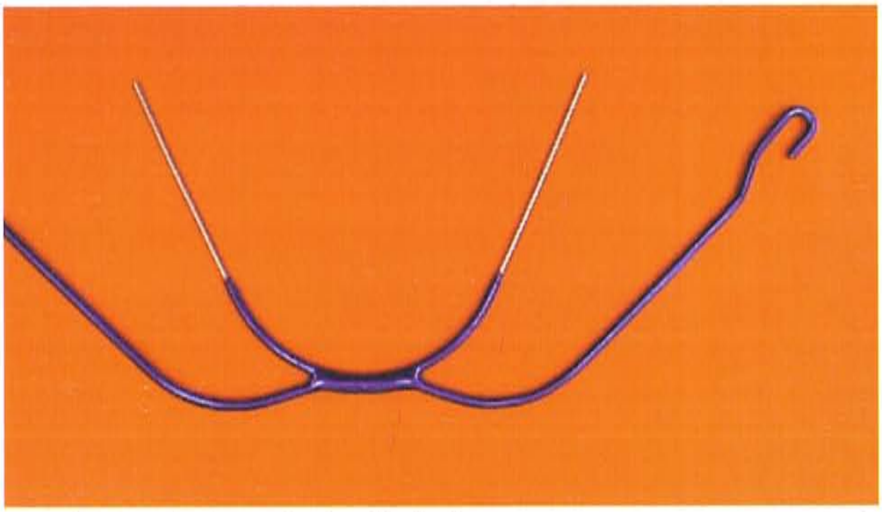
The internal arch must be separated 5 mm to 8 mm from the buccal aspect of the upper incisors approximately, and





Figs. 75 and 76. Bayonet bends for the insertion of the internal bow in the molar tubes.

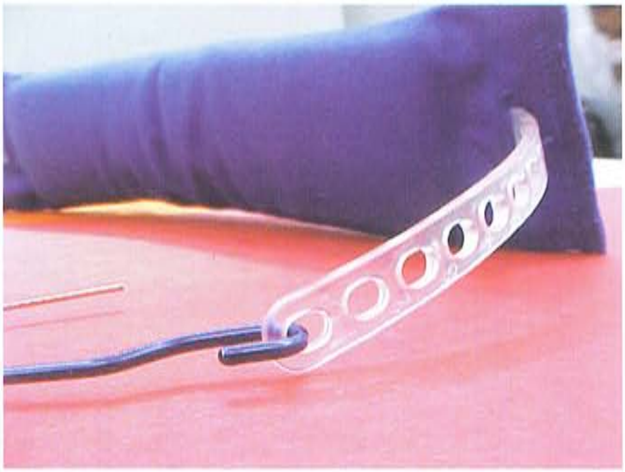




Figs. 73 and 74. Internal and external arches of the face bow.

the ends are inserted in the tubes of the upper molar bands. A stop bend must be placed to impede the inward sliding of the internal arch ends in the tubes.

The external arch also has bends at the endings in which the traction pad is inserted.[21]



Figs. 77 and 78. Facial arch inserted in the neck pad.

A light force is used when we want to move a tooth or a group of teeth; due to this force, the response of the support bone, of the periodontal tissues and of the tooth itself, are favorable; hialinization of the osseous tissue will occur for a brief period of time, and there will be good blood flow with a great affluence of repair and bone forming cells. The dental movement is easier if the tooth is imbedded in trabecular bone and not in the bone cortex. The tooth to be moved must be isolated from the other teeth so it can distalize easier.[21]

In order to better understand the action of the face bow we must briefly analyze its biomechanics:

1. **Force:** It is the factor that alters the position of a body in repose; it changes the direction of its movement or provokes compression or distension of the body (the tooth).
2. **Point of force application:** In the face bow, the point of force application corresponds to the bend or hooks of the outer arm where the pad is attached.
3. **Line of force action:** The spring that joins the hook of the outer arm of the facial bow to the cervical pad determines the line of action or the direction of the force. This can be horizontal or oblique, depending on the location of the extra oral support and the outer arm.
4. **Center of resistance:** It is a point located near the trifurcate of the roots of the first upper molar. All the force that passes through the center of resistance of the tooth will promote a translation movement of the tooth and there will be no inclination. Based on this principle, when we use cervical traction, we must angle the external arm of the face bow above the occlusal plane, so the resultant force applied to the upper molar passes though its center of resistance, annulling the inclination effect on the molar. Therefore, if the molar is being inclined by the use of the facial bow, we must proceed to the correction of the position of the external arm.
5. **Fulcrum:** It is the center of rotation of the dental movement and its localization varies depending on the line of force. The closer the force passes near the center of resistance the farther the fulcrum will be.
6. **Force magnitude or intensity:** It is the amount of force applied through the face bow.
7. **Resultant:** It is the sum of all the vectors that compose the force.
8. **Force duration:** The force can be continuous or intermittent. To correct a Class II, distalize molars and to open a deep bite, 18 to 20 hours of use per day will be necessary.[21]

The external arm can be short, medium or long.

- Short: The external arm is shorter than the internal one.
- Medium: The external arm has the same length as the internal arm, ending at the molar tube level.
- Long: The external arm is longer than the internal one.[21]

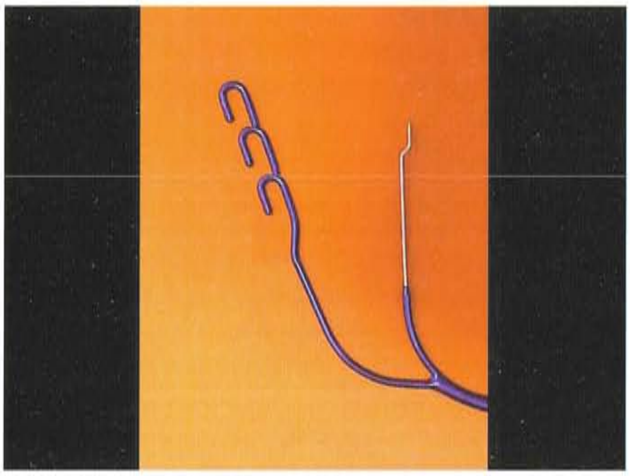


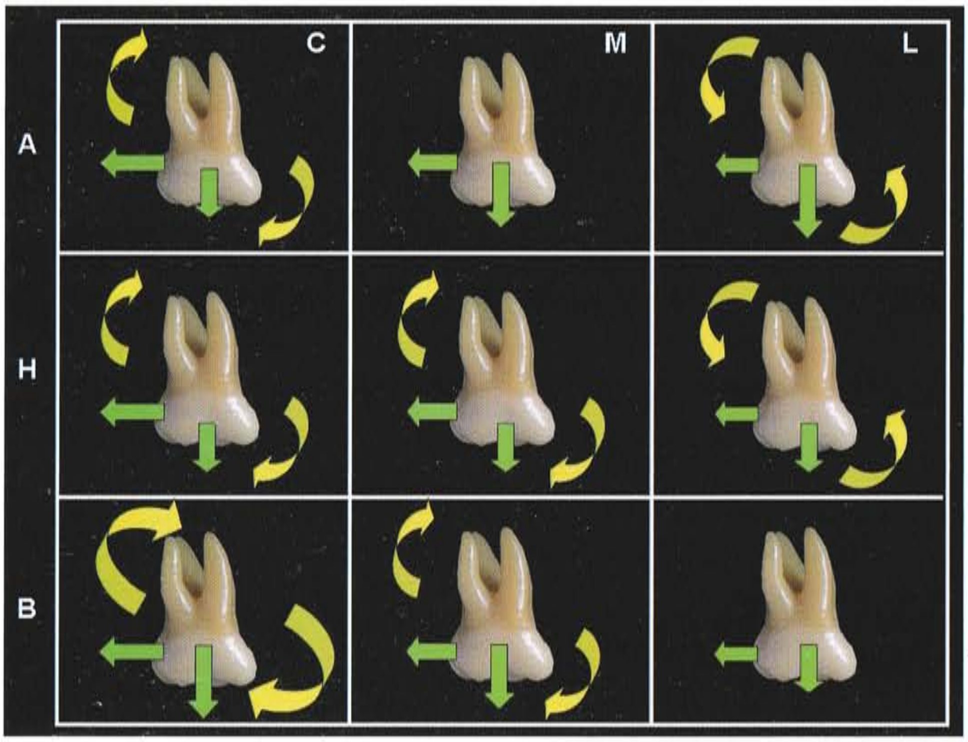
Fig. 79. Lengths of the external arm.

Asymmetrical cervical face bow

This type of force is used for unilateral traction or for asymmetrical force. There are two simple ways to obtain this force:

1. Bend the external arm away from the face of the patient on the side where is needed more force.
2. Another way to obtain an asymmetrical force is cutting a piece of wire of an external arm. This is sectioned at the first molar level. On the side that has been cut we will have less force, so the contra lateral side (the side that has not been cut) will exert almost triple the force compared to the side in which wire of the external arm was cut off.[17]

In order to make the force optimal, we must determine the length and angulation of the external arm, so the line of action of the force passes through the center of resistance of the molar. A molar inclination can accentuate the opening of a bite due to premature contact of the cusps.[21]



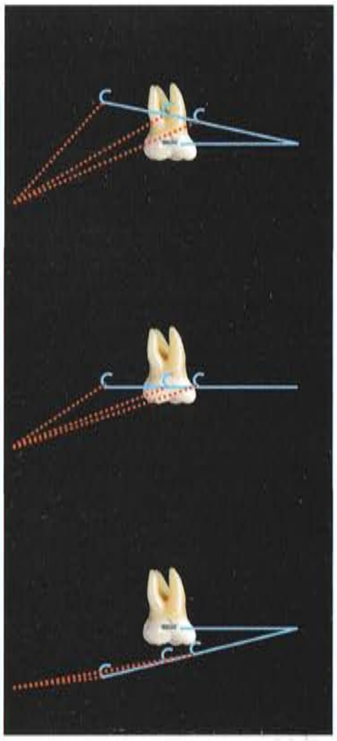
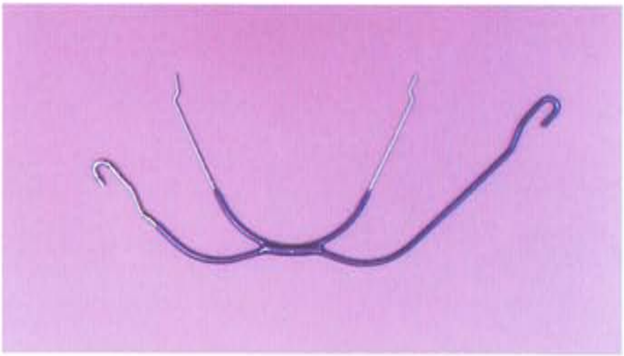
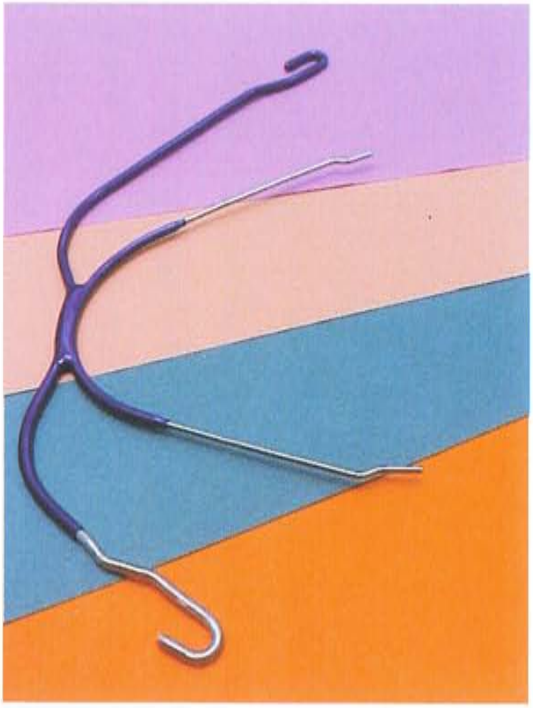


Fig. 80. Cervical traction. "C" short external arm; "M" medium external arm; "L" long external arm. "A" high angulation (30º); "H" horizontal angulation (0º); "B" low angulation (-30º).





Figs. 81 and 82. Asymmetrical cervical face bow.

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Open Bite

5

Esequiel Rodríguez, Rogelio Casasa, Adriana Natera, Elías Burguera

Introduction

Open Bite was described by Carabelli and he defined it as the malocclusion in which one or more teeth do not reach the occlusal plane and do not contact any of their antagonists. Open mouth responds to a lack of evident contact among upper and lower teeth that generally manifests at incisor level, but can be found in the posterior region, or a combination of both. It can appear since early age (three years of age) but is more common to find it between 8 and 10 years of age (mixed dentition period).[3,8,20]

The treatment of open bite must initiate as soon as possible to improve the possibilities of success, so that patients can benefit from early treatment, and this way we can maintain, restrict or redirect vertical growth.[26,27,30,37]

Etiology

Open bite comes from a series of etiological factors of both hereditary and non-hereditary origine that exert their action in the pre and post natal period over the structures that conform the stomatognathic apparatus. Open bites are mainly caused by an over eruption of the upper posterior teeth or by a vertical overgrowth of the posterior dentoalveolar complex, which results in a posterior rotation of the mandible.

Open bite etiology can be divided in Local and General.[2,32,37]

Local

Deglutition

In normal conditions, the tongue is placed on the palate. In abnormal deglutition the tongue is between the upper and lower incisors, in the posterior and the anterior segment, interrupting the muscular equilibrium among lips, cheeks and the tongue. An anomalous tongue position can develop into different types of malocclusions.[22,24,27,30]

There are two abnormal lingual positions:

- Type I lingual position:

In the type I lingual position, there is a Class III malocclusion with a flat and prominent tongue, in which the tongue is placed behind the incisors.

This type of anomaly is related to an anterior cross bite.

- Type II lingual position:

The tongue is flat and retracted.

It is observed in Class II patients due to mandibular retrusion.[25]

Suction

It is of special interest in the ethiopathogeny of open bite. Bound to the persistence of objects, fingers and lip suction that inhibits the growth of the alveolar processes. Non

Figs. 1 and 2.

nutritive sucking has a close relation with the seeking reflex that is present at birth. The indiscriminate use of a pacifier, feeding bottle and finger sucking can increase the chance of development of an open bite in the infant. This suction reflex disappears around the seventh month after birth.[30]

Breathing

Nasal obstruction and mouth breathing habit have been linked to this type of malocclusion, due to this obstruction,the patient beguines to breathe through the mouth so the patient must lower his tongue in order to let air pass through (mouth breathing habit) provoking a muscular unbalance between the tongue and the maxillary bones; the persistence of half open mouth stimulates the growth of the alveolar processes altering the craniofacial growth and provoking an open bite.

The etiology that initiates mouth breathing has many factors, like allergies, adenoid tissue, enlarged tonsils, chronic inflammation of the air ways, tumoral processes, nasal septum deviation, nasal polyps, nasal orifices narrowing, among others. [5,6,14,30,31,34]

Muscular hipotonicity

Teeth receive and support the mechanical loads of the muscles that maintain teeth in a vertical position in their osseous bases. Hypotonicity tends to stimulate molar over-eruption and to separate the maxillary bone bases.[30]

Dentition development

In certain children the eruption of permanent teeth is sometimes altered chronologically; this contributes to the lack of vertical contact. This results in a transitory open bite aggravated by the tongue interposition.[30]

General

- **Genetics.** The genetic influence in the development of bone and teeth is evident, this is why we can say there are hereditary malocclusions; the size, form of teeth and bone are inherited and this leads us to established morphologic patterns.[27,30]
- **Congenital defects.** There are congenital defects that can lead to an alteration of the growth of the maxilla and the mandible; palatine fissures, for example.[30]
- **Muscular alterations.** When our mouth is in repose, teeth do not occlude and lips are in contact producing a lip seal, that is necessary for swallowing and to avoid saliva leakage. In the absence of this seal, the tongue can produce an unbalance between the lips and the teeth producing a malocclusion. Lip and tongue morphology have influence on this, so does the muscle tone of the lips.[30]

Types of open bite

They can be classified as:

- **False or dental open bite.** In this bite the teeth are only proclined without any alteration of the osseous bases and do not extend beyond the canines. These patients have normal facial morphology, a correct bone relation, a pseudobite and dentoalveolar problems.[27,30]

- **True or skeletal open bite.** In this type of bite the alveolar processes are involved or deformed and dolichofacial characteristics are added to this.[4] These patients present hyperdivergency among the maxillas, they are generally dolichocephallic, and their lower facial third and vertical dimension are augmented.[27,30]

According to the zone where the open bite is located they are divided in:

1. Anterior open bite. Anterior open bites, from its etiological point of view, are divided in 2 categories:

- Dental.
- Skeletal.

The dental anterior open bite results from dental eruption impediment. Skeletal is due to posterior facial growth.

2. Posterior open bite.
3. Complete open bite.[28-31]

Clinical characteristics

Dental: We observe an anterior and/or posterior open bite, upper and lower proclination and protrusion, anterior diastemas, mouth dryness, lip incompetence and a "gummy" smile. Increased overbite, interdigited tongue, narrow dental arches, a diminution of the transverse diameter of the maxilla, a deep palate ("V" form), a prognathic premaxilla and gingivitis.[4,23,28,30]

Facial: These patients generally have a long, narrow and protrusive face (adenoid fascie), dark rings under the eyes, malar depression, a long vertical and protrusive nose, increased inferior facial third, clock wise growth, convex profile, mandibular rotation and an increase of the genial angle.[4,7,19]

The options that we will review in this chapter for anterior open bite closure will be the following:

- In block extrusion bend.
- Second order or individual extrusion bend.
- Use of an upper reverse curve and a lower curve.
- Individual by-pass.
- In block by-pass.
- Occlusal bend in the main arch wire (inverted tip back).
- Posterior bite block.
- Posterior intrusion block with TMA wires.
- High Pull (Parietal traction).
- TPA with a palatal plate on molars.
- Use of intermaxillary elastics.
- Gingival brace bonding.
- Tongue habit crib.
- Maxillary surgery.
- Glossectomy.

In block extrusion bend

These arches are made with TMA or stainless steel wire, they can be round (0.020"), square (0.016" x 0.016") or rectangular (0.017" x 0.025") and are utilized for anterior segment extrusion and posterior segment intrusion, and in this way, close or deepen the bite. They will have a 0.5 mm to 1 mm incisal step that will exert an extrusive force on the anterior teeth and an intrusive force on the posterior teeth.[17,21,37]

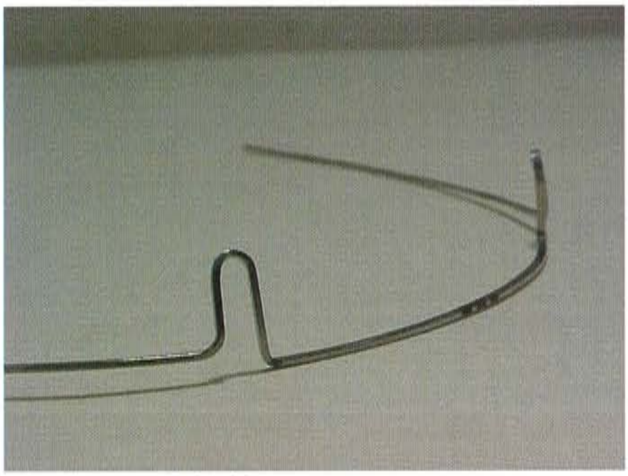


Fig. 3. Upper extrusion arch.

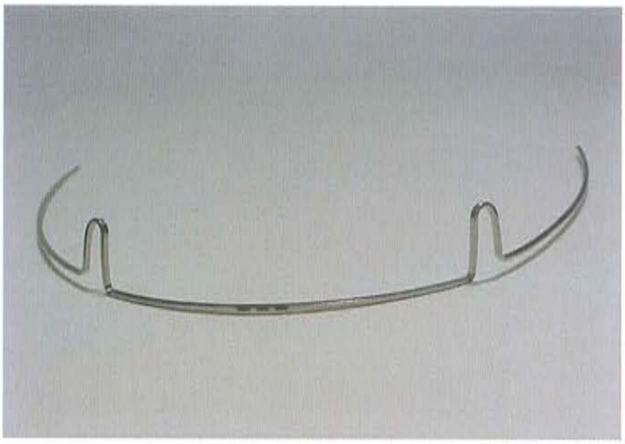


Fig. 4. Upper extrusion arch.

Figs. 5 and 6. Extrusion arch in mouth.

Advantages

1. We do not depend upon patient compliance for the extrusion movement.
2. The extrusion is fast.
3. There is control and stability in anterior teeth extrusion.
4. Making a double helix loop will produce less root resorption, because the arch wire will be more flexible and the force is reduced. (Please refer to Space Closure in Orthodontics chapter).

Disadvantages

1. It may cause pain to the patient.
2. The extrusive force can range from 800 g to 1000 g. (29)
3. Due to the excessive extrusion force root resorption may occur.
4. May cause gingival inflammation because of the loops.
5. Chair time increase.
6. If the bend is too marked and if it exerts too much force, we may debond the anterior braces.

Recommendations

1. Preferably, they should be placed after we finished the alignment and leveling treatment phase.
2. Place 0.5 mm to 1 mm increments to the extrusive step in order to avoid pain and root resorption.
3. After bite closure, leave the arch 2 to 4 months to stabilize and to lessen rebound.
4. The most recommended wire is the rectangular wire, because it controls torque better.
5. Lace with ligature (in a sectional manner) the anterior and posterior teeth.

Second order or individual extrusion bend

This bend can also be made on round or rectangular arch wire. These bends are designed for individual movements, not for in block movements. It is made with Tweed pliers or with intrusive and extrusive step

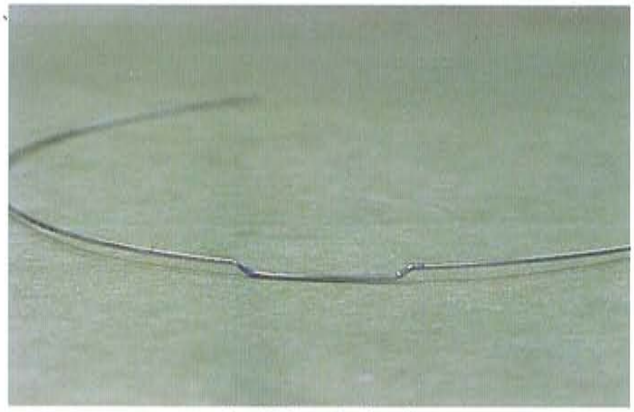


Fig. 7. Extrusion bend.

pliers of 0.5 mm or 1mm. The extrusive movement will take about 1 or 2 months.(17,21,37)

Advantages

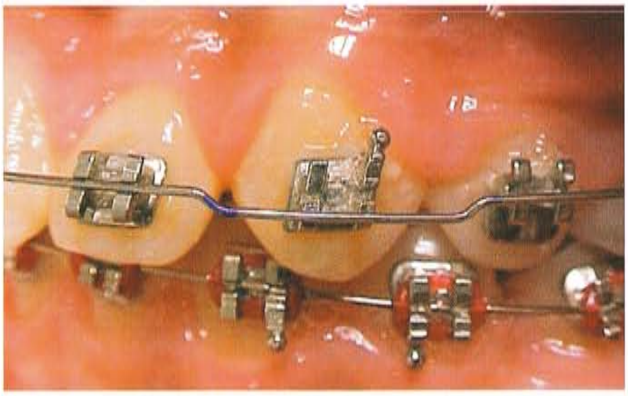
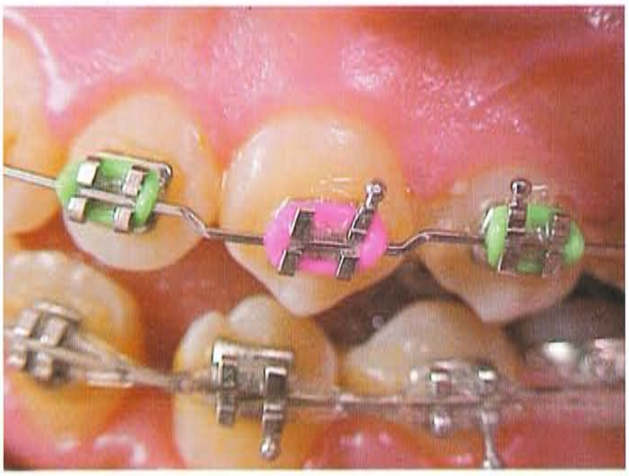


Fig. 8. Passive extrusion bend.

1. We do not depend upon patient compliance for the extrusion movement.
2. The extrusion is fast.
3. There is control and stability of the extrusion.

Disadvantages

1. It may cause pain.
2. The necessary extrusive force will be 30 g to 40 g for upper incisors and 20 g for lower incisors (please refer to the Ricketts charts in the Space Closure in Orthodontics chapter).
3. Gingival inflammation.
4. If the step is too marked and it exerts too much force, there is a risk of bedonding the brace that is on the tooth being extruded.
5. The horizontal movement of the extruded tooth is now limited.
6. After the tooth extrusion, all the subsequential arches must have this bend or we should reposition the brace in order to place a straight wire and perform horizontal movements if needed.



Figs. 9 and 10. Active extrusion bend.

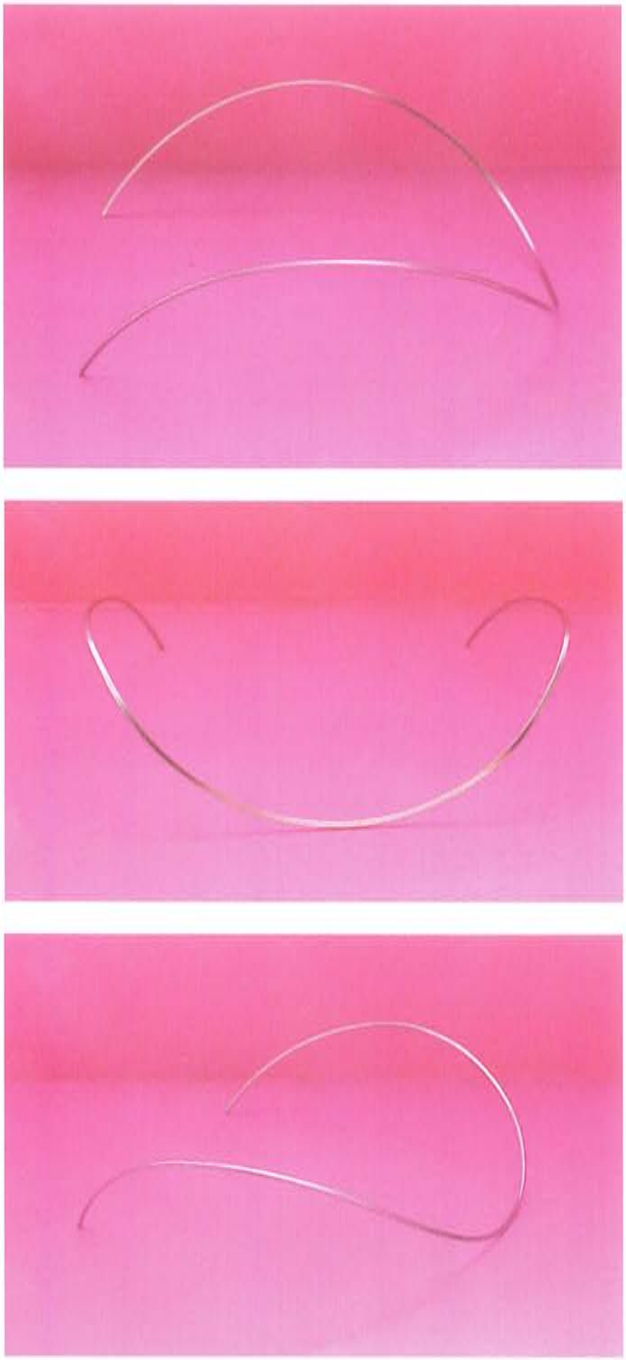
Recommendations

1. It should be placed after we finished the alignment and leveling treatment phase
2. Place 0.5 mm to 1 mm increments to the extrusive step to avoid pain and root resorption.
3. Leave the arch with the bend 2 to 4 months to stabilize and to lessen rebound.
4. We recommend a fixed retainer on the tooth where the bend was made.

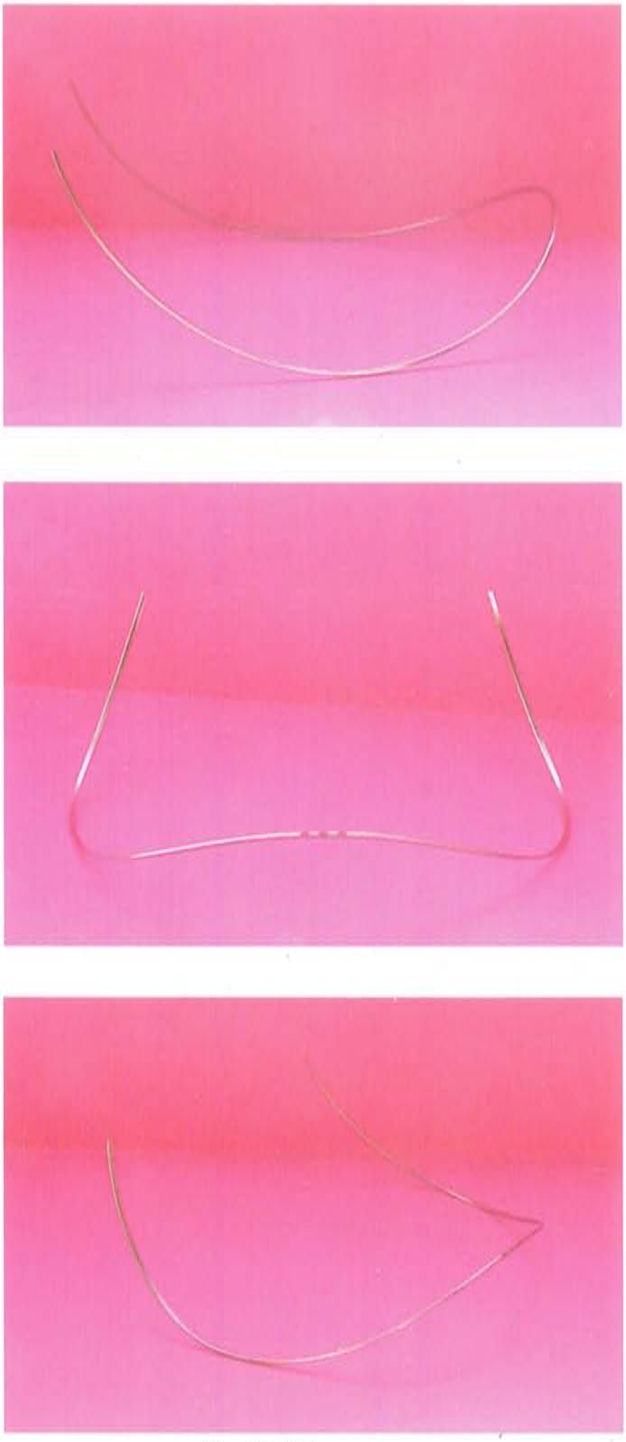
Use of an upper reverse curve and a lower curve

This type of wire is very useful for space closure in the anterior segment. We just have to place a reverse curve on the upper maxilla and in the lower maxilla we place a curved wire. This will provoke an extrusion and a palatal movement of the upper and lower incisors.(15,21,30,37)

We generally use round 0.020"or 0.017"x 0.025" rectangular wire NiTi or TMA.



Figs. 11-13. Upper reverse curve.



Figs. 14-16. Lower curve.

Advantages

1. The bite closes rapidly because the wires have a continuous force between 300 g to 400 g on the lower incisors.[29]
2. We do not depend on patient compliance.
3. The bite closes 1 mm per month approximately.
4. The extrusion is slow, so the patient does not feel pain.

Disadvantages

1. The anterior segment is not stable.
2. Unwanted distal inclination of the molars.
3. Possible TMJ alterations due to molar contact points.

Recommendations

1. Use box or delta elastics in the posterior segment to avoid further deepening of the Spee curve.
2. Place a lingual arch to avoid molar inclination.
3. We can help ourselves with anterior box elastics to accelerate the closure of the open bite.
4. Bond the braces 0.5 mm closer to the gingival margin.

Individual bypass

This form of extrusion is very fast and simple. We just place a brace or button to the tooth that we want to extrude and pass over an "elastic" wire (NITi or TMA). This will provoke the extrusion of the tooth.[30,37]

Fig. 17. Bypass on canine.

Fig. 18. Seven days later.

Fig. 19. Fifteen days later

Fig. 20. Bypass on canine.

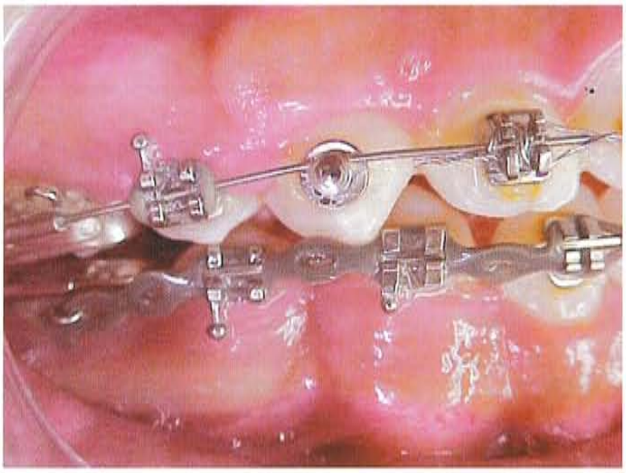


Fig. 21. Fifteen days later.

Advantages

1. The bypass provokes an immediate extrusive movement.
2. It provides 2 mm of extrusive movement per month.
3. We do not depend upon patient compliance.

Disadvantages

1. There is no tip or torque control of the tooth.
2. Teeth with extrusive bypass tend to incline lingually.
3. The movement provokes periodontal inflammation and pain.

Recommendations

1. Make the bypass with "elastic" arches like NiTi or TMA.
2. The diameter or the arches can range from 0.012" to 0.020".
3. After the dental extrusion, we must apply tip and torque to the tooth.
4. Lace with ligature the teeth adjacent to the bypass.
5. After the tooth extrusion, all the subsequential arches must have this bend or we should reposition the brace in order to place a straight wire and perform horizontal movements if needed.

In block bypass

This is another way to extrude teeth and to close bites. It is very similar to the individual bypass; the difference is that this technique is done to a group of teeth. We can use sectional round or rectangular wires in the zone to be extruded (placed in the slot of the braces) and the bypass of NiTi or TMA with a diameter of 0.016" to 0.020" is placed above the braces.[30,37]

Figs. 24 and 25. In block bypass.

Advantages

1. The bypass provokes an immediate extrusive movement.
2. The extrusive movement is of 1 mm to 2 mm per month.
3. We do not depend upon patient compliance.

Figs. 22 and 23. In block bypass.

Disadvantages

1. It provokes periodontal inflammation and dental pain.
2. If the placement of main arches after the extrusion is necessary, all must have an incisal bend or we must reposition the braces.
3. The placement of "elastic" arches would be difficult after the extrusion movement.

Recommendations

1. We must apply this bypass in the last phase of treatment.
2. We must leave the bypass in place for at least three months.
3. We can help ourselves with anterior box elastics in order to accelerate the bite closure.
4. Lace the teeth adjacent to the bypass in order to avoid its proclinement.

Inverted tip back

This is done by placing two 45° bends at the ends of the arch wire. These bends are introduced in the tubes of the molars, provoking rotation in the posterior segment and extrusion in the anterior segment.

At the moment of introduction of the wire in the molar tubes (passive arch), the wire will move incisaly; we must then place the arch in the slots, and then the extrusion of the anterior segment will begin (active arch). The diameter of the stainless steel wire can range between 0.016" to 0.020".[21,37]

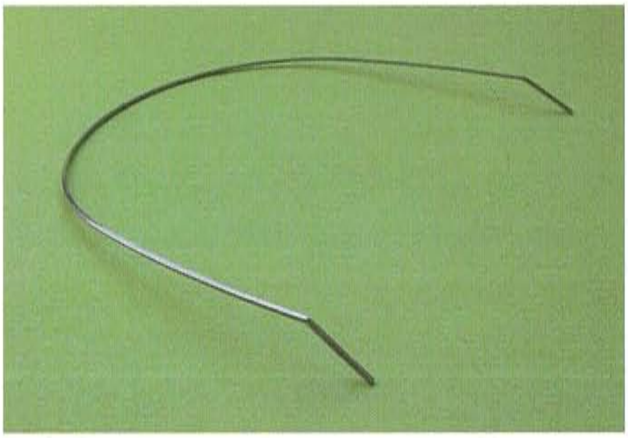


Fig. 26. Upper arch with bends toward the occlusal aspect of the tooth.

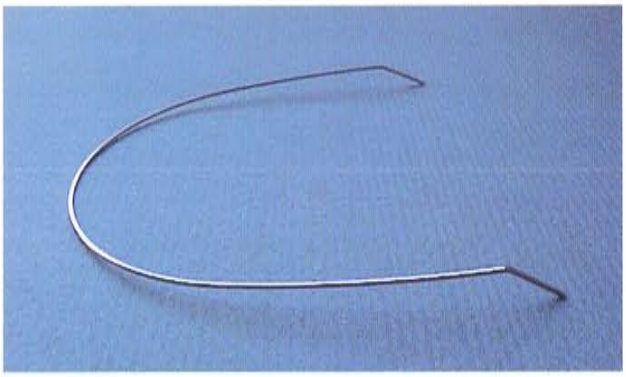


Fig. 27. Upper arch with bends toward the occlusal aspect of the tooth.

Fig. 28. Passive arch.

Fig. 29. Active arch.

Advantages

1. We do not depend on patient compliance.
2. The movements are light.
3. Easy to make.
4. Good patient acceptance.
5. It produces 1 mm to 1.5 mm of extrusive movement per month.

Disadvantages

1. It provokes an undesired molar tip that can produce premature contact points.
2. Possible TMJ alterations due to the molar contact points.

Recommendations

1. Keep this movement until the teeth are aligned.
2. Anchor the molars to avoid undesired tip.
3. In case of TMJ alterations, immediately remove the arch wire.

Posterior bite block

One of the functions of bite blocks is the intrusion of the posterior segment which provokes a mandibular autorotation that successfully closes open bites. Among orthodontic movements, intrusion is one of the most violent and painful, due to the compression of the apical nerves and blood vessels upon alveolar bone.[9]

These blocks can be place in the upper and lower dental arches, and they can be fixed or removable.We generally make them with acrylic and they must not cover the posterior braces. The ideal period for placement is around 9 -12 years of age, when the second permanent molar has not completed its eruption; this does not mean that it can not be used after this age, but it is the period in which can obtain the best results.

In case there are no fixed appliances, we can extend the acrylic to the buccal aspects of bicuspids and molars; it can be combined with a rapid maxillary expander (RME). It must be used 24 hours a day for 6 to 8 months.[10,11]

Fig. 31. Lower bite block.

Fig. 32. Upper bite block.

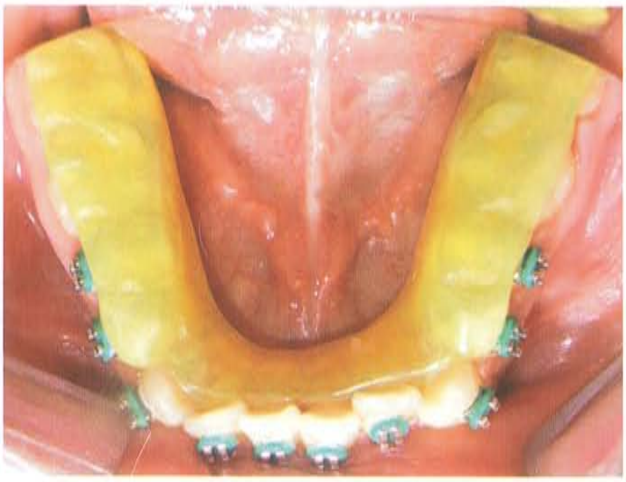


Fig. 30. Lower bite block.

Fig. 33. Bite block with a Hyrax.

A way to substitute the acrylic block is to use resin on the occlusal aspects of the molars. We use Block Out resin, of Ultradent. This way, the laboratory procedure is eliminated and food entrapment will be lessened.

Figs. 34 and 35. Block Out bonded to the permanent molars.

Advantages

1. This appliance is easy to make and to place.
2. It is economic.
3. It intrudes 0.25 mm to 0.5 mm per month.
4. In case it is fixed, we do not depend upon patient compliance.
5. The molar and premolar intrusion will be in block. It is very important that the acrylic touches all the antagonist teeth.
6. In case it is removable the patient will be able to clean it and tolerate it more.

Disadvantages

1. Acrylics retain too much food, so it can be unhygienic and produce a foul smell.
2. The block may fracture due to occlusal forces.
3. We depend on patient compliance if the appliance is removable.
4. The placement of the block creates an anterior open bite that can be uncomfortable to the patient.

Recommendations

1. If necessary do some stripping in the segment to be intruded.
2. If the block is fixed, take it off every two months to clean it and adjust it.
3. The acrylic must occlude with the antagonist teeth, so we must wear off the acrylic until all the antagonist teeth make total contact with the acrylic.
4. The recommended thickness for the posterior bite block is 1 mm to 2 mm; we must not forget that we will provoke an anterior open bite of +3mm due to the scissor effect.
5. We must take the bite block off immediately if the patient refers pain in the TMJ.
6. In case the second molar has not erupted totally, we must allow its eruption till it reaches the first molar level. If the bite block is made in this moment, we must isolate the occlusal aspect of the erupting second molar with wax and make the appliance over this. This may be inconvenient due to the accumulation of food, so we must reinforce hygiene.

Posterior intrusion block with TMA wire

Another way to intrude posterior teeth and to provoke a mandible autorotation is placing a posterior intrusion block with TMA wire. This appliance consists in a Hawley plate with Adams hooks for retention and two posterior intrusive occlusal tracks which are joined to helicoidal 0.032" TMA springs on each side (left and right). The tracks must be made out of high resistance acrylic in order to tolerate the forces of occlusion; the Hawley plate must cover the lingual aspects of the lower teeth to prevent overeruption or unwanted lingual movements. Sometimes we prefer to place buccal shields in the anterior and posterior segments for improved retention and to lessen undesired movements of the Hawley plate.

The helicoidal springs must be progressively activated to maintain continuous pressure on the mandibular neuromuscular system.[10,11,27]

This block stimulates upper molar intrusion with continuous use; this type of intrusion is less likely to rebound compared to anterior bite closure. For this appliance, in order to function correctly, certain steps must be taken.

Indications: preferably in patients with an anterior open bite of no more than 6 mm. The best age for the use of this appliance is between 9 and 12 years of age.

Counter indications: patients with a diminished lower facial third, and skeletal open bites.

Use: as many hours as possible night and day. The appliance is placed in the mouth, activated, and the degree of aperture must be measured at the moment of installment. In two or three weeks the first changes must be observable, we can obtain 10 mm of closure on the anterior region, depending on the age of the patient and the problem that caused the open bite. The best effects are obtained in young patients with open bites due to mouth breathing or sucking habits once the causing agent is eliminated.

Fig. 38. TMA right helicoid.

Fig. 36. Passive block

Fig. 39. Bi helicoids.

Fig. 37. Active block.

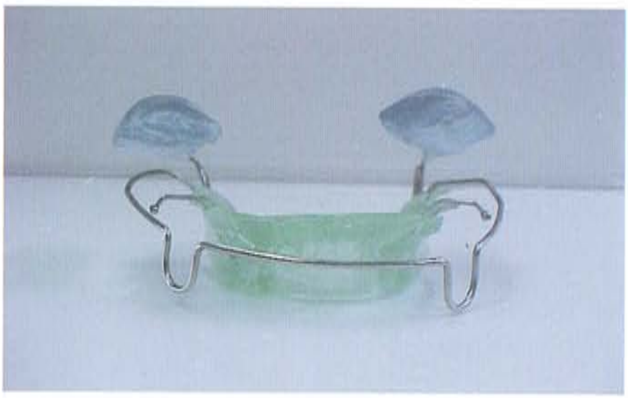


Fig. 40. Front view.

Fig. 41. Occlusal view.

Fig.42. Occlusal view.

Fig.44. Block with open mouth.

Advantages

1. It is economic.
2. The intrusive movement is less violent due to the helicoidal springs.
3. Less root resorption due to the flexibility of the TMA wire.

Fig. 43. Block with closed mouth.

4. Patients with this appliance do not report pain.
5. The intrusion of molars and premolars will be in block. This is why the acrylic must contact all the antagonist teeth that are going to be intruded.

Disadvantages

1. The acrylic retains food particles, so it may have a foul smell if it is not kept clean.
2. The TMA wires and the block may separate if it fractures due to occlusal forces.
3. We depend upon patient cooperation.
4. Installing this appliance will create an anterior open bite.

Recommendations

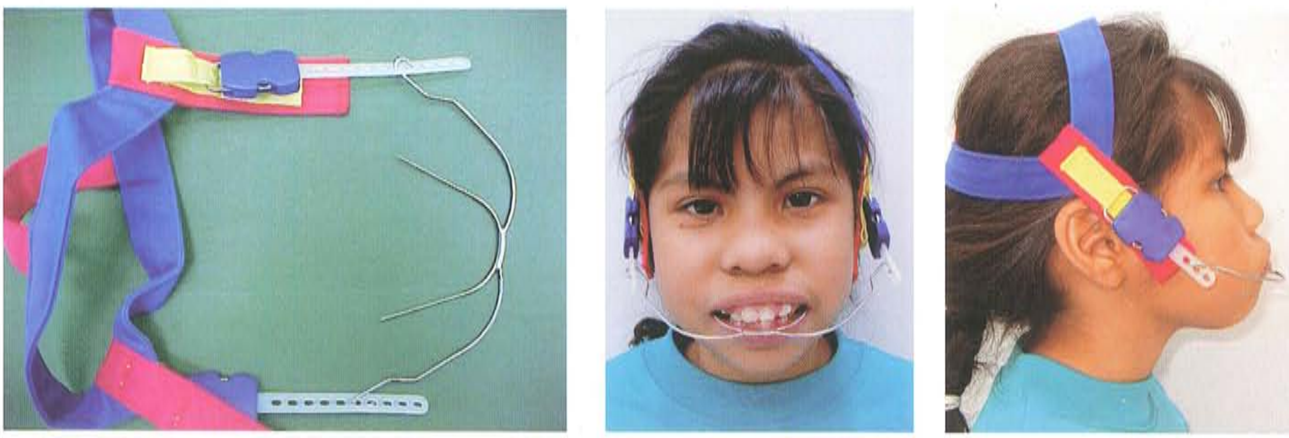
1. If necessary, do some stripping in the segment to be intruded.
2. The tracks must occlude with the antagonist teeth.
3. The recommended thickness for the posterior bite block is 1 mm to 2 mm; we must not forget that we will provoke an anterior open bite of +3 mm due to the scissor effect.
4. Activate the helicoidal springs every two months with a bird beak plier.
5. In case of TMJ alterations, immediately remove the appliance.

High Pull

Extra oral arches are appliances that are generally used as distalizers, to intrude molars or to redirect maxillary growth, depending on the vector produced by the position of the pads.

The high pull is anchored in two additaments, one extra oral (high pull cap) and an extra oral (molar bands with double or triple tubes). This force system will benefit Class II patients with long faces, with high mandibular plane angle (hyperdivergent), where the upper molar intrusion will diminish the facial height, improve the profile and close the bite allowing a mandibular rotation and maximizing the expression of the horizontal component of mandibular growth (Tweed -1966).[31,35,37]

A high or parietal traction force, as vertical as possible, will have a molar intrusive action, that added to the anterior teeth extrusion will provoke the closure of the anterior bite. While an orthopedic force directed over the center of resistance of the maxilla is applied (upper portion of the pterygomaxillary fossa), the palatal plane will incline, the mandible will rotate in a counterclockwise manner favoring the correction of the anterior open bite.[36]



Figs. 45-47. High Pull.

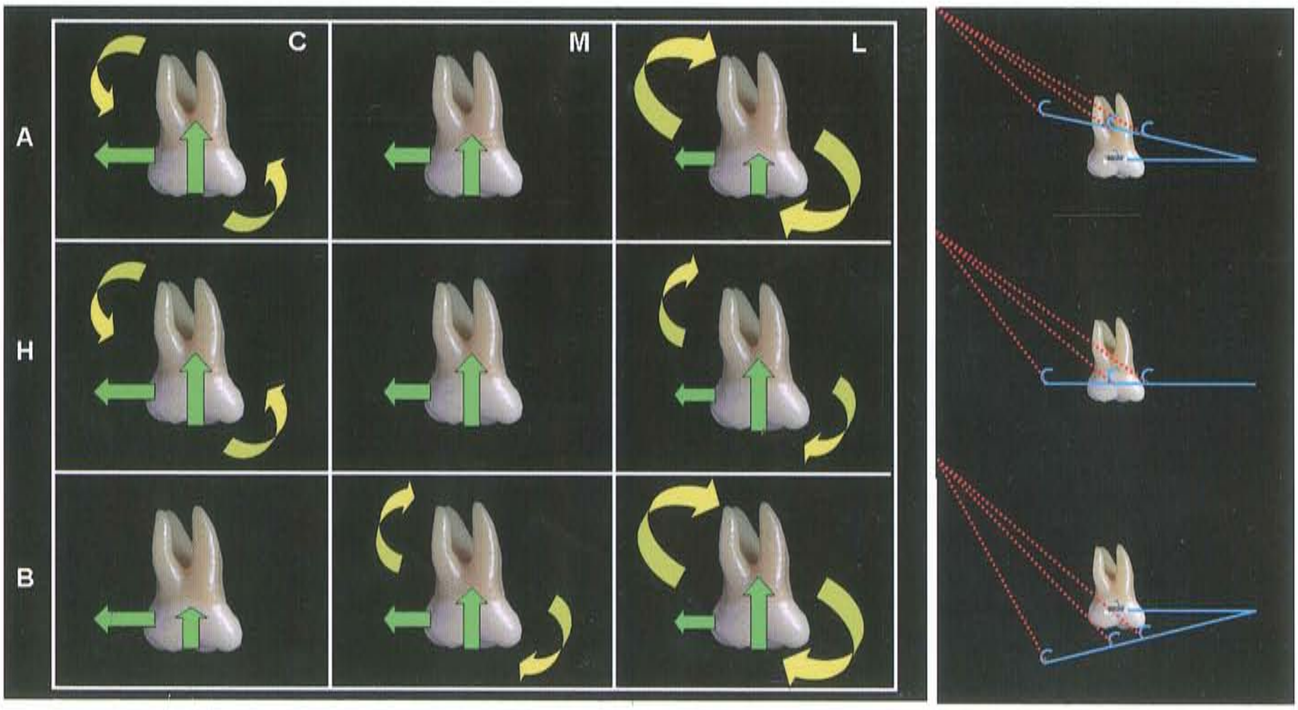


Fig. 48. Parietal traction. "C"" short external arm; "M" medium external arm; "L" long external arm. "A" high angulation (30°); "H" horizontal angulation (0°); "B" low angulation (-30°).

Depending upon the length of the external arm and its angulation we will obtain a certain movement in the upper molars (please refer to Deep Dite, chapter 4).[37]

Advantages

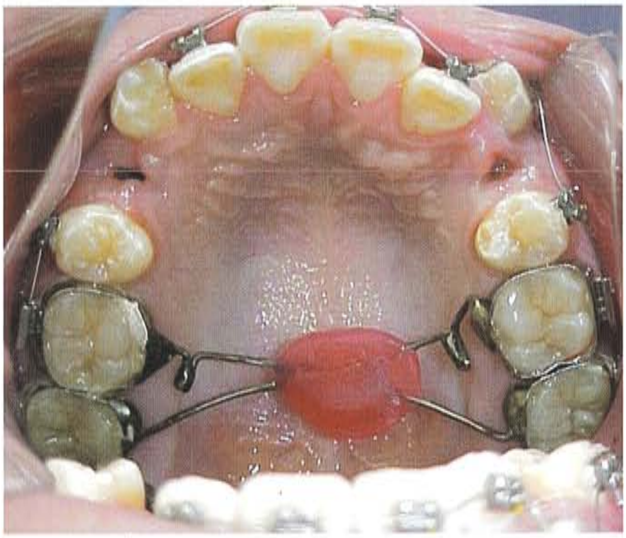
1. It is an excellent growth redirector.
2. One can "play" with the forces, depending on the length of the arms of the face bow.
3. It is a multipurpose appliance; it can distalize, redirect growth, intrude and extrude molars and can be used as moderate anchorage.

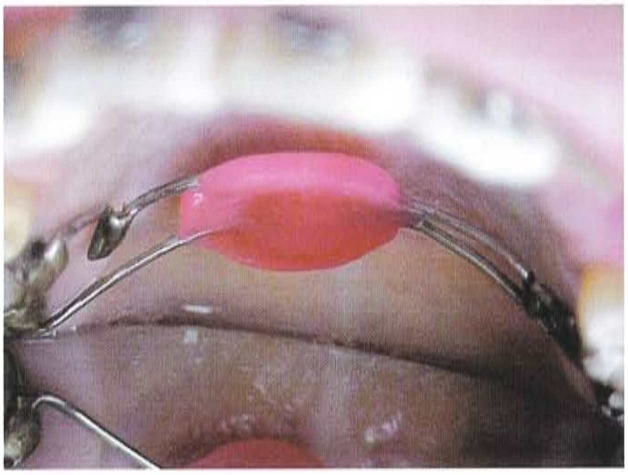
Disadvantages

1. We depend 100% on patient compliance.
2. The appearance of the face bow is not very pleasing.
3. It might irritate the corners of the mouth.

Recommendations

1. It must be used at least 16 hours daily.
2. Pass the line of force over the center of resistance of the maxilla (4 mm over the apexes of the roots of the first molar).
3. For the younger the patient, the easier the molar intrusion will be.





Figs. 49 and 50. Chromosome arch with an intrusion disc. The disc must be separated two millimeters from the palatine vault.

TPA or Chromosome Arch with a disc on molars

Another way to intrude molar and to close an anterior open bite is placing a TPA or a chromosome arch with an intrusion disc. The tongue will lean on the disc while passing saliva or swallowing food, intruding the molars. The intrusive force is approximately 80 g. This disc must be 2 mm to 3 mm separated from the palatal vault so the intrusive forces do not impinge the disc. This TPA can be single or double, depending on how many molars we want to intrude.[1,16,21]

Advantages

1. It is economic and easy to do.
2. We do not depend upon patient compliance.
3. The patient does not refer pain or discomfort.
4. It is a double purpose appliance, because we can use it for molar intrusion and at the same time as moderate anchorage.

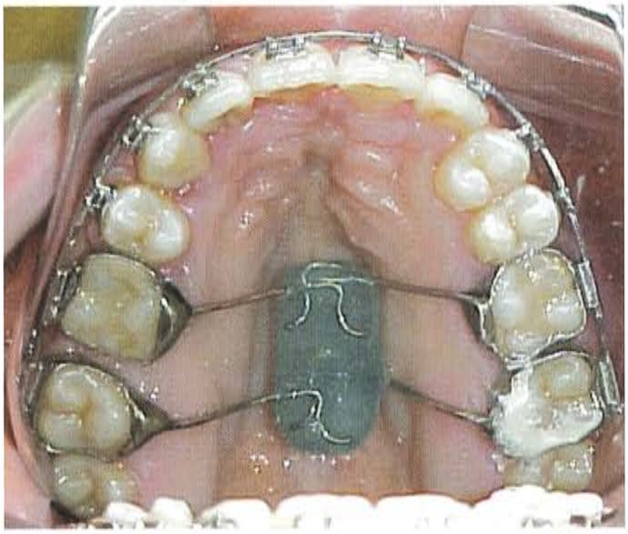


Fig. 51. Double TPA.

Fig. 52. Simple TPA.

Fig. 53. Anterior open bite.

Disadvantages

1. The acrylic plate retains too much food, so it can be unhygienic and produce a foul smell.
2. It can ulcer the tongue.
3. Molar intrusion is slow (1mm in two or three months).
4. If we do not cement it correctly, we can impinge the acrylic disc.

Recommendations

1. Cement the appliance 2 mm to 3 mm separated from the palatal vault.
2. It can be combined with a tongue thrust appliance to aid the closure of the bite.
3. The acrylic disc must be 2 mm thick.
4. The omega of the TPA must be mesially oriented.
5. The appliance must be used at least 9 months.
6. In case the patient reports tongue ulcerations, take the appliance off and prescribe pain killers.

Use of intermaxillary elastics

These elastics are used for bite closure, occlusion detailing etc. This type of elastic must be worn 24 hours a day and must be replaced every 12 hours due to memory and elasticity. The force can vary from 2 to 6.5 ounces (1 ounce=28.35 g) and they can be placed in many configurations (box, trapezoid, delta, spaghetti, etc.). It all depends on the required vector. The size of the elastic can vary from 1/8" to 5/16". [18,21,30]

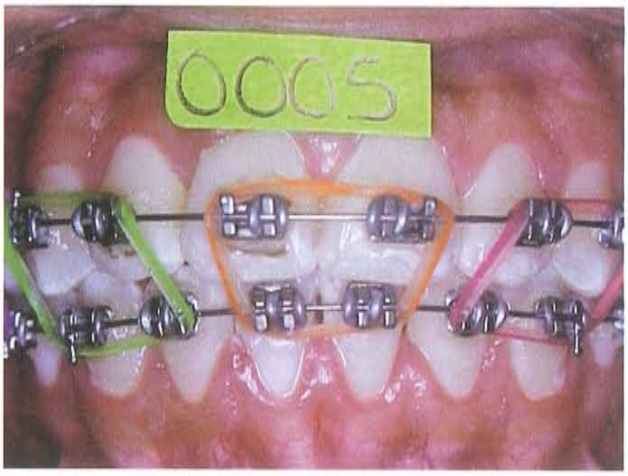


Fig. 54. Two months after elastic use.

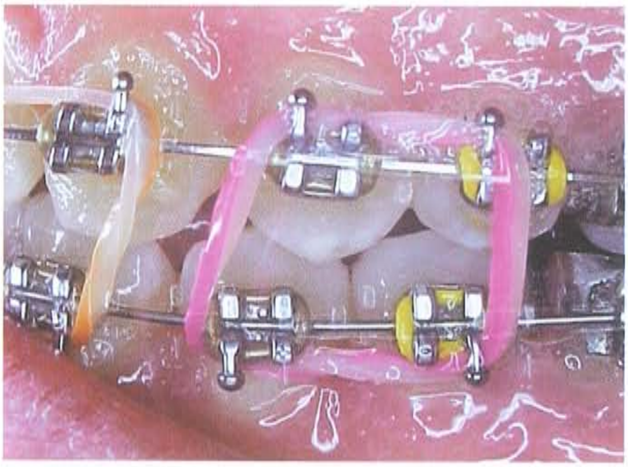


Fig. 55. Posterior box elastics.

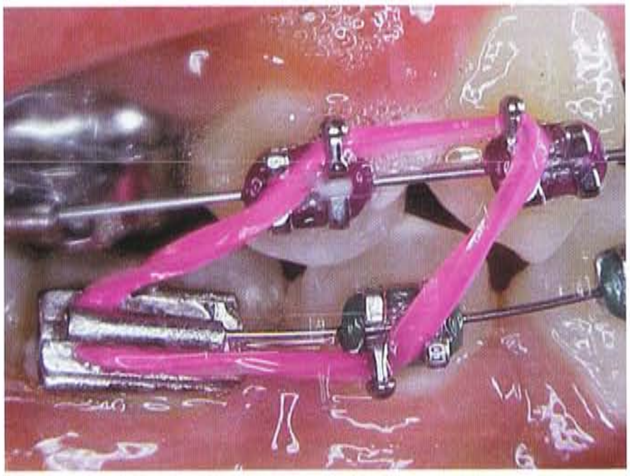


Fig. 56. Posterior box elastics.

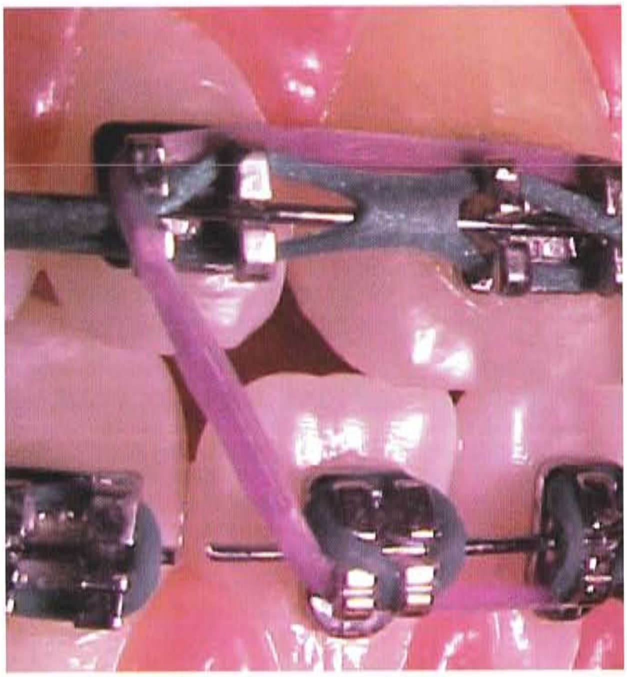
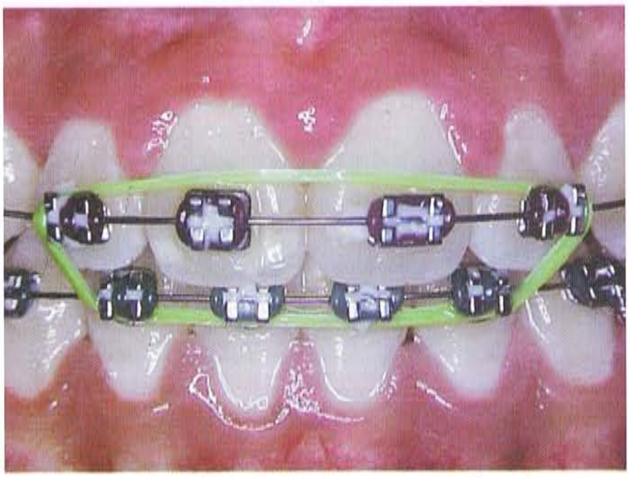
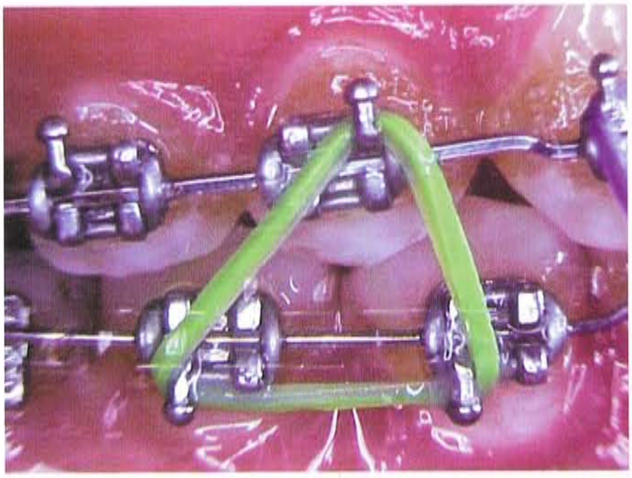
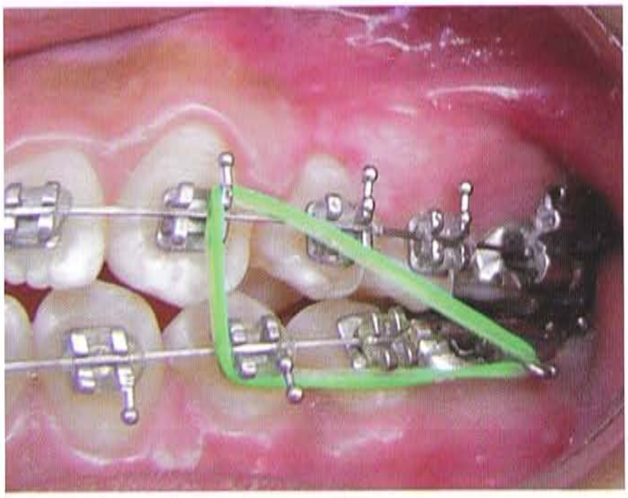


Fig. 59. Sectioned lower arch.



Figs. 57 and 58. Anterior box elastics.





Figs. 60 and 61. Delta elastics.

Figs. 62 and 63. Finalizing elastics.

Advantages

1. The bite closes rapidly.
2. The bite closes 1 mm per month.
3. They are hygienic because they are replaced every 24 hours.
4. We can combine different diameters and different forces.

Disadvantages

1. We depend 100 % upon patient compliance.
2. We can provoke dental pain if we do not choose the right elastic diameter.
3. Possible TMJ discomfort due to prolonged use of the elastics.
4. The elastics can fatigue and lose their elasticity.

Recommendations

1. To close an anterior open bite with intermaxillary elastics we recommend the use of rectangular wires (0.017" x 0.025").
2. To close a posterior open bite with intermaxillary elastics we recommend the use of round elastic wires (0.016").
3. We recommend sectioning the wires in order to close the bite faster. This will depend on the type of smile of the patient, for example, in case the patient has a gummy smile, we should section the lower arch.
4. The elastics must be changed every 12 hours.
5. If the patient refers pain in the TMJ, we must suspend the use of the elastics.

Brace bonding closer to the gingival margin

Bonding the anterior braces 0.5 mm or 1 mm closer to the gingival margin (central 4.5 mm or 5 mm and the lateral 4 mm or 4.5 mm) and the posterior braces near the occclusal aspect of the tooth, will aid us in the closure of the anterior bite, because there will be an anterior extrusion and a posterior intrusion.[21,30]

Fig. 64. Braces bonded gingivally.

Advantages

1. We do not depend upon patient compliance.
2. We can close the bite with round wires if we wish.
3. The braces are closer to the center of resistance, so there is more control over the tooth.

Disadvantages

1. Palatal or lingual movement of the anterior teeth.
2. Loss of positive torque of the anterior teeth.
3. Detailing the case becomes difficult.

Recommendations

1. Place anterior intermaxillary elastics to accelerate the bite closure.
2. Place positive torque on the anterior teeth at the end of the treatment.
3. Lace the posterior teeth as anchorage.
4. Place delta elastics (upper canine-lower canine-lower premolar) as anchorage.
5. The patient must have good periodontal health, or the cementoenamel junction of the teeth will be exposed.

Tongue habit crib

Normally the tongue is placed on the palate. In an anomalous swallowing pattern the tongue is positioned between the upper and lower incisors, in the anterior and posterior segments, provoking a disruption of the muscular harmony among the lips, cheeks and the tongue.[30,31]

Sometimes the open bite corrects spontaneously after the habit that caused it during the early mixed dentition is gone, and only if its etiology was linked to a tongue thrusting habit.

Fig. 65. Anterior open bite.

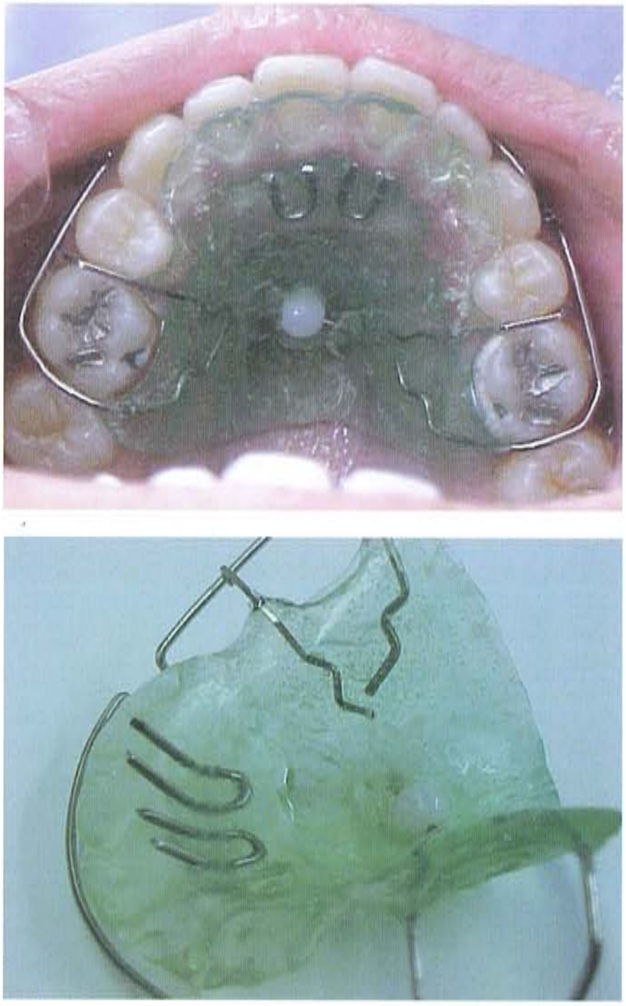
One of the ways to eradicate this bad habit is to place tongue cribs or distractors. These can be fixed, removable, upper, lower, with additaments like acrylic rolls, blue grass, rakes, elastics, etc. (please refer to Habits, chapter 8).

Fig. 66. Lingual trap.

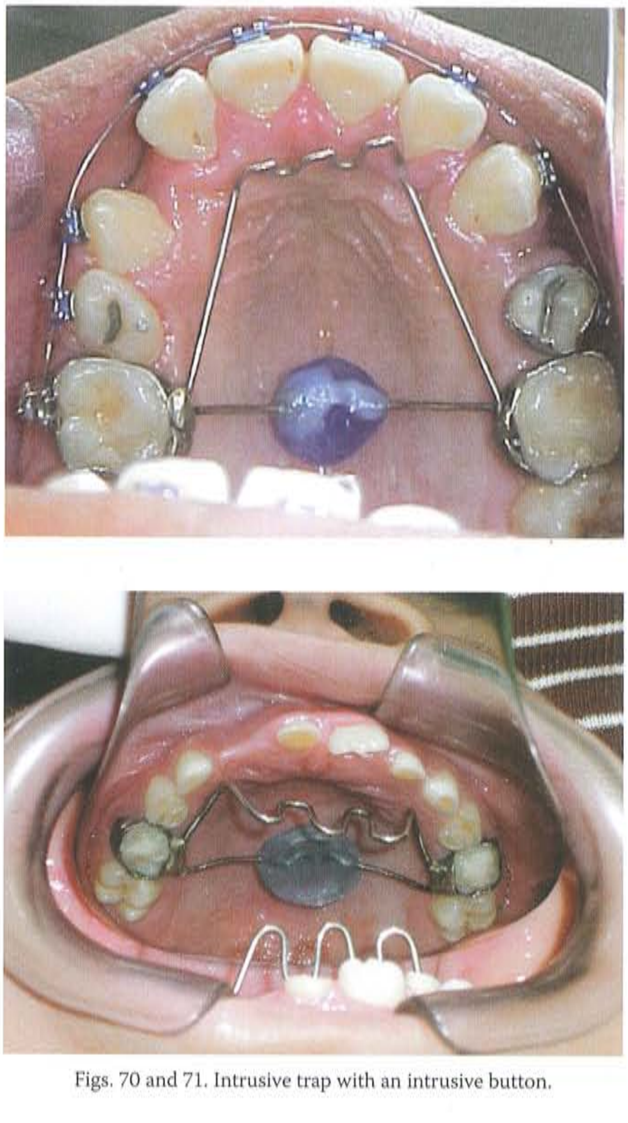
Fig. 67. Eight months later.

Fig. 68. Fixed lingual trap.

Fig. 69. Removable lingual trap.



Figs. 72 and 73. Trap (rake) with a Tucat pearl or blue grass.



Figs. 70 and 71. Intrusive trap with an intrusive button.

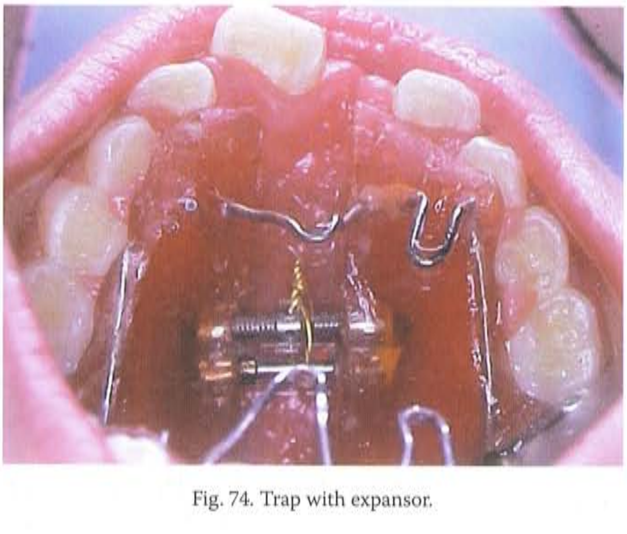


Fig. 74. Trap with expansor.

Advantages

1. It eliminates the tongue habit.
2. Reeducates tongue position.

Disadvantages

1. Speech is momentarily impaired.
2. Possible impingement of the crib in the palatine mucosa.
3. The tongue can ulcer due to constant friction with the crib.

Recommendations

1. Tongue traps must be worn 24 hours a day for a minimum of 6 months.
2. Never place a trap or a crib on patients with respiratory problems (adenoid hypertrophy or tonsils) or mouth breathers.
3. In case the trap is on the upper maxilla, be careful not to damage the lower mucosa when the patient occludes.

Maxillar surgery

When the open bite is of skeletal origin, one of our options is to take the patient to the operating room. A Lefort I type surgery is preformed in the upper maxilla in which the maxilla is impacted and as a result the mandible autorotates. In these cases, we must take into account the facial height, the length of the lower facial third, the amount of gum exposure, the amount of millimeters of the open bite, among other characteristics. Segmentary surgeries (anterior or posterior) can be combined with this surgery.[13,27,31]

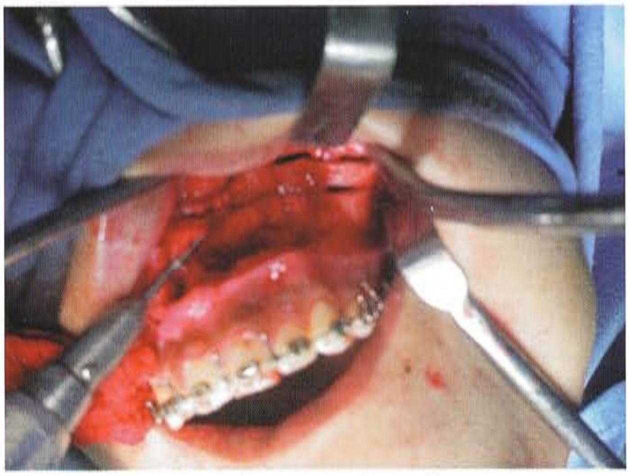


Fig. 75. Incisions on the maxilla.


Fig. 76. The maxilla is loose.

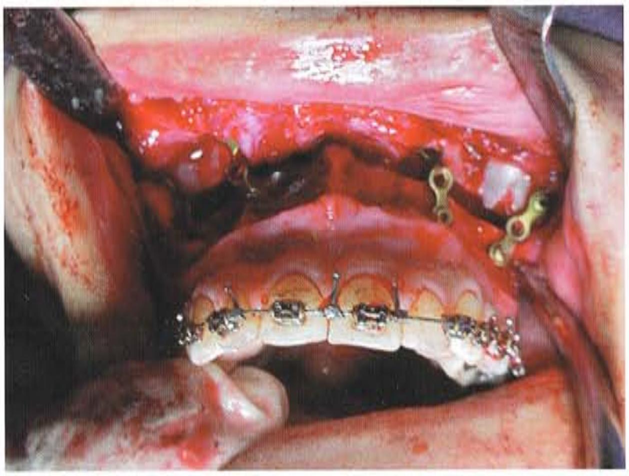


Fig. 77. Impact and fixation of the maxilla.

Advantages

1. The bite is closed in a few hours.
2. We do not depend upon patient compliance.
3. The lower third of the face is diminished.
4. An important facial change.

Disadvantages

1. Surgical risk.
2. Post operative recovery.
3. The treatment time increases (pre-surgical orthodontics, post-surgical orthodontics and retention).

Recommendations

1. Make the diagnosis with a maxillofacial surgeon.
2. Make study models of the patient every 6 months during pre-surgical orthodontics.
3. Decompensate the patient.
4. Place heavy arches on the patient before surgery (0.017" x 0.025" minimal).
5. Place surgical hooks on the arch wire.
6. Have an excellent work relation with the maxillofacial surgeon.

Glossectomy

The tongue is a muscle that intervenes in the chewing process, swallowing, speech and tasting. Its anterior two thirds are located in the mouth and the posterior third in the pharynx.

Macroglossia is an increment of the volume of the tongue that provokes a functional and cosmetic problem. Practically swallowing is not altered but chewing is difficult.[12,33]

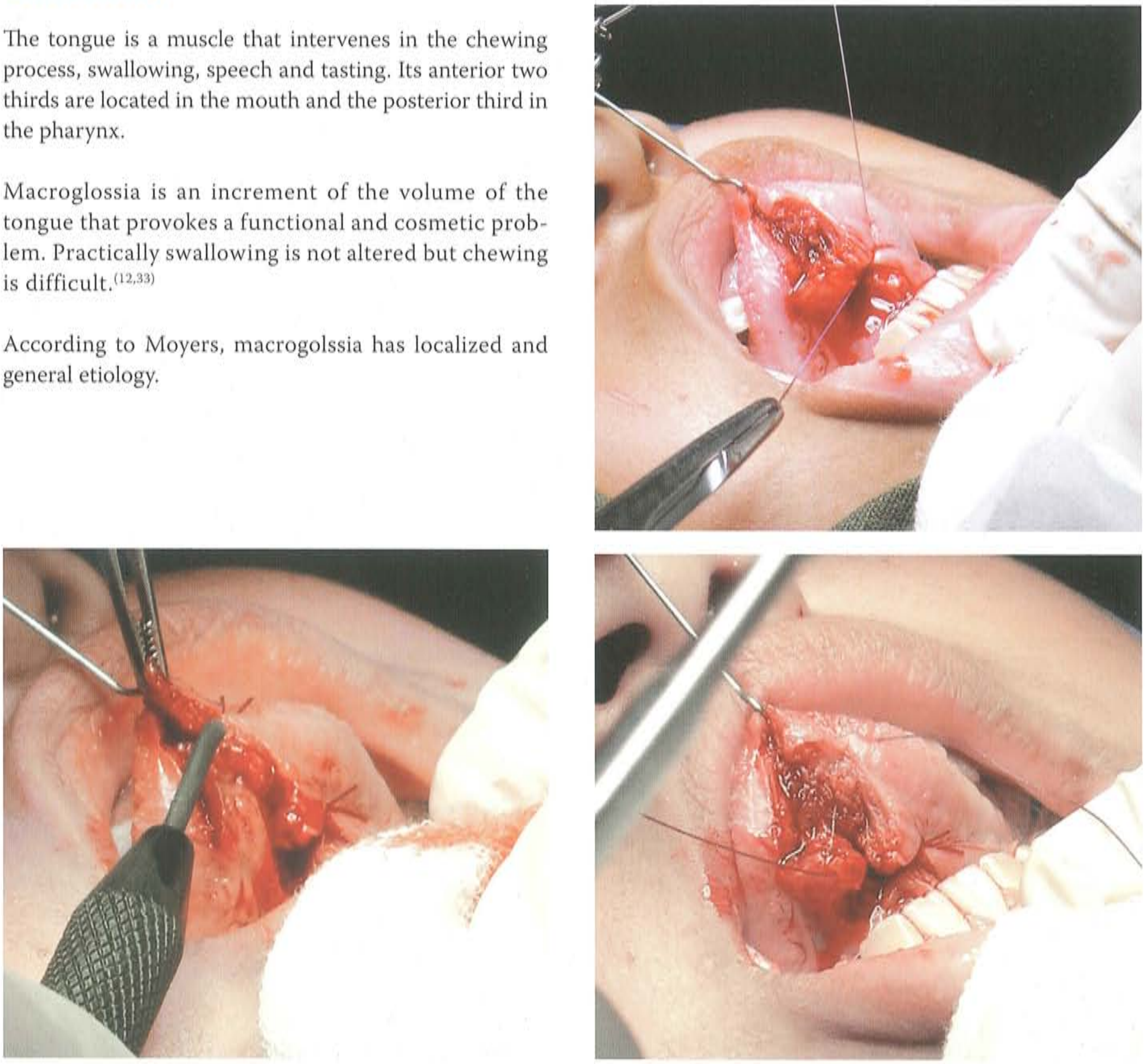
According to Moyers, macrogolssia has localized and general etiology.

Localized:

1. Congenital: Hemangioma, lymphangioma.
2. Imflamatory : Tuberculosis, actinomycosis, subgingival calculus, syphilis, ranula.
3. Traumatic: Irritation, post-operatory edema.
4. Neoplasic: Gland cell tumors, lipoma, leiomyoma

General:

1. Congenital: Idiopathic, hemangioma, cretinism.
2. Inflamatory: Chronic glossitis.
3. Traumatic: Due to post operatory edema.
4. Methabolic: Acromegally, proteinosis, Steroid therapy, mixema amileidos.



Figs. 78-80. "V" glossectomy.

Macroglossy can be a manifestation of a syndrome like Beckwhit-Wiedemann syndrome, Hurler syndrome and Down syndrome.[33]

There is another classification:

1. True macroglossia: when there is true enlargement of the tongue.
2. Relative macroglossia: When there is insufficient space in the oral cavity.

Both pathologies can be congenital or acquired and the symptoms are proportional to the degree of macroglossia and the age of the patient.

The clinical diagnosis of macroglossia can be done on this basis:

- Tongue protrusion.
- Speech.
- Swallowing.
- Breathing.

When the patient presents true macroglossia, one of the alternatives is surgery to reduce the dimension of the tongue (glossectomy).[12]

Advantages

1. The tongue is reduced in hours.
2. The cause of the open bite is eliminated.

Disadvantages

1. Surgical risk.
2. Post surgical recovery.

Recommendation

1. The diagnosis must be done in conjunction with a maxillofacial or plastic surgeon.

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Cross bite

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Introduction

Cross bite is a type of malocclusion that is frequently encountered in the practice of orthodontics. We can identify this malocclusion when the lower teeth are in a buccal or labial position in regard to the upper teeth, in a unilateral, bilateral, anterior and/or posterior manner.(7,24,22,31) These malocclusions can have a skeletal or dental component or a mix of both, they are relatively easy to treat if they are intercepted at an early age; doing so can avoid the need for surgical correction in the future.(7,24)

At the **transversal** level, a normal occlusion is considered as such when the palatine cusps of the upper molars and premolars occlude in the main fossas of the lower molars and premolars. At the **anteroposterior** level, the occlusion is considered normal when the upper incisors occlude on the buccal aspects of the lower incisors; thus, a posterior and anterior overbite exists, meaning that, the upper teeth must cover the lower teeth.(16)

We can divide this type of malocclusion in:

1. Sagittal type cross bite (anterior cross bite).
2. Transversal type cross bite (posterior cross bite).

In this chapter we will discuss the many treatment options for the correction of this malocclusion.

ANTERIOR CROSS BITE

Anterior cross bite is one of the most common orthodontic problems in growing patients. It generally occurs in the primary and mixed dentition as the result of a disharmony in the skeletal, functional and dental components of the child. This is characterized by one or more anterosuperior teeth that occlude behind the lingual aspect of the antero-inferior teeth.(7,12,22)

We know that anterior cross bite can de caused by a retrusive upper maxilla, a protrusive mandible or a combination of both (skeletal type cross bite); but when one or more teeth are affected individually, the cause can be purely

Fig. 1. Anterior cross bite.

dental, in which we can find upper incisor palatoversions with or without buccoversions of lower incisors.(12,13) An anterior cross bite can appear as a predisposing factor in the development of a Class III malocclusion.(31)

Etiology of anterior cross bite

- Hereditary influences.(12,33)
- Habits (to chew with the mandible forward can force the upper incisors to retrocline). (12)
- Inadequate dental arch length. This problem can provoke the lingual deviation of one or more permanent tooth during eruption.(12,33)
- Over retained deciduous teeth can cause malposition of the permanent teeth.(12)
- A traumatic lesion in the deciduous dentition that can occasionally displace the developing permanent tooth, forcing it to erupt with a palatal inclination and provoking an anterior cross bite.(12,33)
- Supernumerary teeth that are buccally placed.
- Anterosuperior teeth overcrowding.(33)

By general rule, developing Class III malocclusions express themselves as an anterior cross bite in the mixed dentition. They can be dental, functional or skeletal. To make a diagnosis, the doctor must evaluate the following:

- The profile of the patient.
- Inclination of the maxilla.
- Inclination of the upper and lower incisors.
- The presence of a functional displacement between centric relation and centric occlusion.[5]

How to differentiate between a dental and a skeletal cross bite

Dental evaluation: We must observe if the Class III molar relation is accompanied by an underjet. If the incisors are in edge to edge relation and the lower incisors are retroclined, we must suspect a compensated Class III malocclusion, meaning that the upper incisors are proclined and the lower incisors are retroclined to compensate the skeletal discrepancy. In case there is an underjet, this must be confirmed with a functional evaluation.[5]

Functional evaluation: We must evaluate the relation between the mandible and the maxilla to determine if there is a discrepancy in centric relation (CR) or in centric occlusion (CO). The forward positioning of the mandible can produce an abnormal dental contact that can generate a forward mandibular displacement. Patients with a forward mandibular displacement during closure or maximum intercuspidation may have a Class I skeletal pattern, a normal facial profile and a Class I molar relation in CR, but with a dental and skeletal Class III pattern in CO, a situation known as pseudo Class III malocclusion takes place. The elimination of the CO-CR displacement must reveal if it is only a simple Class I malocclusion or a compensated Class III malocclusion. On the other hand, a patient without deviation during closure most probably has a true Class III malocclusion.[5]

Fig. 2. True Class III malocclusion.

Fig. 3 Pseudo Class III.

Profile evaluation: This evaluation implies an examination of the facial proportions, chin and face position, for which we must perform the following analysis:

1. We must determine if the profile is concave, straight or convex. Generally patients with maxillary deficiency have a concave profile that manifests as a flattening of the infraorbitary ridge and of the zone next to the nose.[5]

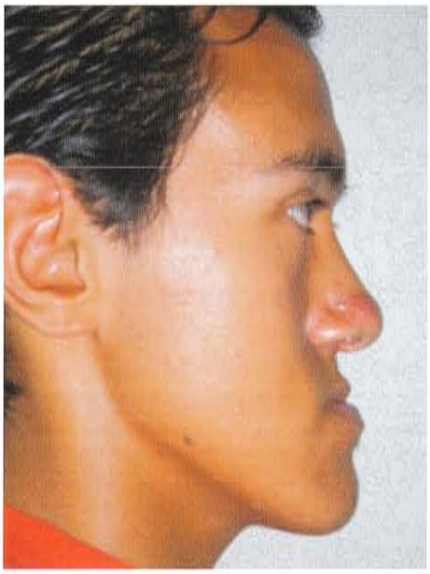


Fig. 4. Concave profile with depressed infraorbital ridge.

2. Chin position: we must cover the upper and lower lip to evaluate the position of the chin according to the nose, to the upper portion of the face and the forehead. In this manner we can determine if the chin is protruded or retruded. The chin must not protrude from a vertical line traced downward from the glabella.[5]

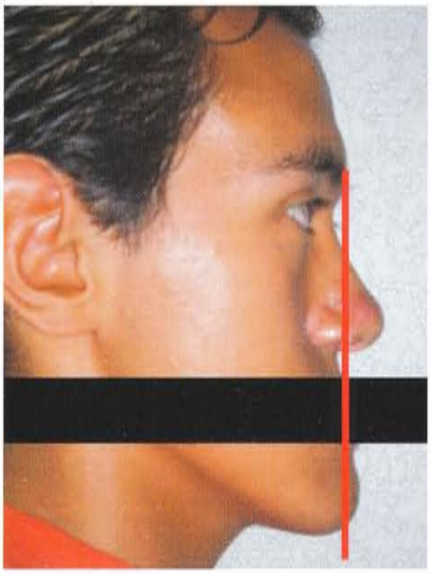


Fig. 5. Protrusive chin according to the forehead and the nose.

3. Facial position: covering the lower lip and the chin, we can evaluate the middle third portion of the face, which must have a convexity according to an imaginary line traced from the lower edge or the orbit to the base of the nostril, reaching the angle of the mouth. A straight or concave soft tissue profile will indicate a deficiency in the middle third of the face.[5]

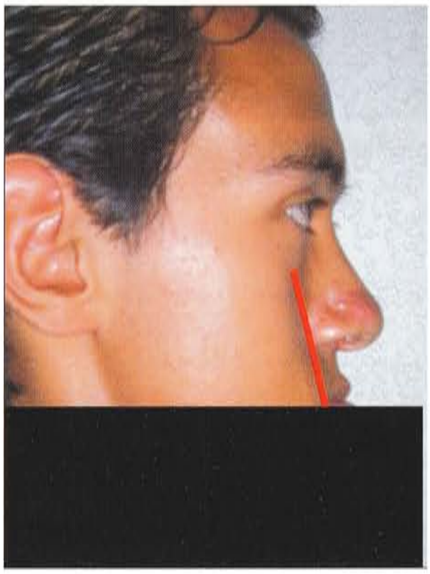


Fig. 6. Straight contour of the middle third of the face caused by depressed infraorbitary zone.

- **Cephalometric evaluation:** Cephalometric measurements can be used to determine the position of the maxilla and the mandible; we can also determine the position of the upper and lower incisors, and determine the skeletal and dental relations of a Class III case. So, a Class III malocclusion can be classified as an incorrect dentoalveolar relation, a skeletal malocclusion or a pseudo Class III malocclusion.[5]

Types of anterior cross bite

1. **Dental anterior cross bite:**
   - It usually involves one or two teeth. [31]
   - The profile is straight in centric occlusion and in centric relation.
   - Class I molar and canine relation.
   - In a cephalometric evaluation the angles SNA,SNB, ANB are within normal limits.[33]
   - Generally, it is the product of an abnormal axial dental inclination.[31]

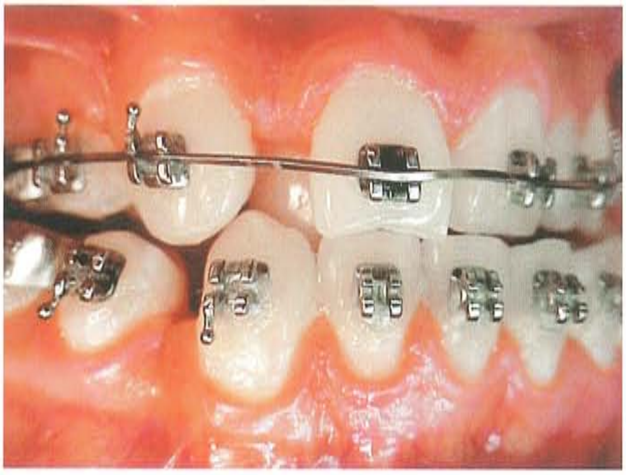


Fig. 7. Upper lateral in cross bite.

2. **Functional anterior cross bite (pseudo Class III):**
   - There is an anterior cross bite that affects the four upper incisors. This is caused by mandibular hyper propulsion, which also provokes a lower tongue position and a premature canine contact that entraps the upper maxilla.[12]
   - It is the product of mandibular advancement, that in occasions is necessary to obtain maximum intercuspidation.[12,33]
   - There is a Class III molar relation in centric occlusion and a Class I relation in centric relation, meaning that a mesial mandibular displacement must be made to attain intercuspidation.
   - The patient can reach an edge to edge incisal relation in centric relation.
   - The facial profile is straight in centric relation and concave during maximum intercuspidation.
   - A false ANB alteration can result from the cephalometric analisys.[33]

Fig. 8. Anterior cross bite caused by mandibular hyper propulsion (pseudo Class III).

Fig. 9. Anterior cross bite caused by mandible hyper propulsion (pseudo Class III, front view).

Fig. 10. Anterior cross bite caused by mandible hyper propulsion (pseudo Class III, right view).

Fig. 11. Anterior cross bite caused by mandible hyper propulsion (pseudo Class III, left view).

Functional anterior cross bites usually involve all four upper incisors and the degree of version has little importance, due to the fact that the cross bite has been established by mandibular propulsion, causing a low tongue position, premature contact of temporary canines that are not worn down, entrap the maxilla, resulting in a functional forward displacement of the mandible to obtain maximum intercuspidation.[5,12,31]

Fig. 12. Upper canine to canine anterior cross bite (pseudo Class III).

The classification of pseudo Class III comes from the fact that it is not an osseous hyperplasia or hypoplasia; mandibular hyper propulsion originates this maloclusión. The osseous bases are well related and the origin of the problem is dental.[12]

Many authors recommend that functional anterior cross bites in the primary dentition must be corrected as soon as they are identified, to favor optimal dental and skeletal development.[5,12,31]

3. **Skeletal anterior cross bite:**
   - The patient has a molar and canine Class III relation in centric occlusion and centric relation.
   - An edge to edge incisor relation cannot be obtained in central relation.
   - The patient has a concave profile and a retrusive upper lip, predominant chin and a diminished lower third.
   - In the cephalometric analysis the SNA angle is smaller, SNB is increased and ANB is negative.
   - Horizontal growth pattern.[33]

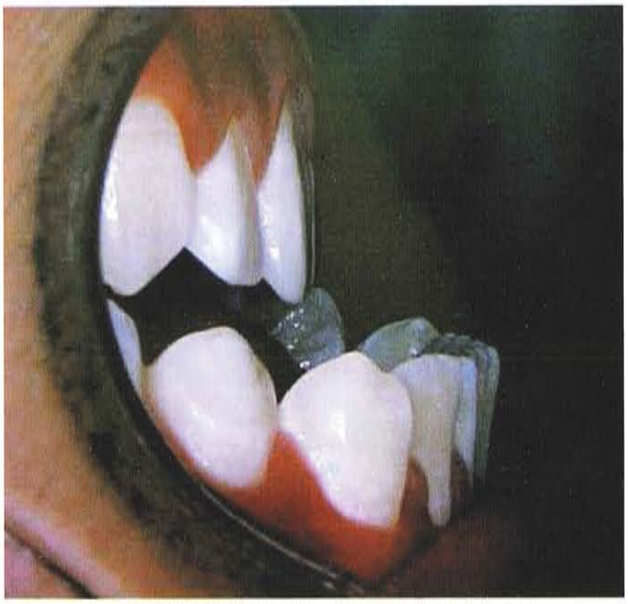
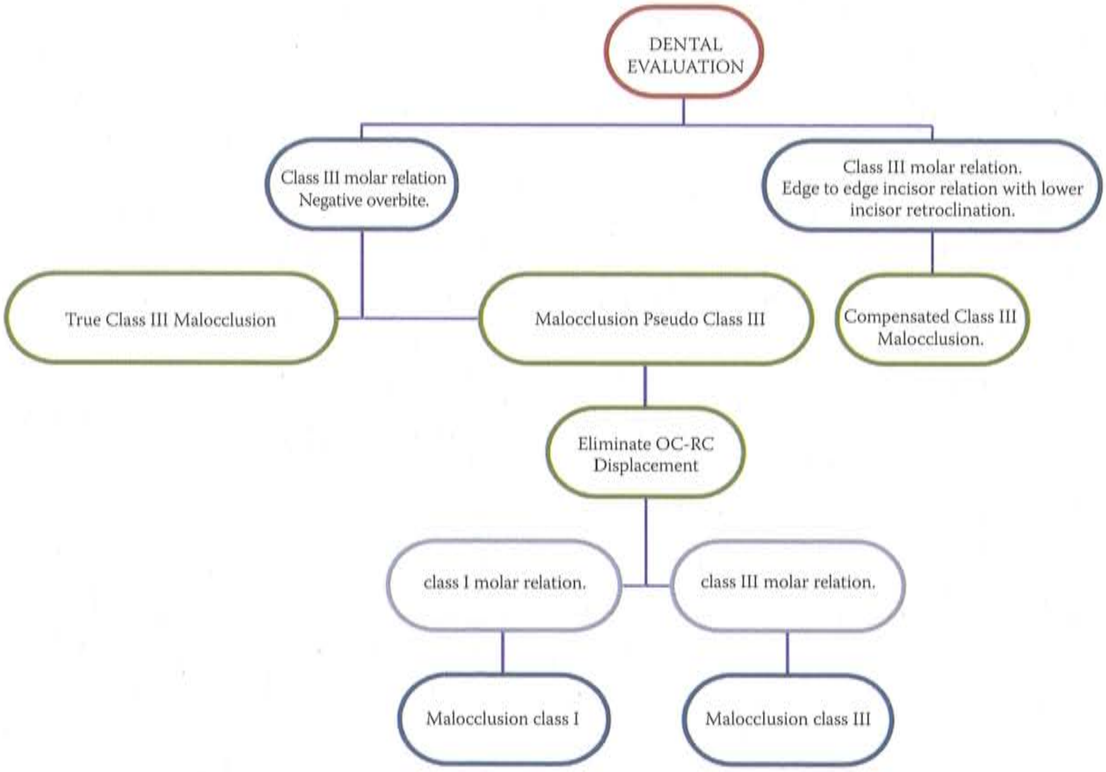


Fig. 14 Skeletal anterior cross bite. (lateral view).

Fig. 13. Skeletal anterior cross bite (front view).

Fig. 15. Lateral X ray of the head of a patient with skeletal anterior cross bite.

Diagnostic schematics for dental and skeletal anterior cross bites.[5]



Variables that can influence the correction of anterior cross bites

1. **The displacement from anterior centric relation to centric relation.** The presence or absence of anterior displacement from centric relation (CR) to centric occlusion (CO) during mandibular closure must be established as a part of the diagnosis. The study of centric occlusion will determine the existence or not of a functional Class III problem. The patients with an anterior displacement are classified as pseudo Class III; the majority of the patients have a Class I molar relation in CR. Aside from the anterior displacement, other signs of pseudo Class III malocclusions are:

    a) The capacity of the patient to establish certain contact between the incisal edges of the upper incisors with the incisal edges of the lower incisors in the most retrusive mandibular posture.
    b) The upper incisors can be more inclined toward the palate than normal.
    c) The lower incisors can be more buccally inclined than normal.

When there is no detectable anterior displacement, the chances for being in the presence of a true Class III malocclusion increase. Aside from the lack of anterior displacement, other signs of true Class III malocclusion are:

a) The incapacity of the upper and lower incisors to establish an edge to edge contact.
b) The upper incisors can have a buccal inclination.
c) Lower incisors can have a lingual inclination.
d) Also, the skeletal relation indicates mandibular protrusion or maxillary retrusion.

The distinction between true Class III malocclusions and pseudo Class III maloclusions have a great impact upon the treatment plan, the prognosis and the stability of the correction. Pseudo Class III malocclusions can be treated in a very short period of time and rebound is easy to prevent. True Class III malocclusions are difficult to treat and to maintain, can require a very long time period of treatment if treatment begins at a young age, and can sometimes culminate in maxillofacial surgery.[5,12,30]

2. **Overbite.** Overbite has great impact upon treatment and retention of the teeth evolved in the cross bite. When an anterior cross bite presents a deep anterior overbite, a posterior bite plane will be needed so the upper incisor can move forward without any occlusal interference from the lower incisors. Once this is corrected, the stability of the retention will depend upon the presence of an adequate overbite. So, patients with incisor cross bite, associated with little or no overbite, are more difficult to treat and to retain.[5,12]

Fig. 16. Upper laterals slightly extruded and in cross bite, the bite must be lifted in order to uncross the lateral incisors.

If the horizontal overbite is -2 mm to -3 mm and only one tooth is involved, the tongue can be used to correct the anterior cross bite when the patient is in the primary or mixed dentition, only if there is enough space for the tooth. Once this has been corrected, the occlusion itself will prevent the relapse of the cross bite.[10]

3. **Anterior arch length.** A crossed upper incisor must have enough space to be moved. If there is not enough available arch length, we must create the sufficient space before trying to uncross it. In straight wire mechanics, open coils are regularly used to create enough arch length to move the tooth to its appropriate position. In patients with a lot of overcrowding the extraction of a premolar and lengthy orthodontic treatment may be needed.[5,12]

Figs. 17 and 18. Insufficient upper arch length to accommodate the crossed upper lateral.

4. **Upper incisor root torque.** Many upper incisors that are crossed have their root in a palatal position. At the moment in which the crown is moved forward, the long axis of the tooth remains with an increased buccal inclination. After the tooth has been uncrossed, a buccally inclined tooth is prone to go back again. This is the reason why we should give negative torque to the root to move buccally. To accomplish this movement we can bond an inverted brace (180°) and place 0.018" x 0.025" or 0.019" x 0.025" stainless steel wires. Another way to apply negative torque is to make a third order bend in the arch wire.[5,12]

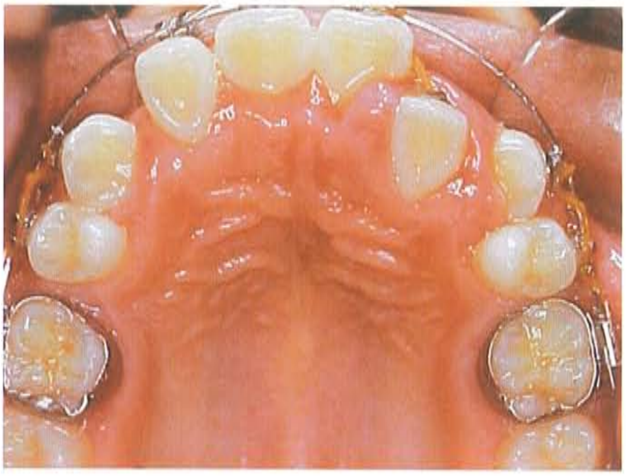
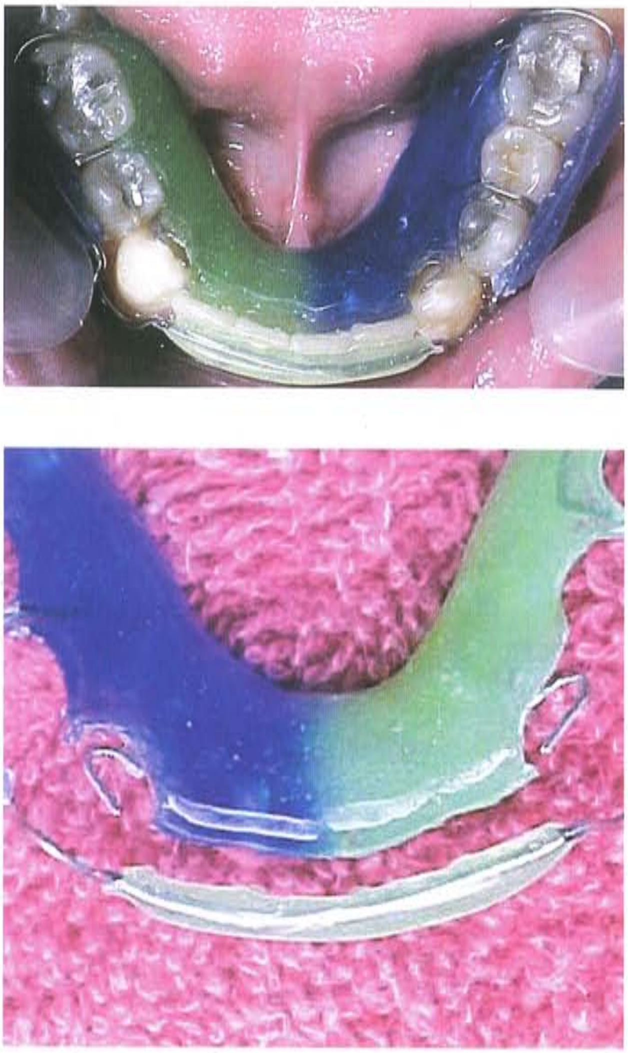


Fig. 19. Upper lateral incisor in a cross bite with a lot of positive torque in the root.

5. **Mandibular teeth alignment.** The alignment of the upper teeth must not commence until the antero-superior teeth have been uncrossed. The premature alignment of the lower teeth usually complicates the treatment of the anterior cross bite.[5]

Fig. 20. Upper alignment to uncross the upper incisors before beginning the alignment of the lower teeth.

6. **Retention.** As explained before, an adequate overbite and a normal inclination of the longer axis of the tooth to be treated are important for the stability of retention. Once the bite is uncrossed, the stability can be checked by taking off the wire from the braces for a two to three week period. If the upper or lower teeth remain stable, a retainer will not be needed. But if the teeth move toward the palate or the lips, they may need additional treatment and a retainer will be necessary.[5]



Figs. 21 and 22. Circumferential retainer with springs at canine level.

POSTERIOR CROSS BITES

Posterior cross bites are occlusal alterations on the transverse plane.[13,16] This type of bite has the buccal cusps of upper molars and premolars occluding on the fossas on the lower molars and premolars, in a way that, the lower teeth surpass bucally the upper teeth during occlusion.[11,14,16]

The cusp to cusp occlusion is an intermediate situation between normal occlusion and posterior cross bite. In this anomaly, there is no cuspid to fossa occlusion and it is considered an incomplete posterior cross bite.[16]

Fig. 23. Posterior cross bite.

Etiology of posterior cross bite

The most frequent etiological factors of posterior cross bite are:

1. Genetic factors

- **Maxillary hypoplasia:** Maxillary compression due to a lack of development can be accompanied with two different clinical patterns:

  a) Maxillary compression with dental overcrowding, and lack of space for the eruption of the upper canines.
  b) Compression with protrusive incisors with a Class II anteroposterior relation.

If there is a combination of transversal hypoplasia and insufficient maxillary anteroposterior development, the characteristic clinical pattern is a Class III caused by insufficient maxillary development.[16] Sometimes we can find insufficient hemi-maxillary development, presenting itself as an asymmetrical compression with posterior cross bite with the absence of mandibular deviation.[16]

According to Chaconas and Schöder, the majority of posterior cross bites are caused by skeletal problems due to bilateral maxillary compressions.

- **Mandibular hyperplasia:** presents itself in the transversal and anteroposterior planes, this is why posterior cross bites caused by mandibular hyperplasia in Class I are not frequent, but they are in true Class III cases.[16]

- **Malformative syndromes:** posterior cross bite can be associated with malformative syndromes like Treacher-Collins, Robin complex, achondroplasia, hemifacial microsomia, congenital hemi-maxillary hypertrophy, etc.

2. Habits

- **Mouth breathing:** Patients that breathe through the mouth as a habit usually share certain facial features, like "adenoid fascia", that can be resumed in half open mouth, insufficient nasal development with small nostrils, a short upper lip and dark rims under the eye lids.

The majority of the studies about the occlusal characteristics of mouth breathers show a high prevalence of posterior cross bites. Some authors establish a cause-effect between mouth breathing and posterior cross bite, because during mouth breathing the lips are partially open and the tongue is low, restraining the transversal development of the maxilla.[16]

It is also very common to find posterior cross bites in patients with hypertrophic tonsils or adenoids. But there are studies that sustain that the height of the upper maxilla usually normalizes after the adenoid tissue is removed.[2,16]

- **Anomalous suction:** the suction reflex is present in the newborn and tends to disappear with growth. The baby feeds and explores the environment with this reflex placing any object in between the gums, like a pacifier, a finger, the lower lip or a sheet. Suction is maintained until the teeth and mastication appear, if this reflex persists after the child is four years old, it is considered a habit.[2,16]

The most frequent suction habit is finger sucking, of one or more fingers. The repercussions of this habit can derive in:

a) A lower tongue position, so the tongue does not exert any pressure upon the palate.
b) Buccinator muscles hyperactivity, that tends to compress the palate.
c) The palate deepens and collapses, due to the active pressure that the finger exerts against the palate.

The possible alterations as a consequence of the habit are specially dental, and if they persist or are executed with greater force, can affect the alveolar process. Many studies done in children with posterior cross bite have encountered a very high prevalence of finger sucking habits in these patients. The proportion of girls with posterior cross bite is slightly higher than boys with the same problem. This difference is attributed to the fact that girls have a higher frequency of finger sucking habit.[2,16]

Another suction habit is pacifier habit. The prevalence of posterior cross bite in patients in the mixed dentition that have a suction habit is greater, and this habit has been catalogued as an important etiological factor in the development of this malocclusion.

According to Larsson, posterior cross bite usually disappears spontaneously in the permanent dentition, due to the fact that the habit is interrupted before the eruption of the premolars and permanent canines.[16]

Infantile deglutition: the typical deglutition pattern of a child before teeth erupt is characterized by the fact that the tongue is placed between the gingival pads and is projected forward. Deglutition is controlled by the contact of the lips, the tongue and the perioral muscles.[16] The persistence of infantile deglutition can be provoked by hypertrophic tonsils, mouth breathing or psychological sucking habit. The tongue is interposed between the teeth to stabilize the mandible and to seal the oral cavity. The lack of tongue pressure and strong pressure of the buccinator muscles provoke a deficient transversal development of the maxilla, which is usually associated with an anterior open bite because the anterior teeth have not erupted yet.[2,16]

- **Lingual interposition:** the persistence of this habit is similar to the one just described, but the action of the tongue is prolonged through time. The role of the tongue in the etiology of malocclusions is related with a series of variables, like position, pressure, volume and time.[16]

3. Interferences and occlusal factors

The anatomic characteristics of teeth serve as a guide to establish a correct occlusion, so any type of alteration in teeth anatomy or in the eruption sequence can provoke the development of posterior cross bites. The most common cause of unilateral posterior cross bites is a functional deviation of the mandible, generally produced by occlusal interferences or premature contacts. The presence of occlusal interferences in the deciduous canines that are too long may be the cause of cross bites, because these teeth provoke a lateral deviation of the mandible during closure.[2,16]

4. Trauma

Dental trauma in the deciduous dentition can displace the primary teeth or the buds of the permanent teeth, provoking an anomalous inclination of the upper teeth toward the palate and the apparition of a dental posterior cross bite. The same can occur if the trauma provokes the displacement of the permanent teeth.

Other types of trauma can provoke mandibular or condyle fractures, that cause grave facial asymmetries in patients that are growing and the apparition of skeletal cross bites.[2,16]

A third group of trauma are the ones caused during birth with the manipulation of instruments.

5. Other causes

Some other factors exist that in an indirect way can favor the presence of posterior cross bites. One of them is ankyloglossia. A short lingual frenum maintains the tongue in a low position, favoring the apparition of maxillary compression. [16]

Types of posterior cross bites

Posterior cross bites can be:

- Bilateral, which affects both maxillary hemiarches.
- Unilateral, affecting the right or the left hemiarch.
- Of an isolated tooth.[16]

The following classification was proposed by Moyers (1966), still being applied today.[2]

1. Functional cross bite

- These are produced when there is an occlusal interference that displaces the mandible to the left or the right during the last phase of closure.
- They are unilateral cross bites.
- There may be a chin deviation.[13]
- Lower dental midline deviation as a consequence of the mandibular deviation.[2]

- Alteration of the mandibular mechanics during aperture: during this movement, the condyle of the side of the deviation will suffer a rotation movement; meanwhile the other side has a downward and forward movement. This alteration can induce asymmetric growth of the mandible, therefore this problem must be immediately treated as soon as it is detected.[13]
- The most frequent presentation of this malocclusión is a unilateral posterior cross bite, generally associated to a functional mandibular deviation.[16]
- From the cephalometric point of view we can find:
  - In the sagittal sense, there is a slight tendency to a osseo-dental Class III, a distal position of the upper molar, more linguoversion and retrusion of the upper incisors and moderate protrusion of the lower incisors.
  - In the vertically, we can find a dolychofacial tendency.[2]

To make this diagnosis, we must manipulate the mandible to centric relation without dental occlusion. If the cross bite is functional, the midlines will coincide, the chin deviation will disappear and unstable transversal cusp to cusp relation becomes evident.[13]

Treatment: sometimes they are corrected by eliminating the interference with occlusal grinding or crown remodeling of one or more teeth. In some cases the use of a dento alveolar expander will be needed.[13]

Fig. 24. Unilateral functional posterior cross bite.

2. Dentoalveolar cross bite

- It can affect one tooth or a group of them.
- In this malocclusion, there is an alteration in the direction of the longer axis of the upper and/or lower teeth, but the basal bone is not altered.
- The buccal cusps of the upper premolars and/or molar occlude in the fossas of the opposing lower teeth.
- They are very frequent, in the primary and in the mixed and permanent dentition.
- Generally, unilateral dento alveolar cross bites are functional, they are the most frequent alterations that affect a single tooth.[12-13,16]

Treatment: Expanders like the Quad Helix, the Tandem or the palatine expander are used. [13]

Fig. 25. Dento alveolar posterior cross bite affecting only one upper premolar.

3. Skeletal cross bites

- They are produced by alterations in the transversal dimensions of the maxilla or the mandible, provoked by a growth alteration in some or both of them and can be observed in any stage of development.[13]
- The most frequent alteration is the insufficient growth of the upper maxilla. If the cross bite is unilateral it is usually a transversal hypo-expansion of the maxilla, capable of premature cuspid contacts, that can result in a lateral deviation of the mandible.[36]
- The etiological factors can be mouth breathing habits, atypical deglutition and thumb sucking, and can only be treated with orthopedics, only if the patient still has growth potential; if not, it must be corrected by surgical disjunction or surgically assisted orthopedic disjunction.[13]
- The most frequent cause for this type of cross bite is mouth breathing, where we can observe a notorious compression of the maxilla that shortens the distance between molars, premolars and canines.
- It can also occur as a consequence of an asymmetry of the shape of the mandible (laterognatia). Mandibular

laterognatia implicates a permanent deviation of the mandible; the morphology of the mandible can be altered on the condyle, the ramus, or the body.[2]

Treatment: the treatment of these cross bites is accomplished with rapid maxillary expansion, and for this, appliances like the Hyrax or Hass are used, and in severe cases, orthognatic surgery is required.[13]

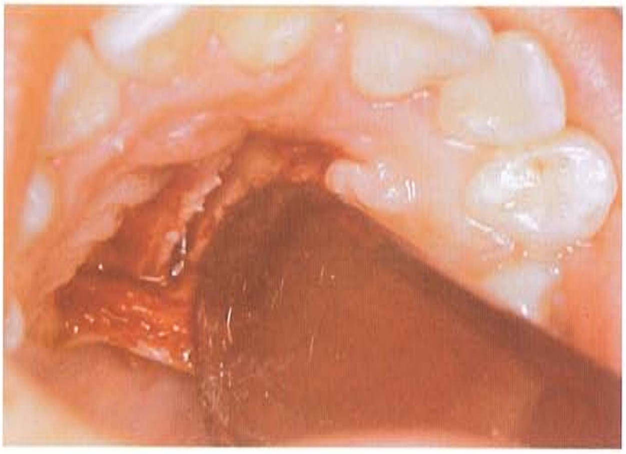


Fig. 26. Surgical disjunction of the midpalatal suture.

Fig. 27. After the surgical separation of the mid palatal suture, a Hyrax screw is placed.

4. Scissor bite

- It is the one in which the palatal aspect of an upper premolar or molar contacts the buccal aspect of the lower antagonist. [13,16]
- It generally affects only one tooth and can be caused by an eruption problem (a lingual deviation of the eruption trajectory of the lower teeth or buccal of the upper teeth).
- It can also be caused by iatrogenic causes, like the excessive activation of an expansion appliance.[13]
- When all the teeth are in scissor bite, it is generally caused by a retrognatic mandible and it is called Brodie syndrome. This generates serious mandibular locking that causes traumatic micrognatia, because it impedes the growth of the mandible.[5,26]

Treatment: the correction of this type of cross bite can only be done if it is dentoalveolar in nature. Expanders with inverse activation are used; buccal arches and sometimes crossed intermaxillary elastics are worn.[13]

Scissor bite can also be:

- Bilateral or Brodie syndrome, which affects both hemiarches.
- Unilateral, if it affects the right or left hemiarch.
- Of an isolated tooth.[16]

Fig. 28. Scissor bite.

Diagnosis of posterior cross bites

For the diagnosis of posterior cross bites we must elaborate a complete dental history chart, perform an intraoral and extraoral clinical exploration, a cephalometric trace over an X-ray, a posteroanterior X-ray (PA), and an analysis of mounted study models on a semi adjustable articulator to view the position of the mandible in centric relation. In order to make an accurate diagnosis we must localize the precise site of the alteration, if it is localized only in the maxilla, the mandible or both.[16]

Variables that can have influence in the correction of posterior cross bites

1. **Tooth inclination.** The buccolingual inclinations of the posterior teeth involved in a cross bite provide valuable information. If an upper molar in cross bite has a palatal inclination, it will have an advantageous position due to the fact that the correction of the cross bite improves with the buccal inclination of the molar. On the other hand, if the upper molar in cross bite has a buccal inclination, it is probable that the cause is a narrowing of the entire upper arch in relation to the width of the lower arch. In these cases, the widening of all the upper arch is convenient with rapid maxillary expansion (RME), instead of the further inclinement of the upper molars.[5]
2. **Lateral functional displacement during mandibular closure.** The majority of patients with unilateral posterior cross bite displace their mandible to the side of the cross bite during closure in CO. The lateral displacement means that the cross bite is bilateral, and consequently, easy to treat with an appliance that can move both sides of the maxilla buccaly. In general, the lower dental midline is displaced to the side where the posterior cross bite is localized.

   When the displacement is not easily detected, we must ask the patient to open wide; if the lower dental midline is displaced toward the facial midline of the patient, or if it aligns during complete aperture with the upper dental midline, there is a functional displacement present. A relaxing occlusal guard used during one or two weeks can verify the presence or absence of such displacement. Occlusal guards or deprogramming guards help to detect lateral displacements in patients with mastication muscles that are programmed to close the mandible in a deviated position.[5] If a complete examination discards the existence of a displacement, the cross bite is caused by a skeletal asymmetry.

3. **Estimation of the necessary expansion.** If the necessary expansion of the upper arch is between 2 mm to 4 mm and the upper molars are inclined toward the palate, a variety of removable or fixed appliances can be used, like the Quad Helix, the thermal expander, Tandem Loop, transpalatine arches, overlay, etc. If the upper expansion needed oscillates between 4 mm to 6 mm the best appliance to use is the Hyrax. A patient that needs more than 12 mm of expansion may require the use of a combination of a Hyrax type screw with orthognatic surgery (surgical expansion).[5]

4. **Age of the patient.** In children and young adolescents, posterior unilateral and bilateral cross bites are easily treated. Patients with a unilateral posterior cross bite present a mandible displacement that can predispose the patient to temporomandibular joint disorders. These unilateral posterior cross bites with lateral displacement can be corrected in the primary, mixed or permanent dentition, being detected and treated at an early age.[5]

   Posterior cross bites in adolescents can be successfully corrected; but the expansion with a Hyrax is not easy, because the middle palatal suture is ossified making separation difficult. For these patients we recommend the expansion with a Hyrax screw assisted by surgical expansion.[5]

   Adults with bilateral posterior cross bites (without displacement between CR and CO) are sometimes left with this functional bite. This is because, in adults, posterior cross bites are mainly corrected inclining the upper and lower molars; the results are usually unstable and tend to rebound.

5. **Vertical changes.** During the correction of a posterior cross bite, the anterior overbite generally diminishes (the anterior bite opens). This happens because the palatal cusps of the posteriosuperior teeth occlude on the occlusal surfaces of the posteroinferior teeth. This opening of the bite is transitory; when the teeth establish their new occlusal relation, the anterior overbite returns to its original condition.[5]

Reasons and periods for treatment of posterior cross bite

These malocclusions must have early treatment for various reasons, among them:

- Once the posterior cross bite is installed it will not correct spontaneously.
- It provokes wear of the crossed teeth.
- It provokes periodontal problems due to occlusal trauma.
- It provokes interferences in the growth and development of the dental arches.

- In cases of functional cross bites, these show a lateral mandibular shift due to the presence of occlusal interferences with condyle position alterations. The condyle on the side of the cross bite is deviated to the posterosuperior side, meanwhile the condyle on the normal side places itself in the anteroinferior side of the temporal glenoid cavity.
- If these deviations are corrected at an early age, we will obtain adequate eruption of the permanent teeth.
- The skeletal relation of the osseous bases is improved.
- It provides mouth closure without deviations.

The treatment for posterior cross bite must commence as soon as the malocclusion is diagnosed, being conditioned to the maturity and cooperation degree of the patient. The most indicated treatment for the correction of skeletal type cross bite is through maxillary disjunction.

Disjunction

We usually require palatal expansion for the correction of skeletal transversal discrepancies with the combination of orthodontic and orthopedic movements.[17] Rapid maxillary expansion (disjunction) is done to increase the transversal dimension to correct skeletal cross bites, and at the same time, to increase dental arch length. For this purpose we utilize expanders that produce intense transversal forces on the lateral dentoalveolar sectors of the upper dental arch.[13]

Initially, the transverse forces will buccaly incline the lateral segments, and if the forces are strong enough, the disjunction of the mid palatal suture can occur (disjunction), the same happens with all the suture complex of the maxilla. Rapid maxillary expansion (RME), is indicated when the expansion necessities are greater than 4 mm or 5 mm and when the origin of the discrepancy is skeletal.[13,17]

The objective of RME is to reduce orthodontic movements and undesired inclinations. RME requires activations and generates heavy forces that range between 2kg to 5kg per activation, in contrast with slow expansion that generates forces that range between 450 g and 900 g that may be insufficient to separate a mature midpalatal suture.[17]

Some authors recommend slow expansion (0.5 mm to 1 mm per week), because they say that a physiologic suture adjustment occurs.[17] But other studies indicate that if the expansion is slow, all that we are going to obtain is a dental expansion (teeth in a buccal position) rather than a basal expansion. Those who support RME have as theoretical fundament that applying a rapid force to the posterior teeth, these teeth would not have enough time to incline and that the force will transfer to the suture and the suture will open, meanwhile the teeth will minimally move. We can obtain 0.2 mm to 0.5 mm per day with inter molar length increment of up to 8 mm.[30]

RME is obtained in 10 to 30 days, but the expander must remain in the mouth during six months to allow new bone to form in the suture.[30] The goal of palatal disjunction is to maximize skeletal movement and to minimize dental movement, meanwhile the physiologic midpalatal suture adjustment takes place.

Effects of disjunction

I. **Effects on the maxillary complex.** When the forces applied to the teeth and the maxillary alveolar processes exceed the necessary limits for orthodontic dental movement, a disjunction is produced.[30] The pressure that orthopedic force exerts, is going to act upon the midpalatal suture splitting it. A compression of the periodontal ligament that will incline the alveolar processes and a gradual aperture of the mid palatal suture will occur. From the frontal point of view, the separation occurs in a pyramid form, the base is located toward the anterior dental sector and the fulcrum is on the Nasion point. Occlusally, the expansion is greater in the anterosuperior sector at the incisor level (fan aperture) than at the posterior edge of the suture at the molar level, where the transversal dimension is maintained by the pterygoid processes that, being of endochondral origin, have structures that are hardly modifiable with this therapy. All this provokes a descent and forward position of the "A" point of approximately 1mm to 2 mm.[6,19,25,30,34,35]

II. **Effects on the alveolar processes.** Because the bone is resilient, the inclination of the alveolar processes occurs early during disjunction. The majority of the forces applied tend to dissipate within 5 to 6 months and once the stabilization is terminated, any residual force can provoke a rebound effect, which makes overcorrection necessary. The slower we make the expansion, the more dental expansion effect and less basal expansion we will have. When an osseous or basal expansion is done, a force that produces hyalinization anchors the teeth to the bone and the aperture of the suture happens. The dental organ begins to move after three weeks, thanks to the indirect osseous resorption that intervenes in the dental alveolus. For this reason, we must take advantage of these three weeks to activate the disjunction appliance, meanwhile, the teeth serve as support for the expander to oppose maximum resistance due to the ligament hyalinization. If the applied force is light and slow, the hyalinization tissue is minimal, and therefore, we will have more teeth buccoversion than suture aperture.[25,30,34]

III. Dental effects

a. The disjunction provokes the opening of a distema between the central incisors. This diastema closes in 2 to 4 weeks due to the reciprocal traction of the transeptal fibers that connect the central incisors, thus producing an increase of arch length.[13,30,34]

Fig. 29. Anterior diastema provoked during the disjunction.

b. The transeptal periodontal fibers unite the crowns of the incisors rapidly, and the roots converge in only four months.[30,34]

c. A slight extrusion and palatinization of the central incisors can be observed. It is believed that the palatinization is caused by the stretching of the perioral muscles.[6]

d. A change in the axial inclination of the molars accompanied with a slight extrusion is observed. This inclination provokes a positive torque of the teeth, and with this, a lowering of the palatal cusps below the occlusal plane. [13,30]

e. It favors the correction of anterior open bite, most of all in patients in the primary or mixed dentition. The RME provokes a slight advance of the "A" point.[13]

IV. Effects over the mandible. It has been proven that the results of the rapid maxillary expansion result in a simultaneous expansion of the lower arch. Hass observed an increase of 4 mm to 6 mm in the inte-canine and inter-molar width. The mandible tends to rotate downward and backward due to the inclination and extrusion of the upper molars. For this reason the anterior bite opens.[30,35]

V. Effects over the adjacent facial structures, An occlusal x-ray examination shows that the midpalatal suture aperture extends through the horizontal processes of the palatal bones, but the distance between the two expanded halves is very narrow. It is very important to remember that the main resistance to RME is not the suture, but the structures that surround it, most of all the sphenoid and zygomatic bones. The resistance increases significantly in the parts closer to the base of the skull.

Anatomically, RME also produces an increase of the width of the nasal cavity due to the descent of the floor of the nasal cavity, resulting in an increase of the permeability of the airways. The nasal cavity widens 1.9 mm in average and at the lower turbinate level the average is between 8 mm to 10 mm.[25,30,34]

Disjunction indications

1. It is done in patients whose maxillary suture system has not fully matured.[13]
2. In collapsed upper dental arches related to a Class III skeletal malocclusion.
3. In collapsed upper dental arches related to mouth breathing and a high palatal vault.
4. Unilateral or bilateral skeletal cross bites.
5. Posterior dentoalveolar cross bites.
6. Patients in the early permanent and mixed dentition between 8 and 15 years of age.[25]
7. Whenever we encounter a transversal deficiency of 4 mm or more between the upper first molars and premolars and the lower first molars and premolars.[13,25]

Counter indications

1. Non-cooperative patients.
2. Open bite cases.

3. Dolichofacial or hyper-divergent patients.
4. Patients with skeletal maxillary or mandibular asymmetries.
5. Patients with pronounced skeletal problems, which are candidates for orthognatic surgery.
6. Buccaly inclined molars.[25]

This chapter will present the different treatment options for the correction of cross bites, which will be divided in:

a. Forward arch.
b. Bite block.
c. Lingually placed braces.
d. Face mask.
e. Modified Tandem.
f. Mini-maxillar protractor.
g. Camacho Badillo regulator (CBR).

Treatments for posterior cross bites:

a. Tandem loop thermal expander.
b. Quad Helix.
c. Transpalatal arch with an extension arm.
d. Inverted NiTi arch.
e. Overlay.
f. "Z" elastics or crossed elastics.
g. Hass.
h. Hyrax.
i. Surgical disjunction.

TREATMENTS FOR ANTERIOR CROSS BITES

Forward arch

Occasionally we can find patients that present anterior cross bite in which the four upper and lower incisors are involved with a minimal vertical overbite or in an edge to edge occlusion. And if we add facial and skeletal characteristics of a Class I type patient, we can use a forward arch on the upper arch to uncross the bite, because the malocclusion will be circumscribed to the anterosuperior sector, which is retroclined.

The forward arch is a very simple way to uncross anterior dento alveolar crossed bites, it consists in a 0.018" or 0.020" stainless steel wire main arch that must be separated 2 mm from the slots of the upper incisor braces. Two stops or omegas are made mesial to the tubes of the molar bands that will impede the main arch from slipping, and in this manner the arch will push the anterior teeth forward. We must remember that the total length of the steel arch will diminish between 1 mm to 2 mm per side when the stops are made on the arch.[28]

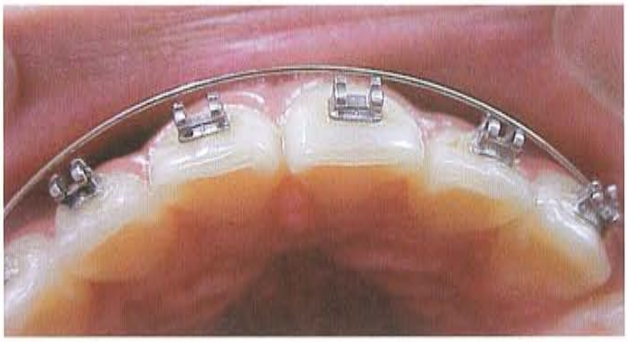


Fig. 30. The forward arch must be separated 2 mm from the slots of the anterior braces.

Fig. 31. Lateral view of the stop and the separation of the wire from the slot of the braces.

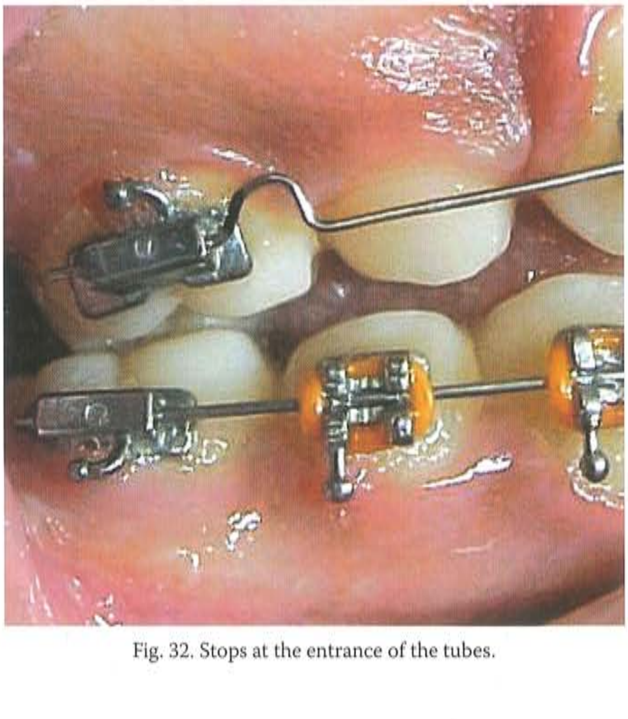


Fig. 32. Stops at the entrance of the tubes.

Advantages

1. With this arch we can procline all the anterosuperior sector, uncrossing the anterior bite.
2. Not only the anteosuperior sector is proclined, but also the upper molars are slightly distalized.
3. Economic.
4. Fast and easy fabrication.
5. We do not depend upon patient cooperation.
6. Not only it can be used to uncross anterior cross bites, but also in cases in which we want to slightly increase the overjet.

Disadvantages

1. The patient can refer momentary pain in the upper incisors while the proclination is taking place.
2. Sometimes when the wire is forced in the slots of the braces, the wire can bulge slightly at the premolar level and this can lacerate the mucosa of the cheeks.

Fig. 33. Occlusal view of the forward arch.

Fig. 34. Lateral view of the forward arch showing the separation of the arch from the slot of the braces.

Fig. 35. The bulging of the arch at the premolar level can cause lacerations in the cheek mucosa.

Fig. 36. Whenever the arch is too far away from the slots of the posterior braces we must not ligate the wire in the slots.
This will avoid possible brace debonding of this sector.

3. If there is a lot of separation between the braces and the wire, some braces can debond.
4. There is no torque control of the upper incisors.

Recommendations

1. In order to uncross an anterior cross bite, the activations must be paused and not exceed 2 mm of separation from the braces.
2. Use Class III elastics.
3. Use anterior box elastics.
4. Once the anterior bite has been uncrossed, we can use the arch as minimal anchorage.
5. Stripping in the anteroinferior sector.

Fig. 37. Anterior cross bite.

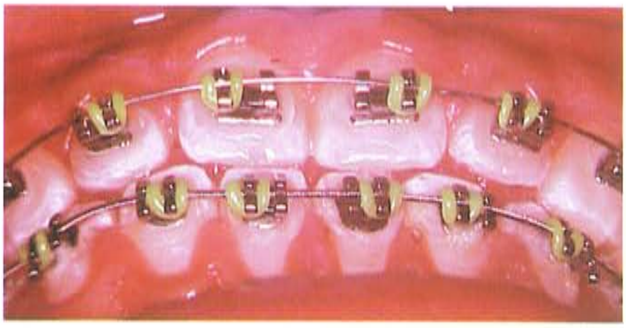


Fig. 38. Frontal view of a forward arch. Note the separation of the forward arch from the slots of the upper braces.

Fig. 39. Front view of the case after the anterior bite has been uncrossed.

Bite block

The bite block is an appliance that can be useful to open the bite in order to uncross an anterior tooth or a group of teeth that are in a palatal position (please refer to Open Bite chapter). It can be a fixed or a removable appliance and can be placed on the upper or lower dental arch on the occlusal aspects of molars and premolars. Generally it is made of acrylic, which must not cover the braces of the posterior sector. The appliance must be worn as long as the anterior cross bite is not resolved.

Fig. 40. Upper right lateral in cross bite.

Fig. 41. Bite block made of acrylic placed in the lower arch. Note that it covers the occlusal aspects of the molars and premolars without touching the braces.

Fig. 42. During closure, the bite block lifts the bite facilitating the uncrossing of the lateral.

Fig. 43. The bite block must remain in the mouth as long as the anterior cross bite is not resolved.

As explained before, prior to uncrossing a tooth we must first gain enough space to accommodate the tooth, and then lift the bite to take the tooth into occlusion.

Fig. 44. In order to take a tooth that is in a cross bite to its place in the arch, we must first gain enough space to uncross the tooth.

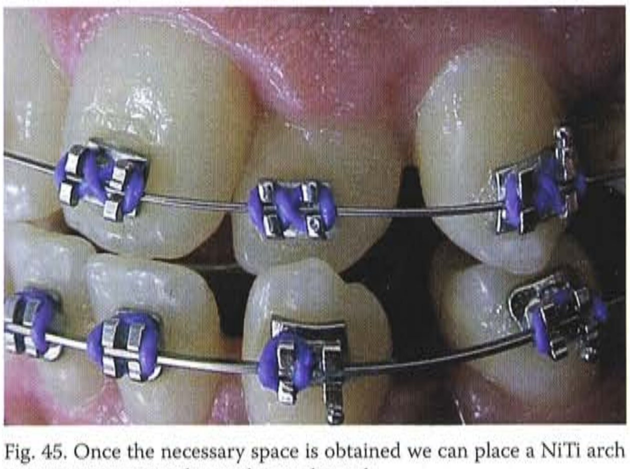


Fig. 45. Once the necessary space is obtained we can place a NiTi arch wire to incorporate the tooth into the arch.

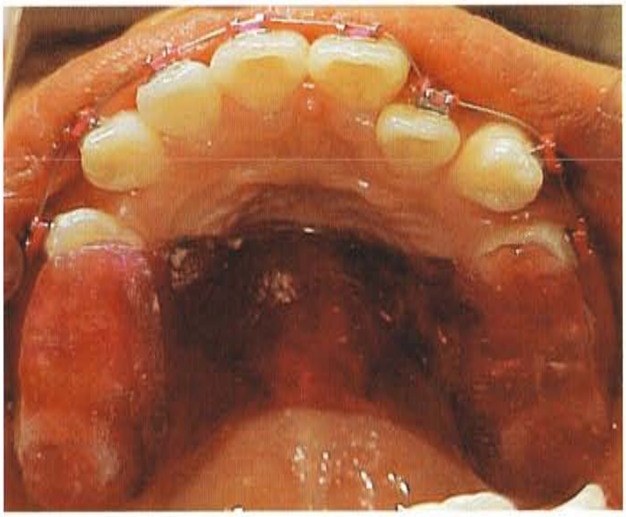


Fig. 46. An acrylic bite block is placed on the upper arch to lift the bite.

Figs. 47 and 48. We must lift the bite enough to permit the uncrossing of the tooth without obstructions.

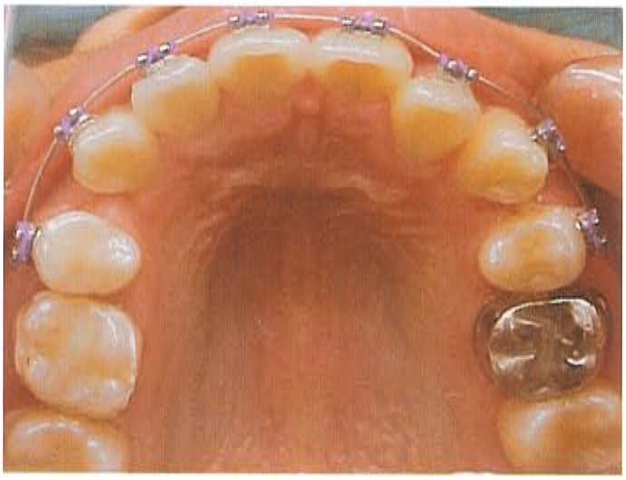


Fig. 49. Once the tooth is uncrossed we can take off the bite block.

Whenever we have any doubt about the cooperation of the patient in the use of the removable bite block, we can apply resin on the occlusal aspects of the posterior teeth in order to open the anterior sector and correct the crossed bite. For this purpose we use Block Out resin, which has a blue color and is marketed by Ultradent.

Fig. 50. Anterior cross bite of the central incisors.

Fig. 51. Placement of Block out resin on the occlusal aspects of the posterior sector in order to lift the bite to uncross the upper central incisors.

Advantages

1. Economic.
2. Easy to fabricate and to place.
3. In case it is fixed we do not depend upon patient compliance.
4. In case it is removable, the patient can maintain better hygiene.

Disadvantages

1. We must invest laboratory time to fabricate the appliance.
2. In case it is removable, we depend upon patient cooperation.
3. The patient can misplace the appliance.
4. The prolonged use of this appliance can fatigue the masseter muscles and on the long run provoke TMJ pain.
5. If we are not careful enough during fabrication, this appliance can block the eruption of the second molar.

Recommendations

1. All the antagonist teeth must occlude on the occlusal surface of the bite block.
2. In case the patient refers any abnormality in the TMJ we must retire the bite block immediately.
3. The recommended thickness of the posterior bite block is 1 mm to 2 mm because we must not forget that we will provoke an anterior open bite of +3 mm due to the scissor effect.
4. Place the bite block as soon as the necessary space to uncross the anterior teeth has been obtained.
5. The bite block can be cemented if the patient does not use it as prescribed.
6. Whenever the occlusal resin dots are used, as soon as the crossed bite has been corrected, we must eliminate the resin immediately or we can provoke intrusion in the posterior sector.
7. After uncrossing any upper anterior teeth we must place negative torque to the root of that tooth.

Lingual placed brace

The placement of a brace on the lingual aspect of a tooth is a very simple way to take a tooth that is in a cross bite to its correct position in the dental arch. This is carried out by the physical properties of the wire that is used for this purpose, in this case thermal NiTi wire, which has six times the flexibility to that of normal steel wire.

These wires are very versatile, because they offer extreme elasticity and can be used for long periods of time with out the need of being replaced.[20]

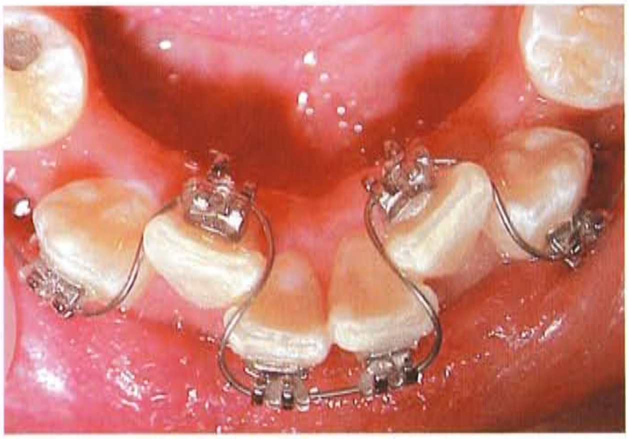


Fig. 52. Braces placed on the lingual aspects of crossed lateral incisors.

Advantages

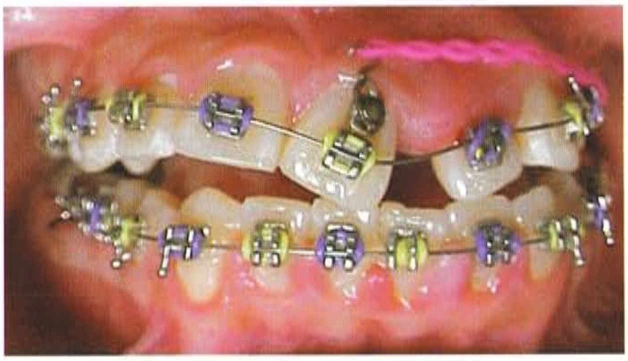
1. It is an easy technique.
2. We do not need anything special because the materials employed are of common use in our practice.
3. We do not require patient compliance.
4. Depending upon the degree of cross bite that the tooth presents, the correction can take about a month.
5. Once the tooth has been uncrossed, just place the brace on the buccal aspect.

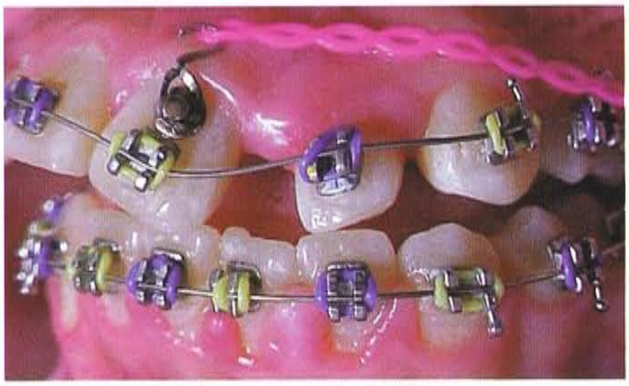
Fig. 53. Brace bonded on the palatal aspect of a crossed lateral incisor.

Fig. 54. To do this technique we need flexible thermal NiTi wire that has a high degree of flexibility.

Disadvantages

1. It requires a strict appointment control, because these wires are activated by body heat, so they are always active and can produce undesired tooth movements.





Figs. 55 and 56. Undesired movements provoked by the thermal wires.

2. Occasionally wire placement can be cumbersome.
3. Because it is a violent movement, it can provoke tooth pain and gingival inflammation.
4. No control on root torque.

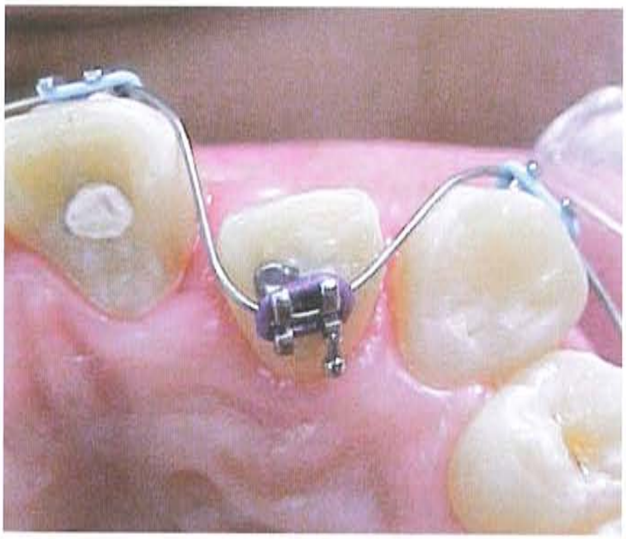


Fig. 57. No control on root torque.

Recommendations

1. This technique is recommended in patients with good oral hygiene.
2. Strict appointment control is imperative to avoid uncontrolled movements.
3. Once the tooth is uncrossed and the brace has been repositioned, we must control the root torque of the tooth to provide more stability to the treatment and to avoid rebound.
4. Supracrestal fiberotomy is recommended in teeth that are very misplaced, because there is a high tendency of these teeth to return to their original position due to the memory of the periodontal fibers.
5. Ferulize with ligature the adjacent teeth to the crossed tooth. This will increase dental anchorage and minimize any undesired movements.
6. The use of round NITi thermal wires is recommended.
7. Place Ortho Ice (Tetrafluorethane) on the surface of the wire to make it more flexible and malleable, so the placement of the wire will be easier.

Face mask

The face mask is an option for the correction of skeletal anterior cross bites due to maxillary hypoplasia in infant patients that are growing and present primary or early mixed dentition. This maxillary traction is possible because the craniofacial complex is very malleable and we can obtain significant changes in the three planes of space. The maxillae bone responds to orthopedic and functional stimulus because it is of intramembranous ossification origin. Therefore, the object of the treatment is to stimulate the growth of this bone.[13,19,35]

Potpeschnigg (1875) was the first to develop the idea of maxillary traction; later Delaire at the end of the 60's renewed the interest of the use of the face mask for maxillary protraction, which was created to correct the posterior rotation of the maxilla and its development deficiency for the treatment of cleft lip and palate patients, Petit at the end of the 70's proposed the use of this appliance for patients with skeletal Class III patients that needed maxillary protraction. Petit modified the basic concept of Delaire, changing the anatomy of the face mask, he also increased the magnitude of the generated force exerted by the appliance and also reduced treatment time.[9,19]

Fig. 58. Petite Type face mask.

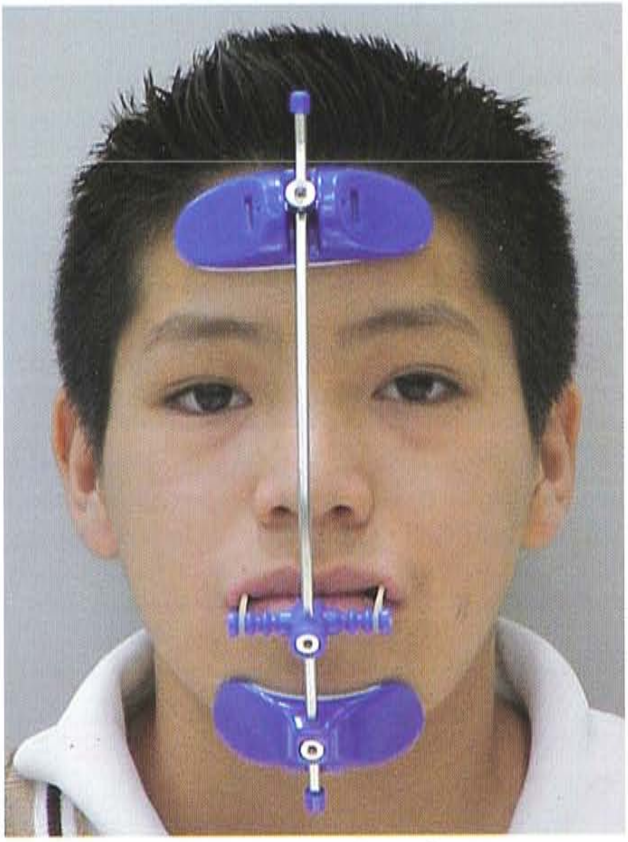


Fig. 59. Petite Type face mask.

This appliance (also called inverted traction mask) in combination with a fixed palatal expansion appliance (Hyrax), is the proposed method of treatment for the interception of true skeletal Class III malocclusions with an anterior cross bite. [35]

This treatment must begin as soon as the upper molars, central and lateral incisors have fully erupted; first of all, we must place a rapid maxillary expansion appliance and we must activate the appliance twice a day (2/4 of a complete turn of the screw) for a week before placing the face mask. The purpose of this is to disrupt the suture system and to facilitate the protraction of the upper maxilla with the face mask. The sutures that compose this system are: the frontomaxillary suture, the nasomaxillary suture, the zygomaticotemporal suture, the zygomaticomaxillar suture, the pterygopalatine suture, the mid palatal suture, the etmoidmaxillar suture and the lacrimomaxillar suture.[19,35]

Components of the face mask

1. Frontal support: This part must be placed 1 cm to 2 cm over the eyebrows or equidistant between the eyebrows and the hair.[19]
2. Chin support: This part must be placed 7 mm under the chin furrow.
3. Central rod: It is made out of stainless steel and it will coincide with the midfacial line of the patient.[19]
4. Horizontal rod: It must be orientated 2 cm to 3cm under the occlusal plane (30° downward approximately).[5,19]
5. Elastics: These elastics are laced at the canine level and have a downward and forward direction 1 cm to 1.5 cm below the occlusal plane in order to not harm the corners of the mouth. We require 5/16" elastics that generate 800 g to 1500 g.[5,22,23]
6. Adhesion palatal expander: It is a rapid maxillary expansion screw like the Hyrax with flat acrylic skidding surfaces on the occlusal aspects of the first and second primary molar and the first upper permanent molar. Hooks are added to this appliance at the primary canine level on which the protraction elastics will be placed.

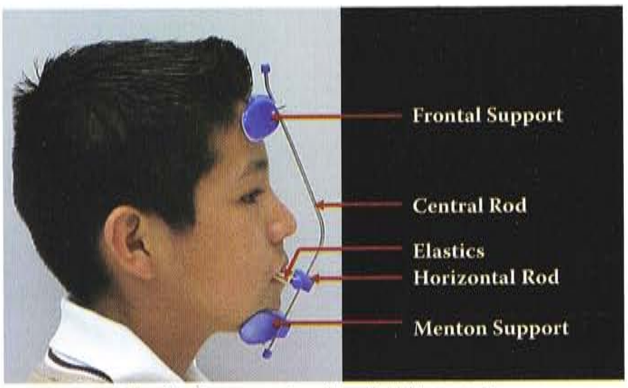


Fig. 60. Components of the Petit face mask.

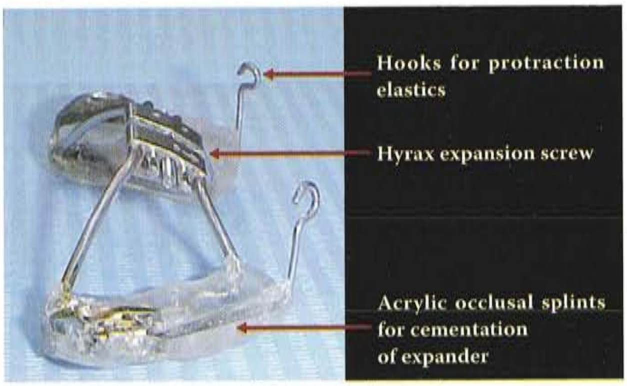


Fig. 61. Adhesion palatal expander.

Indications

1. Patients with deficient anteroposterior maxillary development.

2. Skeletal Class III patients due to maxillary hypoplasia.
3. The patients must be preferably in the early mixed dentition.
4. The use of this appliance is indicated in cleft lip and palate patients.

Effects produced by face mask therapy

1. Correction of discrepancies between centric occlusion and centric relation, most of all in pseudo Class III patients.
2. Skeletal protraction of the maxilla producing 1 mm to 3 mm of advancement.
3. Anterior movement of the maxillary teeth.
4. Lingual inclination of the lower incisors.
5. It redirects mandibular growth due to the downward and backward rotation of the mandible.
6. The lower facial height is increased.
7. Point "A" is moved forward and the maxilla moves forward and downward.
8. The cheekbones increase their volume.

Advantages

1. The face mask is an effective tool for the treatment of skeletal Class III malocclusions that range from mild to moderate, with a retrusive maxilla and a hypodivergent growth pattern.[5]
2. It reduces the possibility of a future surgical intervention.
3. The acrylic skidding surfaces of the adhesion palatal expander help in the control of the vertical eruption of the molars. The main function of these surfaces is to produce a bite jump to uncross the bite and to facilitate maxillary protraction.[5]
4. The use of the face mask produces an increase of the lower third of the face, this is due to the downward movement of the maxilla and the downward and backward rotation of the mandible.
5. In general, patients with skeletal Class III present a concave profile, depressed nasomaxillar region, protrusion of the lower lip and a prominent mandible. With the protraction of the maxilla with the face mask, the facial profile and the position of the lower lip are rectified.[5]
6. Clinically, the anterior cross bite can be corrected in 3 to 4 months depending upon the severity of the malocclusion.[5]
7. The maxilla can be forwarded between 2 mm to 4 mm in 8 to 12 months of protraction, but most of the orthopedic changes can be observed in the first 3 to 6 months of continuous treatment.[5]

Disadvantages

1. A faulty design of the chin support can cause lacerations or can irritate the skin of the chin furrow, and provoke root resorption of the lower incisors.
2. For this appliance to be effective we need 100% patient cooperation.
3. This appliance is not accepted by all patients.
4. The elastics can cause lip corner irritation.
5. The patient can refer sharp pain in the retromolar zone, because the pterygo-maxillar suture opens.[32]
6. Prolonged treatment time can undermine the degree of oral hygiene and cooperation of the patient.[5]

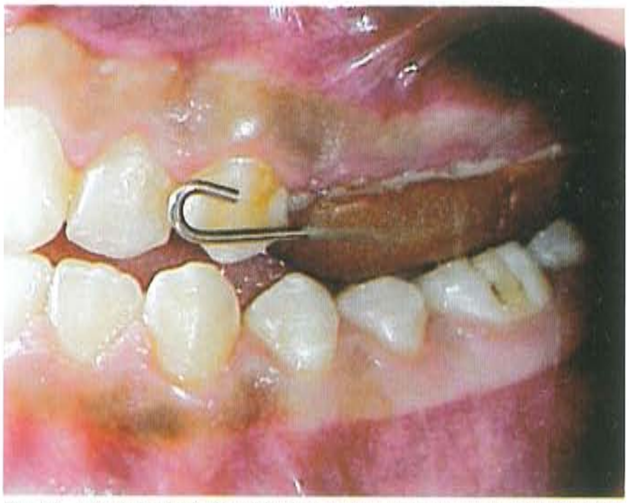


Fig. 62. A very prolonged treatment time can make hygiene a bit more difficult favoring the accumulation of food particles.

Recommendations

1. For face mask therapy, we must first begin with the rapid expansion of the maxilla to disarticulate the suture system; within a week or 10 days after the expansion has begun we can place the face mask. This is to facilitate the protraction of the maxilla.
2. The face mask is used generally until we have an overjet of 3 mm to 5 mm.
3. The skidding surfaces of the expander must cover the first and second deciduous molars and the first upper permanent molar.
4. If the second permanent molars are present, we must extend the skidding surfaces to this tooth to prevent molar extrusion.

5. If there is an anterior open bite present, the traction hook must be placed in a high position to produce an oblique force direction and to favor the closure of the bite.
6. Whenever we want alveolar dental forwarding, the traction hooks must be placed at the canine level.
7. In deep bite cases, the traction hook must be placed at the permanent upper molar level to extrude this tooth and to open the bite.
8. Suspend the use of the face mask if TMJ problems arise.
9. The elastics used for the protraction of the upper maxilla can be 5/16", which will generate heavy forces, following this sequence:

    9.1. 8 ounces at the beginning of treatment (230 g).
    9.2. 14 ounces at the end of treatment (400 g).

10. We recommend periodic appointments to inspect the expander and to evaluate the changes in soft tissues (every 4 to 6 weeks).
11. We must indicate to the patient that the mask should be used all day except during meals or during the practice of a sport.
12. If the patient tolerates the use of the face mask during sleep hours, we must encourage the patient to use the appliance during these hours because the growth hormone is liberated in this time period and the skeletal changes will be most favorable.
13. We do not consider appropriate to direct our efforts in inhibiting mandibular growth, because the mandible grows influenced by a genetic hormonal mechanism that cannot be influenced by functional stimuli or appliances.(13)

Fig. 63. Anterior cross bite before the placement of the rapid maxillary expander.

Fig. 64. Occlusal view of the upper rapid maxillary expander once cemented.

Fig. 65. The flat skidding surfaces help to lift the bite to aid in the protraction of the maxilla with the face mask.

Modified Tandem

The modified Tandem is an anterior maxillary traction device, indicated in cases where the patient presents maxillary hypoplasia with an anterior cross bite and when the patient is still growing (Class III patients due to a maxillary skeletal deficiency). This appliance has four components:(15)

1. Fixed:
    a. Adhesion upper expander with skidding flat surfaces with protraction hooks on the bands of the upper molars.
    b. Adhesion lower skidding flat surfaces from molar to molar with double tubes imbedded in the acrylic at molar level; the arch of the anterior protraction appliance will be inserted in these tubes.

2. Removable:
    a. Anterior protraction arch (modified protraction arch).
    b. Protraction elastics.

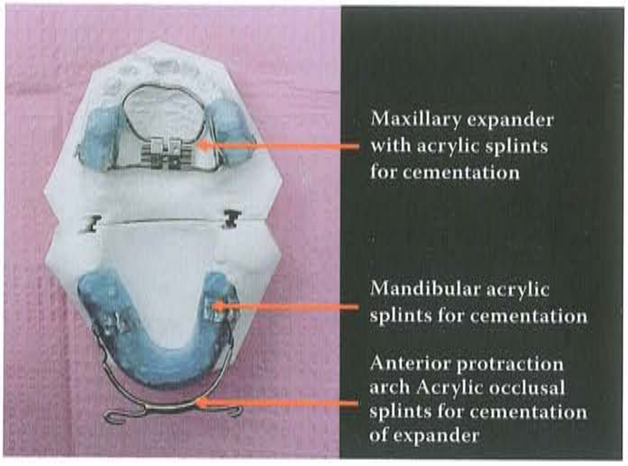


Fig. 66. Components of the Modified Tandem.

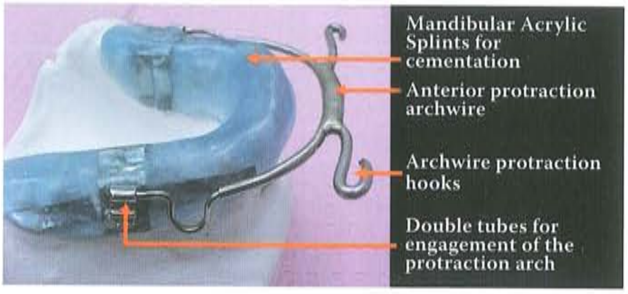


Fig. 67. Components of the Modified Tandem.

The protraction of the maxilla is done through the force exerted by the heavy ¼" elastics that exert 230 g of force per side, which are going to be placed on the hooks of the upper protractor (hooks of the molar tubes), to the hooks of the anterior protractor (modified extra oral arch).(15) The lower adhesive flat skidding surfaces are going to act as anchorage to facilitate the advancement of the upper maxilla. The direction of the elastics must have a downward and forward vector (from the hooks of the upper bands to the hooks of the protraction arch) following the normal growth path of the maxilla.

Fig. 68. The maxillar protraction force will be exerted by the elastics.

Fig. 69. Front view of the Tandem in the mouth.

Fig. 70. Lateral view of the Tandem.

Fig. 71. The direction of the force exerted by the elastics must have a downward and forward vector, following the normal maxillary growth pattern.

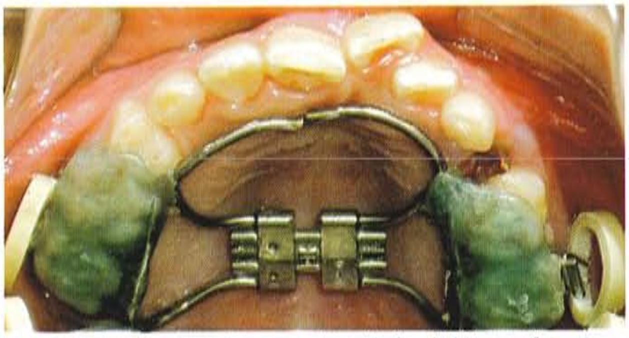
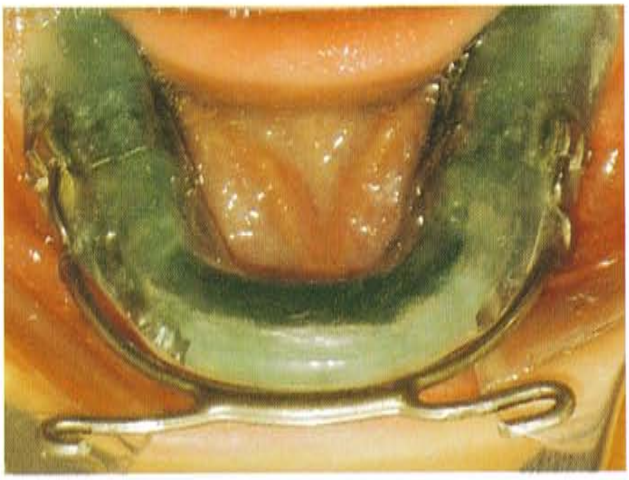


Fig. 72. Adhesive upper expander with flat skidding surfaces.



PFig. 73. Lower adhesion flat skidding surfaces and the anterior rotraction arch.

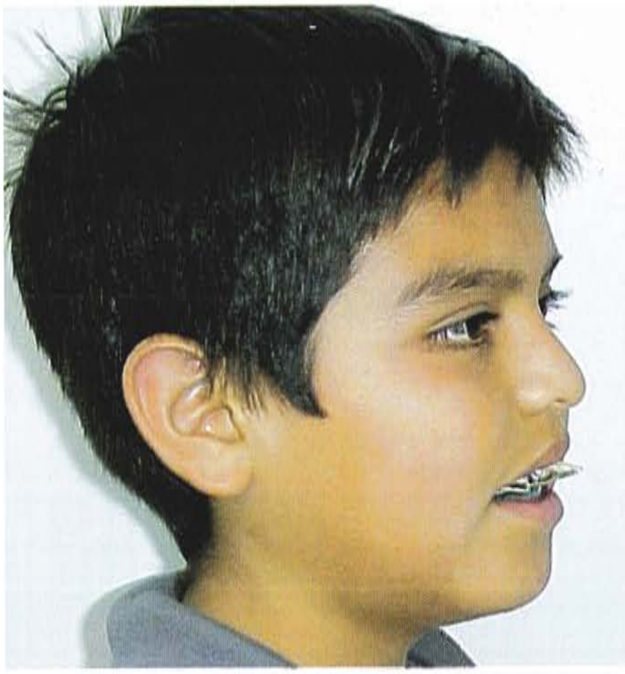


Fig. 74. Extra oral view of the Tandem in the mouth.

Advantages

1. We do not require expensive materials to elaborate this appliance.
2. Easy to elaborate.
3. Much more esthetic than the face mask so we can expect more collaboration from the patient.
4. The appliance not only corrects the malocclusion but also has a positive effect upon the soft tissues. [15]
5. The appliance produces consistent results in a brief time period.[15]
6. It produces between 2 mm to 3 mm of protraction.
7. The Tandem is an effective tool for the correction of mild to moderate skeletal Class III malocclusions, with a retrusive maxilla and a hypodivergent growth pattern.[5]
8. The use of the Tandem produces an increase of the lower third of the face; this is due to the downward movement of the maxilla and the downward and backward movement of the mandible.
9. It reduces the risk of a surgical procedure in the future.
10. In general, skeletal Class III patients have a concave profile, a depressed nasomaxillary region, lower lip protrusion and a prominent mandible. The maxillary protraction produced by the Tandem rectifies the facial profile and the position of the lower lip.[5]
11. Clinically the anterior cross bites can correct in 3 to 4 months depending upon the severity of the malocclusion.[5]
12. The maxilla can be placed forward between 2 mm to 4 mm in about 8 to 10 months of protraction, but the majority of orthopedic changes can be observed in the first 3 to 6 months of continuous treatment.[5]
13. It is a very versatile appliance because it can be combined with fixed appliances during the maxillar protraction.

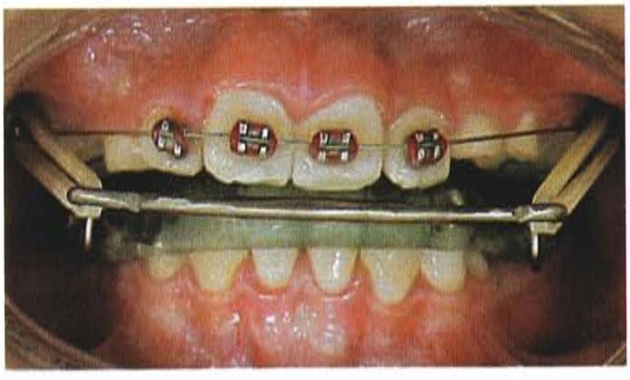


Fig. 75. It allows the use of fixed appliances during the protraction of the maxilla.

Disadvantages

1. We must invest laboratory time to elaborate the appliance.
2. Bad hygiene can provoke food particle accumulation and gingival irritation.
3. The force exerted by the elastics can provoke the debonding of the upper or lower flat skidding surfaces.
4. We need 100% cooperation of the patient.
5. The elastics can cause lip irritation.
6. The patient can refer pain in the retromolar zone due to the opening of the pterygo-maxillary suture.(32)

Recommendations

1. Following the maxillary protraction protocol, we must begin with the upper expansion in order to disarticulate the sutures and to facilitate the advance of the maxilla, so we must indicate to the patient that the expander must be activated twice a day, once in the morning and once at night.
2. The Tandem must be used between 10 and 12 hours a day.(15)
3. If the patient tolerates the use of the Tandem during sleeping hours, we must encourage the patient to wear it during sleep, because the growth hormone is liberated during this period and the skeletal changes will be much more favorable.
4. The elastics used for protraction will be ¼", which will generate heavy forces, following this use sequence:

   a. 8 ounces at the beginning of treatment (230 g).
   b. 14 ounces at the end of the treatment (400 g).

5. We recommend periodic appointments to inspect the expander and to evaluate the changes in the soft tissue (every 4 to 6 weeks).

Mini-maxillary protractor

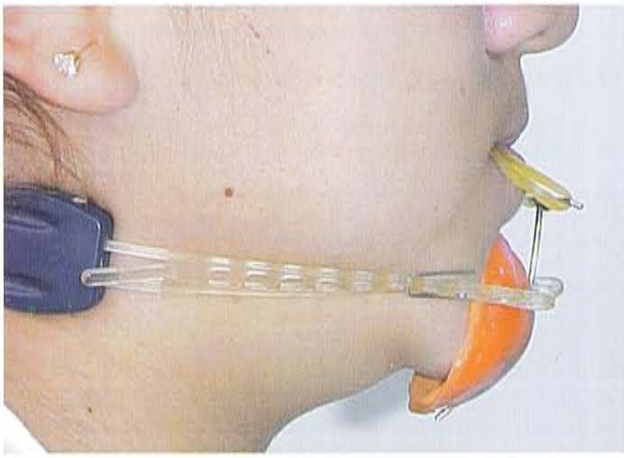
The mini-maxillary protractor, like the Tandem and the face mask, is an anterior maxillary protraction appliance that is indicated in patients that are growing and have an anterior cross bite (Class III patients with skeletal maxillary deficiency). This appliance has three components:(15)

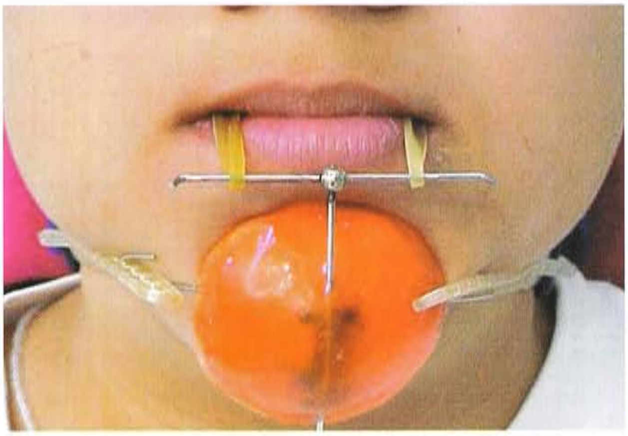
1. **Fixed**
   a. Upper adhesion Hass Type expander with flat skidding surfaces and protraction hooks.
2. **Removable**
   a. Anterior protraction arch with chin cup.
   b. Neck pad.

The advancement of the maxilla and its dento-alveolar process is obtained as an effect of the force exerted by the 5/16" elastics upon the intraoral appliances. These heavy elastics

Fig. 76. Front view of the Mini-maxillary protractor.

Fig. 77. Lateral view of the Mini-maxillary protractor.





Figs. 78 and 79. The horizontal rod of the protraction arch must be localized 30° bellow the occlusal plane.

Fig. 81. Front view of the expander with the protraction hooks.

Fig. 82. Hass type expander with flat skidding surfaces.

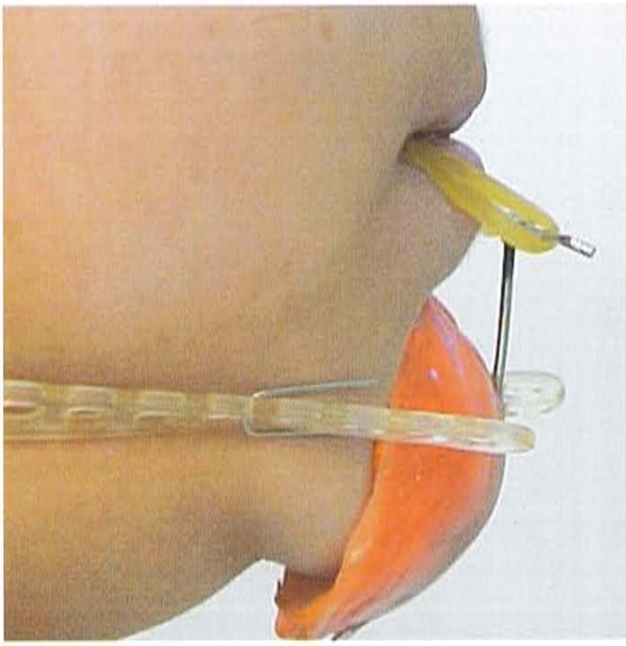


Fig. 80.The force direction exerted by the elastics must be forward and downward, following the nórmal growth path.

Fig. 83. The protraction hooks must be at the canine level.

are going to exert a force between 230 g to 400 g per side, and are going to be inserted from the protraction hooks of the Hass type expander to the horizontal rod of the anterior arch.[13,15] The chin cup serves as geniomolar anchorage to facilitate the forward movement of the maxilla. The direction of the elastics must be downward and forward, from the upper protraction hooks to the horizontal rod of the protraction arch, following the normal path of maxillary growth.

Advantages

1. It is economic.
2. Easy to make.
3. It is more esthetic than a face mask so it is more likely to be used by the patient.
4. Corrects the malocclusion and has a positive effect upon the profile on the patient.[15]
5. Produces consistent results in a brief time period.[15]
6. Produces between 2 mm to 3 mm of protraction.
7. The Mini-maxillar protractor is an effective tool for the correction of mild to moderate skeletal Class III malocclusions, with a retrusive maxilla and a hypo divergent growth pattern.[5]
8. The use of the Mini-maxillar protractor produces an increase of the lower third of the face, this is due to the downward movement of the maxilla and a downward and backward rotation of the mandible.
9. It reduces the possibility of a future surgical procedure.
10. In general, skeletal Class III patients present a concave profile, depression of the nasomaxillar region, lower lip protrusion and a prominent mandible. With the protraction effect of the appliance the facial profile and the position of the lower lip is rectified.[5]
11. Clinically the anterior crossed bites can be corrected in 3 to 4 months of treatment , depending on the severity of the case.[5]
12. The maxilla can be brought forward 2 mm to 4 mm in about 8 to 12 months of protraction, but the majority of orthopedic changes will be observed in the first 3 to 6 months of continuous treatment.[5]

Disadvantages

1. A faulty design of the chin cup can irritate the skin of the chin and root resoption of the lower incisors.
2. The expander can accumulate food particles and cause gingival irritation.
3. We must invest laboratory time to fabricate the appliance.

Fig. 84. Gingival irritation caused by food accumulation.

4. The force produced by the elastics can debond the upper skidding surface.
5. We need 100 % cooperation of the patient.
6. The elastics can irritate the skin of the chin and the corners of the mouth.
7. The patient can refer sharp pain in the retromolar zone because the pterygo-maxillary suture opens.[32]

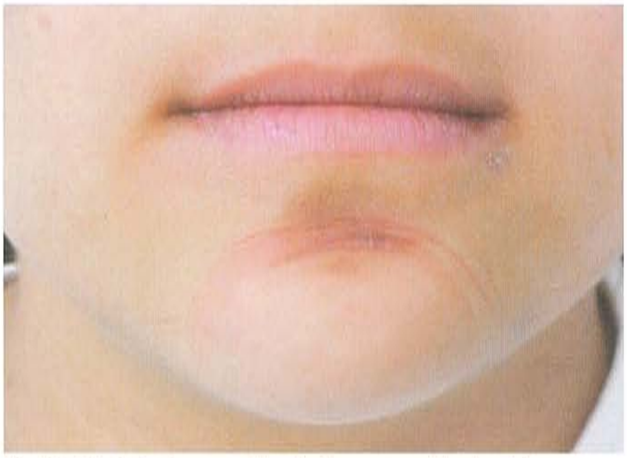


Fig. 85 Skin irritation caused by the force exerted by the chin cup of the Mini-maxillary protractor.

Recommendations

1. Following the maxillary protraction protocol, we must begin with the upper expansion in order to disarticulate the sutures and to facilitate the advance of the maxilla, so we must indicate to the patient that

the expander must be activated twice a day, once in the morning and once in the night.

2. The Mini-maxillary protractor should be used between 10 and 12 hours a day.[15]
3. If the patient tolerates the appliance during the hours of sleep, we should encourage its use because this is the time period in which growth hormone is liberated and the skeletal changes will be more favorable.
4. We recommend periodic appointments to inspect the expander and to evaluate any changes in the soft tissue (every 4 to 6 weeks).
5. The elastics that are used for upper maxillary protraction are 5/16", which generate heavy forces , using this sequence:

   a. 8 ounces at the beginning of treatment (230 g).
   b. 14 ounces at the end of the treatment (400 g).

Camacho Badillo Regulator (CBR)

This appliance was designed in 2005 by Dr Mauricio Camacho Badillo, resident of the orthodontic specialty program of Centro de Estudios de Ortodoncia del Bajío (CEOB), in the city of Irapuato, Guanajuato, México.

This appliance is an alternative for patients that have anterior and posterior cross bites with a tendency to a hypodivergent growth pattern (Class III), because it stimulates transversal and anteroposterior maxillary growth, and produces mandibular retropulsion; this is done with intermaxillary elastics that produce 400 g of force per side.

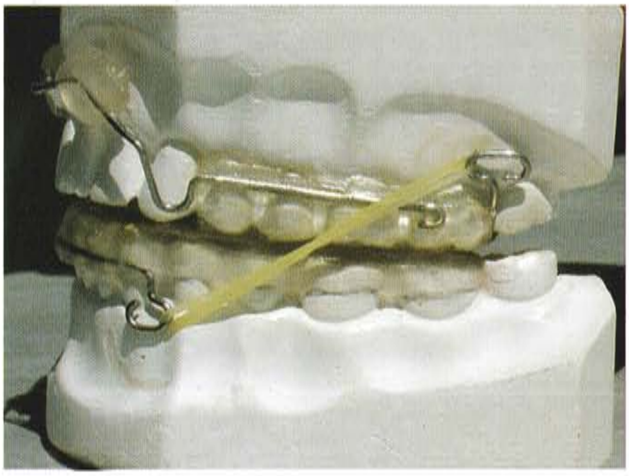


Fig. 86. CBR.

Fabrication

1. This appliance is constituted by two palatal 0.036" TMA rods, which will transmit to the teeth of the lateral sector (premolars and molars) the transversal forces needed for the correction of the posterior cross bite. Two 0.036" stainless steel wire protraction hooks are placed between the first molar and the second premolar 4 mm from the marginal rim, in order to place the point of traction as close to the center of resistance of the maxilla.
2. We place a vestibular arch on the anterior zone which is going to be separated 3 mm from the inserted mucosa in the buccal fold. On the lower model two protraction hooks are going to be located at canine and premolar level.

Fig. 87. TMA wire palatal rods.

Fig. 88. Protraction hooks at molar level.

3. Most of the metal skeleton is covered with acrylic, including the occlusal aspects of the posterior teeth, only the upper and lower protraction hooks are exempt. Two acrylic shields are placed on the vestibular arch, which are going to function as shields to separate the mucosa of the upper lip and stimulate the anterior growth of the maxilla.

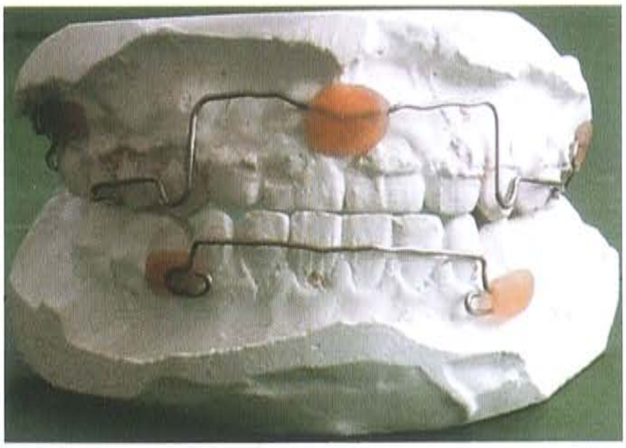


Fig. 89.

4. Finally the CBR is placed in the mouth.

Fig. 90. All the wire skeleton is going to be covered of acrylic except the protraction hooks.

Fig. 91. CBR with acrylic.

Advantages

1. Economic.
2. Easy to make.
3. Intraoral.
4. It stimulates the transversal growth of the maxilla thanks to the palatal TMA rods.

Fig. 92. CBR placed in the mouth.

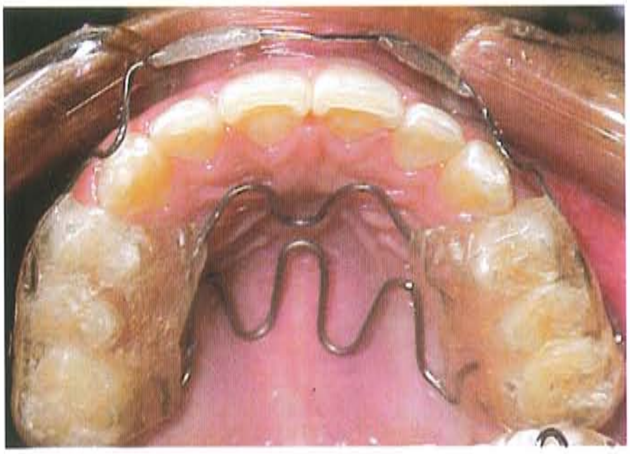


Fig. 93. Occlusal view of the CBR.

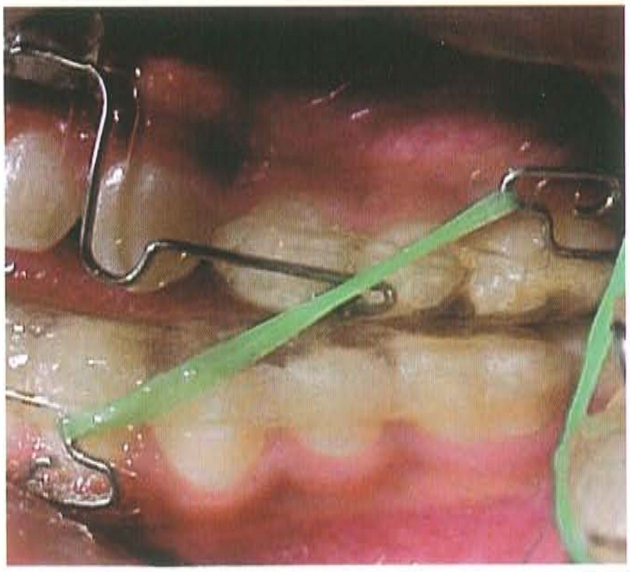


Fig. 94. CBR with protraction elastics (Class III elastics).

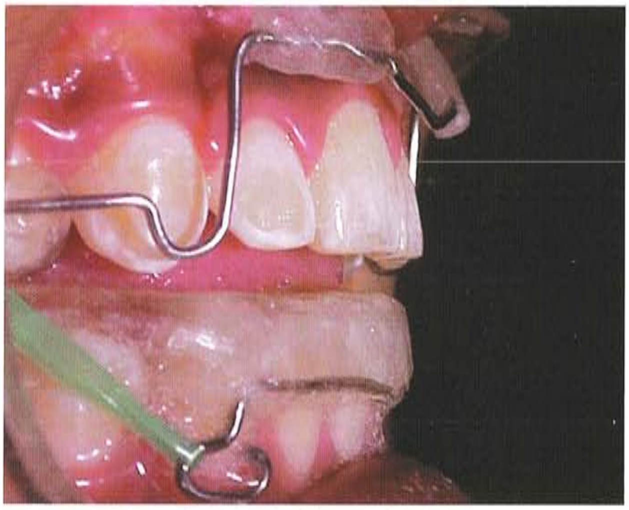


Fig. 95. CBR placed in the mouth. Lateral view.

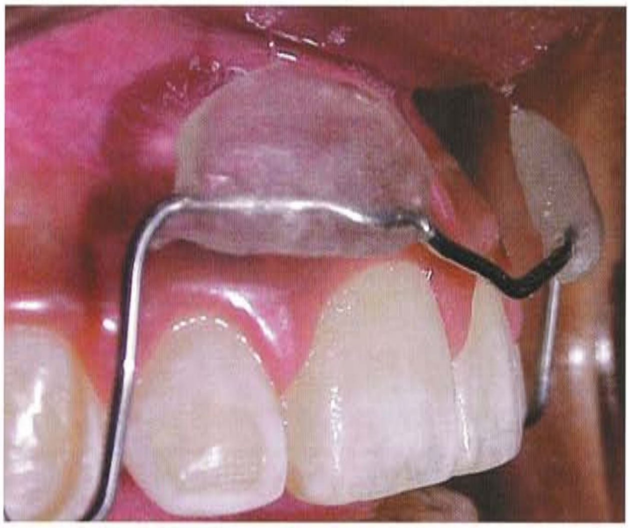


Fig. 96. The buccal shields are separated away from the inserted mucosa.

5. It stimulates the anterior growth of the maxilla thanks to the vestibular shields and the Class III elastics.
6. The Class III elastics stimulate retropopulsion of the mandible, which allows the correction of the anterior cross bite.
7. There is good vertical control, which is obtained by the flat acrylic surfaces that allow and limit the extrusive movements of the posterior zone, avoiding a non-desired rotation of the upper maxilla segment.
8. The expansion, done by the TMA palatal rods, separates the mid-palatal suture and activates the neuromuscular system.
9. The maxillary expansion during the early mixed dentition can produce a spontaneous correction of Class III malocclusions.
10. The flat acrylic surfaces allow free mandibular sliding and the overlap of the overbite.

Disadvantages

1. It requires laboratory time to fabricate.
2. We depend upon the collaboration of the patient for the use of the Class III elastics.
3. With continuous use, the acrylic tends to change color and to absorb foul odors.
4. It retains food.
5. Speech is impaired.
6. Sometimes the patient does not accept the appliance easily.

Recommendations

1. The thickness of the acrylic flan surfaces must not exceed 0.5 mm or 1 mm.
2. The TMA rods must be active upon placement.
3. The patient must have an excellent oral hygiene.
4. We must indicate to the patient that the appliance must be worn 24 hours a day and must only be removed during meals.
5. Patients with a Class III tendency can use the appliance as a retainer.
6. The elastics must be changed every 24 hours.
7. The elastics used for maxillary protraction are 5/16", which generate heavy forces, and must follow the following use sequence:

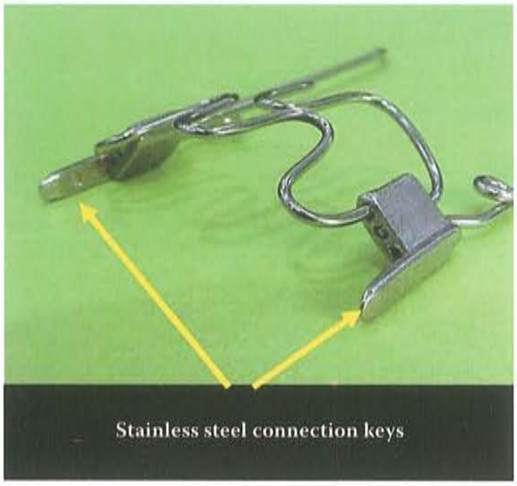
a. 8 ounces at the beginning of the treatment (230 g).
b. 14 ounces at the end of the treatment (400 g).

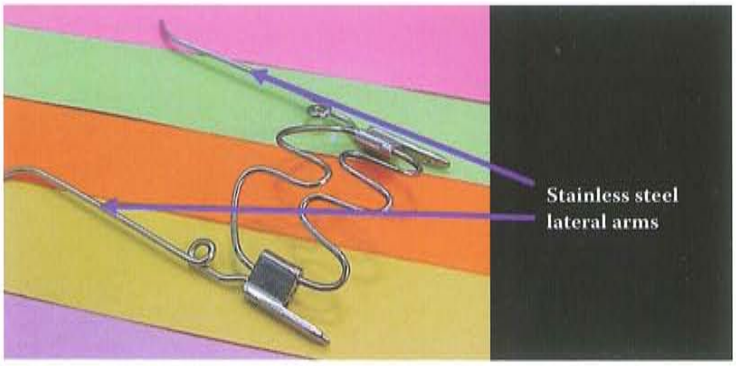
TREATMENT FOR POSTERIOR CROSS BITES

Tandem loop

The ARNDT Tandem loop palatal expander is a prefabricated appliance designed for the correction of dento-alveolar posterior cross bites. It is constituted by two 0.036" thermal NiTi wire palatine rods, the ends of the rods are connected with a stainless steel connector, from which two lateral arms emerge and transmit to the teeth of the lateral sectors (canines and premolars) the forces produced by the palatine NiTi rods. Because the structure is made of steel, it allows a series of manipulations to be adapted to different necessities. The expander is inserted in the palatal sheaths of the bands of the molars through two "coupling keys" which are parallel in a mesiodistal sense. This appliance exerts a uniform, soft and continuous expansion force of approximately 350 to 450 g.[8,13,21]

Fig. 97. Tandem Loop thermal expander





Figs. 97-101. Components of the Tandem Loop.

The nickel titanium component has a transition temperature of 34.5°C. Before we insert the appliance in the mouth, we must place the expander in cold water of spray Tetrafluoroethane on it to make it more flexible (martensitic state). Once the appliance is in the mouth, it will begin to activate at body temperature and to return to its original state (austentitic state).

The degree of expansion will depend upon the age of the patient. In those patients that are in the early mixed dentition, the expansion can be accomplished in about two months depending on the severity of the case. Expansion in adolescents can take 3 months, and in adult patients the expansion will take more time.[17]

The expander is made in eight sizes that range between 26 mm to 47 mm with a 3 mm difference between them. Generally, the expansion need range is between 4 mm to 5 mm (2 to 2.5 mm per side), and in order to select the appliance we can take a compass and measure the distance between the palatal sheaths, add 4 mm to this distance and then select the appliance.[13]

Advantages

1. The appliance is light and comfortable to the patient.
2. Hygienic.
3. Because it is a prefabricated appliance, we do not need impression appointments nor sending any work model to the laboratory, because we can adapt it directly to the mouth due to the characteristics of the NiTi alloy used in its construction.[13,17]
4. It reduces costs and chair time.
5. The expander can be used simultaneously with conventional fixed appliances; it only needs the addition of sheaths on the molar bands.[17]
6. The ARNDT Tandem loop generates optimal, constant and uniform expansion forces.[8]
7. It is a very effective expander.
8. It does not need any manipulation on behalf of the patient, and the operator can control the appliance easily.
9. It can be programmed to expand exactly the amount of expansion needed, so we can eliminate the possibility of over expanding the arch.[13]
10. It produces light, soft and continuous forces.
11. It can also derotate molars.
12. It can maintain vertical control of the molars.[13]

Disadvantages

1. The patient can refer slight initial pain as soon as the appliance is in place and body temperature begins activating the appliance.
2. The steel arms can irritate the palatal mucosa if these produce certain degree of ischemia.[13]
3. Patients repose position of the tongue is in contact with the palate can present indentations. We recommend the use of orthodontic wax during the adaptation period in these patients.[21]

Recommendations

1. The retention period must oscillate between 50% and 100% of the time it took to complete the expansion.
2. We always recommend over expanding 1 mm to 2 mm to compensate the tendency that the posterior sector has to return to its original state.
3. We must control the vertical component in patients with increased lower inferior third.
4. We recommend the use of a head gear for vertical control of the eruption of maxillary molars while the molar Class II is corrected.
5. Once the transversal discrepancy is corrected, the expander must remain in the mouth the necessary time to correct any buccal inclination that can occur in the initial expansion process.[17]
6. If a molar is very much rotated, we must manipulate the coupling keys to provoke gradual activations. This obeys to two principles:
   a. Not to exert excessive forces on the molars.
   b. Avoid excessive displacements of the lateral arms toward the midline, which will undermine the tolerance of the patient to this appliance in the initial phases.
7. The NiTi rods of the Tandem loop occupy part of the space of the tongue and will be submitted to the pressures exerted by the tongue, this is why it is an appropriate appliance for vertical control of the molars.[13]
8. If we only want to expand the molars in patients in the permanent dentition, we can use the expander without the lateral arms, but only if the main arch wires are in place, because these wires control the expansion.[13]
9. Pain killers are rarely needed in young patients, but if needed, we can prescribe children's Tylenol during the first 2 or 3 days.[21]

Quad Helix

The Quad Helix was introduced in the 60's by Dr Ricketts. It is a palatal expander made with 0.038" Elgiloy blue wire that incorporates in its design four helicoidal loops. It is an efficient appliance for slight expansions when anterior overcrowding is not the major concern and posterior dento alveolar modifications are seeked, although some studies indicate that this appliance exerts a widening effect in the palatal suture in young patients. Change is slow and not as spectacular as disjunction, but it separates the suture as it allows suture ossification. Slow expansion promotes more post expansion stability, given an adequate retention period. A slow expansion appliance requires minimal adjustments, but allows easy adjustments when required. The Quad Helix transmits constant and physiologic forces while the expansion is taking place.[13,17,27,36]

The Quad Helix can be fixed (soldered to the molar bands) or removable (inserted in the palatal sheaths of the band molars). These two models can be bought in many sizes or made in the laboratory over study models of the patient.

The Quad Helix has 4 spiral helicoidal bends, two on the anterior zone, which must descend from the bridge to the palate, and the other two are located slightly behind the molar band, to allow rotation and molar expansion.[12,13]

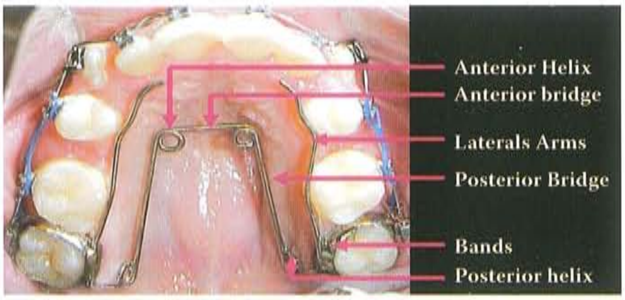


Fig. 102. Parts of the Quad Helix.

Indications

1. In those cases that have transversal problems of dentoalveolar origin that must be resolved in the upper arch.[13]
2. In cases that require a slight expansion in the mixed dentition to create space for the upper laterals.[27]

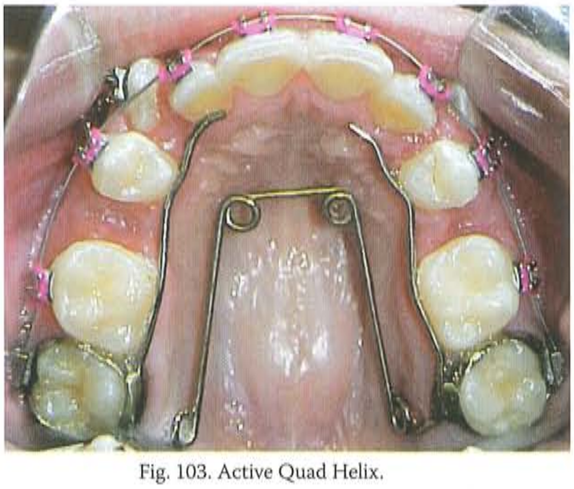


Fig. 103. Active Quad Helix.

3. It is ideal for cleft lip and palate patients, because it produces more force in the anterior sector than in the posterior sector.
4. Class II patients that need a wider upper arch and distal rotation of the upper molars.[27]

Fig. 104. Quad Helix after 6 weeks after placement.

Activation

The activation of the Quad Helix is done in three steps:

1. The first activation is done out of the mouth before we cement the appliance. We must expand the appliance about 8 mm maintaining the lateral arms parallel, [13] in order to have the same magnitude expansion on both sides. This first activation will generate 400 g of force approximately. We cement the appliance and schedule the patient again in 6 more weeks.
2. A second activation is done inside the mouth on the anterior bridge with a 3 prong plier, where the single

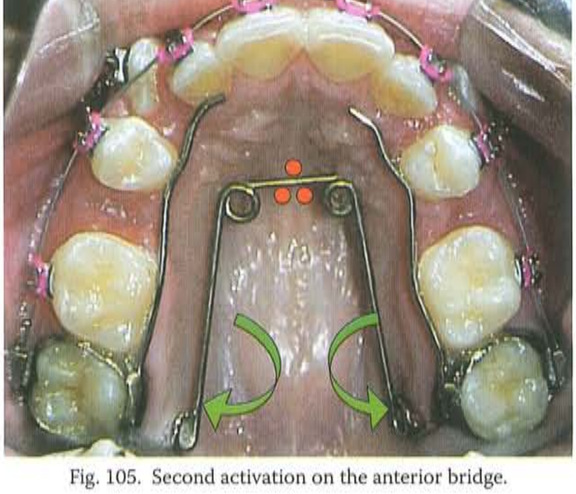


Fig. 105. Second activation on the anterior bridge.

prong of the plier must be in front. This way the posterior sector is expanded and the molars rotate mesially. We again schedule the patient in 6 more weeks.

3. The third and last activation is done in the posterior bridges, to produce distal rotation of the molars and expansion of the lateral arms.[13]

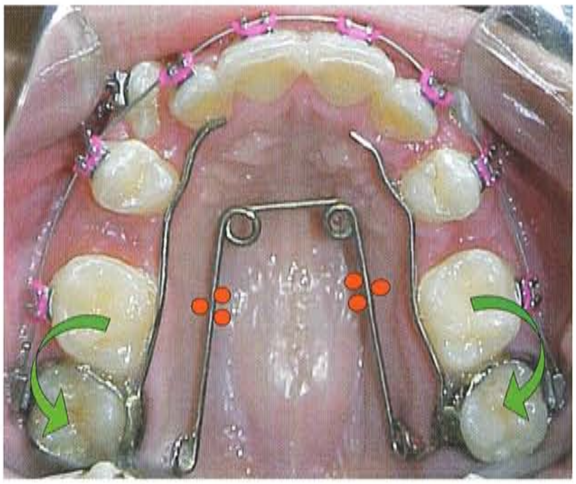


Fig. 106. Third activation at posterior bridge level.

Advantages

1. We do not require patient cooperation because it is a fixed appliance.[36]
2. Hygienic.
3. It produces continuous and light physiologic forces.
4. It can produce up to 6 mm of inter-molar and inter canine width increase.
5. The patient does not refer pain.
6. It can be used in conjunction with fixed appliances.
7. It is easy to make and to use.[36]
8. It can be used as an anchorage and retention appliance.
9. In young patients we can obtain between 3 mm to 4 mm of midpalatal suture separation.
10. Generally the expansion and the rotations are obtained within 60 to 90 days.[13]

Disadvantages

1. The appliance can impair the ability to speak of the patient.
2. Sometimes it can get in the way with the oral hygiene of the patient.
3. After the appliance has been cemented the subsequent activations are difficult to perform.[36]
4. If the appliance is placed in a downward and backward position, the tongue may not function correctly.[27]

Recommendations

1. The expansion must initiate at the beginning of the treatment and must be finalized as soon as the round wires are installed.[13]
2. Until the transversal problem has been resolved, we do not recommend the sequence with rectangular wires, because the expansion movement is going to modify the molar torque.
3. We must over expand the maxilla 2 mm to 3 mm to prevent rebound.
4. After the expansion has taken place, the appliance must remain passive for 6 weeks, and after this it must remain as contention for 3 months, after this we can take it off.

Transpalatine arch with an extension arm

Transpalatine arches are very versatile appliances, because they can be used in a wide range of applications while they are used as moderate anchorage during space closure in orthodontic treatmen.[5] The transpalatine arch is made with 0.036" stainless steel wire and consists of a palatal arch, with a central omega, that is connected to the bands of both upper first molars. A very common situation that we can encounter during the occlusal analysis of a patient is to find molars that are in a buccal position or in a cross bite, which in occasions is product of a dentoalveolar compensation caused by a transversal narrowing of the maxilla, pronouncing even more the Wilson curve. The course of action in these cases is to flatten this curve; this can be done applying torque on the solder point of the bands with the transpalatal arch to correct, the buccal position of the tooth or the cross bite, depending on the position of the tooth.[19]

On the other hand, these arches can be activated to establish and maintain the width of the arches, prevent molar rotations, correct mesiodistal asymmetries, correct asymmetric and symmetric cross bites and to correct third order axial inclinations.[5]

Another situation that can be presented is the unilateral constriction of the upper arch; generally it is a posterior cross bite or a dentoalveolar edge to edge, in which we can use for the correction of this problem a transpalatal arch with an extension arm that is in contact with all the palatal aspects of the teeth that are in cross bite (it is the same principle as the Quad Helix). This arm is going to exert pressure over these teeth, and with the action of the fixed appliances, is going to favor the correction of the malocclusion producing a unilateral dentoalveolar expansion of the maxilla, increasing this way the dental arch length.

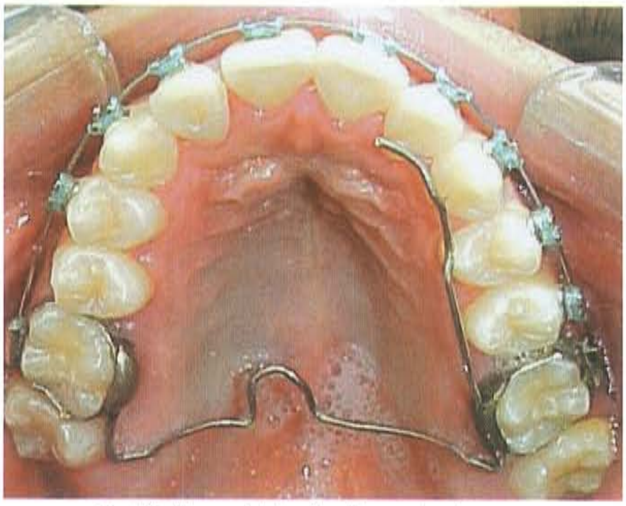


Fig. 107. Transpalatal arch with an extension arm.

Advantages

1. It is a fixed appliance in which we do not need patient cooperation.
2. Well accepted by the patient.
3. Economic and easy to make.
4. Although it is cement activated, we can perform subsequent activations, simply plying the lateral arm near the solder joint point.
5. Hygienic.
6. It can be used as a anchorage or retention appliance.
7. Not painful to the patient.

Disadvantages

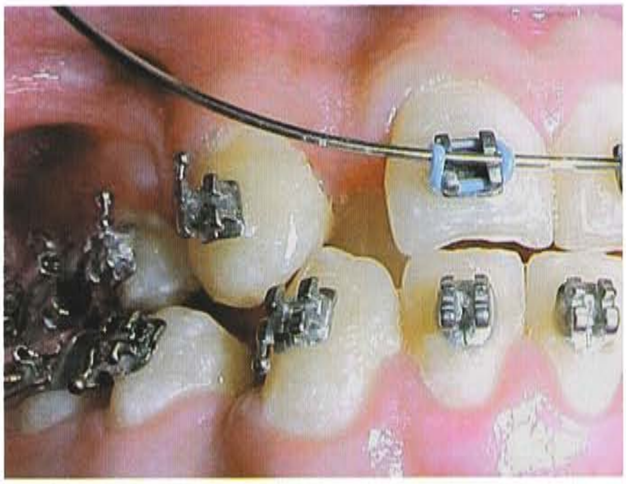
1. It can produce ischemia in the marginal gum.
2. It consumes laboratory time to make.
3. While the patient swallows, the transpalatine can injure the dorsum of the tongue or invaginate in the palatal mucosa (please refer to Lesions and Emergencies during Orthodontic Treatment chapter).
4. Expansion is slow.

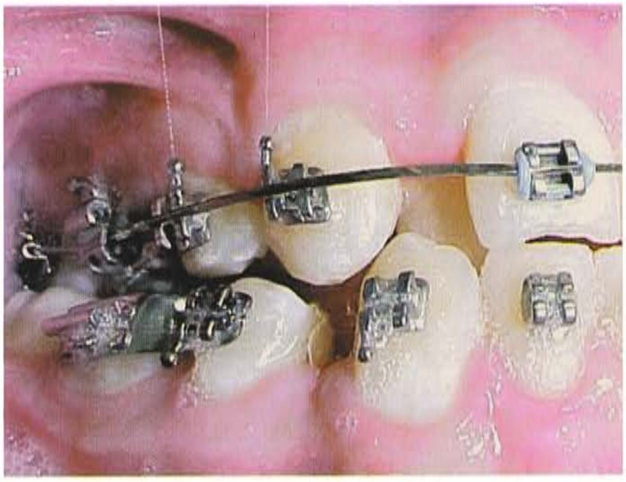
Recommendations

1. We must do some stripping on the teeth involved in the posterior cross bite, to liberate the contact points and to ease their movements.
2. We recommend over expanding 1 mm to 2 mm due to the rebound effect.
3. Once the bite is uncrossed, we must leave the appliance cemented for 3 months.
4. Once the retention time period has passed, we can cut off the arm and leave the transpalatal arch as moderate anchorage.
5. The omega of the transpalatal arch must be separated 1 mm to 2 mm from the palatal mucosa.

Inverted NiTi arch

The use of an inverted NiTi is indicated in those patients that have a bilateral posterior cross bites in the mixed dentition with no more than 2 mm of cross bite, in which we need to expand the dentoalveolar process to correct the malocclusion. This method is based upon the elasticity that the NiTi wires have and the tendency that the arches have to return to their original position.[29] To apply this technique we must use 0.018" x 0.025" or 0.019" x 0.025" rectangular NiTi wires, to prevent the wire from turning around in the slot of the brace. Bioforce wire, from GAC, is much easy to manipulate if sprayed with tetrafluoroethane before placing them inverted. We must take account that the first movement that these teeth are going to experience is a crown inclination, meaning that it is into the teeth are going to tip first due to the compression of the periodontal fibers; after this the alveolar process will remodel. This is the moment in which the bodily movement will begin.





Figs. 108-112. Sequence of the placement of a Bioforce wire to uncross a posterior cross bite.

Advantages

1. It is a very easy technique.
2. We do not depend upon patient cooperation.
3. The bite can be corrected in 2 to 3 weeks; taking into account that the optimal force to move an upper first molar is around 120 g (with this force the molar will move 1 mm per month), and the force generated by the Bioforce arch is around 280 g in the posterior sector, which means that the movement will take half of the required time.
4. Because it is a rectangular wire the molar torque can be controlled during the dentoalveolar expansion.

Disadvantages

1. We must have a strict control of the appointments in patients that need to correct their posterior cross bite with these NiTi inverted arches, because the wire will be placed active and the movement that will be generated is constant and very fast, if we do not have this control, non-desired movements can happen.
2. The patient can refer pain, because this is a fast movement.
3. The tubes and the posterior braces can debond due to the force generated by the arch.
4. The arch will produce an excessive proclination of the anterior sector.

Recommendations

1. We must not leave these arches more than 60 days in the mouth in order to avoid undesired movements.
2. To counteract the proclination of the anterior sector, we recommend the use of Class II elastics and to ferulize the sector with 0.012" stainless steel ligature wire.
3. In case the patient refers pain, prescribe Tylenol for the first two days.

Overlay

The overlay is a useful appliance for dentoalveolar expansion. It consists of an open 0.028" or 0.036" stainless steel wire that is going to be inserted in the accessory tubes of the bands of the first upper molars and bound to the arch wire with stainless steel ligature wire. The overlay is indicated in unilateral, bilateral posterior cross bite cases, because it produces an upper dento alveolar expansion (mainly the molars). The term overlay applies to every wire or accessory wire placed over the main arch wire, to expand, intrude or, in this case, the overlay is placed to produce dentoalveolar expansion in the correction of posterior cross bites.

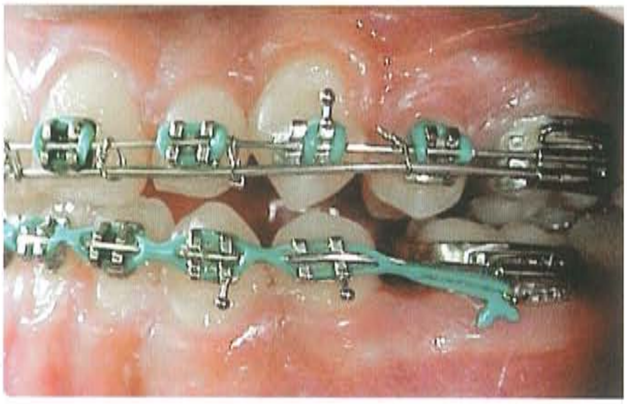


Fig. 113. The overlay must be bound to the main arch and inserted in the accessory tubes of the molar bands.

Fig. 114. Occlusal view of the overlay.

Advantages

1. This arch is indicated in cases in which inter arch discrepancy is not greater than 1 mm or 2 mm.
2. Economic and easy to fabricate.
3. We do not depend upon patient cooperation.
4. It does not need any reactivations.

Disadvantages

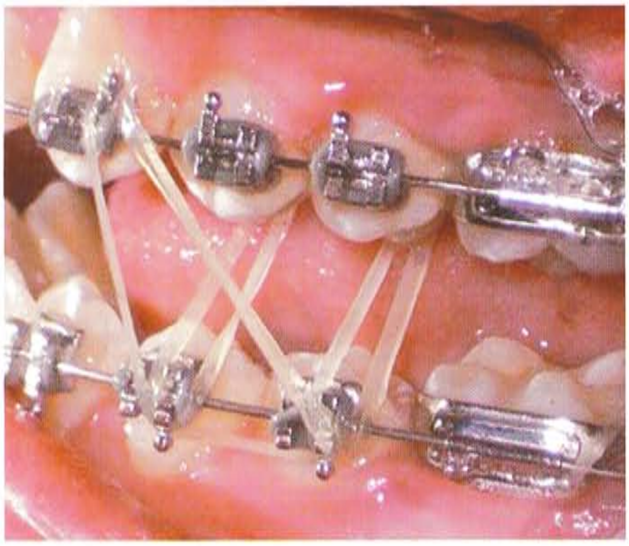
1. The patient can refer pain when the wire is placed.
2. It is not indicated in patients with bad oral hygiene because it tends to retain food particles.

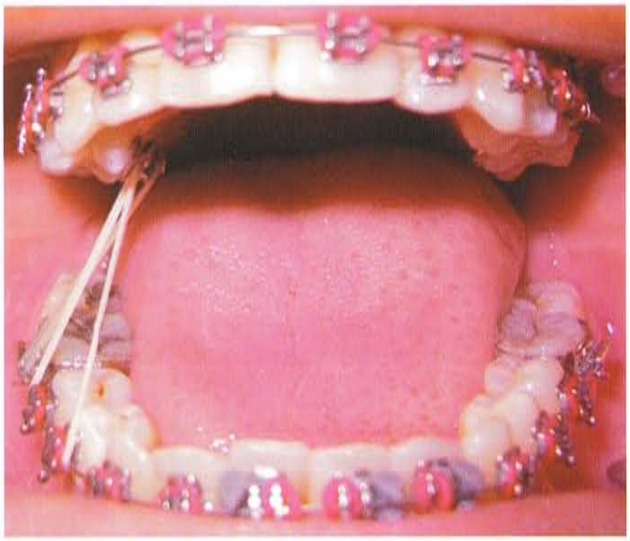
Recommendations

1. We must not tense the ligature wire too much because we can debond some braces.
2. Over-expand the dental arch to avoid rebound.
3. The expansion produced is dentoalveolar, so it will provoke the extrusion of the palatal cusps, thus, the bite is going to open and the lower third of the face is going to increase.
4. Once the bite is corrected, we must maintain the overlay in the mouth for a 3 month period to allow the bite to settle.
5. Not recommended in cases of more than 2 mm of discrepancy.
6. It can be activated uni or bilaterally depending on the case.
7. It can be combined with an open main arch or a straight NiTi arch.

Crossed elastics or "Z" elastics

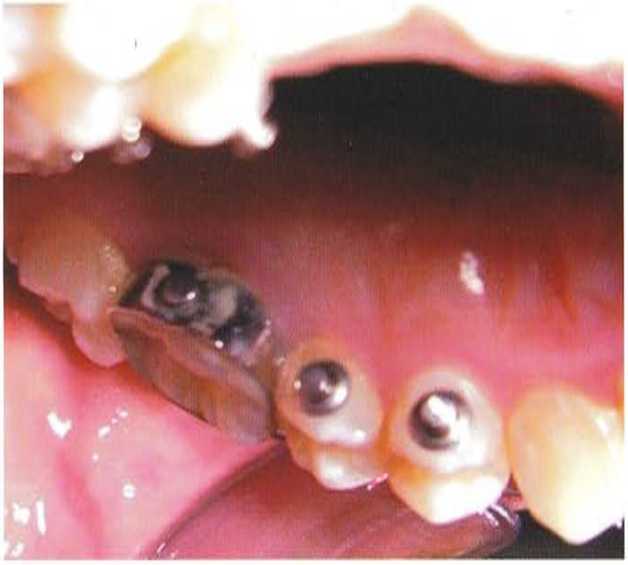
Any application of a force through an elastic induces and uses a certain combination of force and displacement, in which the elastic deforms due to the pressure exerted and at the same time the force is liberated. This principle is applied to all intraoral elastics that are used to co-assist in the orthodontic treatment. "Z" elastics are an important auxiliary that we use in orthodontic therapy to uncross a tooth or a group of teeth. The elastics are placed on the palatine aspects of the upper teeth to be uncrossed to the buccal hooks of the lower teeth. The elastics must be 1/8" in diameter. The effect and activation of these elastics are incremented by the mandibular movements.[29]





Figs. 115-117. "Z" elastics.

We must bond direct adhesion buttons on the palatine aspects of the teeth that we want to uncross, and from these buttons, place the "Z" elastics stretching them to the buccal hooks of the lower teeth.



Figs. 118 and 119. Direct adhesion buttons placed on the palatine aspect of the teeth.

Advantages

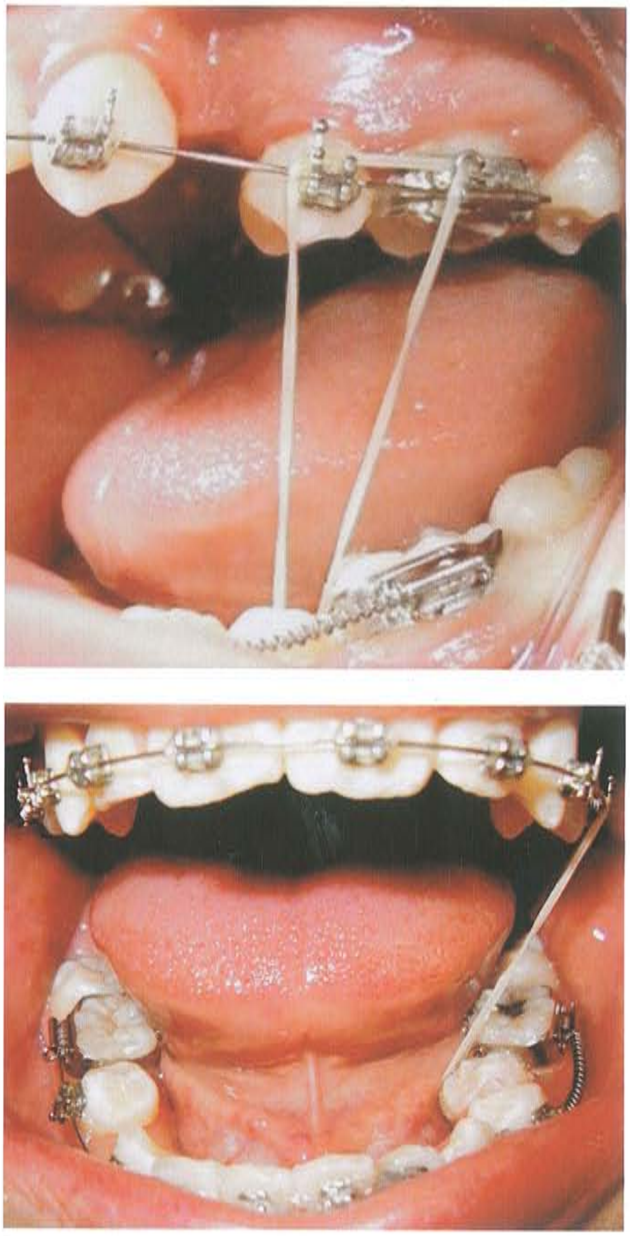
1. It is a very effective orthodontic auxiliary for the uncrossing of an individual tooth or a group of teeth.
2. Economic.
3. Easy to place and to take off by the patient.
4. It does not have to be activated by the orthodontist.
5. The uncrossing of the bite is relatively fast.

Disadvantages

1. We depend 100 % upon patient cooperation for the elastics to be effective.
2. The elastics retain foul odors due to humidity absorption.
3. The elastics can easily break. This happens because the patient "bites" the elastics when the patient occludes.
4. Dental contact points are produced, which can provoke TMJ alterations.
5. Not always well accepted by the patient.
6. Due to the force produced by the elastics, the lower braces or the direct adhesion buttons may debond.
7. If we prescribe elastics with too much force, the patient can refer tooth pain or TMJ pain.

Recommendations

1. It is recommendable that after we have uncrossed any tooth, 3 months before we take off the braces we should perform supracrestal fiberotomy on the tooth that was crossed, because these cases are very likely to rebound.
2. Over treat the crossed tooth.
3. We must have a periodic control over the use of the elastics, because the crossed tooth can move more than planned and provoke a scissor bite.
4. We must tell the patient to change the elastics every 24 hours.
5. The recommended elastics will be of 6 Oz with a 1/8" diameter.
6. We can tell the patient to chew gum, in order to increment mandibular movement and to distend the elastics, accelerating the dental uncrossing.
7. We recommend stripping in the tooth to be uncrossed and the neighboring teeth in order to extend a bit more the contact surface of the tooth and to accelerate the process.
8. If the collapse is only in the maxilla, the lower teeth should be ferulized in order to avoid their lingualization.
9. To accelerate the dental uncrossing, we can place a bite plane to open the posterior bite.
10. We can place open arches on the upper dental arch and closed arches on the lower dental arch.
11. We must obtain the adequate space for the correct positioning of the tooth in the arch.



Figs. 120 and 121. We must obtain the adequate space in order to place the crossed tooth correctly.

Hass

This appliance was the first rapid maxillary expander and was popularized by Hass in the 60's. It is constituted by:

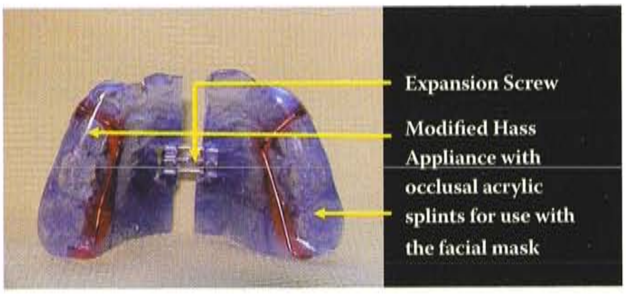
1. Cemented bands on the first upper premolars and molars.
2. Palatine connection wires that are soldered to the bands, which can also be extended through the buc-

cal aspects of the premolars and molars, in order to provide stiffness to the appliance.

3. Two acrylic components assented on the palatine vault in contact with the palatal mucosa.
4. An expansion screw imbedded in the acrylic components on the midline of the palate.

Dr. Hass, in his studies, sustains that this appliance produces a bodily movement of the teeth due to the acrylic support of the appliance, because these forces are not only applied on the teeth, but also on the soft and hard tissues of the palate.(19)

This appliance, in its active phase, liberates lateral forces, and in its passive phase contains the obtained expansion. The active phase begins 24 hours after the appliance is placed and it must be activated two times in the morning and two times at night. This phase is going to last 2 to 3 weeks depending upon the degree of collapse of the maxilla. The passive phase of the treatment consists in the permanence of the appliance in the mouth during 3 to 6 months, period in which the suture will reorganize and the accumulated forces will dissipate.(18)



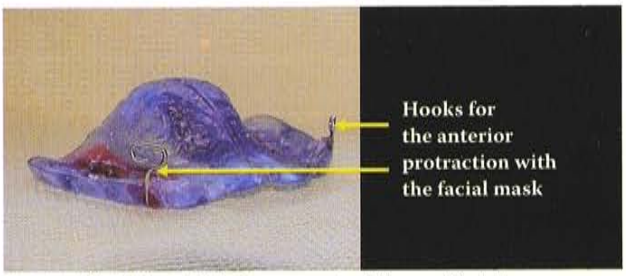


Fig. 123 and 124. Components of the modified Hass..

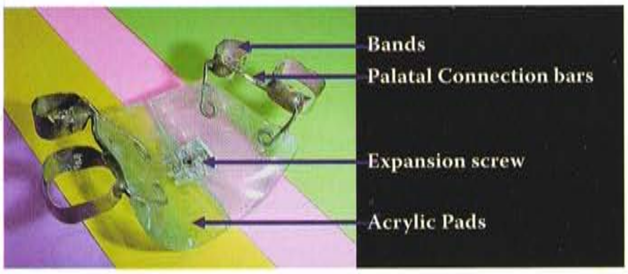


Fig. 122. Hass components.

Fig. 125. Modified Hass for face mask.

Advantages

1. The Hass expander can liberate forces between 4 Kg to 5Kg, ideal for the separation of the mid palatal suture.
2. We can obtain up to 12 mm of expansion.
3. It is a rigid appliance due to the presence of the acrylic palatal components.
4. It is effective and well accepted by the patient.
5. In cases in which this appliance is going to be used with a face mask, the acrylic must be extended to cover the occlusal aspects of the molars and premolars.

Disadvantages

1. Oral hygiene becomes a bit more difficult.
2. Gingival inflammation of the palatal vault caused by the acrylic components.
3. We must invest laboratory time to fabricate the appliance.
4. We depend upon the collaboration of the patient and of the parents for the correct activation of the appliance.
5. The patient can feel a slight pain during the activation of the appliance, which will disappear in a few minutes.

Recommendations

1. Once the contention period has passed, take the appliance off and place a removable acrylic plate for at least 6 months.
2. We recommend over expanding the maxilla 1 mm to 2 mm due to the rebound that can occur.
3. A very strict control is indispensable to avoid any excessive expansion.
4. Once the expansion process has ended, ferulize the screw in the obtained position with ligature in the perforations of the screw, or block the screw with acrylic to avoid any movement.[13]

Fig. 126. Screw ferulized with wire.

5. In case the gingival tissue becomes irritated, we recommend the removal of the appliance and indicate the use of a mouth wash with clorhexidine gluconate (please refer to Lesions and Urgencies during Orthodontic Treatment chapter).
6. The use of an expander with acrylic on the occlusal aspects of the teeth can be very useful to impede the over-inclination of the molars and premolars.
7. Do not extract any premolars until the expansion has been completed.
8. We can use the primary first and second molars as anchorage of the bands, but only if the molars have good root length.
9. Do not move any molars or premolars before the expansion, because this can increase the mobility and inclination of the molars and premolars.[25]

Hyrax

It is the most commonly used rapid maxillary expansion screw in patients that are in the mixed or early permanent dentition. It was designed by Briederman and it is totally made of stainless steel and does not have any acrylic, so it is very hygienic.

The appliance is constituted by:

1. Four bands, 2 on the first premolars and 2 on the first permanent molars.
2. An expansion screw placed on the midline of the palate separated 3 mm from the palatal mucosa. This separation is important, because when the maxilla is separated , the palatal vault descends.[19,34]
3. It also has two palatal support arches soldered to the band providing more rigidity to the appliance. In case the premolars have not erupted yet, the extension arms are contoured up to the first primary molar.

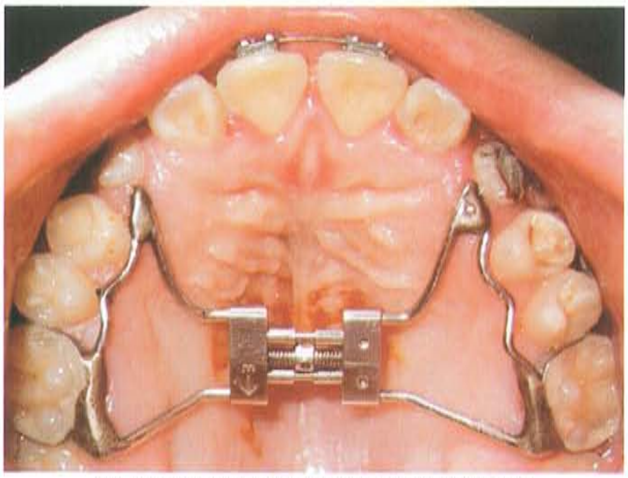


Fig. 127. Rapid maxillary expansion screw (Hyrax).

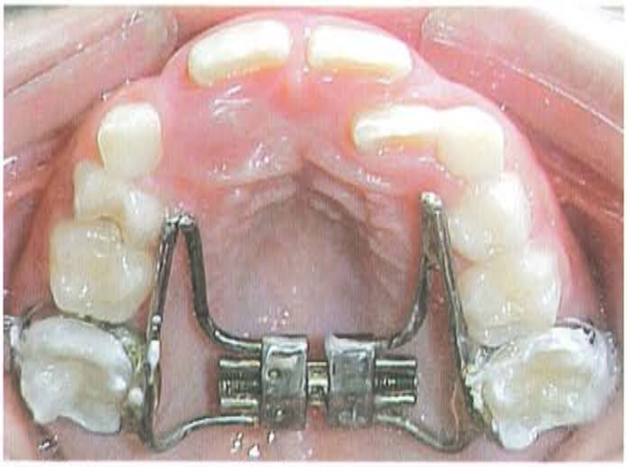


Fig. 128. Hyrax expander with extension arms up to the 1° primary molar.

Advantages

1. It is very hygienic because it does not have any acrylic.

2. Depending on the transversal requirements of the patient we can choose among 8 mm, 11 mm and 13 mm screws.
3. It is a very effective appliance.
4. The addition of acrylic on the occlusal aspects of the molars and premolars will prevent the over-inclination of the teeth that serve as anchorage.

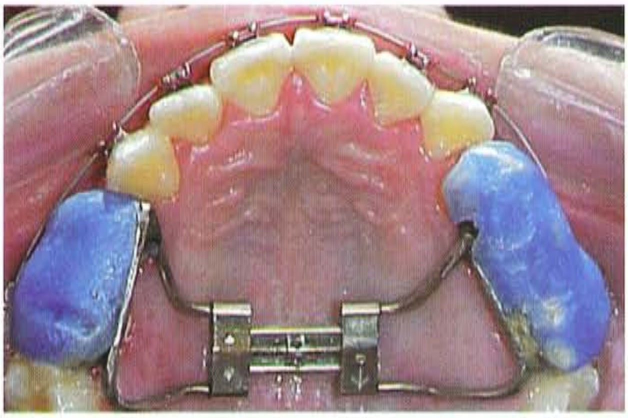


Fig. 129. Hyrax expander with occlusal acrylic.

5. Expansions up to 10 mm to 12 mm are possible.
6. Extremely strong.[34]
7. We can obtain orthopedic effects even in patients in which growth has almost ceased.
8. It modifies the mandibular posture, placing it in a lower and backward position, due to the extrusion of the palatine cusps of the upper molars and premolars.[34]
9. It improves the respiratory capacity of the patients due to the descent of the nasal cavity.[34]

Disadvantages

1. A wrong appliance design can provoke the self impingement of the appliance on the palatal mucosa.

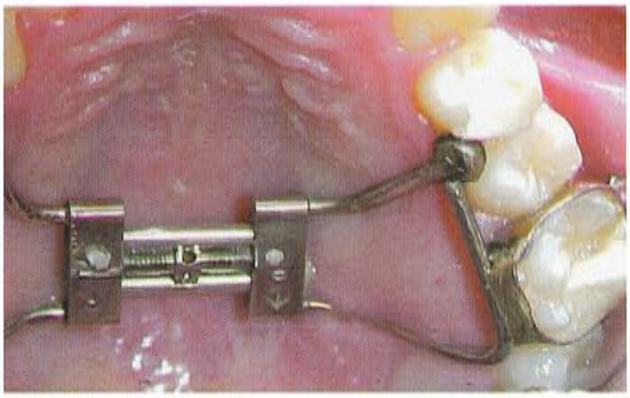


Fig. 130. Impingement of the appliance in the palatal mucosa

2. The manufacture of this appliance consumes laboratory time.
3. We depend 100% upon patient and parent cooperation for the correct activation of the appliance.
4. The appliance is very rigid and difficult to bend.

Recommendations

1. In a treatment for maxillary constriction, we must always resolve the transversal problem and then the sagittal problem.
2. We suggest a daily aperture of 0.5 mm (2/4 of a turn per day, one activation in the morning and another in the night) which is a tolerable measure for the patient (1/4 of a turn=0.25 mm).
3. Begin activating the screw 30 minutes after the appliance has been cemented to allow the complete hardening of the cement.
4. Provide the patient with an activation schedule and a list of possible effects.
5. Monitor the patient clinically and radio-graphically during the disjunction.

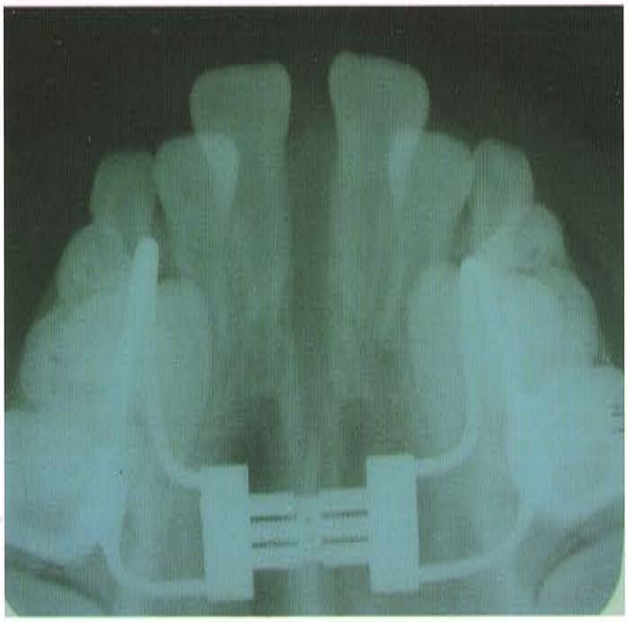


Fig. 131. Control occlusal X-ray of the expansion, in which we can observe the splitting of the mid palatal suture.

6. Once the expansion has ended, use the appliance as a fixed retainer for 3 to 6 months. According to Hass in 1961, the mid palatal suture re ossifies in 3 months, for this motive, we must retain the patient that same time.[19]

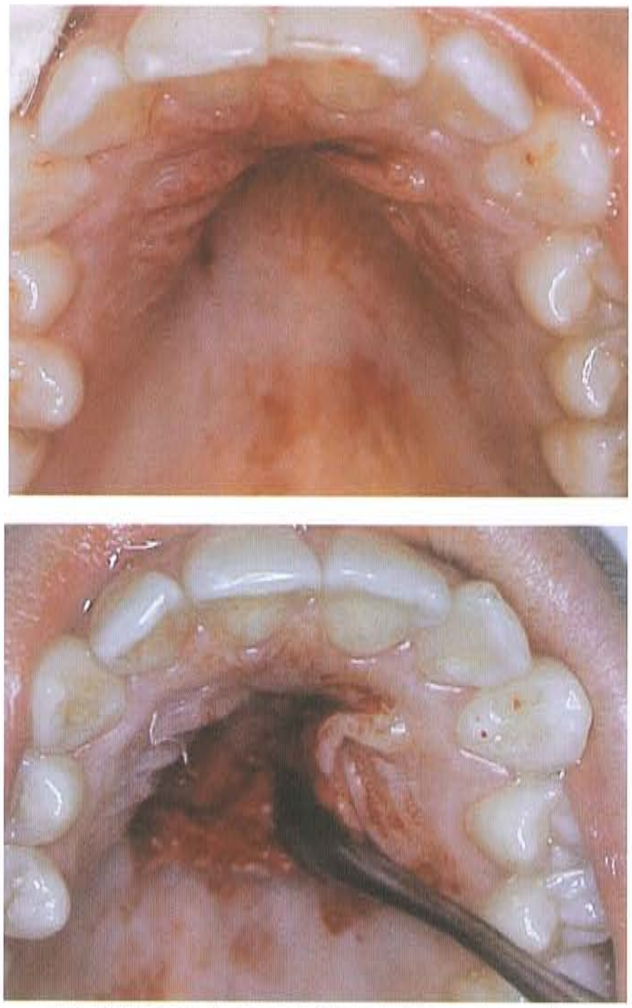
7. Once the appliance is removed, place a transpalatal arch on the upper molars and a heavy stainless steel arch wire.
8. Cement the braces to minimize rebound.[13]
9. Over expand the posterior segments during RME.
10. Stop the expansion as soon as the palatal cusps contact the buccal cusps of the lower molars.[35]
11. We must evaluate which type of patient is a candidate for RME, and hold in account the transversal discrepancy, the facial biotype, molar inclination, age and collaboration degree of each patient, among other factors.
12. We must notify the parents that after a certain number of activations an interincisor diastema will appear, so they can interpret this as a positive sign.
13. During the contention period we must block the appliance with ligature passing it through the activation orifices of the screw. We can also block the screw with acrylic.

Surgical disjunction

Surgical disjunction is indicated in adults with skeletal type unilateral or bilateral posterior cross bite, in which the medial palatine suture is completely ossified and the discrepancy between the dental arches is greater than 12 mm. This disjunction consists in surgically disarticulating the upper maxilla with a series of osteotomies; after this is preformed a Hyrax expansion screw is placed. The osteotomies are done on the lateral walls of the maxilla, and on the medial palatine suture, then the Hyrax screw with 4 turns is placed.[28]

Once the osteotomy is done, we indicate two activations twice a day to the patient until the posterior cross bite is completely uncrossed.

Fig. 132. Adult patient with a bilateral posterior cross bite.



Figs. 133 and 134. Surgical semi lunar incision and separation of the perioustium from the palate midline.

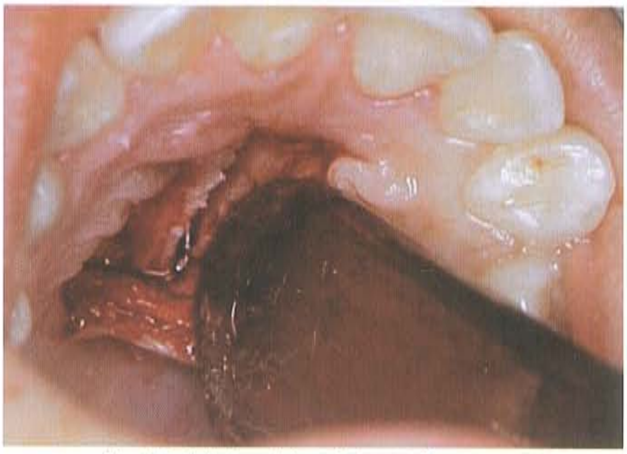
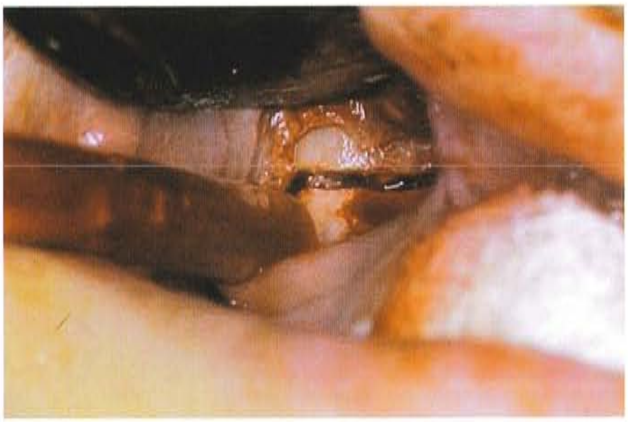


Fig. 135. Splitting of the palatine midline suture.

Advantages

1. Surgical assisted expansion produces very stable results in patients that are no longer growing up.[28]



Figs. 136 and 137. Maxillar lateral wall osteotomy.

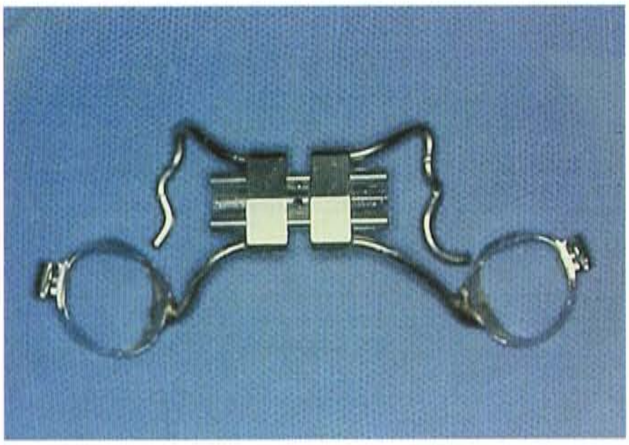
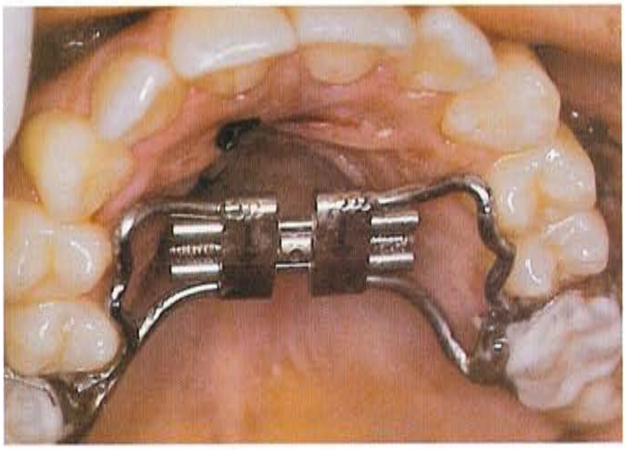


Fig. 138. Hyrax expansion screw.

2. Surgical expansion follows the same principle as osseous distraction.
3. The dental arch length is increased.

Disadvantages

1. The surgical intervention increases the cost of the orthodontic treatment.



Figs. 139 and 140. Wound suture and cementation of the activated expander.

2. After the surgical disjunction, we depend upon the correct activation of the screw by the patient.
3. The patient may refer post-surgical pain.

Recommendations

1. The patient must begin to activate the screw the following day from the surgery, to allow the band cement from the screw to harden.
2. After the posterior bite has been uncrossed, the expander must be left in place for 3 months to allow the re-ossification of the sutures.
3. We recommend the placement of a transpalatine arch as soon as the expander is retired, and we must leave the arch during the length of the treatment to maintain the intermolar distance.
4. Overexpansion is recommended.
5. The activations must be done twice a day, one in the morning and one in the evening.

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Distalizers

7

Esequiel Rodríguez, Rogelio CasasaAdriana Natera, Claudia Razo

Introduction

The search for new treatment modalities that avoid dental extractions (especially premolars) has gained great importance in the practice of contemporary orthodontics; this has created a growing tendency to avoid, as much as possible, any treatment that includes extractions. There are many non-extraction treatment modalities for Class II malocclusion. One of them consists in converting the Class II molar relation into a Class I molar relation; in order to accomplish this we must distally displace the upper first molars.[15,38]

The most frequent dentoskeletal disharmony in the Anglo-Saxon population is the Class II malocclusion. This distoclusion may be the result of a retrognatic mandible, of a prognathic maxilla or a combination of both, although some authors (McNamara, Hilgers, Chaconas, Proffit) coincide in that mandibular deficiencies are more common than maxillary excesses, but in many occasions the distal relation is a product of the mesiogresion of the posterosuperior sectors that bring as a consequence the lack of proper space for the correct alignment of the anterior teeth.[23,35] Dentally, the mesiobuccal cusp of the first upper molar occludes in front of the buccal sulcus of the first lower molar. The disadvantage of this lies in the lack of available space in the upper dental arch, creating the need to utilize appliances that can generate or stretch the available space in order to act distally and transversely.[36,38]

One of the first appliances used for molar distalization was the Head Gear, used by Angle in 1887. In 1961 Kloehn proposed the early treatment with the head gear to redirect the growth of the maxilla and exert "a slight force on the teeth that must be moved". The objective of Kloehn was to distalize the upper molars in order to obtain a functional relation with the lower teeth. Graber noticed that, when the extra oral traction was used upon the first upper molar, when the second upper molar had not fully erupted, the first molar inclined distally but did not move in a bodily manner. In order to prevent the inclination of the molar, Cetlin in 1983 combined the extra oral force with an intraoral force. He used the first force partially and the intraoral force (with removable appliances) was used full time. The force of the removable appliances, used constantly, inclines the crown distally and the head gear controls the position of the root, resulting in a bodily movement of the molar.[29] The principle of extra oral distalization is that the line of action must pass through the center of resistance of the molar. In order to accomplish a successful distalization treatment the amount of force applied and the time of use are very important. There are many criteria over the amount of force that must be applied and the time of use of the head gear. Tenenbaum suggests 12 ounces or 300 g, a force that can be incremented. Muir and Reed recommend 500 g per side. The extra oral traction must be worn for at least 12 hours a day, but preferably it must be between 14 to 16 hours in average.[5,29,33,36,38]

The extra oral arch must be separated 3 mm to 5 mm from the anterior teeth approximately and must be adjusted each time we to obtain a desired movement.[29,36]

During distalization we must be sure the molars do not have any occlusal interferences, in case there are, we should place an anterior bite plane in order to aid in the distalization. Unilateral distal movements will be done modifying the outer arm of the appliance (Please refer to Open Bite chapter).

The use of the extra oral arch can provoke many movements:

1. A distal force and a flattening of the occlusal plane, in which the extra oral traction must be applied over the center of resistance of the molar.
2. A distal force and a settlement of the occlusal plane, in which the extra oral traction must be applied under the center of resistance of the molar.

3. A distal force without changes of the occlusal plane, in which the extra oral traction passes through the center of resistance of the molar.[26,35,36,38]

Unfortunately, we need 100% cooperation of the patient with this appliance.

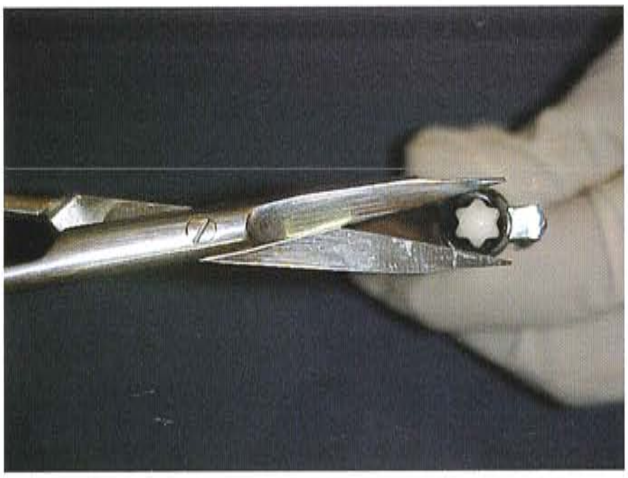
Trying to obtain a fast and easy distalizing method, which would not require patient cooperation, a new arsenal of fixed new modalities designed to distalize upper molars, and to avoid extraction of teeth have been proposed. Some authors have designed their own distalizers, like Wilson 1987 (Wilson distalizer), Miura 1988 (NiTi open coils), Gianelly 1988 (Magnets), Gianelly 1989 (Gianelly Jig), Jones and White 1992 (Jones jig), Hilgers 1992 (Pendulum and Pendex), Greenfield 1995 (Fixed piston), Valrun 1995 (K-Loop), Carano and Testa 1996 (Distal Jet), Belussi 1997 (Belussi distalizer), Veltri 1999 (Veltri distalizer), Prato 2000 (Nitinol spring molar distalizer), Lanteri 2001 (Fast Back), Casasa and Rodríguez 2001 (CEOB-1), Bass 2001 (Sliding distalizing sistem), Echarri and Scuzzo 2003 (Double modified pendulum), Carriére 2004 (Carriére distalizer), Quirós 2005 (Quirós tecnique), García and Gaitán 2006 (GG Distal Spring), among others. Although these appliances distalize effectively, they produce discreet upper incisor mesialization and proclination and upper molar distal inclination.[5,6,7,36,38,44]

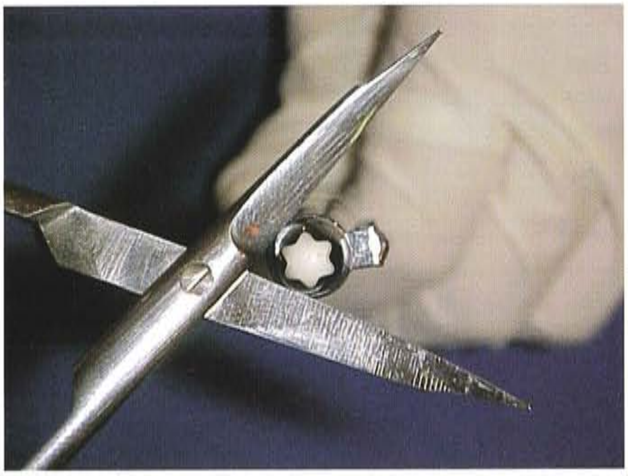
There are three very important points that we must keep in mind during first upper molar distalization:

1. According to Bussick, the best moment to distalize the molars is before the second molars are totally erupted. Gianelly recommends distalization when there is a space between the distal aspect of the first upper molar and the semi erupted crown of the second molar.[36,38]

2. It is important to keep in mind that mouth aperture is done upon the condoyle axis, so aperture and closure movement are like the movement of a pair of scissors (scissor or hinge effect); we must keep in mind this effect because the distalizing movement tends to open the bite just like when we place a pen in the closing movement of a pair of scissors; the more we distalize the molar the more we are going to open the bite.[36,38]

This effect is favorable in patients with deep bites, but counterproductive in patients with open bite or hyperdivergent growth tendency; this is why this effect must be taken into consideration during distalization.[36,38]





Figs. 1 and 2. Hinge or scissor effect.

3. Constant forces move teeth faster than intermittent forces.

Due to the fact that distalizing forces move teeth against the normal mesial movement tendency (that is always present) they were rejected for a long time. But with the arrival of new elastic materials, many orthodontists have reapplied this technique again.[15]

The distalizing appliance must include the following characteristics:

- Must not require patient cooperation.
- High degree of biomechanical control.
- Compact design.
- Minimal interference when the patient eats or speaks.
- Absence of pain during the distalizing process.
- Easy activation.
- Compatibility with other orthodontic techniques.
- Automatic cessation of the distalizing movement.
- Must be easy to clean.(1,5-7,9,15,17,18,22-24,26,33,35,36,38)

Distalizing indications

- Unilateral or bilateral dental Class II relation.
- Increased overjet (up to 5 mm).
- Increased overbite (deep bite).
- Midline discrepancy.
- Minimal or non-existing dental overcrowding.
- Patients with early mixed or permanent dentition.
- Patients with upper dentoalveolar protrusion.
- Patients with minimal skeletal problems.
- Normo or hypodivergent patients.
- Patients that do not accept extractions.
- Another indication for upper molar distalization is when we decide to extract a permanent second molar (due to caries or other causes) complicated with anterior overcrowding or an ectopic canine. In these cases the third molar will occupy the space of the extracted second molar.(1,5-7,9,15,17,18,22-24,26,33,35,36,38)

Distalization counter indications

- Patients that grow vertically.
- Dolichocephalic patients.
- Patients with open bite tendency.
- Overjet greater than 5 mm.
- In some cases with tongue protraction.
- In adult patients we must employ another type of treatment.(1,5-7,9,15,17,18,22-24,26,33,35,36,38)

Recommendations

- In young patients, the best moment to distalize is before the second molars are totally erupted. The upper second molars erupt normally without impaction; meanwhile the second premolar follows the first molar distally.
- Distalize in the mixed or permanent dentition.
- In order to obtain a faster distalization, we recommend the extraction of the third molars.
- Distalizers can provoke an undesired upper first molar rotation.
- Use Class II elastics in order to reduce anterior proclination.
- Lace the anterior teeth with steel ligature or with an acetate in order to minimize anterior proclination.
- After the distalization is completed, place a moderate or maximum anchorage to the distalized molars (Chromosome arch, Transpalanance, Viaro Nance, Nance button, Transpalatine arch).
- The patient must have excellent oral hygiene because the distalizing appliances retain food particles
- Have a strict appointment control.(1,5-7,9,15,17,18,22-24-,26,33,35,36,38)

Collateral effects of distalizers:

- They procline the anterior segment.
- In- body distal movement is difficult.
- They produce condyle deflection.
- Premature points in the palatine cusps.
- Due to the hinge effect, these appliances produce a mandibular posterior rotation that will result in an anterior open bite. (1,5,6,7,9,15,17,18,22,23,24,26,33,35,36,38)

Distalizers are divided in two big groups:

- Intraoral.
- Extraoral.

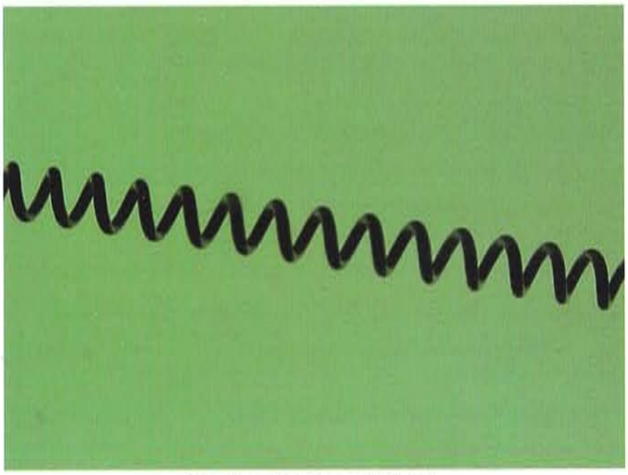
In this chapter we will analyze the intraoral distalizers, and we will divide them in:

1. Fixed.
2. Removable.

Super elastic NiTi coil distalization (open coils)

Open coils are the most simple and cheap appliance used successfully in maxillary molar distalization since the beginning of the twentieth century.

These coils apply approximately 100 g of force and are placed between the first or second premolar and the upper first molar on a 0.016" x 0.022" arch wire.(2,15,16,26,40)



Figs. 3 and 4. Open NiTi coil.

The distal end of the main wire is left "long" slightly (4 mm - 5 mm), meaning that the distal end of the wire must protrude from the distal end of the molar tube so the distalized molar can move that distance. To keep the patient comfortable, the distal portion of the wire is bent toward the palate. Usually there is none or very little discomfort to the patient.[16,31,34]

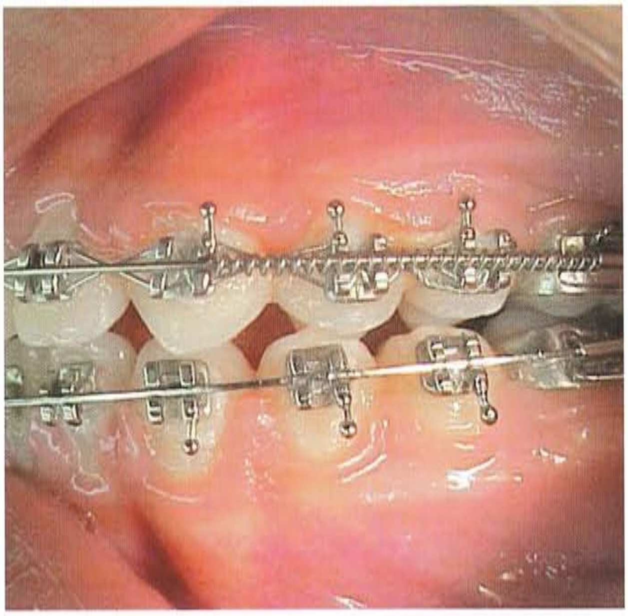


Fig. 5. Passive coil.

We must compress the coil 10 mm in order to activate it. This means that the coil, in a passive state, is 10 mm larger than the space between the distal wing of the brace of the first premolar and the tube of the first molar.[16,31,39,40]

During distalization, the coil opens and loses force, in this moment we can replace it with a larger one or we can place a sliding acrylic pearl on the mesial or distal end of the coil and compress it again.[26,31,40]

With the 100 gof activation, the coil can distalize the upper molar 1.5 mm per month, with approximately 20% of anterior anchorage loss.[23,31,39,40]

The compressed coil slides the molar on the arch wire, which can be continuous or sectioned.

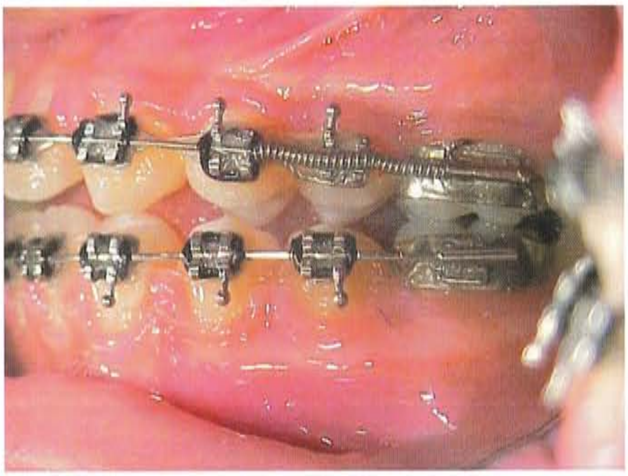
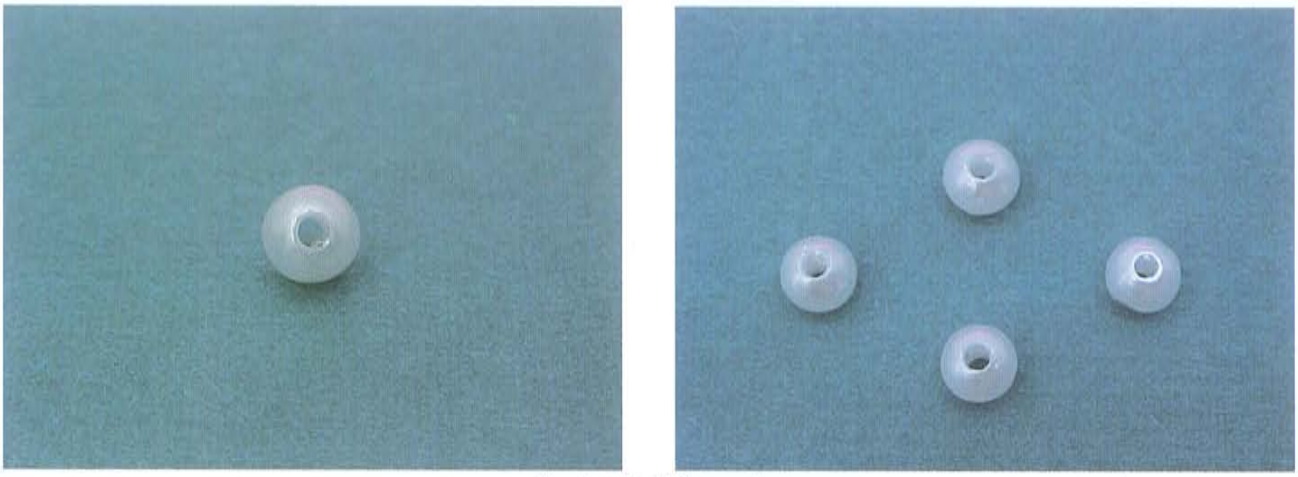


Fig. 6. Active coil.



Figs. 7 and 8. Sliding pearl.

Miura and cols. compared the properties of japanese NiTi coil with traditional stainless steel coil. They found that NiTi coil has more resilience and maintains a more constant and light force than steel coil. Kelles studied the amount of millimeters distalized in a unilateral manner with a NiTi open coil in combination with an anterior bite plane. The NiTi coil was placed from the distal wing of the brace of the first premolar to the tube of the first molar (the first premolars were anchored with a Nance button). He determined that the NiTi coil could move the molar distally 4.9 mm in 6.1 months with 5.2° of distal tipping, but, as negative side effects there was also 1.3 mm of loss of anterior anchorage due to mesial migration of the first premolar (anchored with a Nance Button), there was also

Fig. 9. Pearl on the distal aspect of the second premolar.

Figs. 10 and 11. After 6 months of open coil distalization.

a 1.8 mm increase of incisor proclination and 2.1 mm of overjet increase.[31,34]

Advantages

1. This method is easy to elaborate.
2. Easy to activate.
3. The cost is minimal.
4. Hygienic.
5. We do not depend upon patient compliance.

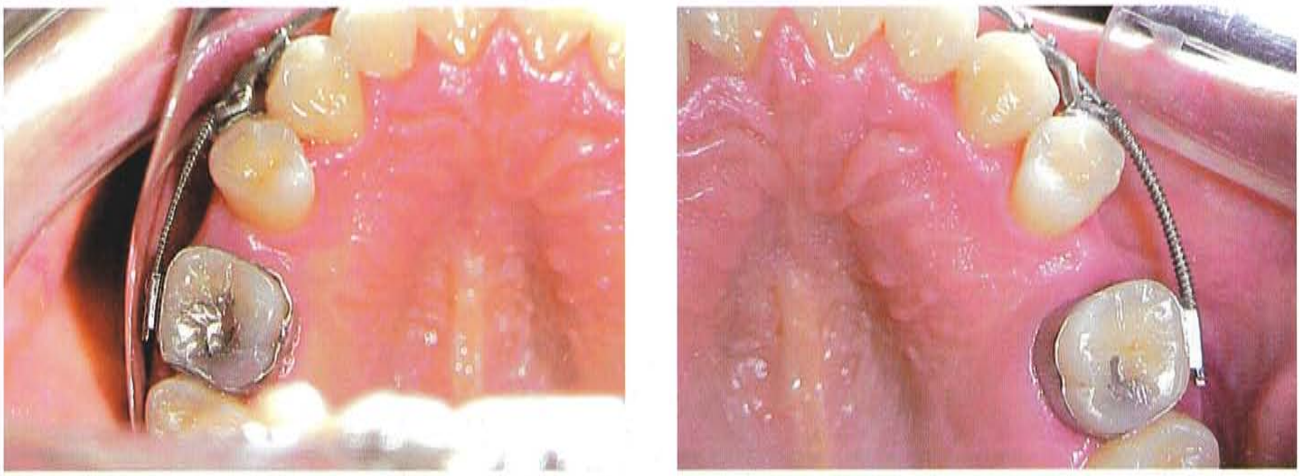
Disadvantages

1. The distalized molars have an undesired tip.
2. There is anterosuperior anchorage loss.

Fig. 14. Acetate placed from premolar to premolar.

Recommendations

1. Anchor the premolar on which the coil will lean upon, or the premolar will rotate mesially.
2. In some occasions we can anchor the entire anterior segment lacing it with 0.012" or 0.014" stainless steel wire ligature or with a 0.060" acetate. This will reduce anterior proclination.[37]
3. Place the open coil on heavy arch wires, keep in mind that the distal movement will be faster if we place a coil with a great lumen combined with a small diameter wire.[31,34,37]
4. Use Class II elastics to counteract anterior proclination.
5. In cases of unilateral distalization, use midline elastics to prevent midline displacement.
6. Activate the open coil every one and a half months.



Figs. 12 and 13. Mesial premolar rotation due to lack of anchorage.

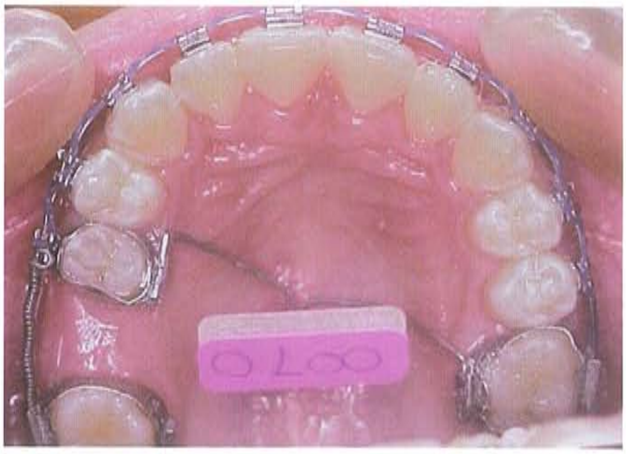
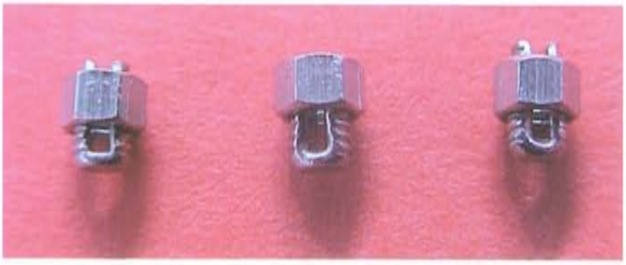


Fig. 15. Midline displacement.

Distalization with super elastic NiTi wires or Dr Richard Vlock's technique

The upper molars are rapidly distalized and arch length is increased with this technique. A super elastic 0.018" x 0.020" NiTi wire that exerts a force between 100 g to 200 g is used. In order to move the molars distally with this wire, we must configure a loop with the wire that opens during activation.[23,25,47] Due to the fact that this arch wire cannot be bent conventionally, the loop is done in the following manner:

1. Two kwik stops are fixed on the arch wire, one on the distal aspect of the brace of the first premolar (distal stop) and the other one on the mesial aspect of the molar tube (mesial stop).
2. Submerge the arch wire in cold water for 20 seconds; the wire can also be cooled with ice and Ortho Ice (tetrafluoroethane) before the insertion, this will soften the wire (martensite phase) and placement will be easier.[25,27]



Figs. 16 and 17. Closed and open kwik stops used in the Vlock technique.

3. The distance between the stops is 5 mm to 6 mm larger than the space between the distal aspect of the brace of the first premolar and the mesial aspect of the molar tube. The wire is inserted in the molar tube

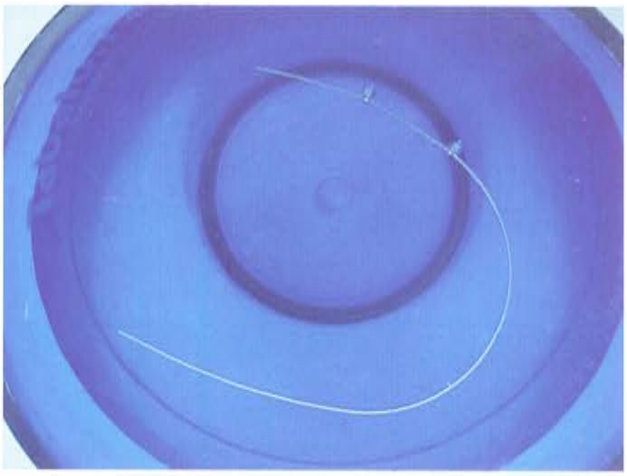
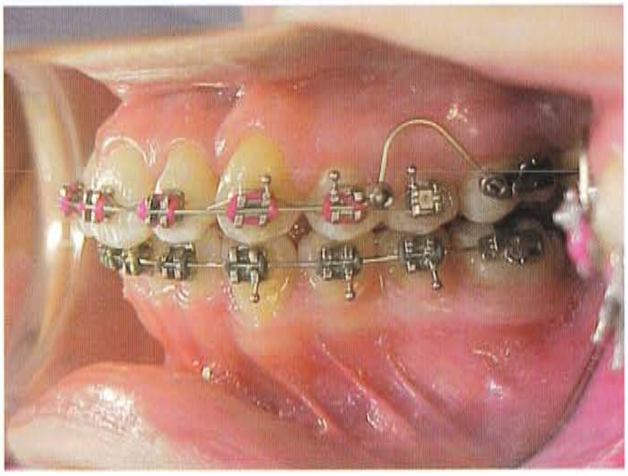


Fig. 18. Bio-Force arch wire in cold water.

Fig. 19. Ortho Ice.

and the mesial stop is closed, then the distal stop is closed against the brace of the first premolar; the first premolars must be anchored with a transpalatine arch or a Nance button. This is going to act as anchorage reinforcement. In occasions this button is going to extend all the way to the palatine aspects of the incisors like an anterior bite plane.(25,32,47)



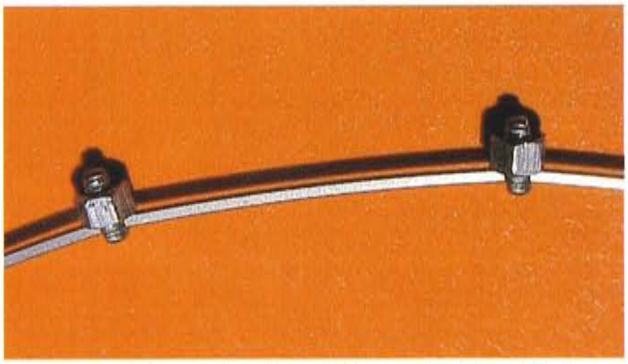
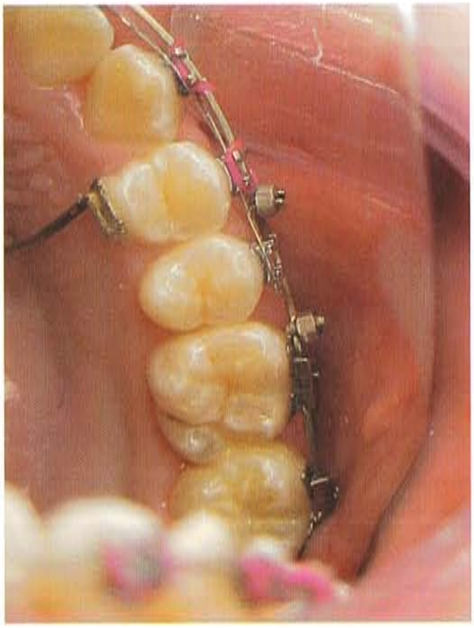
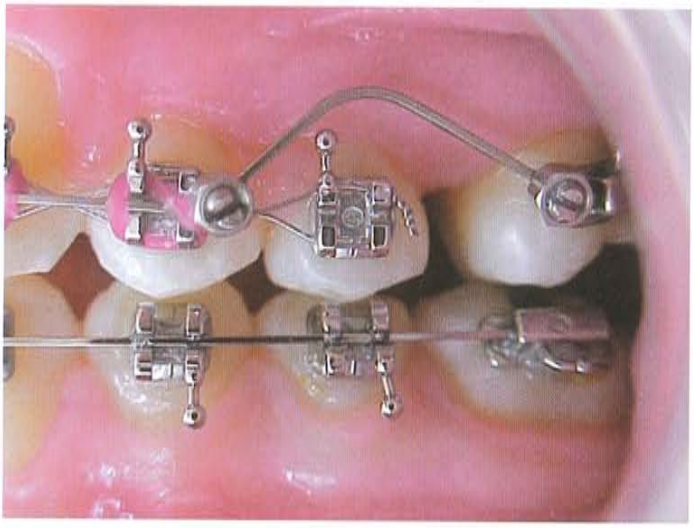


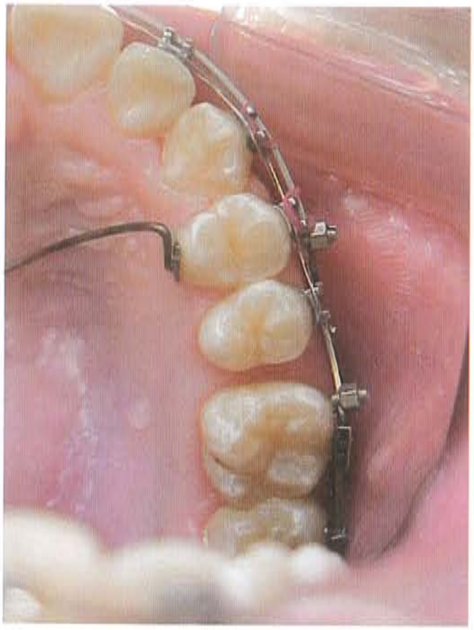
Fig. 20. Bio force arch with two kwik stops (mesial and distal).

Figs. 21 and 22. Active super elastic NiTi arch that is going to distalize the first upper left molar.



Figs. 23 and 24. Anchorage with a direct bond transpalatine arch laced with steel wire ligature from the molar to the second premolar.





Figs. 25 and 26. One month after the beginning of the distalization movement.

The molars are moved distally while the wire tries to flatten in order to recover its original form. In this moment, due to the body temperature (37° C), the arch wire transforms from a martensitic phase (soft) to an austenitic phase (hard).

With the use of super elastic NiTi arches and coils the loss of anchorage becomes evident with the increase of the overjet and of the incisor overcrowding.(31,34,39,47)

Success rates using super elastic NiTi wires and coils:

1. When the molars are moved distally in the late mixed dentition, the procedure is successful in 90% of the cases and molar correction can be obtained in 4 to 8 months.
2. In adolescents, when the molars are moved distally after the eruption of the second molars, they tend to move slower and anchorage loss is increased (anterior proclination). The cuspid to cuspid molar relations are well corrected, but severe Class II relations are much more complicated to resolve. The majority of cases are treated successfully, but the incisors need anterior anchorage to avoid protrusion that can reach up to 2 mm. We can obtain up to 1 mm.
3. In adults, the rate of successful treatments is highly variable and more failures are noted.(23,25,31,34,37,39,47)

In both cases (coils and super elastic wires), the molars must be overcorrected 2 mm approximately. Overcorrection is necessary for two reasons:

1. Loss of anchorage will occur inevitably during premolar, canine and incisor retraction and overcorrection itself helps to compensate the loss of anchorage. This means that the millimeters that are going to be lost during space closure are the same millimeters of the overcorrection. The loss of anchorage can be minimized if the premolars and the canines are allowed to drift distally.
2. The crowns of the distalized molars move more distally than their roots (tipping). After overcorrection, these molars will upright due to their mesial movement (loss of molar anchorage).(25,31,34,40)

Advantages

1. Very hygienic.
2. We do not depend upon patient cooperation.
3. Minimal discomfort.
4. 1 mm to 2 mm of distalization per month.

Disadvantages

1. The cost of the procedure rises due to the purchase of the locks and the super elastic wire.
2. We must invest laboratory time making the transpalatine arch of the Nance button.
3. The activation of the locks requires dexterity.

Recommendations

1. Place orthodontic wax on the locks to avoid ulcerations.
2. Activate the loop of the stops and the super elastic wire each month. The inter-stop distance must be 5 mm or 6 mm larger than the space between the distal wing of the first premolar brace and the mesial end of the molar tube.
3. Use How Pliers to activate the stops.
4. Use Class II elastics and ferulize the anterosuperior teeth to reduce their proclination.
5. Place a moderate or a maximum anchorage on the distalized teeth.
6. Viazis recommends the alternation of a cold beverage with a hot meal once every day. In theory, the cold beverage will make the NiTi wire soft, and the hot meal will stiffen the arch wire rapidly.[46]

Fig. 27. Materials used to fabricate the CEOB-1.

CEOB-1 DISTALIZER

This appliance was designed in 2001 by Dr Rogelio Casasa Araujo and Dr Esequiel Rodríguez Yáñez, director and coordinator of the orthodontic clinic of Centro de Estudios de Ortodoncia del Bajio (CEOB) in Irapuato, Guanajuato, México.

The CEOB-1 is an appliance structurally similar to the Jones Jig. Considering the economic status of the patients that come to the clinic, the appliance is made with materials at hand, making an appliance similar to the one designed by Drs Jones and White; but at a fraction of the cost of the original appliance. The CEOB-1 provides 75 g to 150 g of force, 7.5° of mesial tipping of the upper first molar and 4.5° of mesial tipping of the second upper premolar. The molar will distalize 2.5 mm per month and the second premolar will mesialize 2 mm.[16, 17,18,21,23,28]

Figs. 28 and 29. Sliding jig.

Fabrication

1. Round 0.036" and rectangular 0.017" x 0.025" stainless steel wires are utilized, we also need NiTi open coil, 0.012" stainless steel ligature wire and a sliding jig.

2. Bend the 0.036" wire with a three prong plier and make a bayonet.

Fig. 30. Bend done with a three prong plier.

3. Cut the 0.036" wire distally.

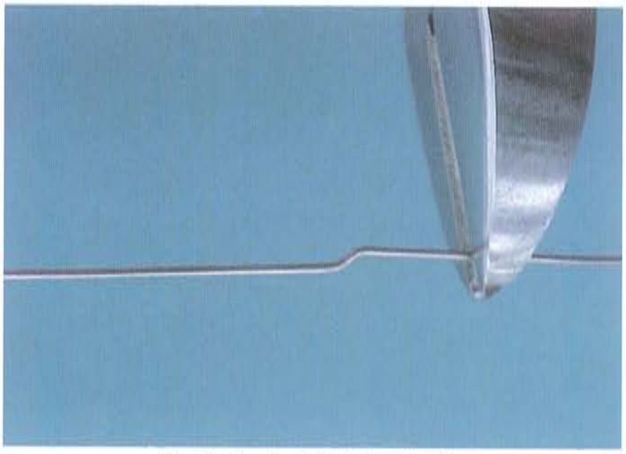


Fig. 31. Cut the 0.036" wire distally.

4. Place the 0.036" and the 0.017" x 0.025" wires together and solder them.

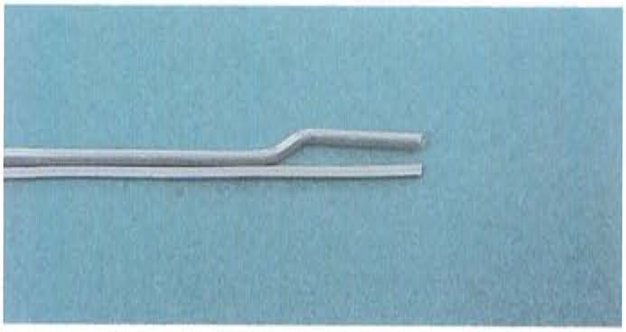


Fig. 32.

5. The wires are clipped together and are soldered .

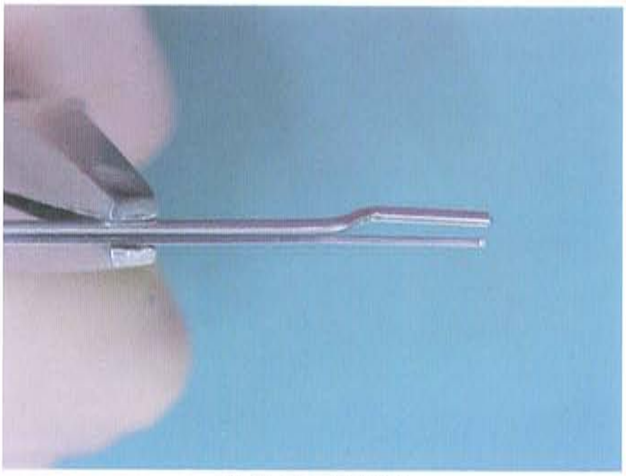


Fig. 33. Clipped wires.

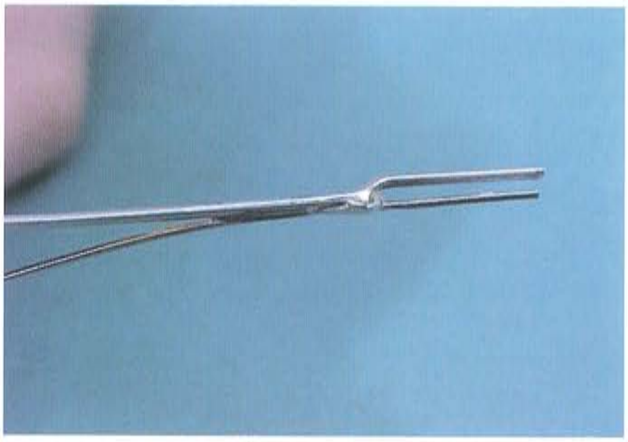


Fig. 34. Soldered wires.

6. Cut the 0.017" x 0.025" wire and polish the soldered end. The wires must form a wishbone or a "Y". This will be the body of the CEOB-1.

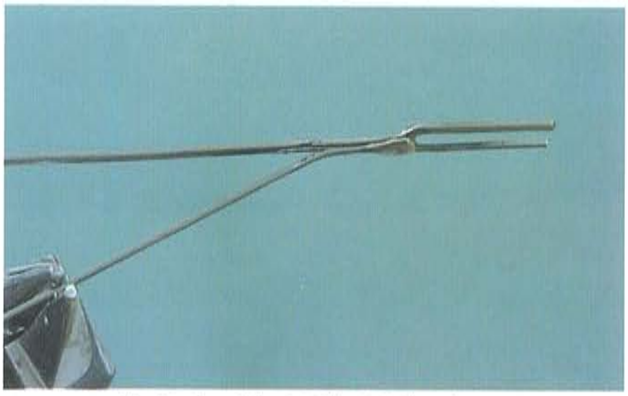


Fig. 35. Cut off the 0.017" x 0.025" steel wire.

7 Introduce a NiTi open coil in the body of the CEOB-1 (in the 0.036" wire) and then place the sliding jig.

Fig. 36. NiTi coil on the 0.036".

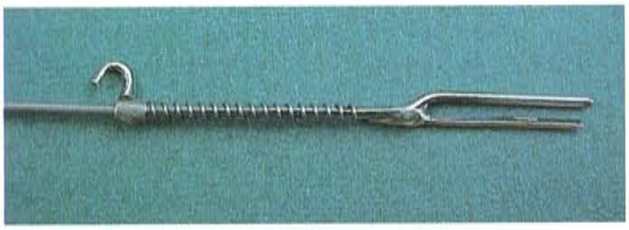


Fig. 37. Sliding jig on the 0.036".

8. Bend the mesial aspect of the 0.036" wire so the open coil and the jig cannot be ejected upon appliance activation. The CEOB-1 is activated by tying the jig to the brace of the second premolar with steel ligature. (The second premolar must be anchored with a Nance button).(17,18,36,38)

Fig. 38. Passive CEOB-1.

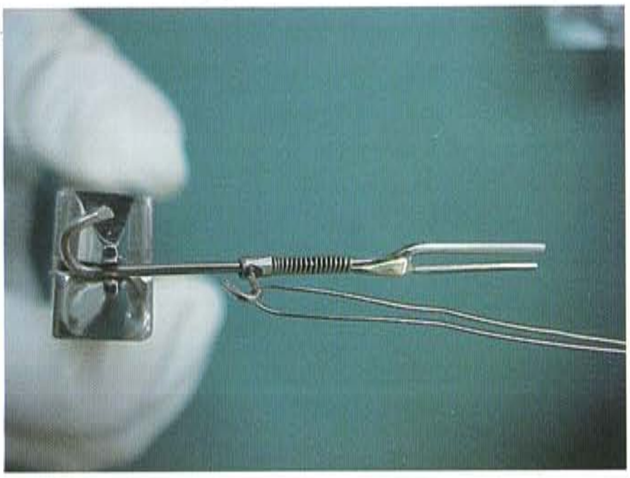


Fig. 39. Active CEOB-1.

The CEOB-1 is placed in the double tubes of the bands of the upper first molars and is activated with steel ligature.

Fig. 40. Initiation.

Fig. 41. Four months in the mouth.

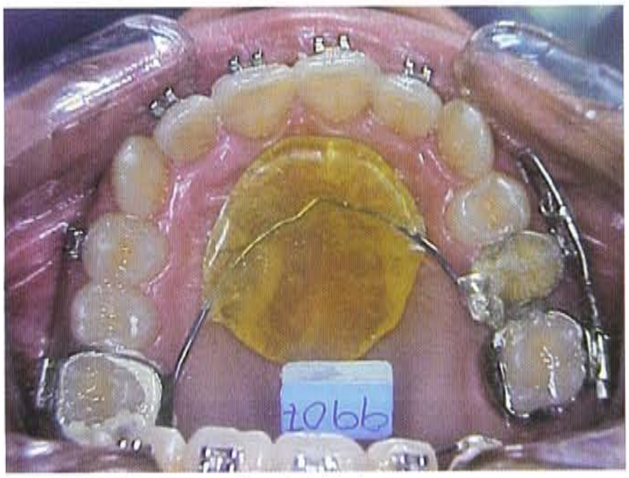


Fig. 42. Initiation.

Fig. 43 . Two months.

Fig. 44. Four months.

Fig. 45. Initiation.

Fig. 46. Four months later.

Fig. 47 and 48. Lateral views of the CEOB-1.

Advantages

1. The activation of the distalizer is comfortable, because we just have to tie back the ligature each month.
2. We do not depend upon patient cooperation.
3. It converts into a passive Nance appliance.
4. May be used bilaterally or unilaterally.
5. Economic, effective and easy to make.

Disadvantages

1. We must be careful with vertical growing patients or patients with open bite.
2. Undesired first molar and second premolar rotations are produced.
3. We cannot bond braces until the molars have been distalized. In some cases we can place braces on the anterior sector in order to begin alignment.
4. The anterior segment is proclined.
5. Not very hygienic because it needs a Nance button as anchorage.
6. An undesired molar tip is produced.

Recommendations

1. The molars must be anchored after they have been distalized in order to avoid molar mesial movement.
2. We must try to encourage excellent dental hygiene due to the food entrapment under the Nance button.
3. If we have a big Nance button we will have greater premolar anchorage but unfortunately we will also have more food retention.
4. The open coil with the sliding hook must be compressed 60 % to 70 % every 3 or 4 weeks.[17,18,38]

Fig. 49. Food retention under the Nance button.

Sliding hooks

In this molar distalizing technique an open NiTi coil, a sliding jig and intermaxilary Class II elastics are combined.

The mechanics of this technique are similar to the mechanics employed in the CEOB-1 and on the Wilson distalizer because they employ NiTi super elastic coils that will produce the distalizing movement. This distalizer will produce a force between 75 g to 150 g depending upon the amount of compression and the diameter of the coil and the thickness of the elastic.[2]

In this technique, the open coil and the sliding jig are inserted in the arch wire, the wire must be a round 0.020" stainless steel or a rectangular 0.017" x 0.025" wire.

The coil and the sliding jig must be passive, meaning that the distance between the distal wing of the canine and the mesial aspect of the molar tube must be the same than that of coil and the jig occupy. We activate it placing an intermaxillary Class II elastic from the hook of the sliding jig to the hook of the molar. During mouth aperture, the elastic stretches, the jig slides and the coil is compressed.[2]

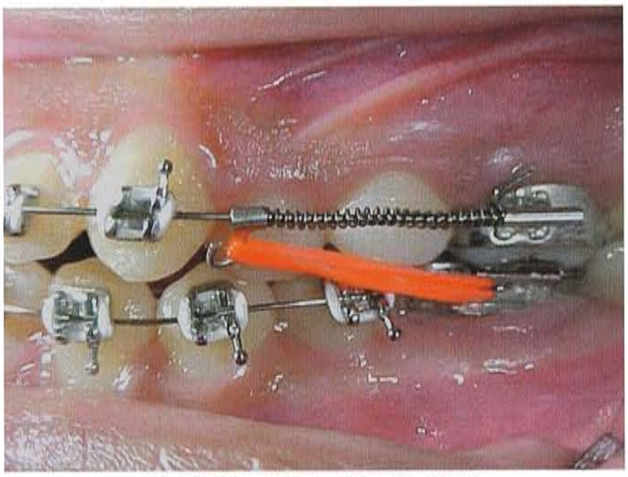
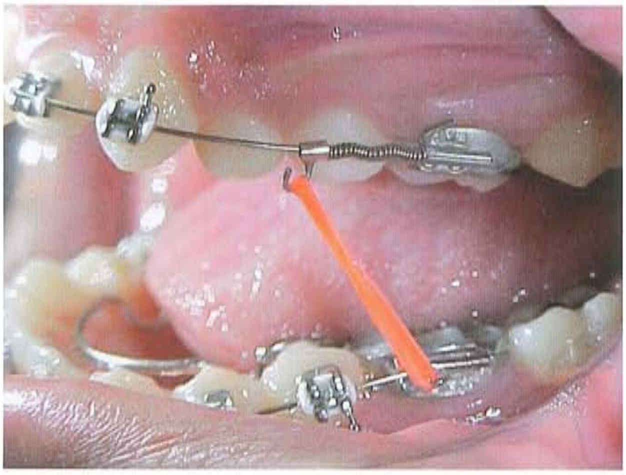


Fig. 50. Sliding hook in a closed mouth.

Advantages

1. Very hygienic.
2. Easy and economic to make.
3. It produces 0.5 mm to 1 mm of distalization per month.
4. Comfortable and well accepted by the patient.
5. It can be used unilateral or bilaterally.



Figs. 51 and 52. Hook in an open mouth.

3. The bigger the inner diameter of the coil and the smaller the diameter of the wire, the faster the distalization will be.
4. The intermaxillary elastic must be changed every 24 hours by a new one.
5. We suggest the use of 6 ounce elastics.
6. The elastic must stretch 3 times its original diameter.
7. Ask the patient to eat with the Class II elastics on during distalization.

Bimetric distalizing arch or Wilson distalizer

Robert Wilson and William Wilson developed, in 1987, a system of removable orthodontic appliances that can be used in conjunction with almost every fixed appliance system. The Bimetric Distalizer, commercialized by Rocky Mountain Orthodontics (RMO), produces maxillary molar distalizing movement. This arch is "bimetric" because the anterior segment is made of 0.022" stainless steel wire and the posterior segment is made with 0.040" stainless steel wire. At the canine level sliding hooks for Class II elastics use are inserted. At the premolar level we find an omega shaped stop. A NiTi 0.010" x 0.045" open coil is placed between the distal extension of the omega stop and the tube of the molar band.[24,29,48]

Disadvantages

1. We depend upon patient collaboration for coil activation (use of the Class II elastic).
2. We can place braces from canine to canine, but the bonding of the premolar braces must wait until distalization is complete.
3. It does not produce bodily distalization.
4. Anterosuperior segment proclination.

Recommendations

1. Ferulize the anterosuperior segment in order to reduce proclination.
2. Anchor the lower molars with a lingual arch. This will diminish molar extrusion caused by the use of Class II elastics.

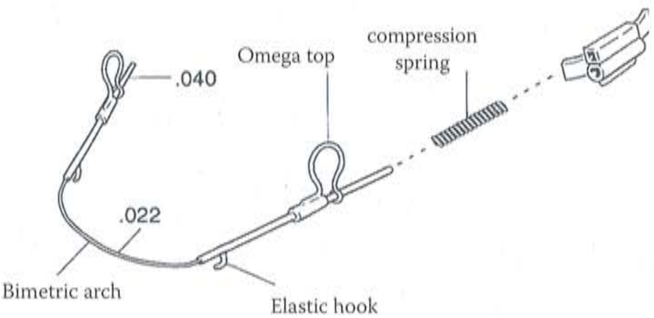


Fig. 53. Parts of the bimetric distalizing arch.

The distalizing arch is placed in the buccal tubes. If the extra oral tubes are located occlusally, a bayonet bend must be made in the posterior portion in order to place the arch above the anterior braces. Due to the fact that the anterior segment of the distalizer is made out of 0.022" wire, it will easily insert in the slot of the anterior braces.[24,29]

The distalizing force exerted on the molars is produced by the compression of the open coil against the molar tubes. The use of Class II elastics is indispensable for the compression of the coil; Wilson & Wilson recommend the use of 6 ounce elastics.[48]

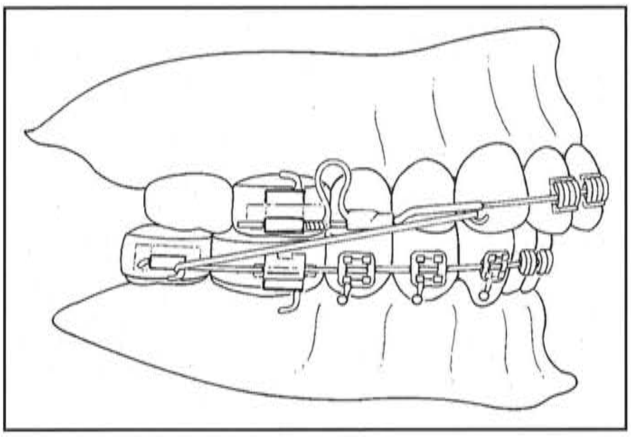


Fig. 54. Distalizer activation with Class II elastics.

In the subsequent appointments, the appliance is activated by clipping the omega with a three prong plier, this way the omega is opened and the posterior part slides distally.

After three or five months of activation, with the complete cooperation of the patient in the use of the elastics, the molar distalization will be observed. This movement is similar to the one produced by distalizing magnets, NiTi coils, sliding hooks and the CEOB-1. The lower arch wire must be rectangular or a lingual arch must be placed. [24,29,48]

After the position of the molar has been corrected (or over corrected to a Class III molar relation) the distalization arch is taken off. Then a transpalatine and a utility arch are placed to stabilize the position of the molar and the incisors, meanwhile the premolars and canines are allowed to move distally, due to the traction of the transeptal fibers. Class II elastics are frequently used during anterior teeth retraction.[48]

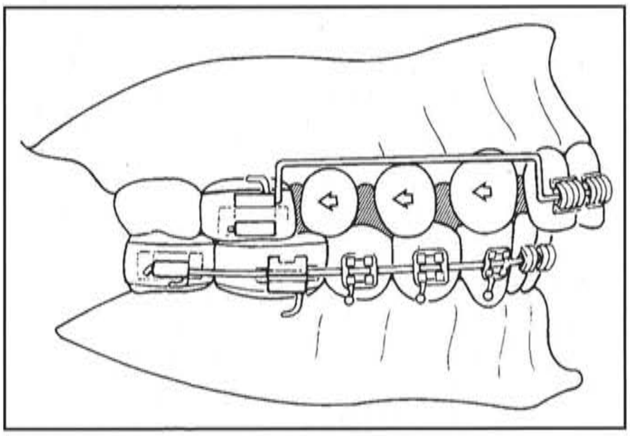
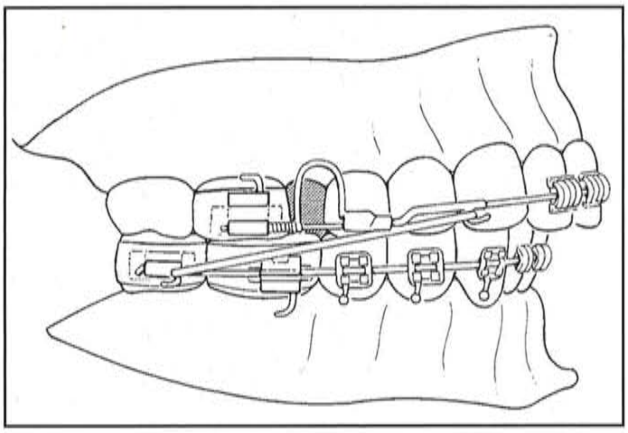
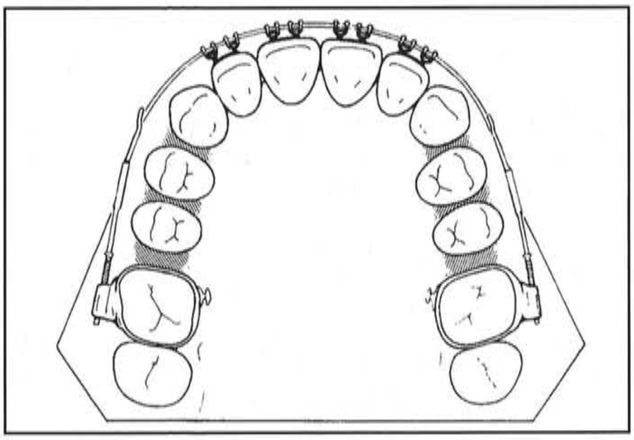


Fig. 57. Utility arch placement.

In 2000, a study done by Rana and Becher considered the distalizing effects of this appliance and they reported that the molars moved distally about 1 mm to 1.5 mm per month and they inclined distally 2°. They also reported 3.5° of positive torque and 2.7 mm of extrusion of the upper incisors.[5]





Figs. 55 and 56. Molar distalization.

Advantages

1. Very hygienic.
2. It distalizes 1 mm per month.
3. Comfortable and well accepted by the patient.
4. Can be used unilateral or bilaterally.

Disadvantages

1. We depend upon patient cooperation for the activation of the coil (use of Class II elastics).
2. We can place braces from lateral to lateral, but the bonding of the canine and premolar braces must be postponed until the distalization is completed.
3. It tips molars.
4. It proclines the anterosuperior segment.

Recommendations

1. Ferulize the anterosuperior segment to reduce proclinement.
2. Anchor the molars with a lingual arch. This will limit the molar extrusion caused by the continuous use of Class II.
3. The elastic must be changed every 24 hours.
4. We suggest the use of 6 ounce elastics.
5. The elastics must stretch 3 times their original diameter.
6. The patient should chew food and gum with the Class II elastics in place during distalization.

GG Distal Spring

This distalizer was developed in 2006 by Drs Víctor Manuel García Hernández and Juan Francisco Gaitán Fonseca, both residents of the orthodontic program of Centro de Estudios de Ortodoncia del Bajío (CEOB), in Irapuato, Guanajuato, México.

This appliance has the same principle as the Pendulum, but in this case the distalizing forces are parallel and the pendular movement is avoided, thus molar palatinization is avoided. This distalizer consists of:

1. An acrylic plate that serves as palatine anchorage, it extends to the incisal edges of the anterosuperior teeth like a bite plane, so proclinement of this sector is limited and distalization is facilitated.
2. A pair of springs made of TMA 0.032" wire that are inserted in the palatal sheaths of the upper first molars.
3. A pair of rests that are going to be cemented to the occlusal aspect of the premolars.

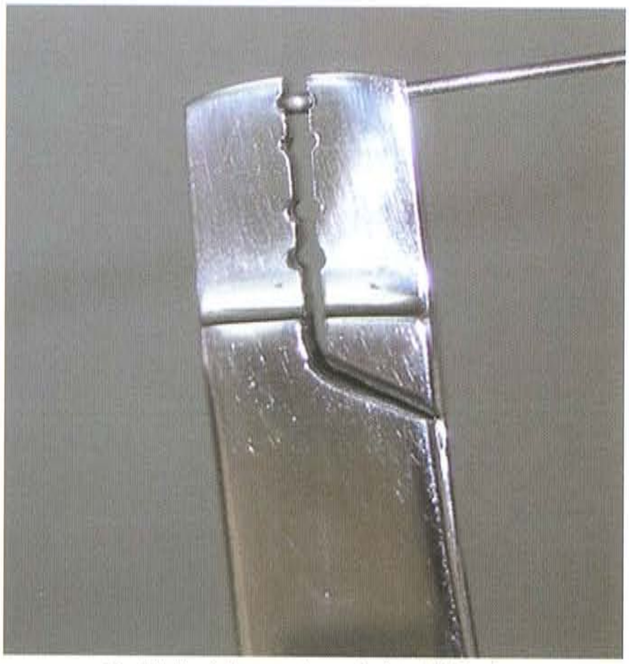


Fig. 58. Bend done on the end of the TMA wire.

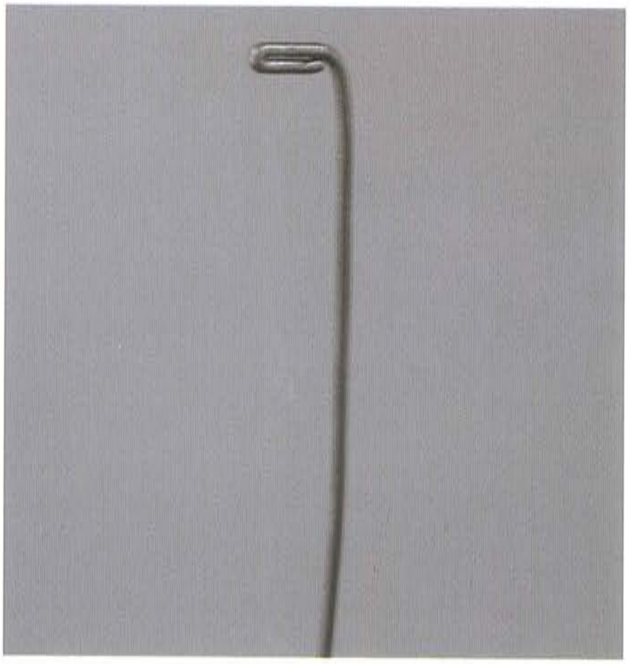


Fig. 59. This bend is going to be inserted in the palatine sheath of he molars.

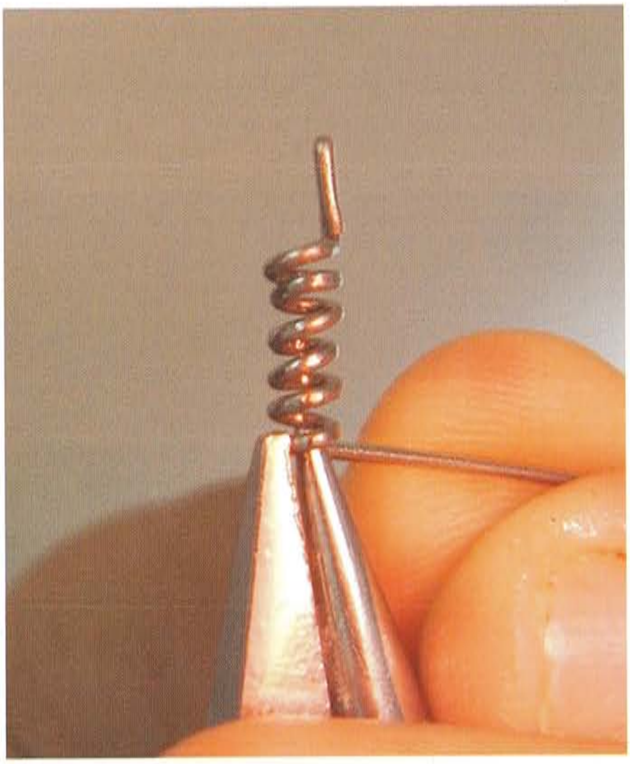


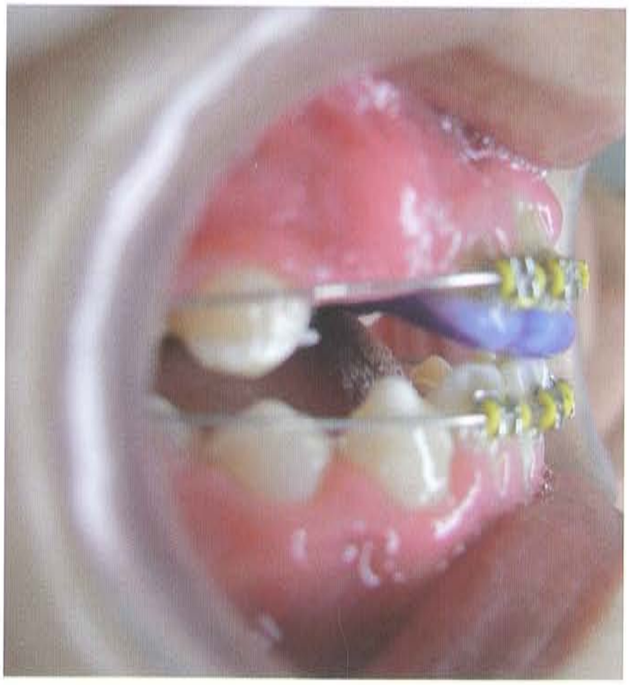
Fig. 60. Finalized TMA spring.

To activate the GG Distal Spring the TMA springs must be opened 3 mm to 4 mm and then inserted in the palatine sheaths.

Figs. 61-64. Passive GG Distal Spring.

Figs. 65-67. Active GG Distal Spring.

Fig. 68. Frontal view of the GG Distal Spring.



Figs. 69 and 70. GG Distal Spring in mouth.

Fig. 71. GG. Distal Spring three months after cementation.

lFig. 72. Class II elastics.

Advantages

1. Economic
2. Easy to make.
3. It produces constant and parallel forces.
4. It produces forces between 100 g to 200 g.
5. It distalizes 1.5 mm to 2 mm per month.
6. Anterosuperior proclinement of the sector is diminished by the acrylic ferula placed on the incisal edges.
7. Excellent distalization appliance for patients with deep bite and hypodivergent growth pattern

Disadvantages

1. We must invest laboratory time to make this appliance.
2. Activation is difficult.
3. The acrylic anchorage retains food particles.
4. Like most of the distalizers this appliance does not produce bodily movement.

Recommendations

1. Strict control of the appointments.
2. The patient must have excellent hygiene.
3. Activate the TMA springs every one and a half months to two months.
4. The activations must be of 3 mm to 4 mm.
5. Use Class II elastics to lessen anterior sector proclination.

Repelling magnets

This distalization system was developed by Gianelly in 1988. These magnets are made out of Samarium Cobalt magnets (MMI, Modular Magnetics Inc., NY, NY).[14] This magnetic system, that does not require patient cooperation, generally moves distally the crowns of the molars in a slightly minor rate than Super Elastic NiTi wires.[4,24,29] This system consists of 2 magnets with opposing poles (negative with positive), and are placed on a sectioned wire. One of the magnets is placed on the mesial aspect of the molar tube, while the other one on the distal aspect of the brace of the second premolar. This last magnet is ferulized to the brace of the first and second premolars with 0.014" stainless steel ligature. They must be reactivated every 2 weeks and will provide 8 ounces of force (200 g to 225 g).[15,24]As anchorage a modified Nance button is used and the range of distalization obtained is around 3.7 mm to 5 mm (4,14,15,42). This procedure is done in the late mixed dentition after the eruption of the premolars and in the permanent dentition, being a promising appliance for adults.

The sequential activation of the magnets (every two or four weeks) produces a force that moves distally the upper first molars. According to Gianelly, approximately 25% of the total dental movement consists in a mesialization of the anchored premolar, which indicates a slight loss of anchorage. In a time period of 4 to 5 months a space equivalent to the diameter of a premolar can be produced in front of the first upper molar.[4,14,42]

Speaking about biological effects, magnetic forces turn red blood cells 1/3 thinner and elongated, therefore, although the periodontal capillaries are compressed, blood will still flow smoothly, provoking little edema and periodontal root inflammation with little discomfort to the patient. It has been proven that the static magnetic field can stimulate the enzymatic systems, cell proliferation and osteogenesis; also it does not provoke any effect in the dental pulp or in the gingival tissue that is close to the magnets.(15,24,43)

The correct orientation of the magnets is very important, the same thing applies to the proper distance between them, because if they are too separated they lose effectiveness, because the repulsion force is diminished and their durability can also diminish. These magnets, like the NiTi coils, are very effective, because both are capable of exerting light and constant forces, but some studies state that NiTi coils are more effective than repelling magnets.(15,26,42,43)

The anchorage loss when the magnets are employed in order to move the first and second molars distally is observed in an overjet increase. This means that two thirds of the space created with the use of magnets to move the first and second molars distally represent molar movement and a third of the space represents loss of anchorage The use of magnets frequently moves the crowns of the molars 0.5 mm per month when the second molars have not erupted yet.(24,29,42,43)

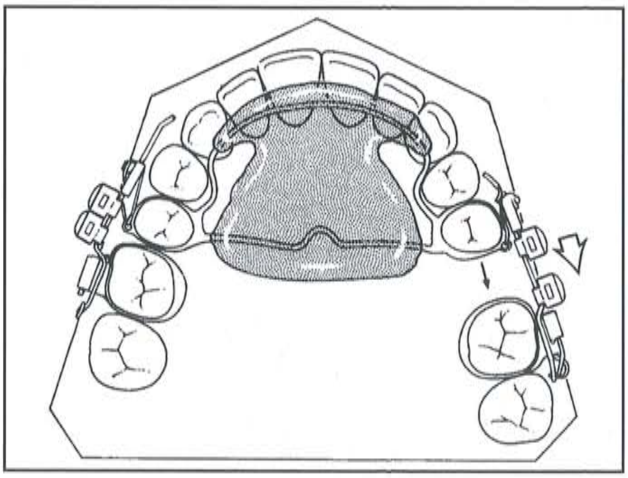


Fig. 73. Magnet distalization.

Advantages

1. It produces a light and constant force for a long period of time.
2. We do not depend upon patient cooperation.
3. Unilateral or bilateral distalization.
4. Minimal discomfort.
5. Minimal pulp alterations.
6. Minimal root resorption.

Disadvantages

1. The price is elevated.
2. Loss of anchorage.
3. Food retention due to the acrylic anchorage.
4. We cannot place braces on the anterior sector.
5. It distalizes molars at a rate of 0.5 mm per month.
6. As other distalizers, it does not produce bodily movement.

Recommendations

1. We must brace the anterior teeth until the molar distalization is complete.
2. Activate the magnets every 2 or 4 weeks.
3. The Nance button can be extended up to the vestibular aspects of the upper incisors. This extension has a double purpose to act as a bite plane and as anchorage, which will lessen the proclination of the anterosuperior segment.
4. After the molars have been distalized, anchor them with a Nance button or a transpalatine arch.
5. We must instruct the patient in how to clean under the Nance button with pressurized water in order to avoid food accumulation.

Pendulum

This distalizer was developed by Dr J. Hilgers in 1992. This appliance produces distalization with little inclination compared to other methods, and at the same time allows rotational control over the molars with minimal mesial premolar anchorage displacement. McNamara, in an ample study, recommends this appliance as an effective distalizer with minimal effects upon the vertical dimension.(8,9,11,36,41) But Ghosh and Nanda (1996) evaluated 41 patients treated with the Pendulum and found that 57% was molar distalization and 43% was loss of anterior anchorage of the upper first premolar. The authors also reported an average 15.7° of distal inclination of the upper first molar. Bussick and Mc Namara (2000) suggested that the Pendulum is much more effective if it is anchored on the deciduous upper second molar with an unerupted permanent upper second molar (this reduces the possibility of an undesired opening of the bite).(8,10,12,30) They also found in their study that the upper molar moved distally an average of 5.7 mm, with 10.6° of distal tip and 0.7 mm of extrusion. The upper first premolar moved mesially 1.8 mm with 1.5° of mesial tip and 1 mm of extrusion. Also the lower third of the face increased 2.2 mm and there were no significant differences among patients with hyper, hypo or normo divergent patterns.[10,15,19,30] Burkhardt and cols. in 2003 conducted a study in which they found that the Pendulum produces a clockwise descent and rotation (aperture of the mandibular plane) of 1.2°. They found that the upper incisors proclined 2.8°, the upper molar moved distally 5.9 mm, with a distal inclination of 10° and 1.7 mm of extrusion.[13,19,20,30,41]

Fig. 74. Passive Pendulum.

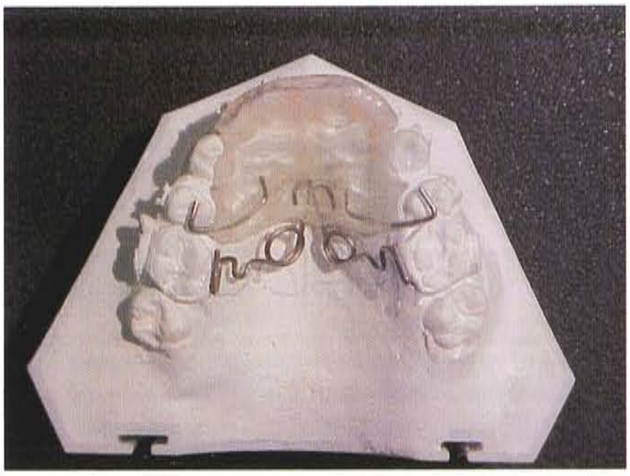


Fig. 75. Active Pendulum.

This distalizer basically has 3 sections:

1. An ample Nance button that leans on the palatine vault behind the incisor teeth for anchorage, this can be extended to the incisal edges; this will minimize proclination of this sector.[11,12,13]

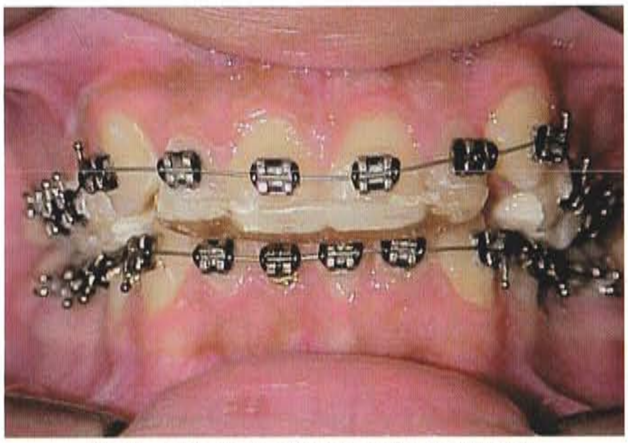


Fig. 76. Acrylic button extended to the incisal edges.

2. A pair of TMA 0.032" wires. When we cement the Pendulum, the arms will be parallel to each other, then they are inserted in the molar band sheaths. Posterior adjustments are done pressing the center of the adjust-

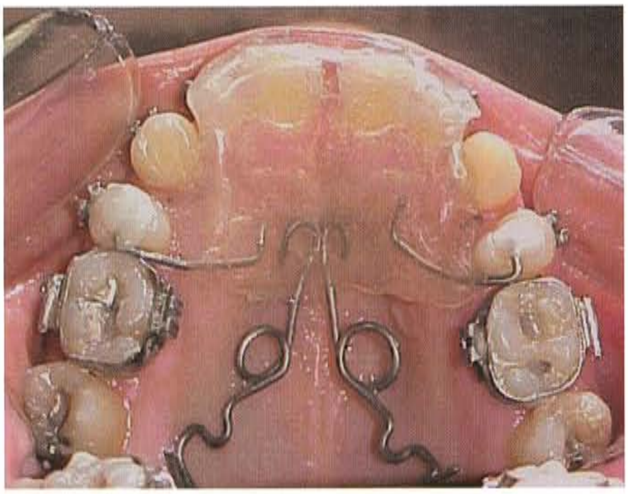


Fig. 77 Pendulum with active arms at 60°

Fig. 78. Active Pendulum.

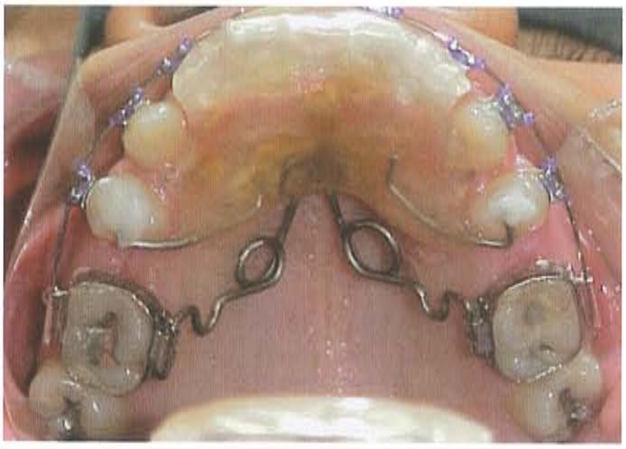


Fig. 79. Pendulum after 4 months.

Fig. 81. Pendex after 2 months.

ment loop. Depending upon the amount of degrees of activation of the arms, will be the amount of force produced. If they are activated to 90°, the distalizing force will be 350 g, if they are activated 60°, the force will be 250 g; if they are activated 40°, the force will be 125 g. These activations must be done before we cement the Pendulum.[24,26,30,36]

3. One or two pairs of rests that are cemented or banded on the premolars.
4. An expansion screw to correct transversal problems. This appliance is called "Pendex". This expansion screw is added in almost every case to modify the shape of the dental arch or to expand it in case it is necessary. This lessens the need to make horizontal adjustments in the loops of the arms.[11,12,30,41]

Fig. 82. Pendex after 6 months.

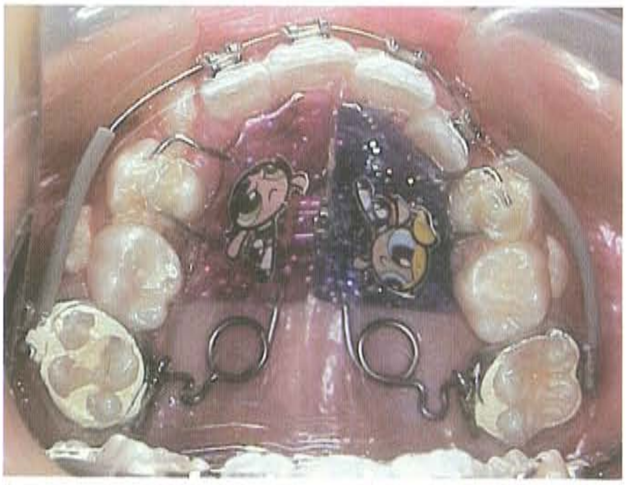


Fig. 80. Pendex cementation.

Advantages

1. We do not need patient cooperation.
2. It produces rapid distalization (1.5 mm to 2.5 mm per month).
3. Esthetic.
4. It can be modified easily.
5. The activation is fast and simple (every 2 or 3 months).

Disadvantages

1. Anterosuperior sector proclination.
2. We must invest laboratory time to fabricate it.
3. High rebound rate.
4. Speech is impaired and hygiene is difficult.

5. It produces a pendular molar movement, so it is possible that a posterior cross bite may develop.
6. The TMA wires can impinge in the palatine mucosa.
7. The occlusal rests can debond.
8. The anterior bite can open due to the fact that the appliance distalizes molars rapidly. This can be an advantage in brachyfacial patients but it can be a problem for dolichofacial patients, especially patients that have lingual protrusion habits.[13,41]

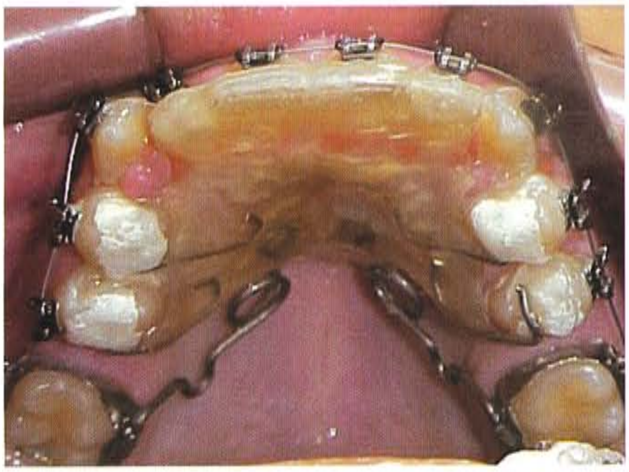


Fig. 83. Debonding of the rest on the second left premolar.

Recommendations

1. After the distalization is complete, cement a moderate or maximum anchorage on the distalized molars for 3 to 4 months at least, or until space closure is completed.[11,12,13]
2. To avoid a posterior cross bite, activate the omegas of the arms with a slight expansion.
3. We must instruct the patient how to clean the acrylic button with pressurized water in order to avoid food accumulation.
4. The omegas must be separated 1.5 mm away from the palatal mucosa. This will avoid impingement of the omegas in the palate.
5. We must keep a radiographic control after the distalization is completed, because if we distalize the first upper molar before eruption of the second upper molar we can entrap the molar and limit its normal eruption.
6. We must have strict control of the appointments, because if the rests debond, the forces will mesialize the anterosuperior segment.

Distal Jet

Within the arsenal of fixed distalizers that have been created in the last years we find the "jet" family, which were designed by Drs Aldo Carano and Mauro Testa (1996), and are presently marketed by American Orthodontics. Within this family we find the Distal Jet, an appliance designed for upper molar distalization, in an individual manner (only the first molar) or in conjunction (the first and the second molar). This appliance distalizes in a bodily manner because the distalization force is located near the center of resistance of the molars.[5,6,10,36,44]

This appliance is very similar to the Pendulum, but it has two advantages. First, the upper molars are distalized without the palatal movement that happens with the pendulum. Second, the Distal Jet can easily convert into a Nance button after the molar distalization has taken place.[5,6,44]

The Distal Jet is composed of:

1. A Nance button anchored to the premolars.
2. Two 0.036" wires.
3. Two telescopic tubes imbedded in the acrylic of the Nance button.
4. Two NiTi open coils.
5. Two stops or screws.

The distalizing wires can be 0.036" stainless steel wire; the distal part of the wire, bent as a bayonet, is going to be inserted in the palatine sheaths of both molars, and the mesial ends are inserted in the telescopic tubes that are imbedded in the acrylic of the Nance button. This is going to work as a piston because the wire can slide freely in the telescopic tube. Over each tube a NiTi open coil and a screw are slipped on. The distalizing force is given by the total compression of the coil, which is accomplished by sliding the screw distally and adjusting it to its new position. The pair of telescopic tubes will be parallel to the occlusal plane and as close as possible to the center of resistance of the molar.[5,6,44]

The Nance button can be anchored on the first or second premolar. If the first premolars are used as anchorage, the second premolars will move with the molars during distalization, but the loss of anchorage and the overjet will increase. If we anchor the Nance button to the second premolars, we will have less anchorage loss, but the treatment time will increase because the canine and the premolars would have to be distalized in mass.

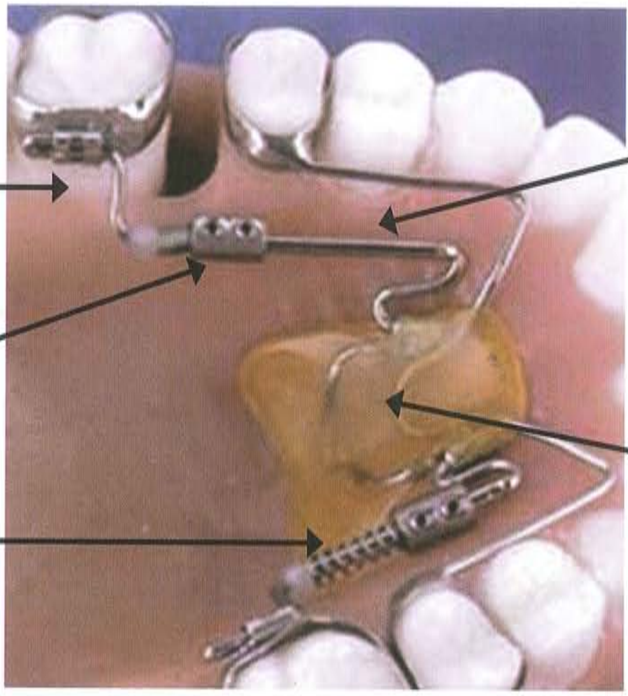


Fig. 84. Components of the Distal Jet.

In the mixed dentition, the second deciduous molars are usually chosen as anchorage, but only if they have at least a third of the root present.(33)

This appliance distalizes in average 0.91 mm per month when the first and second molars are present and a bit more when only the first molar is erupted. The Distal Jet produces a distal inclination (tip) of 0.6° for each millimeter of distalization. The force exerted by the open coils is 180 g to 240 g at the moment of maximum activation. We recommend the use of the 180 g coil when only the first molar is present and the 240 g coil when the first and second molars are present.(5,33)

The removal of the upper third molar is recommended in adults before we initiate the molar distalizing movement. The interferences of the third molar can be an obstacle that can put at risk the effectiveness of the distalization. But in patients in which the third molars are still high and are not in contact with the roots of the second molars, the extraction of the third molar is not indicated.(5,6,24,44)

Advantages

1. Minimal distopalatal rotation and tipping of the distalized molars.
2. Comfortable to the patient.
3. Easily convertible into a Nance button after distalization is completed.
4. We do not depend upon patient compliance.
5. We can combine the molar distalization with the alignment of the anterior sector with fixed appliances. But studies made by Patel (1999) show that the stability of the anchorage unit diminishes with the use of braces during distalization. Drs Carano and Testa recommend the use of the Distal Jet before the placement of braces in the upper dental arch.
6. 80% of the space obtained is due to the distal movement of the upper first molar and 20% is due to the loss of anterior anchorage.(5,6,33)

Disadvantages

1. Anterosuperior sector proclination.
2. High rate of rebound.
3. The appliance impairs speech and is difficult to clean.
4. Due to the fact that the Distal Jet distalizes the molars quickly, the anterior bite can open. We can take advantage of this while we treat brachyfacial patients, but this fact can pose a problem in the treatment of dolichofacial patients, especially those that have a protractile tongue habit.

Recommendations

1. Monitor the patient every 4 weeks.
2. If the screw or the stop is in intimate contact with the palatal mucosa, the distalizing process will not occur.
3. The screw and the stop must be separated from the palate 1 mm to 2 mm.
4. An incorrect position of the Distal Jet can increase the friction in the telescopic tube; and a high level of friction can reduce the rate of molar distalization.
5. The open coils must be totally compressed once a month, until we reach a Class III or Super Class I molar relation.
6. After we obtain the molar distalization, we can remove the open coils and convert the Distal Jet into a Nance button; this is done by applying light activated or self curing acrylic in the wire base.
7. Use Class II elastics and/or ferulize the anterior segment with ligature, with an acetate or with a bite plane in order to reduce anterosuperior proclination.
8. We must instruct the patient how to apply pressurized water under the Nance button in order to avoid food accumulation.

Cetlin plate

This distalizer was developed by Dr. Norman Cetlin in 1983. It consists of an acrylic plate that has 2 TMA springs that emerge from the palatine aspect and contour the mesial aspect of the molar to be distalized or they are inserted in the tubes of the molar bands. It also has 2 retainer wires on the premolars and a buccal rectangular or round wire covered with a slight film of acrylic, which functions as anchorage to counteract the mesial forces and avoids upper incisor proclination.[15,26]

We must place an elastomeric separator in the mesial aspect of the molar before we place the Cetlin plate. This way we can insert the TMA wires in between the molar and the second premolar and we can skip the placement of the separator.[15,26,29]

The plate is used full time, except during meals, and can be combined with a cervical traction face bow during sleep time. The springs of the plate incline the molars distally, and the face bow can tip distally the roots of the molars, this way we can maintain an upright molar position.[29]

Distalizing plates are useful not only for obtaining additional space, but also to regain space lost due to the premature exfoliation or extraction of the deciduous second molar. In these cases we can use the plate without the extra oral traction.[29]

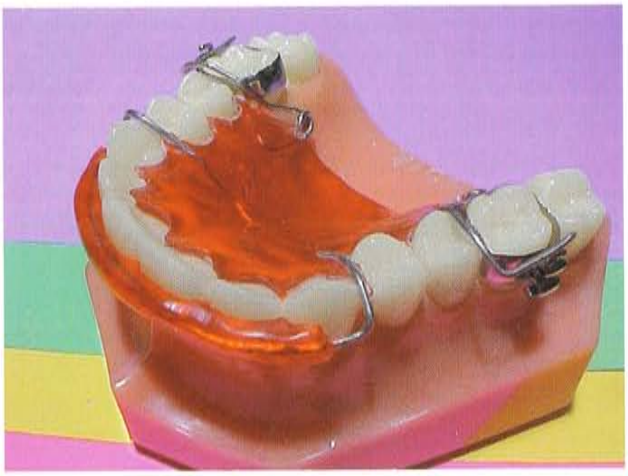
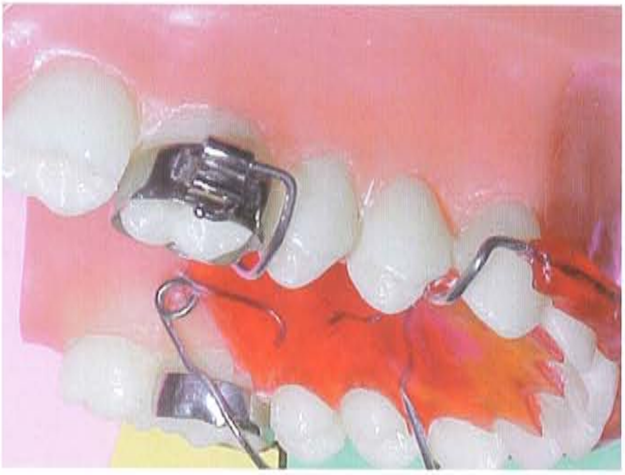


Fig. 85 and 86. Cetlin plate.

Figs. 87 and 88. Active Cetlin plate.



Figs. 89 and 90. Springs inserted in the extra oral tubes.

Advantages

1. The orthodontist controls the distalization.This depends directly on the amount of millimeters the TMA springs are activated.
2. Very hygienic because it is removable.
3. Minimal anterior segment proclination due to the acrylic shield on the buccal arch.
4. When the plate is combined with the face bow the distal tip of the molar crown is diminished.

Disadvantages

1. Due to the fact that the plate is removable, we depend upon patient compliance.
2. Due to the distalizing force, the plate can be expelled from the maxillary teeth.
3. The distalizing movement is slow.
4. We cannot bond braces.
5. The treatment must be divided in two phases, first the distalization phase and then the orthodontic phase.

Recommendations

1. The distalizing springs must be activated 1 mm per month.
2. After the molars have been distalized, we must place a Nance button or a transpalatine arch on the distalized molars.
3. It is best to insert the TMA springs in the extra oral tubes, because in doing so the plate becomes more stable.
4. Place the Cetlin plate in a glass of water or mouth wash when the patient is eating. Doing so will lessen foul odor absorption.

Veltri distalizer

This distalizer was developed by Dr Nicolas Veltri in 1999 and is marketed by Leone. It is constituted by a palato-sagittal expansion screw, cemented at 90° to obtain bilateral molar distalization. The screw is linked to the bands of the first upper molars and to the upper second premolars (or on the upper second deciduous molars). Anchorage is accomplished by a Nance button that is soldered to the body of the screw. The screw is activated twice a week. Knowing that each activation equals 0.2 mm, the appliance distalizes approximately 1.5 mm per month. The complete correction of a Class II molar relation (approximately 5 mm) will require, in average, 3 and a half months of treatment. At the end of the active phase of distalization, the screw is ferulized or blocked with acrylic and the arms that link the screw to the bands of the second premolars are cut off. The appliance now becomes a ferulized screw, a Nance button with bands on the molars.[1,36,45,49]

Fig. 91. Passive Veltri.

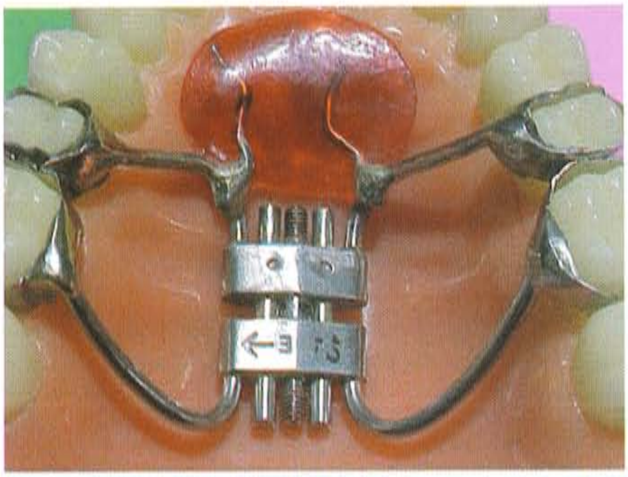


Fig. 92. Passive Veltri.

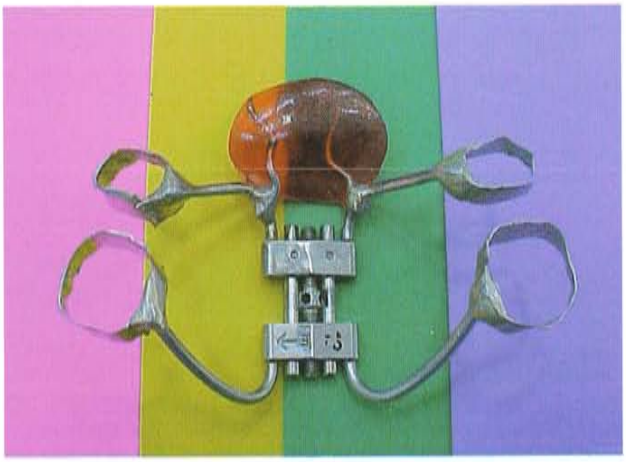


Fig. 93. Active Veltri.

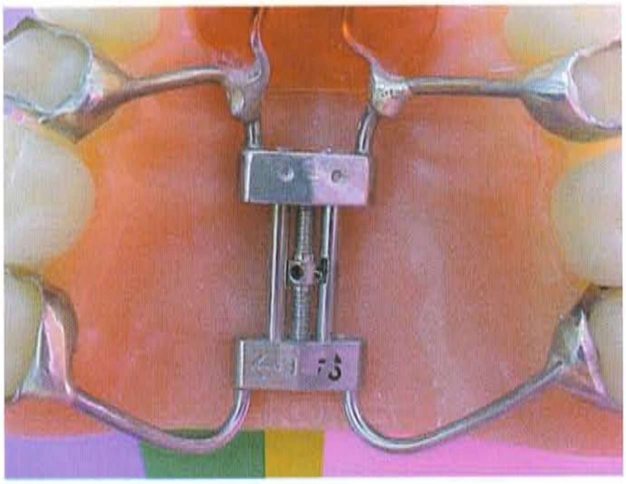


Fig. 94. Active Veltri

Advantages

1. From the biomechanical point of view, the distalizer can produce a bodily first molar movement. Due to the ruggedness of the screw-arms-bands set, the point of force application is at the screw level. Therefore, the force vector passes close to the center of resistance of the upper first molars.
2. The activation of the distalizer is very easy; we just have to activate the screw.
3. It is esthetic.
4. Minimal discomfort to the patient.
5. It converts into a passive anchorage. We do this by cutting the arms that link the premolars to the expansion screw.
6. Some cases treated with this distalizer suggest that the anchorage loss that occurred in the anterior segment of the upper maxilla with this appliance was less than the loss experienced with the Jones Jig or the Pendulum.

Disadvantages

1. We depend upon patient cooperation, because the activation is done by the parents of the patient.
2. The cost of the appliance increases due the cost of the screw.
3. Due to the force exerted, the Nance button can impinge itself in the palate.
4. Anterosuperior sector proclination.
5. The Nance button can be hard to clean.
6. We must invest laboratory time to fabricate it.

Recommendations

1. In case the upper first molars are rotated, we should correct this anomaly before we distalize the molars.
2. Use Class II elastics.
3. Teach the parents how to activate the screw.
4. The screw should be separated about 2 mm to 3 mm from the palatal vault.
5. The screw must be activated twice a week.

K loop

This system was developed by Dr Valrun Kalra in 1995 and is commercialized by Ortho Organizers. This system consists in a compressed loop that resembles a horizontal K that will exert the distalizing force and a Nance button cemented to the upper first premolars or to the first deciduous molars, the button will provide anchorage.[22,24]

The K loop is made with 0.017" x 0.025" TMA wire, the ends of the wire will be bent 20° occlusally and will be inserted in the molar tube and in the brace of the first premolar. These bends lessen molar tip once the K loop is activated. Each loop will be 8 mm high and 1.5 mm wide.

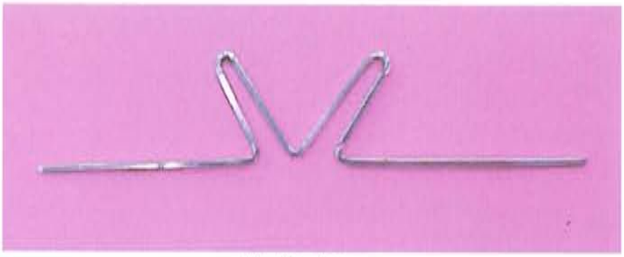


Fig. 95. K Loop.

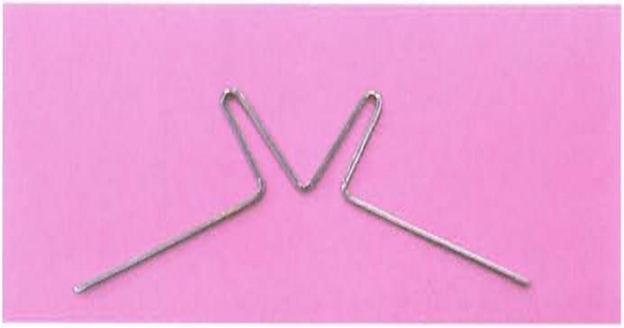
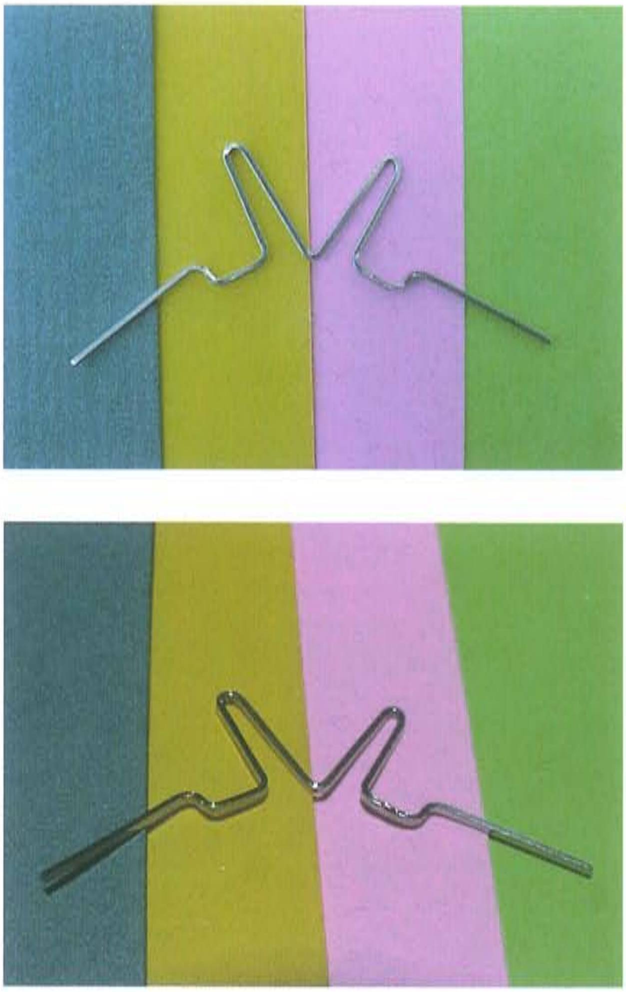


Fig. 96. K Loop at 20°.

With the first activation the molar will move 4 mm, if we want more distalization it can be reactivated 2 mm after 6 or 8 weeks of treatment. The rate of anchorage loss is 1 mm of mesial movement of the first premolar per 4 mm of distal movement of the molar, a similar result is obtained using magnets or NiTi coils.[22,26,36]



Figs. 97 and 98. Mesial and distal stops made on the K loop. These stops will avoid slippage and will provoke molar distalization.

To activate this wire we must place a pair of stops on the arms of the K loop. One is placed mesial to the tube of the molar and another distal to the brace of the first premolar, this will prevent slippage and will distalize the molars. These stops will be 1.5 mm long.[22,26,36]

The K loop is distended 2 mm to 3 mm its original size. During placement, it is compressed and due to the memory of the TMA wire the molar distalization will occur.[22]

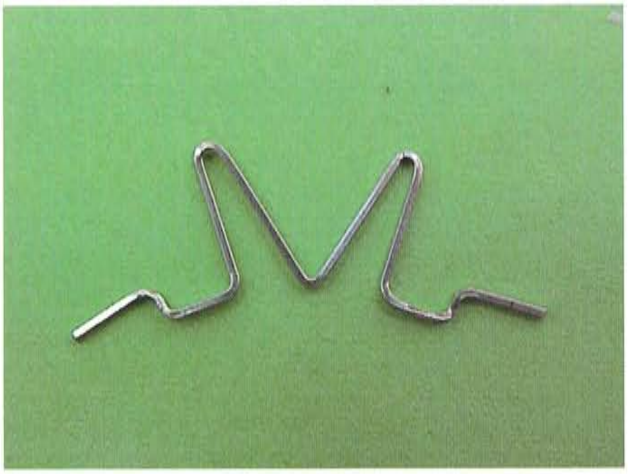


Fig. 99 Activated K Loop. Ready to place between the molar and the first premolar.

Advantages

1. We can place molar and premolar intrusion and extrusion movements, this will depend upon how off or centered the loop is between the molar and the premolar.
2. The molar tip is controlled.
3. Hygienic.
4. Economic.
5. Easy to place and take off.
6. Easy to elaborate.
7. We do not depend upon patient cooperation.

Disadvantages

1. Maladjusted or long loops can injure the inner lining of the cheek or the gums of the patient.
2. Anterior segment proclination.

Recommendations

1. The K loop can be elaborated with stainless steel. The disadvantage of this material is that it has less memory and can deform easily. The TMA K loop exerts lighter and more constant forces than the loop made of stainless steel.[22,24]
2. Reactivate the loop every one and a half or two months.
3. As soon as the distalization is completed, place a Nance button or a transpalatine on the distalized molars.

Belussi Distalizer

This appliance was developed by Dr Ugo Belussi in 1997 and it is derived from 2 distalizing appliances: the Pendulum and the Distal jet.

This distalizer is constituted by:

1. A modified Nance button bound to the first premolars.
2. Two unilateral expansion screws. These are placed between the first molar and the first premolar and are imbedded in acrylic as perpendicular to the occlusal plane as possible.
3. Two TMA distalizing springs (similar to the ones on the pendulum) that are inserted in the palatal sheaths of the molars and the acrylic of the button of a modified Nance button.

During screw activation (2/4 of a turn per week) the distalizing springs are simultaneously set in action,

Fig. 100. Passive Belussi.

Figs. 101 and 102. Active Belussi.

and in this way the molar distalization is produced. Dr Belussi recommends the alternate activation of the right and the left screw every 4 days, this means that the same screw is activated every 8 days; the objective of this is to not to apply a lot of force on the palate, avoiding irritation.(3,27,49)

Advantages

1. Distalization control.
2. If the screw does not turn any more and we have not accomplished the desired molar position, we must activate the TMA spring.
3. The activation of the distalizer is easy, because it is done in the screws.
4. Esthetic.

Disadvantages

1. We depend on patient compliance, because the activation of the appliance is done by the parents.
2. Due to the force exerted, the Nance button can impinge itself in the palate.
3. Anterosuperior sector proclination.
4. The Nance button can be difficult to clean.
5. We must invest laboratory time to fabricate it.

Recommendations

1. When we activate the springs that go in the molar tubes, we are going to obtain molar derotation, inclinement and buccal version; when the screw does not turn any more we can distalize the molars activating the springs. The activation must be done by the orthodontist.
2. We must teach the parents how to activate the screws.
3. Once the distalization has concluded we must cut the wire that connects the premolars to the acrylic button and transform the button into a Nance Button; this will give us enough anchorage, meanwhile the premolar and canines continue distalizing.
4. We must instruct the patient in how to clean the bottom of the Nance button with pressurized water in order to avoid food accumulation.

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Habits

8

Adriana Natera, Esequiel Rodríguez, Rogelio Casasa, Jennifer Solís, Ana María Gómez, Heidi Villanueva

Introduction

A habit can be defined as a custom or practice acquired by the frequent repetition of the same act, that at the beginning is done consciously, and latter is done unconsciously, like nasal breathing, chewing, speech and deglutition, which are considered functional or physiologic. There are also those that are not physiologic. like suction, that can be of a thumb or another finger, a pacifier or a lip; mouth breathing, lingual interposition in repose and immature deglutition.[5]

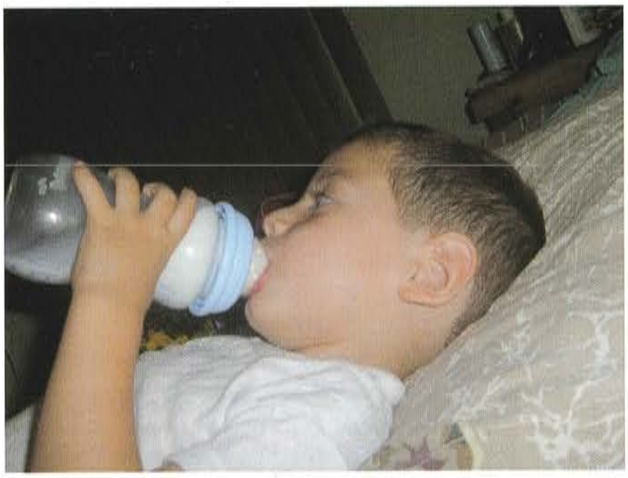
Non-physiologic oral habits are one of the main etiologic factors that cause malocclusions or dento-skeletal deformities, which can alter the normal development of the stomatognathic system, and can cause an unbalance between the oral and perioral muscle forces, which can finally lead to an osseous deformity that can have major or minor repercussions, depending on the age in which the habit begins; if the habit is picked up at a very young age, more damage will be caused because the bone has more modeling capacity at a very young age.[2] If we act soon we will be more capable of modifying the growth pattern of the jaws and of the dental arches. If we eliminate the deforming habit before the patient is three years old, the problem usually corrects itself spontaneously.[3,6,7,21,23,25]

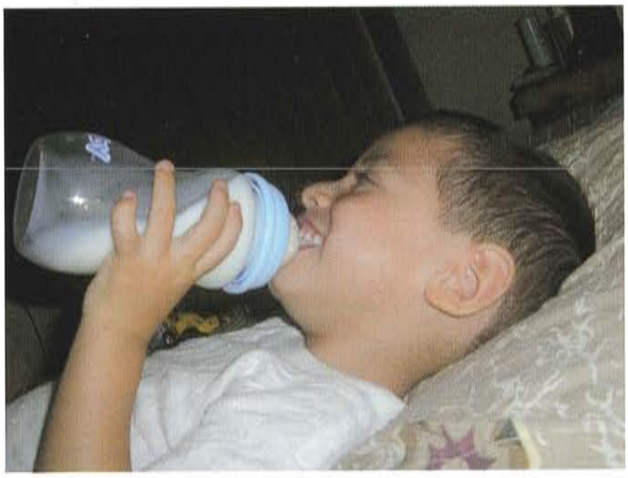
However, it is also certain that for a habit to be established during the growth and development of an infant there are factors that predispose the appearance or not of an oral habit; one of them is breast feeding. Breast feeding contributes much more than optimum feeding to the infant, because it has immunologic factors, anti- inflammatory cells, growth factors, enzymes and hormones, that complement the development capacity of the child, it also benefits the overall health of the mother, it strengthens the bond between the mother and child and, during nursing, the set of oral muscles are stimulated and the structures of the stomatognathic system are mobilized, thus stimulating normal growth and development. Nevertheless, if the child is bottle fed, the suckling baby does not close his lips with the same force as a breast fed baby; the action of the tongue to regulate the excessive flow of milk is affected and all this brings as a consequence a weaker stimulation of the oral muscles and it will not promote the adequate growth and development of the stomatognathic system, which will favor the acquisition of non-nutritive sucking habits as thumb or finger suction, pacifier, labial, or other object suction. The presence of some of these habits can alter the occlusal pattern in later stages of development of the child.[7]

Fig. 1.

Some studies indicate that 81.8% of infants that were bottle fed had some type of non-nutritive sucking habit and 88.2% of infants that were breast fed did not have any non-nutritive sucking habit.[7]

The consequences of the lack of breast feeding are inadequate suction and deglutition patterns, which will affect the development of the stomatognathic system of the newborn causing occlusal alterations.[7]





Figs. 2 and 3. Bottle feeding.

Etiological classification of habits

1. **Instinctive:** Like the suction habit, it is functional at the beginning of life, but can be harmful if it persists with time.
2. **Pleasant:** Some habits become pleasant, like some cases of thumb or pacifier sucking.[21]
3. **Defensive:** In patients with allergies, asthma, etc., in which oral breathing becomes a defensive habit.
4. **Hereditary:** Some hereditary congenital malformations can carry a habit related to the malformation itself, for example: short insertion of the lingual frenulum, lingua bifida, among others.
5. **Acquired:** Nasal phonation in cleft lip and palate patients even after they have been surgically intervened.
6. **Imitative:** The way the lips and the tongue are placed among family groups during speech, gestures, etc., are clear examples of imitative attitudes.[21]

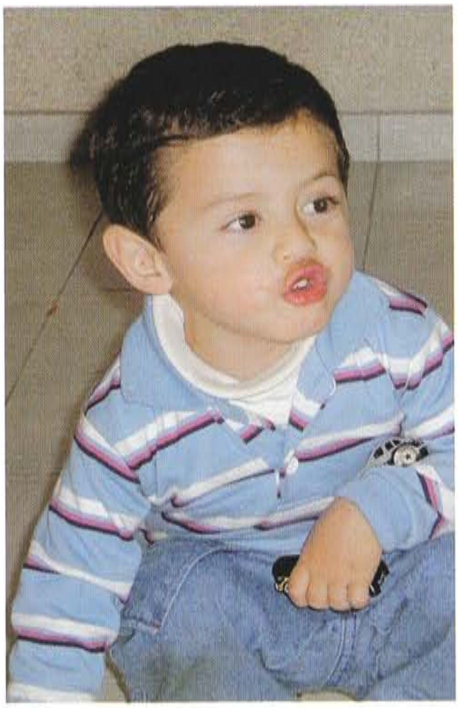


Fig. 4.

Factors that modify the action of a habit

1. **Duration :** According to the duration of the habit they can be classified in:

   a. **Infantile** (up to 2 years). In this period it is part of the normal pattern of child behavior, in general they do not have any detrimental effect.[21]
   b. **Pre-school** (2 to 5 years), if suction is occasional, it does not have any detrimental effect on the dentition; if it is continuous or intense, it can cause primary teeth malposition; if the habit is abandoned before the 6 years of age, the deformity is reversible in a high percentage of cases with relative ease.
   c. **Elementary** (6 to 12 years).Requires a deeper analysis of the habit etiology, it can produce dental malposition and dento-skeletal malformations.

2. **Frequency:** It can be intermittent (diurnal) or continuous (nocturnal). Some children suck at any time of the day and some only in the night or while preparing to go to sleep.[21]

3. **Intensity:**

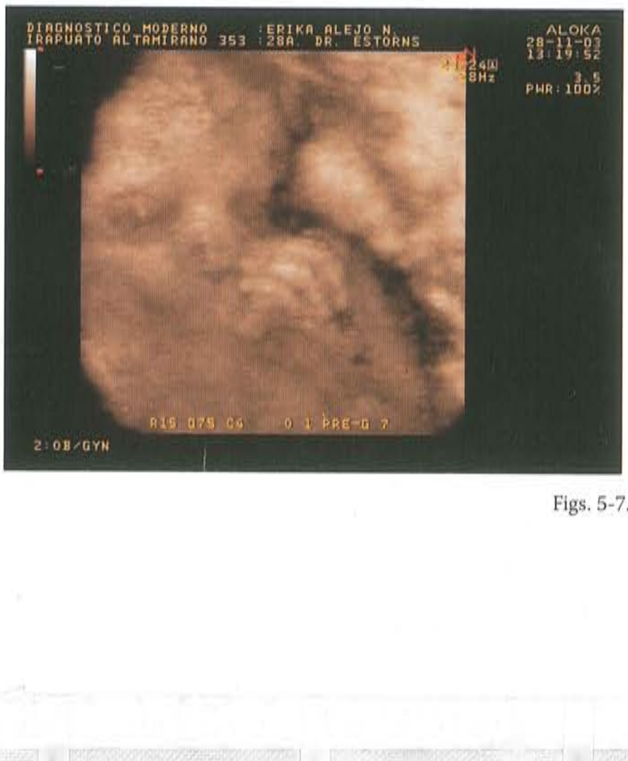
   a. **Low intensity:** When the insertion of the finger is passive, without any major muscular activity, primordially the buccinators. Generally the finger is not completely inserted in the mouth.
   b. **Intense:** When we can easily appreciate the contraction of the buccinators and the muscles around the lips. [21]

4. **The age** in which it begins, if the habit starts at an early age it will cause more damage, because the bone is developing and it is more moldable.[3]

The habits that alter occlusion with more frequency are: persistent immature deglutition, thumb sucking and mouth breathing. Other abnormal habits that can cause malocclusions are lower lip interposition or sucking, pacifier suction or nail biting (onychophagia).[5]

Finger sucking habit

The survival of the newborn depends upon instinctive oral suction that will allow nutritional satisfaction and a sensation of security and well being; this mechanism serves as a way to interact with the outer world. The suction reflex constitutes an innate response that is produced by a stimulus to the oral region, in a way that when something contacts the lips or the cheeks, the infant directs his movements to the stimuli and will try to introduce the stimulating object into the mouth. This early nerve organization allows the child to feed from his mother, so prenatal and neonatal suction is physiologic.[18,20,25] This suction reflex is considered normal until 3 years of age, moment in which, with the appearance of the deciduous teeth it is gradually replaced with mastication; this is why it is considered a



Figs. 5-7. Finger sucking.

bad habit ,when the habit persists in the presence of the deciduous teeth in the mouth.[3,5,15]

The most common suction habit is finger suction of the thumb or of one or more fingers, this generally provokes an anterior open bite and a distal mandibular position, caused by the pressure exerted by the hand and the arm.[13,15,23]

Etiology

Larson considers artificial lactation as an etiologic factor of non-nutritive sucking, due to the fact that it is frequently brief and requires less physical effort; the baby is not sleepy due to the lack of physical fatigue and does not exhaust all the natural suction instinct the baby has.[3,11] Late suction habits are the result of psychological frustrations due to family and school misfortunes. The child takes refuge in suction to escape the real world that seems very harsh. Non-nutritive sucking can emerge as a manifestation of other underlying psychopathologies, or, as an associated disarray to other behavior alterations. So, some children with a finger sucking habit present other problems like enuresis, withdrawal and nail biting.[3,20]

Finger sucking presents itself in moments of depression, boredom or tiredness and it generates tranquility and induces sleep. The presence of the habit lessens with age and a high percentage of children abandon the practice around 3 or 4 years of age; after this age psychological, phonoaudiology and dental approaches must be undertaken.[25]

Stress is a potent stimulant for the development of a thumb sucking habit. It is probable that it is one of the causes of its high frequency, considering that today children are submitted to a lot of stress.[3]

The Freudian psychoanalytic theory states that a child goes through different phases in their mental development, and for this to be satisfactory, the finger sucking habit must be satisfied during the oral phase. If the habit still persists in the next phase of emotional development, the habit will remain "set" and will continue.[20]

The repercussions of this habit derive in a low tongue position, that ceases to exert pressure on the palate, the hyperactive buccinator muscles tend to compress the palate, the offending finger applies pressure over the dental arches and also exerts pressure against the palate.[15]

Oral effects of finger sucking habit

1. The upper and lower arches tend to narrow at the canine, premolar or deciduous molar region and with less intensity in the permanent upper molar region.[15,23]
2. The stability of the alveolar bone is jeopardized, because the habit impedes the functional contact of the inclined plane of teeth.[23]
3. Anterosuperior teeth tend to move buccally.[12,20,23]
4. The upper teeth and the alveolar bone tend to protrude, with the presence of diastemas.[10]
5. Anterior open bite originated by the interference of the thumb between the arches.
6. Posterior cross bite due to upper arch narrowing.[20]
7. An increase in the anterior location of the maxillary apical base and an increase of the SNA angle.[20]
8. Reduction of the interincisal angle.[20]
9. Clockwise rotation of the occlusal plane.[20]
10. Clockwise mandibular rotation because there is no dental contact.[23]
11. The pressure of the finger over teeth, alveolar bone and the palate, is going to provoke intraoral negative pressure, causing deepening and narrowing of the palatal vault.[15,23,25]
12. The tongue, during deglutition, places it self in front to allow anterior buccal seal. This lingual interposition creates an atypical deglutition pattern that in case there is an anterior open bite during deglutition this is compensated with the forward motion of the tongue in order to obtain an anterior seal.[3, 23]
13. Lingualized lower incisors due to the placement of the finger over the mandible.[10,20]
14. Excessive horizontal overbite.[25]
15. Lip incompetence.[10,20]
16. Phonation problems.[10,20]
17. Finger deformity (callous) and paronychium.[17,20]
18. Mandibular retrognatia.[20]
19. The position of the hand and the arm on the mandible has an orthopedic effect that aggravates the mandibular position.[23]
20. Increased risk of gastrointestinal alterations, of infections and poisoning.[20]

Not every patient that practices an abnormal suction pattern will necessarily present deformed arches and teeth in malocclusion. This will depend upon the position that the offending finger or fingers have, the duration, intensity and the frequency of the repetition of this habit, the dentofacial pattern and the initial occlusion, the finger that is introduced in the mouth and the leverage that it exerts, and finally the type of osseous tissue it acts upon.[5,13,20,23]

Of the factors mentioned before, duration is the most critical function in dental movement, a duration of 4 to 6 hours originates important dental movements.[1] It is important to mention that the majority of intents to eradicate this conduct with strong words, punishments or any other aggressive conduct towards a child that has this habit have been counterproductive because far from eliminating it, it has only reinforced this conduct making it stronger and more frequent.

We must not mistake abnormal suction habits with a normal child development phase or oral phase, when perception and touch are in their peak in the mouth.[23]

If the child really does have the suction habit is because it has the psycho-emotional need to practice it, at least emotionally. Children that have oral habits intimately tied to their emotional state practice them in moments of anguish and anxiety. Prolonged finger suction can cause emotional difficulties in the infant because it usually generates frustration symptoms in the child that wants to abandon the habit but cannot do so, this will retard its emotional maturity and will create difficulties to the child to obtain satisfaction out of activities proper to his or her age, so the child tends to isolate and becomes introvert.[5,13,23,25]

Fig. 8. Hawley plate with a palatal grill.

Fig. 9. Hawley plate with palatal grill, frontal view.

Correction

We must be very careful if we want to eliminate the habit. From the Freudian point of view an abrupt interference can provoke the appearance of antisocial behavior, much more difficult to live with than the habit itself. For this motive, the general practitioner must have enough psychological training in order to refer the patient with a specialist for adequate treatment.[5,6,15,21]

A simple Hawley plate will impede the introduction of a finger against the palate; this will take the pleasure out of the suction habit, and gradually the child will drop the habit. A grill can be added to the plate just as a reminder, but the child must know the purpose of the appliance.

We must keep in mind that the malocclusion can be corrected at any time, but a serious psychological problem can persist a lifetime, with much more serious sequels than the malocclusion itself.[23]

The decision to interfere with a non-nutritive suction habit in the primary dentition must be based upon the following factors:

1. If the finger habit is tied to a developing Class II malocclusion, the skeletal malocclusion will worsen while the habit continues.
2. It is believed that finger habits are less detrimental or ever benefit dental development if the child is developing a Class III malocclusion or if the child is prognathic.
3. Anterior open bites derived from finger sucking habits usually do not need to be treated because there is a spontaneous correction after the habit is abandoned, especially if it ceases before the patient reaches three years of age.[5]
4. The attitude of the child: the child must always be part of the decision-making process, this way the child will not consider the intervention as a punishment.

Pacifier suction habit

Suction is one of the first manifestations of physiologic activity that a human being develops, because it corresponds with a basic organic need, which is to be fed. The newborn sucks food, but even in periods in which the child is not being fed, the child is still sucking, placing between the gums any object, like a pacifier, a finger, the lower lip or a toy.[28]

Figs. 10 and 11. Non nutritive sucking.

This non-nutritive suction of fingers, toys, pacifiers, lips or other objects not related with the intake of nutrients is considered a normal activity in fetal and neonatal development, which also calms and comforts them. The use of the pacifier as a comforting object is a widely extended practice, but continuous use during the deciduous dentition is associated in the majority of cases with an increase in the prevalence of posterior cross bites and anterior open bites.[4,16] It also creates injurious habits like not grabbing adequately with the mouth the nipple of the mother because the infant becomes accustomed to the latex nipple of the pacifier. Does not generate adequate neuromuscular stimuli for the functional matrix of the stomatognathic system and predisposes the fixation of oral habits.

Benefits of the pacifier

The pacifier has a tranquilizing effect on infants, but it should not be used every time a child cries, because crying can be a normal form of communication. About which is the best tranquilizer, the thumb or the pacifier, the thumb has been associated with a greater number of dental deformities, although some authors state that there is not much difference and that the thumb causes less contamination; but we cannot eliminate it as we can with the pacifier.[16]

Another benefit is that it stimulates the maturation of the suction reflex in premature infants, most of all children submitted to nasal gastric tube feeding, which facilitates a faster transition to a oral feeding, reducing hospital internment time.[16]

Figs. 12-14. Pacifier use.

The pacifier has been associated with a lesser incidence of sudden death syndrome; it presumably avoids the obstruction of the airways, preventing the backward movement of the tongue. Furthermore, it would avoid certain positions, which also diminish the frequency of this syndrome, even though there is no association between the use of the pacifier and sleep position.[16]

In summary, although there is evidence in favor, we cannot recommend it yet.

Risks in the use of the pacifier

About the risks, the pacifier would reduce the duration of breast feeding; the reason for this is that the infant develops "nipple confusion", because the pacifier suction pattern is different and interferes with the acquisition of the necessary abilities for breast feeding. Children with nipple confusion do not stimulate enough the maternal nipple and are going to suck less, thus the mother will produce less prolactine.[16]

Malocclusion is another risk, being anterior open bite the most frequent, which usually resolves by itself when the habit is abandoned precociously. Most severe, but less frequent is posterior cross bite, which can have a deleterious effect upon the craniofacial growth of the child. The use of the pacifier and the incidence of posterior cross bite have been significantly correlated, most of all when the habit is prolonged more than 36 months. It is considered that such relation is because the oral position of the pacifier entails a lingual displacement over the mandible and an elongation of the orbicular and buccinator muscles. These changes provoke an increase in the mandibular transversal distance and a diminution of the maxillary transversal distance. Children that present this habit suffer an alteration of the oral flora and hypertrophy of the lymphatic system and they usually are mouth breathers, which also contributes in the development of malocclusions.[16]

The presence of oral ulcers is also described, specifically in the posterior third of the palate (Bednar aftous ulcers), that are due to a traumatic effect produced by the intensive use of non-orthodontic type pacifiers. Furthermore, accidents caused by the cutting edges of pacifiers have been reported, with the production of wounds with the characteristic shape of this implement, and there is a risk of aspiration of home made pacifiers, at home and in the hospital.[16]

The use of a pacifier can promote the appearance of feeding bottle syndrome (multiple caries in the deciduous dentition), caused by the prolonged use of a pacifier impregnated with sugar based products.[16]

We must suspect the presence of Candida in the pacifier when a treatment for oral Candida fails.[16]

A safe pacifier is a one piece pacifier, with a big 4.4 cm shield, rigid or semi rigid, but flexible enough not to provoke any trauma. It must have anti choking orifices, a holding ring with a safety pin, to avoid any contact with the floor if the pacifier falls. We must clean it every time the patient uses it or when it falls on the floor, but it must never be introduced in sugar or chlorine. Adults must not place it in their mouths; we must change it as soon as it deteriorates.[16]

Retained infantile deglutition habit

Before the teeth erupt, the typical infantile deglutition pattern is characterized by the separation of the maxillas, the tongue is interposed between the gingival pads and the mandible is positioned forward, this way the tongue can press the nipple against the upper dental arch during breast feeding. At this point deglutition is controlled by the contact of the lips, tongue and the perioral muscles. After the teeth erupt, the deglutition pattern changes, the point of the tongue is placed on the palate, the dental arches contact each other and there is no lip contraction.[3,15] The typical adult deglutition pattern usually develops around 5 years of age.

Atypical deglutition, also called lingual interposition, is produced when the infantile deglutition pattern still persists after the eruption of the anterior teeth.[10] Occasionally, it can also be affirmed that infantile deglutition is a phenomena derived from the presence on an anterior open bite.[21] If an anterior open bite did not exist, the tongue would not obturate the hole to obtain a correct seal during deglutition. Although many authors support this theory, many controversies persist about the direction of the arrow of cause-effect in the relation between infantile deglutition-anterior open bite, which justifies certain therapeutic approaches, like the elimination of the cause of the open bite and to close it if necessary, or waiting for the automatic correction of the abnormal deglutition pattern or to reeducate the posture of the tongue first, as an indispensable condition for the closure of the open bite.

Etiology

Among the etiologic factors that favor the installment of this habit we can quote:

1. Bottle feeding. [5,23]
2. Inflamed tonsils: constant inflamed tonsils episodes provoke that each time the child swallows the tongue is projected forward inside the oral cavity so the tongue does not touch the tonsils and this way pain is avoided.[4, 5,15,23]
3. Neurological disorders: Children with neurological disorders cannot control their muscles, and as a consequence cannot control their deglutition muscles.[23]
4. Macroglossia: These are less frequent and generally occur in cretinism patients.[23]
5. Ankylosed tongue: The ankylosed tongue cannot perform the deglutition movements correctly.[15,23]
6. Premature loss of the anterior deciduous teeth and the presence of big interincisal diastemas make the child place the tongue in these spaces, acquiring the deglutition with anterior lingual interposition habit.[4,5,15]
7. Symbiotic factors like mouth breathing, finger suction habit, etc.[4,23]

There are transition stages between the primary dentition and the mixed dentition in which due to the loss of the incisor group a space that allows the temporary interposition of the tongue is produced, but they do not last long, they do not produce adverse effects nor require treatment.[10]

Oral effects of atypical deglutition:

1. Symmetric anterior open bite.[10]
2. Anterosuperior teeth protrusion and the appearance of diastemas.[10]
3. Hypothonic upper lip and hyperthonic lower lip.
4. Hypertonicity of the *quadratus menti* muscle.
5. Chewing muscles hyperactivity.
6. The vertical growth of the alveolar proceses is inhibited.[10]
7. Labial incompetence.[10]
8. Phonetical problems.[10]

These anomalies do not manifest cephalometrically at skeletal level, so the differential diagnosis of skeletal open bites is very simple.[10]

Diagnosis

In order to diagnose atypical deglutition, some aspects must be observed in the patient during the act of deglutition, such as:[23]

1. Atypical tongue position.
2. Lack of contraction of the masseter muscles.
3. Participation of the perioral muscles with lip pressure and head movements.
4. Blowing instead of sucking.
5. Size and tonicity of the tongue.
6. Night drooling.
7. The patient has difficulty eating solid foods.
8. Phonation problems.
9. The patient accumulates saliva during speech

Correction

The treatment of choice for atypical deglutition is myofunctional therapy, which consists in a series of exercises focused in the elimination of atypical deglutition patterns and to establish new neuromuscular patterns, focused in the establishment of a normal physiologic deglutition pattern, rehabilitating not only the tongue muscles, but the lips, cheeks and the soft palate. To accomplish this, there must be an excellent relation between the patient and the therapist, the professional must:

- Explain the treatment objectives.
- Explain the function of the exercises that are going to be indicated to the patient.
- Show the correct way to execute the exercises.
- Motivate the patient and the parents.[22]

The use of a sugarless lozenge has been employed with success in order to reeducate the tongue, we must instruct the infant to keep the lozenge against the palate with the tip of the tongue until it dissolves. While the lozenge is dissolving, saliva flows and the child must swallow. After the patient has reeducated the tongue and the muscles to function adequately, we can place a lower lingual arch with a grill or a Hawley plate with a grill just as a reminder of the correct position of the tongue during deglutition.

The duration of the treatment varies accordingly with the patient and the degree of collaboration of the patient. Age is also a variable to take in account, since it is easier to motivate an adolescent than a child because the therapy is based on very technical exercises. This is the reason why it is preferable not to begin therapy before 6 or 7 years of age.[22]

Orthodontic: with the use of very simple appliances (grills for lingual interposition) we can contain the tongue and avoid the interposition and force the tongue to lean on the hard palate during closure.[10]

Among the orthodontic appliances available for myofunctional therapy we have:

1. The restrictors, that possess as only objective to avoid with "obstacles" the continuation of the incorrect function and the alteration of the occlusion (grills, shields, pinchers, anti-suction devices and the lip bumper).
2. The stimulators, which are used for the therapeutic resolution of the habit, aiding the myofunctional therapy (lingual crib of Testa, Blue grass, acrylic shields, Trainers.[22]

Atypical deglutition therapy

A. **Functional methods:** done by the phonoaudiologist, with the purpose of reeducating the muscles that intervene in deglutition.

B. **Psychological methods:** applied by psychologists by conditioning or hypnosis.

C. **Mechanical methods:** executed by the orthodontist with appliances that impede or guide the position of the tongue during deglutition. Some also act upon the position of the lips and the chin muscles, activating or liberating their activity.

D. **Mixed methods:** these are the best, because they integrate appliances with specific myotherapeutic exercises.[23]

Postural habits

Dental arches can suffer deformities caused by anomalous position pressures during sleep or while being seated, being the most frequent the habit of sleeping with the face reclined on a hand, on a forearm or the use of pillows. The type of malocclusion caused by this habit usually is unilateral and located in the upper arch.[23]

Figs. 15 and 16.

What happens is that the weight of the head is passed to the tissues of the maxillary region by the action of the hand, the arm or the pillow. The maxillary teeth tend to incline toward the palate causing a unilateral posterior cross bite without a deviation of the dental midline, meanwhile, the mandibular tissues are not affected because it is a mobile bone and escapes the pressure by sliding.[23]

When a shift of the midline is present, the cause of the cross bite will not be the posture habit but a mandibular shift caused probably by a premature contact of the deciduous canines (functional or false posterior cross bite) (please refer to Cross Bite chapter).

Correction

For the correction of a posture habit, the use of a Hawley plate with a buccal grill on the side where the cross bite is being produced is indicated. This appliance will serve as a reminder to the patient, and whenever the patient leans the head on the hand or the arm, they will squeeze the cheek against this grill.

For the correction of true unilateral cross bites in the permanent dentition, we can use "Z" 1/8" diameter elastics, from the palatine aspects of the upper teeth to the buccal aspects of the lower teeth on the side where the cross bite is located (please refer to Cross Bite chapter).

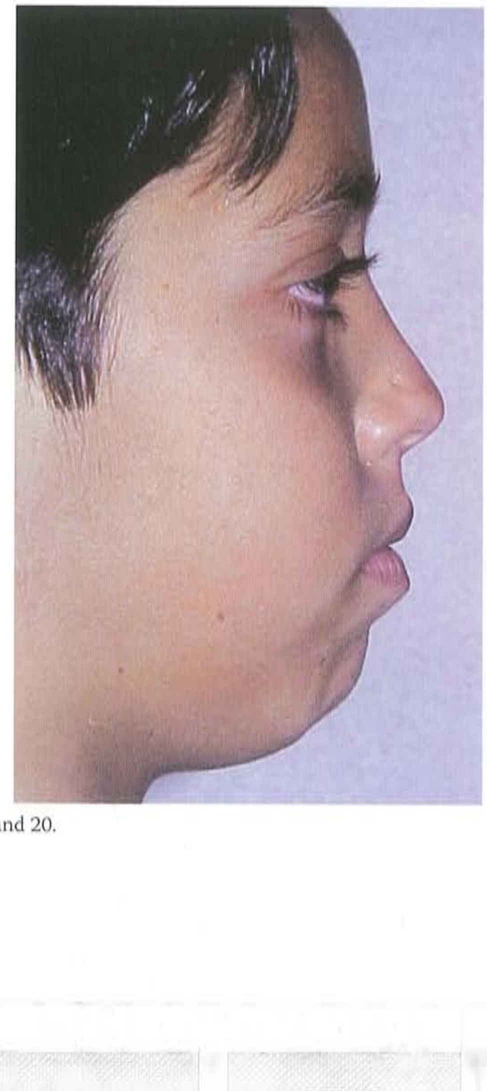
Now then, if the unilateral cross bite is in the deciduous dentition, it can be corrected with a plate with a unilateral expansion screw.

Mouth breathing habit

Normal breathing, also called nasal breathing, is the one in which the air flows freely through the nose with a simultaneous closure of the oral cavity, therefore creating a negative pressure between the tongue and the hard palate at the moment of aspiration; the tongue is elevated and it leans against the palate, exerting a positive development stimuli. When the patient breathes through the mouth the tongue adopts a descendant position to allow the flow of air. Oral breathing is normally associated to patients with lingual and lip interposition.

Figs. 17 and 18. Mouth breathing.

During mouth breathing, the air passes through the oral cavity, and as a consequence, an increase of pressure in the intraoral area is produced. The palate becomes deeper, and at the same time, because air does not flow through the nasal cavity, the maxillary sinuses become atresic, giving the patient a characteristic aspect (long face or adenoid fasciae).[23]



Figs. 19 and 20.

When the infant is bottle fed, the infant must be in an upright position, in order to avoid breathing problems, that could bring, as a consequence the habit of mouth breathing. The position in the cradle is also important, the neck of the patient must not be flexed, because if the infant does not breathe normally this can develop into a mouth breathing habit.[18]

Etiology of mouth breathing

Mouth breathing can develop as a consequence of functional or anatomical obstruction or by a habit.

1. Functional or anatomical obstruction occurs when the presence of an obstacle impedes the normal flow o fair through the nose, for example the presence of hypertrophic adenoids, palatine tonsils, hypertrophic turbinates, asthma, nasal septum deviations, polyps, sinusitis and tumors that force the substitution of nasal breathing for mouth breathing. The inflammation of the nasal mucosa by infections or allergic rhinitis (considered the most common cause), produces air resistance, this obligates the individual to use the oral cavity as an accessory air intake way. [15,19,21,23]

2. Oral habits, among them we can find: atypical deglutition, lingual interposition, finger or thumb sucking, among others. The individual can also breathe through the mouth as a consequence of anatomic pathologic or functional obstructions, that even if they are corrected the patient still uses the mouth as an accessory for breathing.[10,15,19,23]

Bucco facial and skeletal effects of mouth breathing [4,8,10,13,15,19,21,23,25]

1. Adenoid fasciae, it is characterized by a long and narrow face, the nasal bones are not fully developed, the patients have deep rings under the eyes, deep nasolabial furrows, an open mouth and labial incompetence.
2. The nostril of the side with respiratory deficiency is narrow, the other side can be wider than normal or both sides can be narrow.
3. Pale skin.
4. Hypertrophy of the *quadratus labii inferioris* muscle.
5. Hypotonic upper lip.
6. Hypertonic lower lip.
7. The lips are cracked and dry, with the presence of fissures in the angles of the mouth (angular queilitis).
8. Anterior open bite with or without lingual interposition.
9. Uni or bilateral posterior cross bite.
10. Deep and narrow palate, this is the result of the compressive action of the buccinator muscles at premolar level, occasioned by the altered muscle equilibrium caused by the low position of the tongue during respiration.
11. Opacity and hypo-development of the paranasal sinuses that are the base of the upper dental arch.
12. Predominance of the lip elevating muscles over the paranasal muscles that insert in the anterior part of the maxilla and favor the anterior growth of the premaxilla, producing retrusion and elevation of the anterior nasal spine.
13. Triangular upper arch.
14. Presence of secondary habits (atypical deglutition, lip suction).
15. Mandibular retrognatia or clockwise mandibular rotation.
16. Increase of the lower facial third.
17. Upper incisor buccoversion.
18. Lower incisor linguoversion.
19. Posterosuperior teeth linguoversion.
20. Overcrowding.
21. Bleeding and hypertrophic gums (chronic gingivitis), produced by the superficial dehydration of the gums as a result of improper mouth seal and the passage of air.
22. Deep sternum "Pectus escavatum" and "Winged scapula" (wing form). These two characteristics are produced by the lack of thoracic development in an anteroposterior sense, narrow thorax.
23. Diaphragmatic hypomobility.
24. Xifosis (dorsal).
25. Lumbar lordosis. In a lateral view of the patient, the spine has an "S" shape.
26. Feet point inward, due to the position of the spine.

We can also affirm that mouth breathing produces intellectual disorders, due to the chronic diminishment of 5% of PO2, that brings as a consequence low brain oxygenation. This translates in apathy, less voluntary activity, memory disorders, a diminishment of the capacity to voluntarily fix the attention on one subject and chronic tiredness (all this also associated with sleep disorders).[26]

Not all children with respiratory problems develop the same type of anomalies and patients with normal breathing patterns can show similar deformities that have been linked to mouth breathing. The fact that inadequate breathing can have more or less influence in the orofacial morphologic-functional pattern does not mean necessarily that the resulting alterations must be always the same.

Correction

After a complete case evaluation we must refer the patient to an ear, nose and larynx specialist to resolve the nasal obstruction in case it exists. But sometimes, once the cause of mouth breathing is eliminated, the perioral muscles must be rehabilitated with functional exercises to promote adequate lip seal, so the way the patient breathes must be reeducated with respiratory exercises because the patient breathes through the mouth by habit. The muscle exercises must be done with a buccal shield or a Trainer. Both are going to obstruct the flow of air through the mouth, and, as a result, breathing must forcefully be done through the upper air ways.[23] The stimulation of the upper air ways through respiratory exercises can have a positive influence upon the growth of contiguous bone structures. Due to the fact that nasal breathing is more difficult than mouth breathing, the buccal shield or the Trainer, provide a much more intense exercise to the breathing muscles.

Lip sucking or lip interposition habit

This habit is usually secondary to a finger or thumb habit or to an atypical deglutition pattern, because this type of patient has a great overjet, and consequently, the lower lip is placed behind the upper incisors maintaining or aggravating the condition.[10]

Bucco facial effects of lip interposition[10]

1. Upper dento alveolar protrusion.
2. Lower incisor retroclination.
3. Hypotonic upper lip.
4. Hypertonic lower lip.
5. Lip incompetence.
6. Hypertrophy of the mentalis muscle.
7. The excessive pressure of the lower lip impedes the correct development of the lower dental arch.
8. Deep bite.

Fig. 21. Lip suction.

9. Generally the lower incisors occlude on the palatine mucosa.
10. Mandibular retrognatia.

Correction

The best treatment option to eliminate lip interposition is the lip bumper; it is a fixed and passive appliance that has one or two acrylic shields on the anterior sector that separate the lower lip from the anterior teeth, not allowing the lip between the buccal aspects of the lower incisors and the palatine aspects of the upper incisors. This appliance will have a favorable influence in the development of the lower dental arch, because it will separate the lip from the anteroinferior teeth, producing spontaneous lower arch expansion.[9,10]

In the mixed dentition, aside the lip bumper, the 2 x 4 technique is used, by placing braces on the anterior sector and with the action of upper retrusion arches or lower protrusion arches; according to the cephalometric requirements of the case, we can correct the overjet by reducing the space needed for the interposition of the lower lip.[10]

Nail biting habit (onychophagia)

Finger sucking and nail biting are daily and common examples of developmental habits. They are often considered automatic reactions that can manifest in stressful or frustrating situations, or if the patient is bored or fatigued. The habit of nail biting coincides regularly with finger suction; authors like Meneghello consider this habit as an indicative of emotional conflict that must alert the doctor, this is the reason why the patient must not be reprimanded.(23)

Fig. 22. Nail biting (onychophagia).

The incidence of nail biting is exceptionally high. Both sexes are equally affected but females worry more due to the esthetic problem so they seek help much more than males. Surveys show that close to 45% of children during puberty, around 25% of university students and more or less 10% of adults older than 35 years of age bite their nails compulsively. Generally the patients bite all their nails.

This habit does not cause occlusal problems because it only exerts pressure through the longitudinal axis of the tooth. But some authors believe that onychophagia interferes with the normal development of the face and can bring as a consequence, depending mainly on the frequency, intensity and of the predominance of the vertical growth component face, whose result in conjunction with atypical deglutition is the triggering factor of anterior open bite.

Fig. 23. Onychophagia is generally reflected i
n all the nails of the hand.

Etiology

Some think that the etiology of this habit is the consequence of a behavior that was not conveniently finished at the appropriate time when the patient was 2 or 3 years old, when the child was sucking a finger or a thumb. It is also affirmed that at the moment in which the deglutition pattern changes, when the fist teeth appear, the impulse to bite is installed. In this period a more solid diet is required to compensate this impulse. One way to exercise mastication is to offer the infant a steak so the infant can hold it and begin to bite and suck, even before the complete eruption of all the deciduous teeth. If this impulse is not satisfied, the child will seek things to chew, mainly the nails, so the onychophagia habit is installed.(23)

Effects of the habit

1. It does not affect the occlusion.
2. Onychophagia in a critical phase can damage the nail bed and the germinal matrix of the nail.
3. It can complicate with periungual warts and bacterial and viral infections of the lips and oral mucosa.
4. We can appreciate dental alterations by abrasion, erosion, chipping and malposition.

We must know the different alterations caused by the habit and know how to differentiate them from a systemic alteration like ferric anemia. In a patient with ferric anemia we can find a concave of spooned shaped nail, confusing it with a symptom related to onychophagia.

Correction

In order to correct onychophagia, we must first make the patient realize that he or she has a problem, that the patient must want to stop the habit, taking in account that this unsatisfied need to bite obeys to a psychoemotional state of anxiety. To begin we must give to the patient a rubber object to bite and we must ask the patient to bite the object five minutes without stopping every time the patient feels the urge to bite his or her nails. We can also ask the patient to do the same exercise during five or ten minutes if the patient feels anxious. Another alternative to eliminate the habit is to place night guards on both dental arches covering the occlusal aspects of molars and premolars, in order to slightly lift the bite and to difficult the practice of the habit.

In this chapter we will show the different options to eliminate oral habits, these options will be divided in restricting and stimulating appliances.

I. Restrictors: These appliances posses as only objective to avoid, through "obstacles" the continuity of the incorrect function that may or already has altered the occlusion. These appliances present mechanical barriers like screens, bends and shields, placed where the tongue or other external elements like fingers have or potentially can create any alteration.[22]

Among the restrictive appliances we can name:

1. Palatine shields.
2. Tongue shields.
3. Tongue spurs.
4. Graber trident.
5. TCA.

II. Stimulators: These appliances are intended to therapeutically resolve an altered function, aiding myofunctional therapy. Stimulators are also called Reminders, these appliances are going to participate actively in the rehabilitation program, reeducating in a stable manner the faulty neuromuscular impulses.[22]

Among these appliances we can find:

1. Tucat pearl.
2. Testa rocker.
3. Lip Bumper.
4. Trainers.

Restricting appliances

Palatal grill

Therapy with fixed intraoral appliances have demonstrated to be an effective tool eliminating finger or thumb sucking habits.[12] These fixed appliances are made of 0.036" stainless steel wire, soldered to the bands of the upper molars, and they are going to cover the portion of the palate where the finger or thumb is placed during suction. This way, the satisfaction felt by the placement of the finger on the palate is annulled by the presence of the grill.[5,25]

Fig. 24. Palatal grill to eliminate a finger suction habit.

Advantages

1. The palatal grill is one of the most simple and well tolerated appliances and aids in the elimination of finger or thumb sucking habit.[25]
2. The use of this appliance interrupts the finger sucking habit by impeding the placement of a finger or fingers on the palate, so the child does not feel the satisfaction derived from suction, thus the conduct is eliminated.
3. Economic and easy to make.

Disadvantages

1. Not well accepted by the patient.
2. It requires laboratory time to fabricate.
3. It is important to mention that the use of these appliances can cause certain temporary secondary effects, like alterations in the feeding patterns, phonation and sleep, that will disappear in about three or seven days of use.

Recommendations

1. Once the habit has ceased, the appliance must remain in the mouth for about 3 to 6 months to avoid the possibility of a habit comeback.[25]
2. After the appliance is removed we must evaluate the occlusal and functional conditions of the patient to apply as early as possible corrective therapy as needed.[25]
3. The appliance must not be designed to cause pain, but to serve as a reminder.

Tongue screens or restrictors

These restricting devices are the most commonly used to block excessive tongue pressure over the anterior or posterior teeth. These are characterized by the presence of rows of bends, of variable number and diameter, over the space to be covered. The screens can be fixed, soldered to a lingual arch or removable, imbedded in an acrylic plate or bound to molar bands by lingual sheaths.[22]

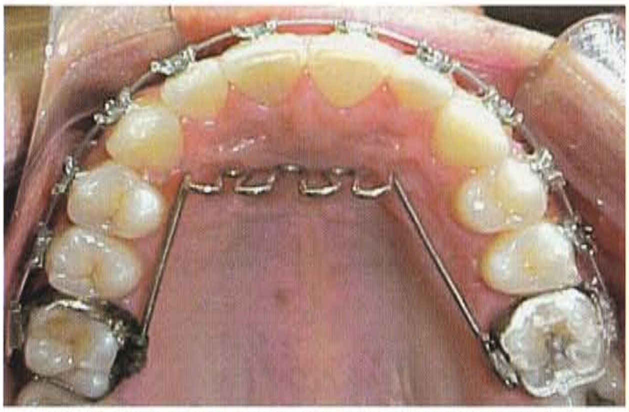


Fig. 25. Removable tongue screen inserted in lingual sheaths.

Fig. 26. Fixed tongue screen soldered to the bands of the upper molars.

They can be applied either on the upper or lower dental arch. In those cases in which the screen is fixed, it must not touch the soft tissue, to avoid the possibility of appliance impingement in the soft tissues.

Depending upon the severity of the case, there are many different designs that can be used, all have the same purpose.

Fig. 27. Front view of the tongue screen placed in the mouth.

Whenever we want to close an anterior open bite, the screen can be built in combination with an intrusion disc in order to intrude the posterior sector.

Fig. 28. Tongue screen with an intrusion disc.

Fig. 29. Front view of the tongue screen.

Fig. 30. Hawley retainer with tongue screen.

In extraction cases the screen can be adapted to the anchorage appliance.

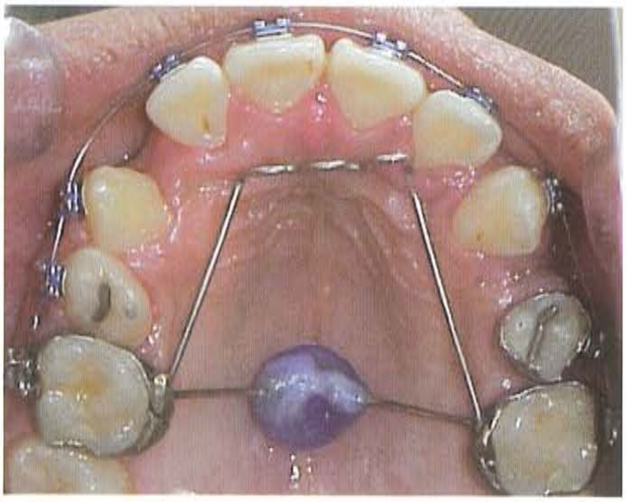


Fig. 31.Tongue screen soldered to a transpalatine arch.

When the tongue interposition includes the anterior and the premolar sectors, the screen can be soldered to a palatal arch following the contour of the upper arch, in the form of a bird cage.

Another type of removable screen consists in a small perforated steel plate imbedded in acrylic. It works as a tongue restrictor but it is not very popular due to the risk of tongue lacerations caused by the steel plate.

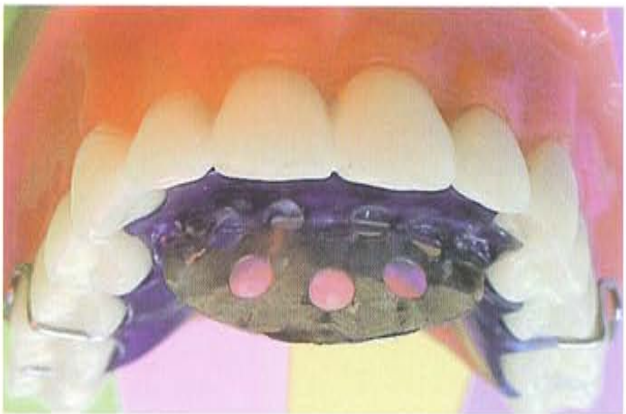
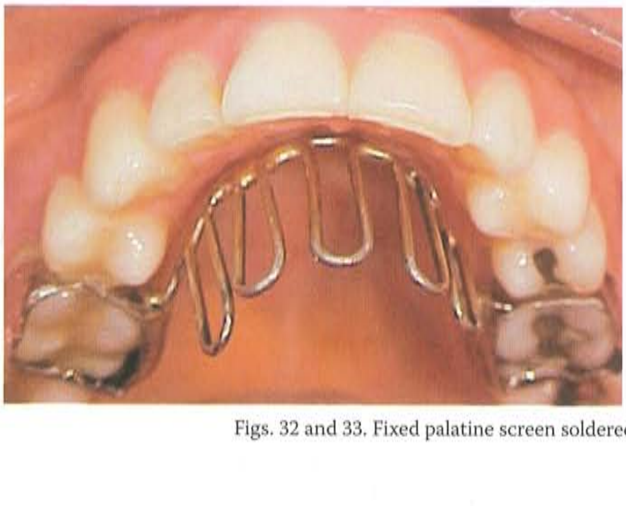
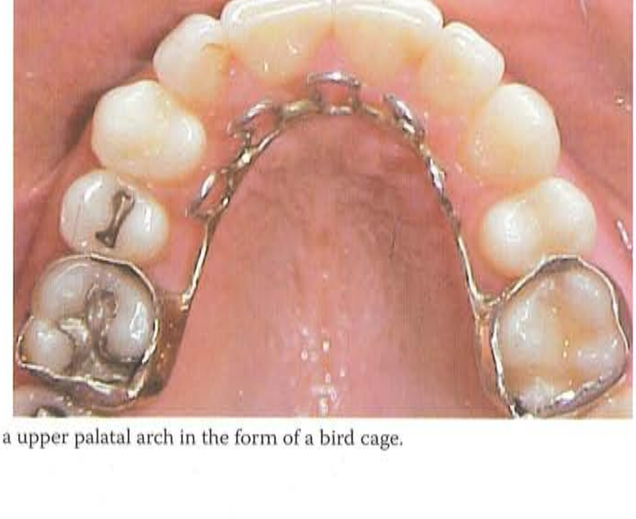


Fig. 34 Perforated steel plate.

Fig. 35. Front view of the perforated steel plate.





Figs. 32 and 33. Fixed palatine screen soldered to a upper palatal arch in the form of a bird cage.

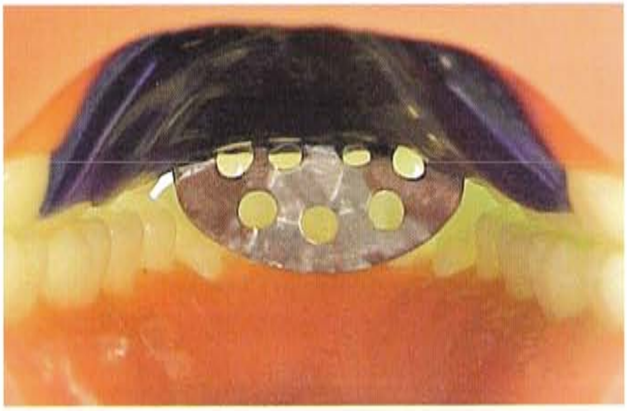


Fig. 36. Lingual view of the perforated steel plate.

Advantages

1. It is a very versatile appliance that can be used with the anchorage system during orthodontic therapy.
2. It can be fixed or removable.
3. Economic and easy to make.
4. Hygienic.
5. It helps in the reeducation of the tongue placing it in a more adequate position.

Disadvantages

1. It is a very versatile appliance that can be used with the anchorage system during orthodontic therapy.
2. It can be fixed or removable.
3. Economic and easy to make.
4. Hygienic.
5. It helps in the reeducation of the tongue placing it in a more adequate position.

Recommendations

1. The appliance should be left in place for a period of 3 to 6 months after the malocclusion has been corrected to prevent rebound.
2. In addition to the use of this appliance we must prescribe myofunctional exercises to reeducate the tongue.
3. We must leave about 2 mm of space between the appliance and the floor of the mouth to prevent lacerations.

Tongue spurs

The function of this appliance is similar to the function of the crib, but this appliance has sharp spurs as a reminder to eliminate the habit, inducing a modification of the neuromuscular behavior.[22] The spurs are made of 0.032" stainless steel that are going to protrude about 5 mm from

Fig. 37. Hawley plate with tongue spurs.

Fig. 38. The points of the tongue spurs must protrude 5 mm from the acrylic plate.

the acrylic plate, they must not be sharp because they only function as a reminder and must not cause pain or damage to the tongue.

Fig. 39. Tongue spurs.

Advantages

1. It teaches the tongue to attain a more physiologic position.
2. Well accepted by the patient.
3. Hygienic because it is removable.
4. Economic and easy to elaborate.

Disadvantages

1. The patient can misplace the appliance.
2. It requires laboratory time to elaborate.

Recommendations

1. The patient must use it 24 hours a day, except during meal time.
2. It can be used as a retainer once the orthodontic treatment has finalized to prevent rebound caused by tongue projection.

Graber trident

This fixed anti-suction device was proposed by Graber, the structure of the device resembles a fork and is placed on the anterior and middle portion of the palate. It is made with 0.036" stainless steel wire and soldered to the upper molar bands. Finger sucking is avoided, and the tongue cannot be placed forward.[22]

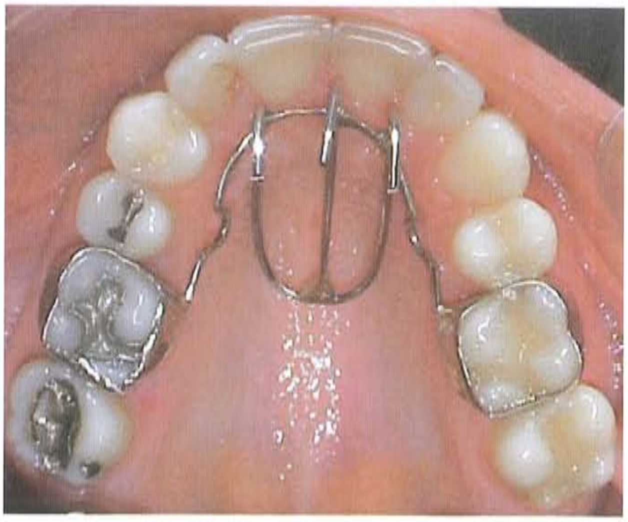


Fig. 40. Graber trident.

Fig. 41. Front view of the Graber trident.

Advantages

1. It is a very versatile appliance, it not only stops finger sucking habits, but it also stops the forward propulsion of the tongue.
2. Economic and easy to make and to place.
3. It diminishes the pleasure provoked by the contact of the finger against the palate.
4. It is the appliance of choice for the elimination of both habits (suction and tongue interposition).
5. It can be used in combination with orthodontic therapy.

Disadvantages

1. The patient can have difficulty to speak and to eat during the first days of use.
2. During the time period in which the patient has the appliance in the mouth, ulcers can appear in the tongue.
3. Not always well accepted by the patient.
4. It requires laboratory time to fabricate.

Recommendations

1. The points of the fork must be rounded in order to avoid any tongue lesions.
2. Once the orthodontic treatment is finished, the appliance can be left in place for a 3 to 6 month period to avoid rebound, later we can place a removable tongue spur appliance.

Thumb Control Appliance (TCA)

The TCA is an anti-suction device marketed by GAC, which is made of 0.036" stainless steel, and consists of an arch that is inserted in the lingual sheaths of the bands of the upper molars, on the anterior aspect there are two loops that are going to localized in the anteroinferior portion of the mouth, covering the entire open bite and impeding the insertion of the thumb in the mouth. It is available in different sizes.[24]

Advantages

1. Available in many sizes for easy adaptation in the mouth.
2. Economic and easy to place.
3. It does not require an impression appointment.
4. Well tolerated by the patient.
5. Once the habit has seized we can easily remove the appliance.
6. It can be combined with fixed appliances.
7. It also serves as a lip bumper because it takes the pressure off the lower lip from the lower dental arch; this allows spontaneous lower arch development.

Disadvantages

1. The patient can misplace the appliance.
2. Speech can be momentarily impaired at the beginning of treatment.
3. The patient can complain of traumatic ulcers in the inner aspect on the lower lip at the beginning of treatment.

Recommendations

1. Place the appliance and persuade the patient to cease the habit, generally the patient will comply.
2. This appliance is well accepted and tolerated by the patient.

Fig. 42. Front view of the TCA.

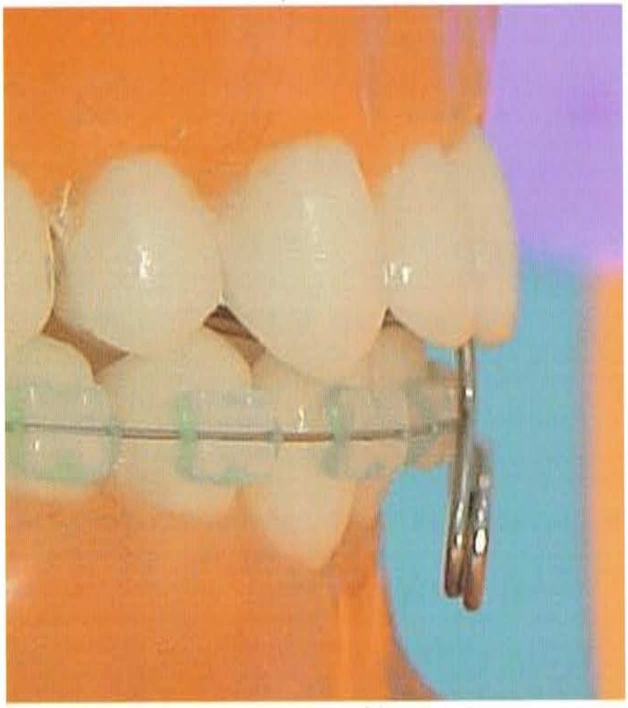


Fig. 43. Lateral view of the TCA.

Fig. 44. Occlusal view of the TCA, showing the arch inserted in the sheaths of the molar bands.

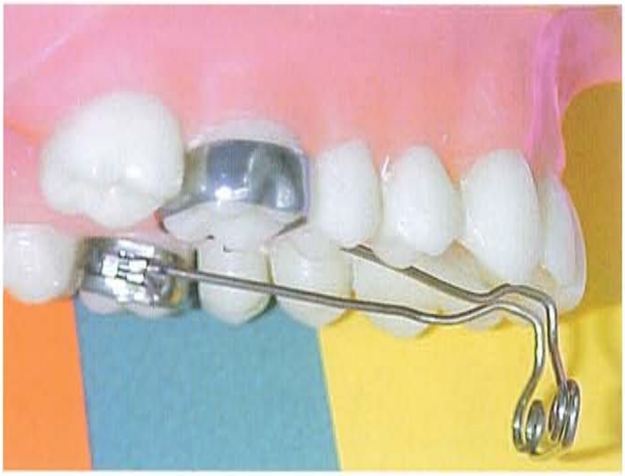


Fig. 45. Lateral view of the TCA in which we can see the curvature that avoids interferences with the occlusion of the lower incisors.

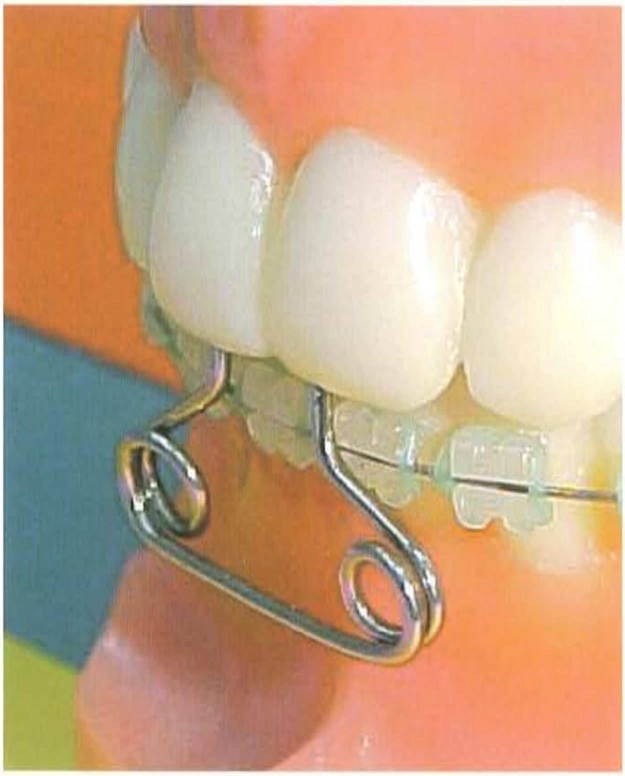


Fig. 46. TCA (Thumb Control Appliance).

3. Improvement of the open bite can be observed in 2 to 4 months after the habit has been abandoned.
4. In case the patient relapses with the habit, the appliance can be placed again in the palatal sheaths of the upper molars.
5. This appliance can only be placed if there is a pronounced overbite and overjet.

Stimulating appliances

Tucat pearl or Blue Grass

The Tucat pearl is one of the first oral stimulating appliances used, not only as a tongue distracter, but also to stimulate the tongue to adopt a posterior position and, in this way control or eliminate a tongue interposition habit. It is a sphere that rotates freely around a metal wire, that can be placed on removable appliances or on the omega of a transpalatine arch when we want a fixed pearl.[22] Authors like Petit propose that the pearl should be placed in a posterior position, to guarantee the new position of the tongue and to avoid the vestibulization of the incisors after the treatment is completed.

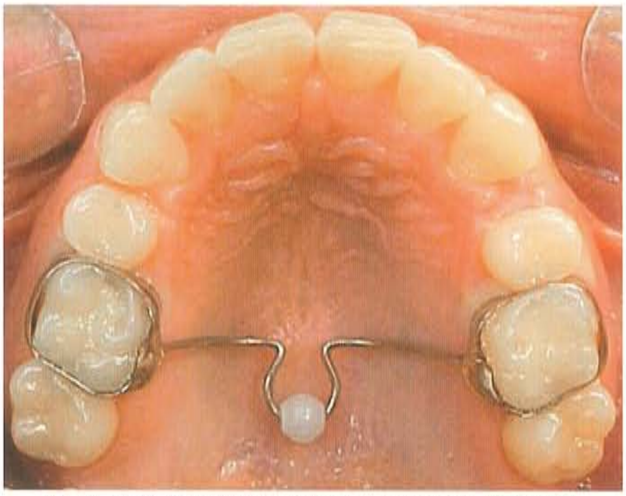


Fig. 47. Tucat pearl fixed on the omega of a transpalatine arch.

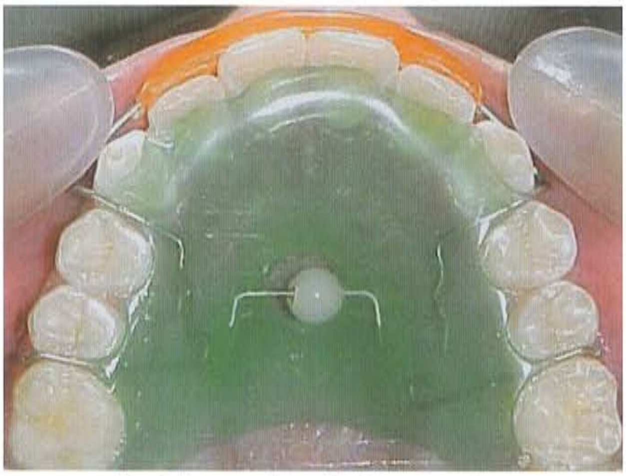


Fig. 48 Tucat pearl on a Hawley type retainer.

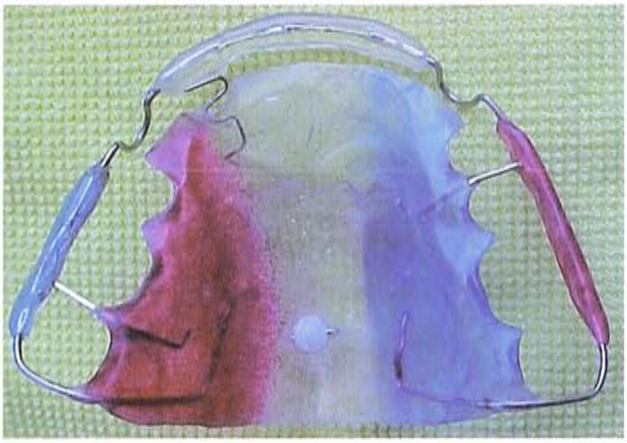


Fig. 49. Tucat pearl on a circumferential type retainer.

Fig. 50. The Tucat pearl can be used with a lingual crib to reinforce the effectiveness of tongue therapy.

Fig. 51. Tucat pearl on a retainer with tongue pinchers to reinforce the therapeutic effectiveness of the appliance.

Advantages

1. It is a light appliance and well accepted by the patient.
2. Economic and easy to place.
3. It can be fixed or removable, imbedded in the acrylic of the retainer.
4. The therapeutic principle is based upon tongue curiosity; the tongue will always be in contact with the pearl, so the tongue will adopt a posterior position in the mouth.

Disadvantages

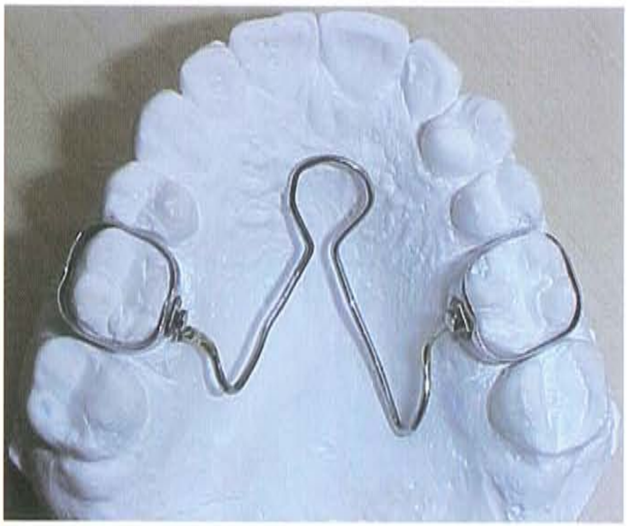
1. It consumes laboratory time.
2. With time it tends to retain foul odor.
3. Food tends to accumulate around the pearl.
4. The pearl can fracture.

Recommendations

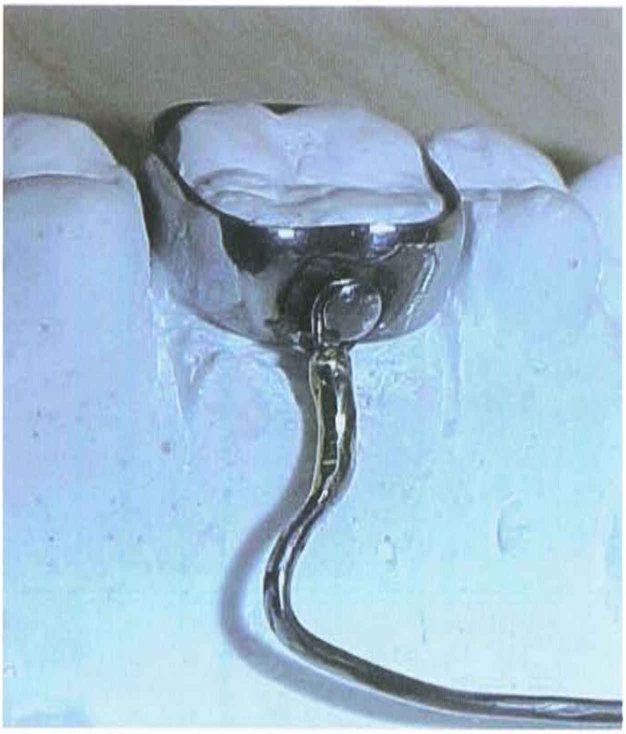
1. It is a small and light additament that can de used with a tongue restrictor device like a lingual crib during orthodontic treatment, to stimulate a posterior position of the tongue.
2. In the same way, during retention it can be used as a lingual distracter once the active orthodontic treatment is over, to avoid any possible rebound.
3. We must instruct the patient to place the tip of the tongue on the pearl every time the patient swallows, this way the tongue will place it itself in a much more physiologic position.

Testa rocker

This is a fixed appliance adapted to the upper permanent molars. It is made of 0.036" stainless steel that goes all over the palatine area from the retro molar zone up to the anterior portion of the palate, just behind the retro incisive papilla and is attached to the palatine aspect of the bands of the upper molars through a special additament (buttons) that allow the rocking movement. The objective of the rocker is to recreate the peristaltic groove of the tongue through the movement that simulates the path of the food bolus.[22]



Figs. 52 and 53. The Testa rocker will reprogram the tongue in cases with atypical deglutition.



Figs. 54 and 55. Detail of the additaments or buttons of the Testa rocker.

Advantages

1. It helps the tongue to reprogram its functional movements.
2. Because it is a fixed appliance, it acts inside the mouth of the patient without interruption.[22]
3. Due to its design it allows activations like expansion and molar rotations.
4. Economic and easy to make.
5. Well accepted by the patient.
6. Apart from being indicated in cases of atypical deglutition and finger sucking, it can also be used in cases of mouth breathing to induce the elevation of the tongue within the oral cavity.

Disadvantages

1. We must invest laboratory time to elaborate it.
2. Because it is an intraoral mobile appliance, the thinnest part of the union with the button can fracture due to the force exerted by the tongue.
3. The patient can experience a bit of difficulty during speech or while eating until he or she becomes accustomed to the appliance.

Recommendations

1. Encourage the patient to constantly "play around" with the rocker using the tongue, this way the reprogramming stimuli will be always present.
2. We must indicate to the patient that the tip of the tongue must be placed on the omega of the appliance and to do the swinging movements and at the same time swallow saliva, and that during meal times every time the patient is going to swallow the tongue must be placed in the same place. In this manner the tongue is induced to place itself to a more physiologic position during deglutition and at the same time the atypical deglutition habit will be corrected.

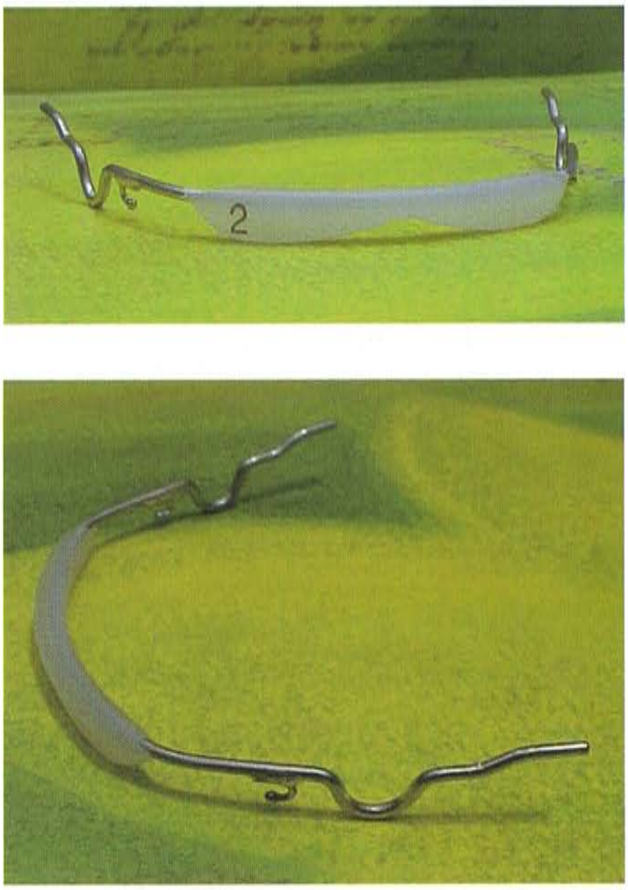
Lip Bumper

The Lip Bumper is considered a true myofunctional appliance, it is widely indicated in cases in which there is an inadequate pressure of the lower lip over the lower dento alveolar complex, and in cases that, due to an excessive overjet, a lip interposition or sucking habit is beginning.[14,24] They are made of 0.036" stainless steel wire, the anterior section can or cannot be covered with acrylic, the acrylic must be 2 mm to 3 mm separated from the buccal aspect of the lower incisors, we can also find pre fabricated versions in a wide size selection. Normally lip bumpers are soldered to the lower molar bands or they can be removable, these are inserted in the accessory tubes of the molar bands, or we can rarely find them placed in a removable acrylic plate. (please refer to Anchorage chapter).

Fig. 56 Lip Bumper.

Their function consists in preventing incorrect lip pressure during deglutition, and to free the lower dental arch from the tonicity of the lip and of the muscles of the chin.[14,24]

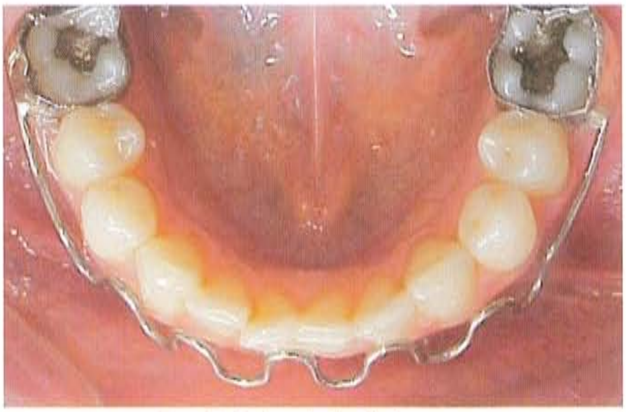
Fiig. 57. The buccal shield must be separated 2 mm to 3 mm from the buccal aspects of the incisors.

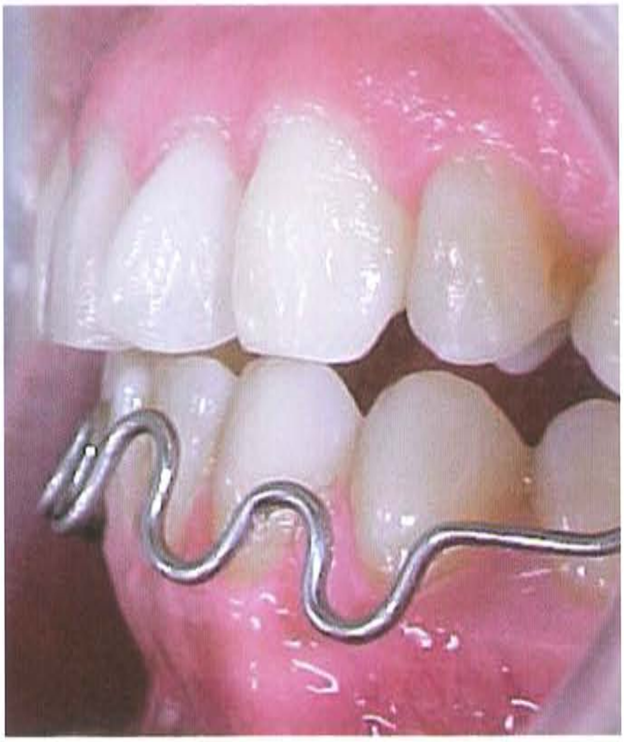


Figs. 58 and 59. Prefabricated lip bumpers.

Advantages

1. It is very versatile; it can be used in combination with practically every corrective appliance like braces, lingual arches, removable extra oral appliances, etc.
2. When the appliance eliminates the excessive pressure of the lower lip, it allows a passive expansion of the lower dental arch and the correction of anteroinferior overcrowding.
3. The lip bumper can be acrylic free.





Figs. 60-62. Acrylic free lip bumper.

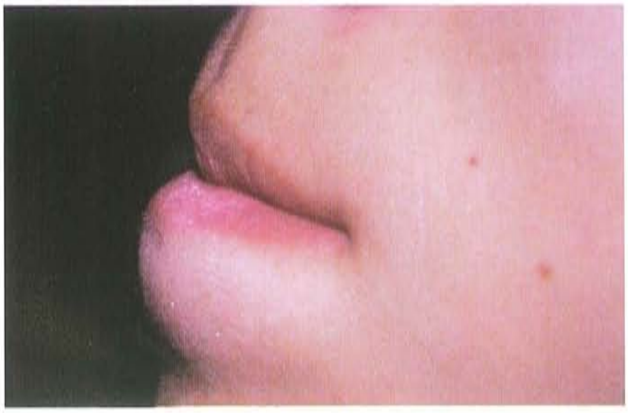


Fig. 63.

4. It helps in the correction of atypical deglutition caused by lower lip interposition.
5. It serves as anchorage.
6. It annuls the action of the buccinators and the quadratus labii inferioris muscle.
7. Labial seal is restituted.

Disadvantages

1. Once the appliance is in place, the patient usually does not like how he or she looks.
2. If the appliance is removable, we depend upon patient cooperation.
3. If the appliance is removable it can be lost.
4. If the bands debond they can lacerate the oral mucosa.

Recommendations

1. The labial shield must be worn continuously between 6 to 18 months, in order to reeducate the stimuli of the neuromuscular system that cause the compression of the lower dental by the perioral muscles.
2. We can correct the hypotonicity of the upper lip with some exercises to increase the muscle tone and promote a correct lip seal.
3. We recommend the use of the lip bumper combined with a bite plane and a cervical traction head gear (HBL) in patients that present a Class II division 1 malocclusion with a protruding upper maxilla, vertical growth and open bite caused by an atypical deglutition pattern with lower lip interposition.
4. The treatment results are much more stable, because the expansion of the lower dental arch is spontaneous and the causes of the malformation are eliminated.

Fig. 64. Pre-orthodontic blue trainer.

Trainers

Trainers are myofunctional reeducating appliances that aid in the correction of tongue, finger and lip sucking and mouth breathing habits and dental malposition. These appliances are distributed by Ah-Kim Pech and come in different presentations according to the case to be treated.[27]

The habit eradicators are basically three:

1. **Pre-orthodontic trainer.**
   a. Blue beginning trainer.
   b. Pink functional/finalizing trainer.
2. **Braces trainer.**


Fig. 65. OrFifices for the correction of mouth breathing habit.

1. **T4K Pre-orthodontic blue beginning trainer:**[27]
   a. It is soft and flexible so use is easy for the patient.
   b. It comes in one size.
   c. It has two orifices for the gradual eradication of the mouth breathing habit.
   d. Made of non thermoplastic silicon.
   e. No need for adjustments or laboratory work, saving chair time.
   f. It has anterior indentations that serve as a lip bumper.

2. **T4K Pre-orthodontic pink finalizing/functional trainer:**[27]
   a. It is rigid.
   b. Only one size.
   c. It does not have any orifice, to reaffirm the elimination of the mouth breathing habit.
   d. Made of non thermoplastic silicon.
   e. It exerts a constant force upon misaligned teeth, correcting their position and also serving as a dental eruption guide.
   f. No need for adjustments or laboratory work.

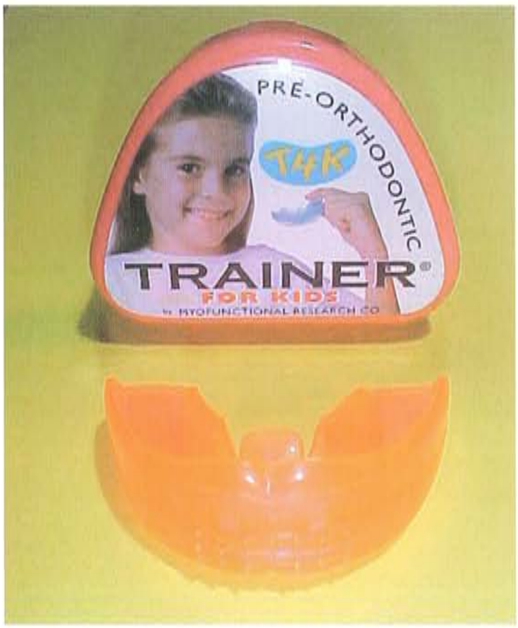


Fig. 66. Pre-orthodontic pink finalizing/functional trainer.

Fig. 68. Trainer for braces.

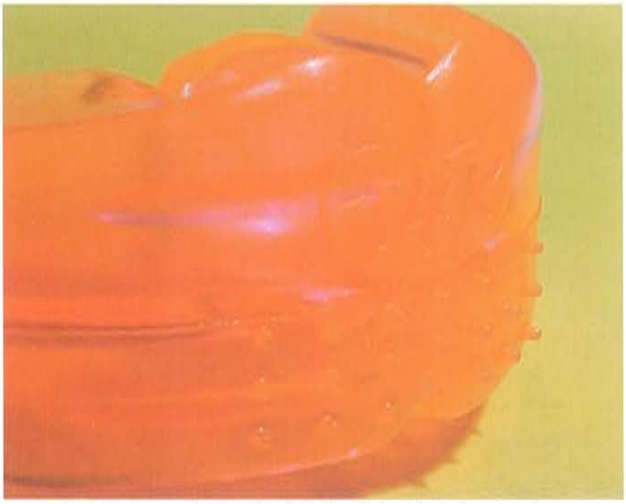


Fig. 67. Pre-orthodontic pink f inalizing/functional trainer.

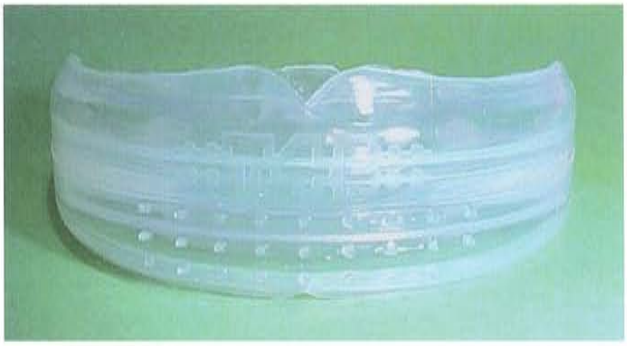


Fig. 69. The trainer for braces does not have any type of breathing orifice.

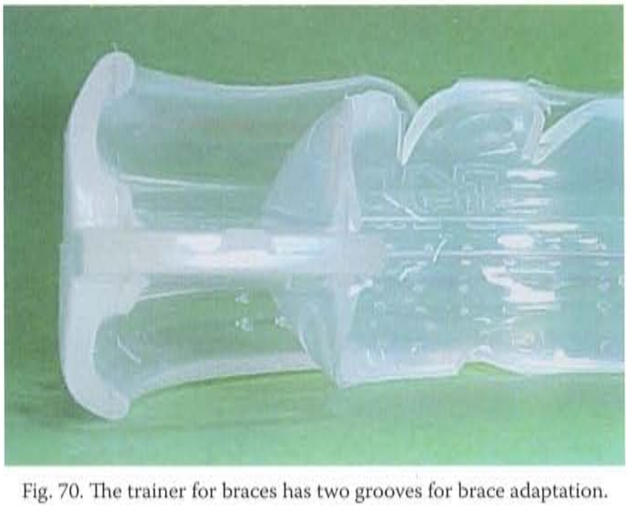


Fig. 70. The trainer for braces has two grooves for brace adaptation.

3. **T4B braces trainer:**
   a. It aids in the correction of: tongue, lip, finger sucking and mouth breathing habits.
   b. It does not have breathing orifices.
   c. It accelerates orthodontic treatment. Only one size.
   d. Made of non thermoplastic silicon.
   e. No need for adjustments or laboratory work.

Advantages[36]

1. Low cost.
2. Placement only requires one appointment.
3. Well accepted by the patient because they are esthetic and pleasing to the eye.
4. Easily placed by the patient.
5. It serves as a dentition guide and as myofunctional therapy to eradicate oral habits.
6. No need for adjustments or laboratory work, saving chair time.

Disadvantages

1. Because it is a removable appliance we totally depend on patient collaboration for the correct effectiveness of the habit eradication.
2. The patient might lose it.
3. **It deteriorates with time.**

Recommendations[27]

1. Do not place the appliance when the parents or the child do not fully cooperate with the treatment.
2. Do not place the appliance in severe Class III malocclusions or in cases with total nasal obstruction.
3. Instruct the patient to place the trainer with the tongue-piece upwards and to place the tip of the tongue in the tongue-piece, this way the patient will place the tongue in the correct place.
4. The blue and pink trainers must be used between 6 and 18 months, depending on the severity of the case.
5. In order to obtain the best results we must indicate to the patient that the appliance must be used at least one hour during day time and at night while the patient sleeps.
6. Pre-orthodontic trainers are indicated in children between 6 and 10 years of age in the mixed dentition.

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Lesions and Emergencies during Orthodontic Treatment

9

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Introduction

Throughout the history of orthodontics fixed and removable appliances have been used to correct occlusal and facial esthetic problems. Unfortunately, these are foreign bodies that are in intimate contact with oral tissues and can play an important part in accidents, and may initiate a lesion in soft and hard tissues, turning this problem into an orthodontic urgency.[4] The number of orthodontic emergencies is directly proportional to the quality of the materials used. Good quality materials and their correct use (doses, curing times, etc.) will represent a decline in the number of emergencies. This decline in appointments will translate in an increase of the confidence of the patient in our treatment, and consequently the patient will be more willing to cooperate with us.[15]

When an emergency situation arises, the patient contacts us via telephone call or e-mail; our secretary or assistant must look for the chart of the patient to determine the type of appliance the patient has in the mouth and the date of the next appointment, and we must classify the type of emergency and program the appointment according to the priority. This emergency appointment represents a stressful situation for the patient and the orthodontist, and is going to require a fast response from the office staff in order to resolve the problem; an excessive delay in the attention of these appointments may occasionally unleash iatrogenic dental movements by a deformed wire, the aspiration of a wire or an expander, or to the extreme that the patient "tears off" the appliances if his or her problem is not swiftly resolved. This way we are going to classify urgencies in two groups:[15]

- The programmed visit. A maladjustment of a removable appliance, the blockage of an expansion apparatus, brace or band bonding failure, the loss of a separator or a ligature, etc. are situations that can be programmed for an appointment (as soon as possible) but generally do not require immediate action.[15]

- The immediate visit. Other situations, like a lesion caused by the arch wire or the loops, the loosening of a rapid palatal expander or an anchorage appliance, the insertion of soft tissue in the hooks of the braces or tubes, the deformation of the arch wire, loose auxiliary elements (risk of aspiration), etc. These urgencies must trigger immediate action to counteract possible secondary effects that can potentially generate anguish to the patient.[15]

When the patient comes to our office, we can identify the site and degree of the lesion. These lesions can be rounded up in three groups:

- Lesions produced by extra oral-appliances. These are made by appliances like extra-oral arches, facial masks, tandems, etc.

- Lesions produced by intra-oral appliances. These are very common during orthodontic treatment and are caused by fixed or removable appliances; for example, rapid maxillary expanders, lingual arches, transpalatine arches, braces and loose molar bands; these appliances can injure tissues like the marginal gum up to the bone of the palatal vault.

- Lesions produced by bad hygiene habits. These are caused by a lack or reduction in the frequency of teeth brushing of the patient. This manifests itself with a gingival hyperplasia, and in extreme cases, in enamel decalcification.[4]

Pain in orthodontics

One of the major concerns of our patients when they begin orthodontic treatment is pain, for this reason we must know the etiology, pathogenesis and possible solutions to this problem. Some of the most frequent questions are: ¿Does orthodontic treatment hurt? ¿Why does dental movement hurt? ¿How long will the pain last? ¿How can we eliminate pain during treatment? We will try to explain this as easily as possible and without complications.

Teeth are bound to the alveolar bone through the periodontal insertion, which is composed by the root cement, the periodontal ligament and the alveolar bone. The cement (completely avascular) is barely modified by orthodontic forces, but all the attention lays on the two other components: the periodontal ligament and the alveolar bone.[9,27]

The periodontal ligament occupies a space of 0.5 mm between the alveolar wall and the cement, this ligament is responsible for the dental joint. It is constituted mainly of collagen fibers inserted on one side in the root cement and the other side in alveolar bone. It is mingled with blood vessels, cellular elements, nerve endings and interstitial liquid. Blood vessels are responsible for nutrition of the periodontal ligament and will serve as an access vehicle for the cells responsible for cortical bone and ligament remodeling. The existing nervous endings will transmit pressure sensation and proprioceptive notion. Periodontal fibers and interstitial liquid together form, an effective shock absorbing and force dissipater system of the physiologic forces applied for a brief period during the orthodontic movement.[13,27]

The third and last component of the periodontium is alveolar bone that can be divided in two parts: the fasciculated portion (hard laminated portion of bone), that lines the internal surface of the alveolus and the lamellar portion (spongy bone). As in cement, the fasciculated portion receives the insertion of the periodontal fibers. The process occurs in this manner: when force is applied on the tooth, it moves inside the alveolar socket, this provokes the stretching of some periodontal fibers and the compression of other fibers. At the same time the interstitial liquid of the fibers is also compressed against the osseous walls. As the liquid slowly drains out of the alveolus, it also exerts hydraulic resistance against dental movement. Periodontal fibers and interstitial liquid act in conjunction against the forces applied on the tooth, making it return to its original position. It is a paradox, but bone is the most malleable tissue of the human body, adapting to the forces that act upon it. It reacts by depositing osseous tissue in the areas exposed to traction forces and to absorb osseous tissue in areas where pressure is exerted. Orthodontic movement is only possible because of this malleability. This way, the root gets even closer to the alveolar wall, compressing the periodontal ligament on the side where the force is applied and stretching the fibers on the opposite side. Osteoclasts are responsible for cortical alveolar resorption where ligament compression occurs. In the phase where ligament distension occurs, osteoblasts and fibroblasts, the cells that form bone tissue and collagen fibers are present. Clinically, this period is characterized by moderate pain in teeth submitted to pressure but without movement. Around two days after the force is applied, osteoclasts and osteoblasts initiate the remodeling process. Slowly the alveolus dislocates in the direction of the applied force, with the sub sequential orthodontic movement.[27]

¿What happens at cellular level? The tissue response is similar to an inflammatory process, in which histamine is liberated by the mastocytes of the attacked region. This histamine has immediate action over the blood vessels of the periodontal ligament provoking vasodilatation and opens spaces between endotelial cells that conform the walls provoking a permeability increase (this first local reaction is called immediate response); later, prostaglandins are produced which increase vasodilatation and vascular permeability. Due to this increase of permeability monocytes come out of the interior of the blood vessels and they fuse and convert into multinuclear cells called osteoclasts, which are responsible for resorption of the alveolar cortical bone in which the ligament is being pressed . On the other hand, in the region with periodontal ligament tension undifferentiated mesenchyma cells transform into osteoblast and fibroblasts that form osseous tissue and collagen fibers respectively. Clinically this period is characterized by a slight or moderate dental pain without tooth movement. All this happens from the first seconds the orthodontic force is applied till the second day (the first 24-48 hours).[9,19,27]

On the third day, the osteoblasts and the osteoclasts initiate the bone remodeling process, with apposition on the periodontal fiber tension side and resorption on the osseous side compressed by the ligaments. In this moment, the tooth begins to move in the direction of the applied force and pain disappears.[27]

We have the wrong idea that if we apply more force we will have more tooth movement. When we apply heavy forces there will be excessive pressure on the periodontal tissues. In these regions, generally on the ligament pressure side, blood flow will slow down or almost cease, provoking degeneration or necrosis of the periodontal fibers. This phenomenon is known as hyalinization. The hialinized areas slow down dental movement, the more hialinized areas are present, the slower the dental movement will be. Clinically the patient will refer a moderate to severe pain and chewing will be uncomfortable for some days.[24,27]

Solutions to orthodontic pain

Among the options we have to reduce pain in orthodontics, we can count with three alternatives, which are the following:

I. Analgesics.
II. Vibratory stimuli.
III. Therapeutic laser.

I. Analgesics[3,9]

An excellent alternative for this problem is the use of non opiod analgesics. These inhibit the biosinthesis of prostaglandins and thromboxanes due to the interference of cyclooxigenase. They possess analgesic, anti-inflammatory, antipyretic and anti-rheumathoid properties. The non-opioid analgesics are classified as:

- Antipyretic analgesics.
- Non-steroidal anti-inflammatory drugs (NSAID).

Antipyretic analgesics

These control pain elevating the pain threshold, and act upon the thermoregulator center of the hypothalamus producing antipyresis. They do not have anti-inflammatory properties. Among these analgesics we can find the following:[3,9]

1. **Acetaminophen (Tylenol, Tempra, Winasorb, Datril, Panadol, Sinedol)**

The only aniline derivate currently in clinical use, and is the antipyretic analgesic of first choice in orthodontic treatment. It effectively controls moderate pain, does not have anti-inflammatory action and has minimal adverse effects at gastrointestinal level.

Figs. 1 and 2.

Presentations:
- 100 mg/ml Drops.
- 300 mg Suppositories.
- 160 mg/5ml Syrup.
- 80 and 160 mg Chewable tablets.
- 500 mg Tablets.

Dosage:
- Adults: 500-1000 mg every 6 or 8 hours (oral).
- Children: 30-40 mg/kg every 6 or 8 hours (oral, rectal).

2) **Sodium dipyrone-metamizole (Prodolina, Neo-melubrina, Magnopyrol, Conmel, Beserol)** [3]

Figs. 3 and 4.

Presentations:
- 500 mg/ml Drops.
- 300 mg and 1gr Suppositories.
- 50 mg/ml Syrup.
- 1 gr/ 2 ml and 2.5 gr/ 5ml Ampoules.
- 500 mg Tablets.

Dosage:
- Adults: 500-2,500 mg each 8 or 12 hours (intramuscular, intravenous, rectal).
- Children: 15mg./kg. 4 doses per day (rectal).

3) Lysine clonixinate (Dorixina, Donodol, Firac)[3]

Fig. 5.

An anthranilic acid derivative, it has good analgesic action, does not intervene at platelet level and produces minimal gastric irritation.

Presentations:
- 100 mg Ampoules.
- 125 and 250 mg Tablets.

Dosage:
- Adults: 100 mg each 6 or 8 hours (oral).
  125 mg each 8 or 12 hours (intramuscular).

Non-steroidal anti-inflammatory drugs (NSAID)

Indicated in acute pain and inflammation. They are counter indicated in patients with heart burn, peptic ulcer, hypersensitivity to the components of the formula, during pregnancy and breast feeding patients.

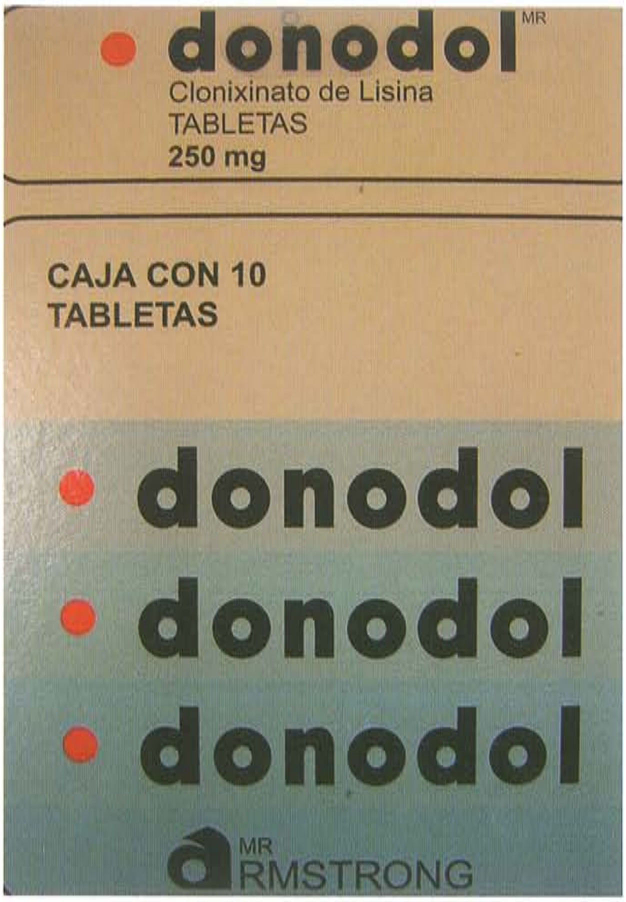


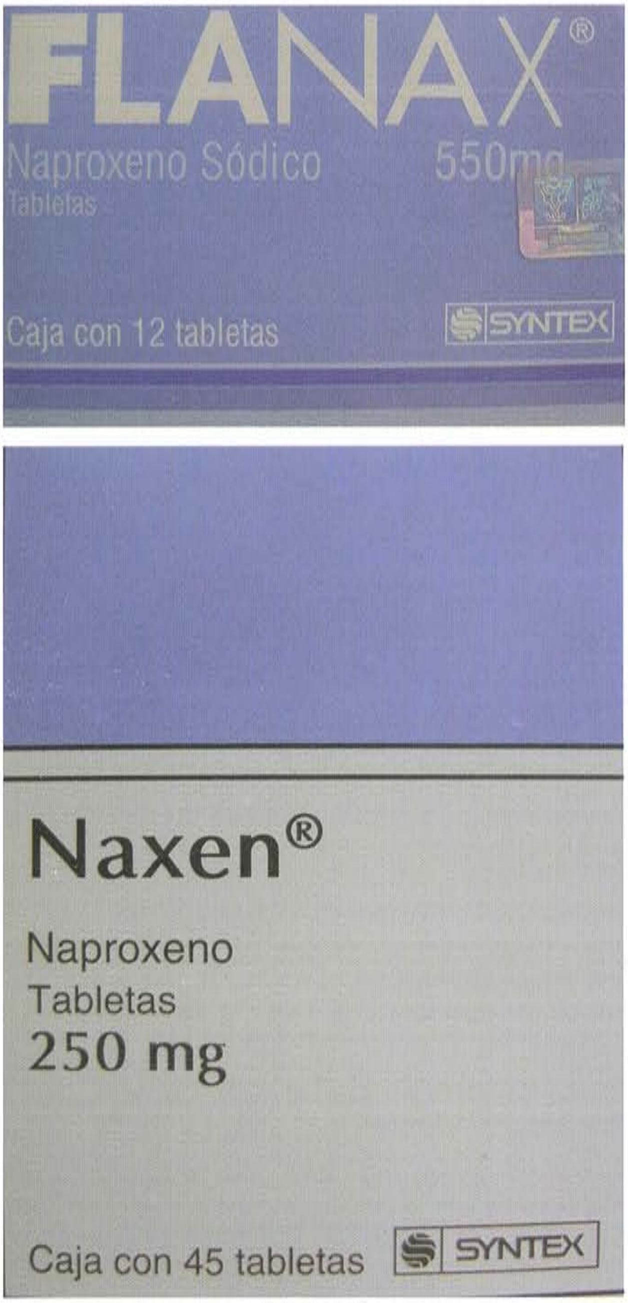
Fig. 6.

These are classified as:
a) Propionic acid derivates.
b) Carboxilic acid derivates.
c) Acetic acid derivates.
d) Oxicam derivates.
e) Non acid derivates.[3]

a) Propionic acid derivates

They have excellent anti inflammatory and analgesic action. It is considered the first option in moderate to severe pain management in dental practice. It has great use in oral surgery, endodontics, periodontics and in TMJ problems. It provokes gastric irritation, and for this reason the patient must take food with the drug.[3] Studies done by Dr. Polat compare the efficiency between naproxen and ibuprofen. We found that taken an hour before the orthodontic adjustments, naproxen is more effective than ibuprofen.[17]

1. Naproxeno (Flanax, Naxén)[3]



Figs. 7 and 8.

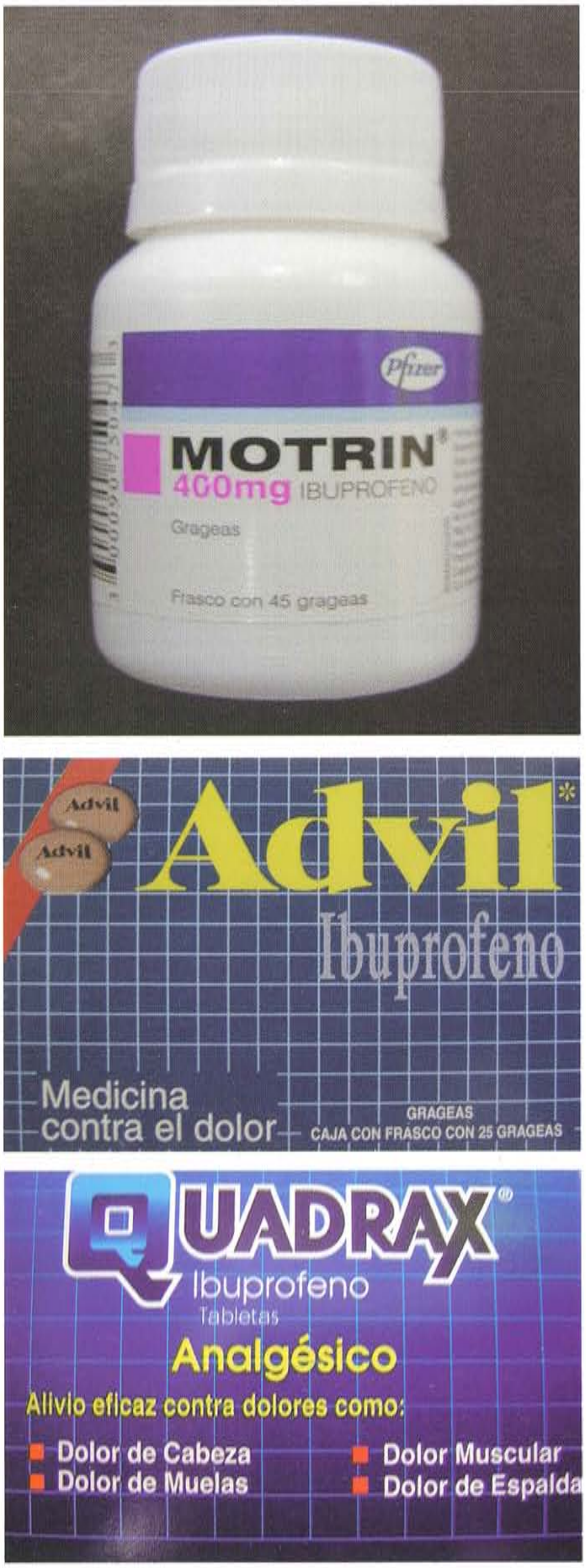
Presentations:

- 250 and 550 mg Tablets.
- 100 mg Children capsules.
- 125 mg/5ml Syrup.
- 50 mg Suppositories.

Dosage:

- Adults: 250 mg each 6 or 8 hours (oral).
- Children: 5 mg/kg each 6 or 8 hours (oral).

2. Ibuprofen (Motrín, Tabalón, Advil, Quadrax, Ainex)[3]



Figs. 9-11.

Presentations:
- 400, 600 and 800 mg Tablets.

Dosage:
- Adults: 400-800 mg every 6 or 8 hours (oral).
- Children: 30-40 mg/kg/day (3-4 doses oral). [3]

3. Ketoprofen (Keduril, Profenid) [3]

Fig. 12

Presentations:
- 100 mg and 200 mg Capsules.
- 50 mg and 100 mg Suppositories.
- 37.5 mg/5ml Syrup.

Dosage:
- Adults: 50 mg every 6 hours (oral).
  100 mg every 8 hours (rectal).
- Children: 1.5 mg/kg every 8 hours (oral or rectal).

4. Flurbiprofen (Ansiad)[3]

Fig. 13

Presentations:
- 100 mg Tablets.

Dosage:
- 100 mg every 8 hours (oral).

5. Ketorolac tromethamine (Dolac, Findol)[3]

Fig. 14

Presentations:
- 10 mg Tablets.
- 30 mg/1ml Ampoules.

Dosage:
- Adults: 10 mg each 6 or 8 hours (oral).
  30 mg each 8 or 12 hours (intramuscular o intravenous).
  Maximum dosage: 120 mg every 24 hours during 5 days.
- Children: Not recommended.

b) Carboxilic acid derivates[3]

1. Acetyl salicylic acid (Aspirin, Alka-Seltzer, Mejoral, Ecotrin)

Fig. 15 and 16

Although it has good analgesic and anti inflammatory action, the use of this product is restricted in orthodontics due to its adverse effects: prolonged bleeding time, severe gastric irritation and intolerance syndrome. Not recommended for children.

c) *Acetic acid derivates*[3]

Of immediate, prolonged, and powerful anti-rheumatic action. Very helpful in TMJ acute dysfunction.

1. Diclofenac sodium (Voltarén, Cataflam, Artrenac)

Figs. 17-19.

Presentations:
- 50 mg and 100mg Tablets.
- 75 mg/3ml Ampoules.
- 100 mg Suppositories.

Dosage:
- 150-200 mg/day every 12 or 24 hours (oral, rectal, intramuscular, intravenous).

d) *Oxicam derivates*[3]

Excellent long lasting anti-inflammatory action. It can seriously irritate the gastric mucosa. First option in TMJ dysfunctions because it concentrates in sinovial liquid.

1. **Piroxicam (Feldene, Facicam)**[3]

Figs. 20 and 21.

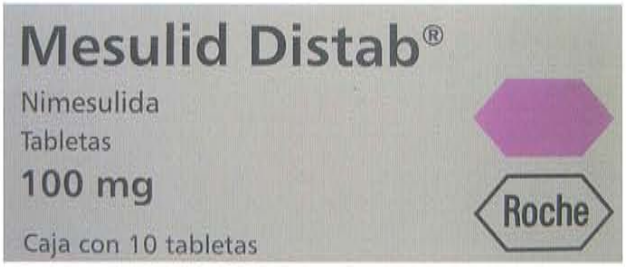
Presentations:
- 10 mg and 20 mg Capsules.
- 20 mg Suppositories.
- 40 mg/2ml Ampoules.

Dosage:
- 20 mg every 12 or 24 hours (oral). 40mg every 12 or 24 hours (intramuscular).

e) *Non acid derivates.*[3]

They produce good and prolonged analgesia.

1. Nimesulide (Mesulid, Eskaflam)



Figs. 22 and 23

Figs. 24 and 25.

Presentation:

- 100 mg Tablets.

Dosage:

- Adults: 100 mg each 8 or 12 horas (oral).

II. Vibratory stimuli

As mentioned before, one of the causes of orthodontic pain is the ischemia and the hyalinization that these movements produce. When the patient chews gum, preferably sugarless gum like Trident Xtra Care that contains Recal Dent (a remineralizer), a vibratory stimuli is produced that reestablishes blood circulation that produces as a consequence a diminishment of the ischemia. This is a non-pharmacologic, non-invasive method and we generally have the full cooperation of the patient, we instruct the patient to start chewing gum 15 or 20 minutes after. We change the arch wire. This is done before the pain appears because if the patient chews gum when the pain is present the discomfort will not disappear. Some authors recommend the combination of analgesics (one hour before the appointment) with the posterior vibratory stimuli.[25,29]

III. Therapeutic laser

The word laser is an acronym composed by the words "Light amplification by stimulated emission of radiation".[8,30,31]

Lasers can be classified according to different aspects:

1. According to their active media (solids, liquids or gases).
2. According to their wave longitude (ultraviolet, visible or infrared).[30]

According to their clinical application they are divided in:

1. **Soft laser.**
2. **Power laser.**[30]

The soft or therapeutic laser is used for analgesic, anti inflammatory and tissue regeneration purposes (recommended in orthodontics). Within this group these stand out: Helium-Neon (He-Ne), Gallium Arsenide (GaAs) and Gallium Arsenide and Aluminum (Ga-As-Al).[30]

The power laser or surgical laser is used for surgical purposes mainly. The most used in dentistry are: CO2 laser, the Nd-YAG (Neodinium/Ytrium-Aluminum-Garnet) laser, the ND-YAP laser, the Holmium-YAG laser, the Argon laser, the Eximer laser and the Er-YAG (Erbium: Ytrium-Aluminum-Garnet) laser. This last laser can partially substitute the high speed hand piece; this is one of the newest and more promising to work upon hard tissue (bone-teeth), because it emits a wave longitude that is well absorbed by hidroxiapatate and water. It is designed to work in soft and hard oral tissues, and unlike other lasers, this one does not have an haemostatic coagulant effect while it cuts; another difference is that the laser does not travel through a flexible fiber optic rod; this laser requires an articulated arm and a special hand piece.[30]

According to the laser being used, we can produce a biological effect at cellular level that consists fundamentally in a selective stimulation of the mitochondria that will result in an increase of the production of ATP, thus there will be an increase in cellular metabolism that is known as "bio-stimulation".[30]

The therapeutic laser action is studied at two levels:

1) **At cellular level.**
2) **At systemic level.**

1. **At cellular level:** it is said that the therapeutic laser is a bio-stimulant or a bio-regulator and it acts on three cellular structures basically:

    - Mitochondria: increasing the transformation of ADP into ATP, thus obtaining more intracellular energy.
    - Cell membrane: The laser repolarizes the membrane when it is depolarized. While it is acting, it normalizes the intra and extra cellular ionic situation; as a result we obtain more cellular vitality and the functions of the cells tend to normalize.
    - Cell protoplasm: some investigations have demonstrated the possibility that the photons of the laser emission can interfere with the ultra weak cellular structure photon production centers. This phenomena facilitates the intra-structural energetic reactions, as well as the highly oxygen consuming intracellular metabolic cycles that confirm a cell activation action.[30]

2. **At systemic level:** this effect is transmitted from the irradiated zone to the central nervous system, obtaining as a result analgesic and anti-inflammatory effects.[30]

The laser that we use at Centro de Estudios de Ortodoncia del Bajío (CEOB) is the diodic laser (GaAs), it is a therapeutic laser that emits in the infrared range close to 904 nanometers of wave length and has a range in soft tissue of 3 to 6 cm and 1 cm in low density bone tissue (like the upper maxilla).[33] These types of lasers produce potent analgesia, anti-inflammatory effect, tissue regenerative effect and a slight haemostatic effect. Once the laser has been absorbed by the tissues, the photons interact with diverse cell structures.[30] The diodic laser does not produce ionizing radiation and because the potency is limited and not focalized, it does not provoke tissue or cellular necrosis. We must be very careful not to direct the laser to the eyes, because the transparency of the cornea can allow the laser to affect the retina. This is why the patient and the

Figs. 26 and 27. Diodic laser with polarized lenses orthodontist must wear polarized protective eye gear or Ray-ban G-40 lenses.[33,34]

The skin of the zone where we are going to apply the laser must be cleaned thoroughly, without any presence of substances that may reflect the light of the laser and, in particular any metallic or reflective media. If there is no other remedy, the patient and the orthodontist must wear protective eye gear.[33,34]

Figs. 28 and 29. "Lasertech" diodic laser used to diminish orthodontic pain.

Cosmetics should not be used before or after laser application, because it has been demonstrated that after the application, skin is more prone to absorption; this is because the blood vessels are dilated, therefore gels and creams can be more easily absorbed. In patients with sensible skin the point of the laser must move in a circular motion, if this is not done, skin micro burns can occur.[33]

Laser dosage in orthodontic treatment

- 4 minutes at 2000 Hz are applied in the upper and lower areas depending on the site where the orthodontic movement is occurring. This is done in a sweeping or circular motion.[33]
- Another measure to diminish pain is to apply 2 minutes at 4000 Hz on the path of the nerve in the dental arch in which orthodontic force is being applied.[33]
- In TMJ treatments we must ask the patient to open as wide as possible, this allows maximum laser penetration.[30]
- In case the pain persists, we can apply the laser directly in the trigeminal nerve 4 minutes at 4000 Hz These activations are done after the orthodontic force is applied.[33]
- The first application of the laser must be placed on the most painful spot, so the patient can appreciate the benefits of the treatment.[33]
- The applications must not last more than 30 minutes.[33]

LESIONS AND URGENCIES DURING ORTHODONTIC TREATMENT

External apical root resoption (EARR)

This is a common consequence of orthodontic treatment. This phenomenon has been published for more than 100 years as one of the secondary effects of orthodontic treatment (Keim, 2001). [10,14]

Ten Cate (1980) mentions that the cell responsible for EARR is the odontoclast, that has cytologic and functional characteristics like the osteoclast. EARR begins appearing mainly in the periodontal ligament pressure zone in which we will find ligament fibers dissolved by odontoclasts, which produce shallow resorption sites with the appearance of a honey comb. The pulp reaction, immediate to the external stimuli, is an increase in vascularization, hyperemia and pulp calculus formation.[5,7,16]

Kaley and cols. (1991) mention that orthodontic forces allow root cement localized resoption which exposes dentine to osteoclastic activity. Nevertheless, cement is repaired in two ways:

- Functional fast repair.
- Non-functional delayed repair.

Functional fast repair is characterized by a fast cement apposition with well defined Sharpey fibers. This type of repair is found in EARR superficial lesions. The repair process in the apical area is characterized by hypercementosis that is generated as a secondary effect, the closure of the apical opening, cement exostosis and the displacement of the pulp tissue toward the tension site, preceded by selective secondary dentine deposition sites.(21)

Non-functional delayed repair is characterized by the absence of Sharpey fibers and by the slow deposition of repair cement. This repair is sometimes found in moderate lesions and frequently in severe EARR lesions with great root dentine exposition. The response of the dentine does not have tertiary dentine.(7,10,12)

Many studies coincide that the teeth that are more susceptible to EARR are:

1. Upper lateral incisors.
2. Upper central incisors.
3. Lower incisors.
4. The distal root of the first lower molar.
5. Lower second premolars.
6. Upper second premolars.(20,21)

Some of the factors that favor root resorption are:

1. **Swinging movements.** The majority of the studies report that the severity of the root resoption is directly related to the time length of the orthodontic treatment. The average root resoption that we are going to find in an average orthodontic treatment is approximately 1 mm to 1.5 mm.(12,14)
2. **Long term heavy forces in orthodontic treatment.** This is why the application of light and constant forces is recommended. Ricketts states that 100 g/cm^2 is an optimal force.
3. **Habits. Protractile tongue, nail biting, thumb sucking.**(14)
4. **Excessive closeness of the dental roots to the bone cortical.** We must calculate the width of the margins of the cortical bone before we initiate orthodontic treatment, because the dental movement against buccal or lingual bone may initiate root resoption or fenestration.(12)
5. **Dental trauma.** Orthodontic movements can begin 4 or 5 months after a tooth has received a trauma with a force less than 70 g Linge and Linge mention that the loss of root length in traumatized teeth is 1.07 mm compared to 0.64 mm of non traumatized teeth.(26)
6. **Racial group.** Asian patients show less EARR than Anglo-Saxons, and these show less than Hispanic patients.
7. **Root anatomy.** Long and thin roots or pipett form apexes are more susceptible to EARR.
8. **Increased overjet.** Class II division 2 patients have an increased risk of root resorption due to the intrusion of the anterior segment necessary for overbite correction and the torque applied to correct the palatine inclination of the incisors.(26)
9. **Brace size.** Mini braces produce less EARR because they have more inter-brace distance. The greater the inter-brace distance, the less root resoption will occur. (12)
10. **Continuous occlusal trauma.** Wrongly applied orthodontic forces can cause occlusal trauma that may implicate root resorption.
11. **Cists and tumors.**
12. **Metabolic or systemic disturbances.** Hyperparathyroidsm, hypophosphatemia, Paget's disease are alterations in which EARR can present itself more often.
13. **Periapical inflammation.**
14. **Dental reimplantation.**
15. **Intermaxillary elastics.** The use of intermaxillary elastics produces intermittent and swinging forces, which are associated with EARR.(2)
16. **Genetics.**
17. **Dental intrusion.** These are the most aggressive orthodontic movements at root apex level; these forces affect the blood that flows to the dental pulp and nay cause necrosis and calcification. An unmeasured intrusive force can also derive in a dental anquilosis.(26)
18. **Mid-palatal suture expansion.** This treatment can damage the teeth on which the expander is supported, it can also damage the furca and the apexes of premolars and molars. (20)

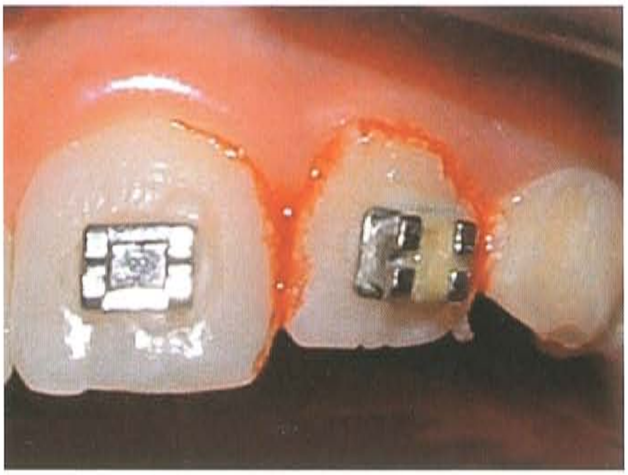
The administration of thyroxine diminishes EARR in the maxillary incisors, this suggests that thyroid function plays an important clinical role in the ethyology of EARR; Loberg and cols. (1994) concluded that patients who had thyroid supplement (0.5g.) did not present any collateral clinical effect and the roots had good morphology after the orthodontic treatment.
Teeth with endodontic treatment are more resistant to EARR due to their increased dentinal density and hardness.

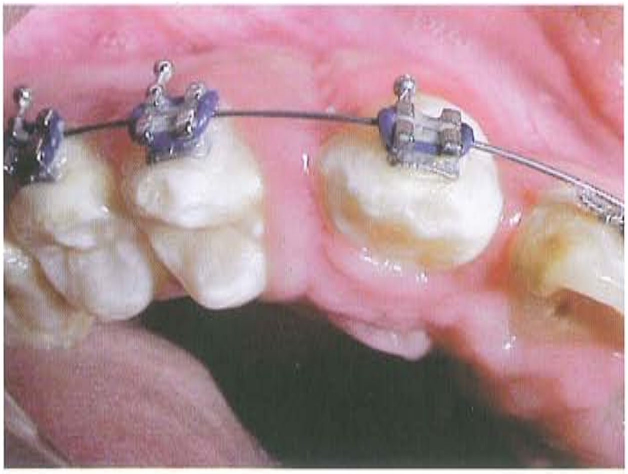
Lesions in soft tissue (gums, mucosa, and skin) during orthodontic treatment are very frequent. Depending upon the type and place of injury, will be the urgency that we are going to face in our office. These lesions are easy to eliminate and generally subside as soon as we remove the aggressing agent.(4,15)

Oral lesions

Gingival inflammation. An orthodontic treatment that does not respect the periodontum is inadmissible; also inadmissible is a periodontal treatment that excludes a future improvement of the occlusion thanks to orthodontic treatment. The orthodontic movements are going to act over the periodontum, so we must consider the relation between orthodontics and periodontics. Furthermore, the orthodontic treatment is going to improve the condition of the patient, only if infection and inflammation are controlled. But apart from any esthetic consideration, malocclusion is the cause of many periodontal problems; fixed orthodontic appliances are the cause of de demise of the oral hygiene conditions of the patient. The lack of an appropriate dental hygiene program is an important factor that can initiate a case of gingivitis or periodontitis. Some investigations about this topic have demonstrated the relation between periodontal disease and the use of braces. Sadowsky and BeGole demonstrated that there is greater prevalence of moderate periodontitis in patients that wear braces (P<0.05) than in patients that do not wear braces. Furthermore, they showed that the prevalence is greater in extraction cases. Davies, Shaw, Worthington, M. Anddy, Dummer and Kingdon mention that braces

Figs. 30 and 31. Gingivitis due to orthodontic movement and plaque accumulation.





Figs. 32-34. Gingival inflammation due to lack of dental brushing.

Figs. 35 and 36. Food retention during orthodontic treatment.

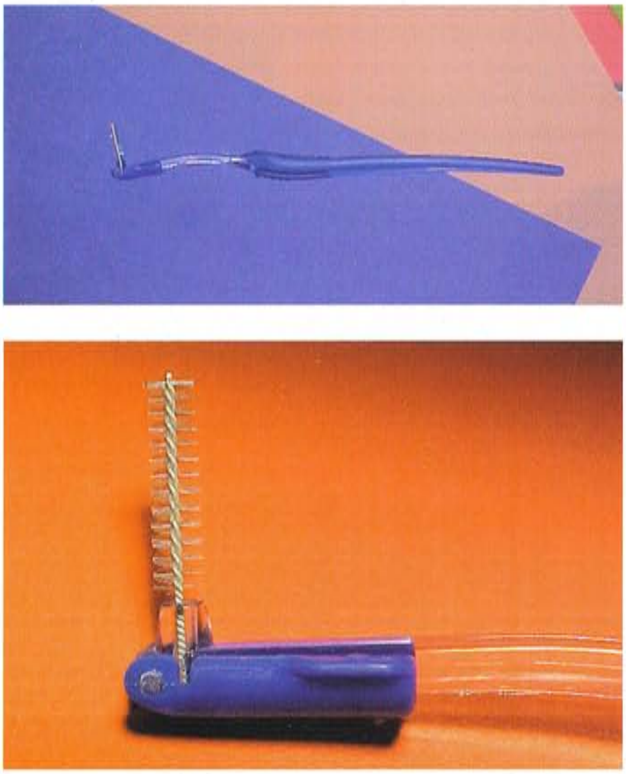
are responsible for plaque accumulation, but the lack of dental hygiene on behalf of the patient is the main cause of plaque accumulation.(2,6,15,23)

Before we initiate an orthodontic treatment we must set an appointment show the patient how to brush their teeth properly. In this appointment we must explain in detail how to brush their teeth and how to use other hygiene auxiliaries (like the interdental brush, mouthwash, dental floss, tooth paste, etc.).(6,23)

Recommendations

1. Correct tooth brushing technique done at least 3 times a day.
2. Use tooth pastes with Triclosan 0.3%, these pastes significantly reduce the percentage of gingival bleeding zones. Bexident Triclosal Gingiprotector is a dental paste formulated to control and prevent dental caries and plaque.The formula is based in free and ciclodextrine encapsulated 0.3% Triclosan, a soothing and effective anti plaque agent and 0.22% sodium fluoride, an effective anti caries agent. Because it contains Dexpanthenol, Dipotasic glicirritate and Laureth-9 it has regenerative and soothing properties, and helps in the reduction of gum inflammation, maintaining it in good conditions, combined with a proper brushing routine inflammation.
3. Use of dental floss and interproximal brush.

Fig. 37. Bexident Triclosan.



Figs. 38 and 39. Interproximal brush.

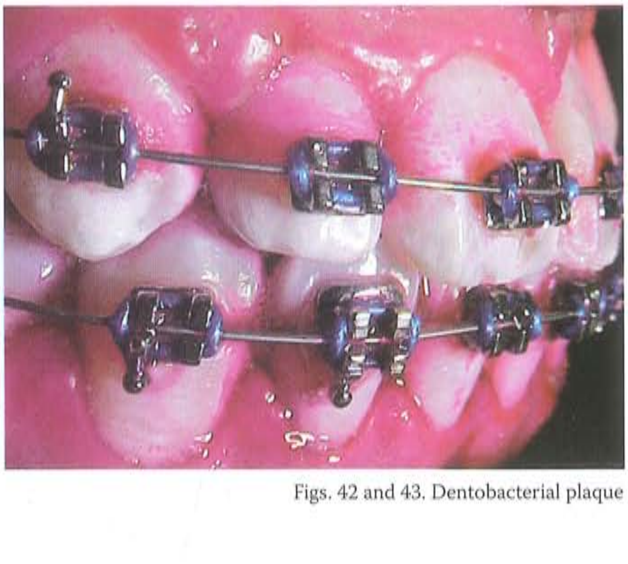
4. Dentobacterial plaque control with plaque disclosing tablets.

Figs. 40 and 41. Disclosing tablets.

5. Clorhexidine gluconate 0.12% mouthwash twice a day. It is an antibacterial agent that has clinically shown to inhibit the formation of dentobacterial plaque (Bexident, Oral-B).[6,34]

Fig. 44. Bexident Encías.

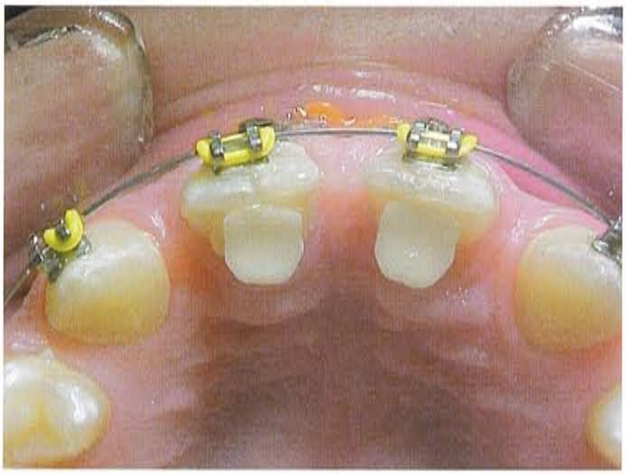
6. Patient cooperation.
7. Place metallic ligature instead of elastic ligature, do the same with power chain, place closed coil instead.
8. Routinely probe the sulcus and suspend orthodontic treatment in case any periodontal problem is not under control.
9. Light and constant orthodontic movements.



Figs. 42 and 43. Dentobacterial plaque accumulated during orthodontic treatment.

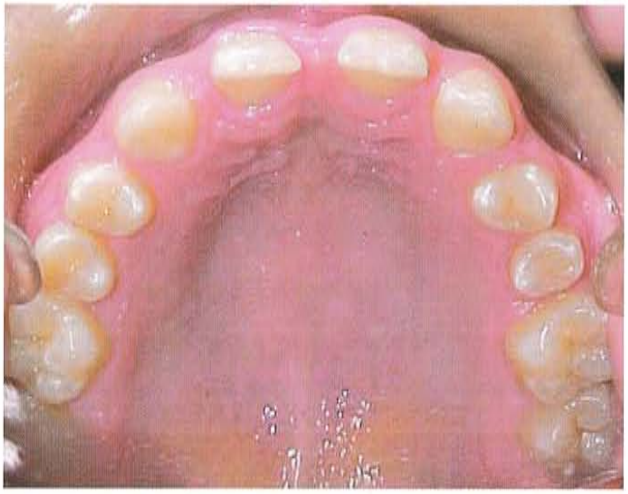
Fig. 45. "Gingivitis" mouthwash.

10. Use mini braces and elastic arch wires (NiTi, Thermal NiTi, TMA).
11. Place direct bond tubes instead of bands.
12. Dental profilaxis every 4 or 6 months.

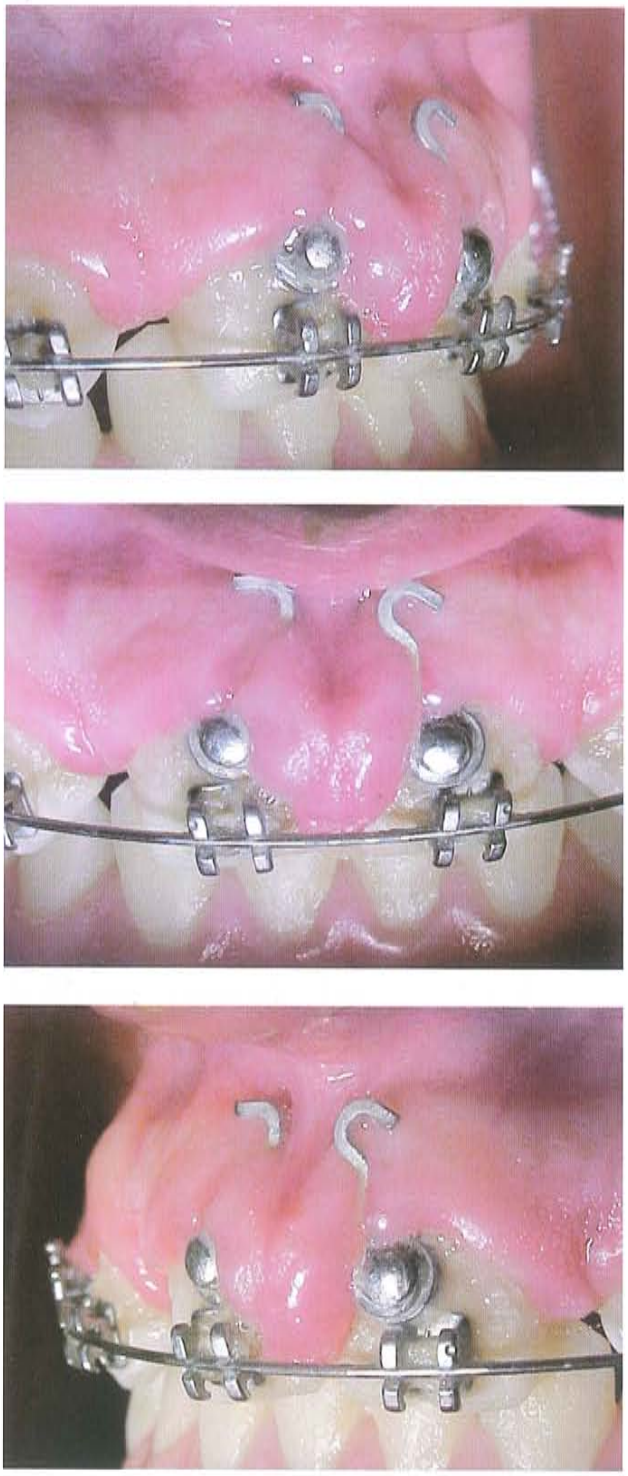


Figs. 48 and 49. Diastema closure with power chain on power arms.

■ **Orthodontic movements.** Two separate processes occur in the gums after applying an orthodontic force. In the first one, there is a lesion in the fibers of the connective tissue in which collagen fiber ruptures. In the second one, collagen and elastine are activated, meanwhile the collagenese tissue is inhibited, and it affects the extra cellular matrix of the gum. Orthodontic forces applied in adults must be light (it prevents root and periodontal damage) and interrupted (the tissue reorganizes after the force magnitude diminishes).In the site in which



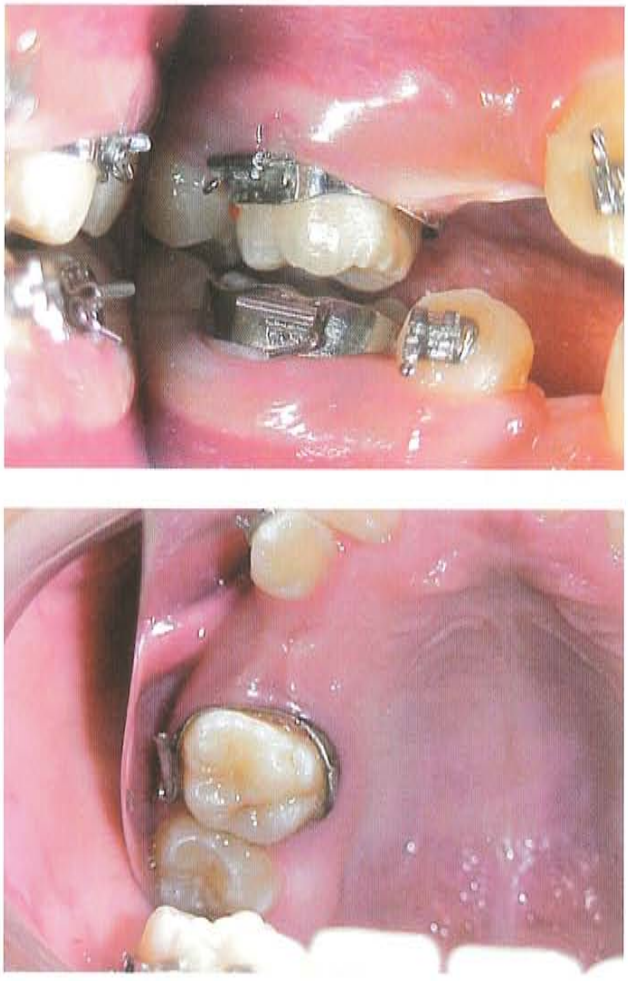
Figs. 46 and 47. Diastemas at the beginning of orthodontic treatment.



Figs. 50-52. Brace and power arm invagination due to gingival hyperplasia.

space closure is going to take place an accumulation of gingival tissue will be observed as a result of retraction and compression (gingival hyperplasia). Due to the fact that the periodontum moves with the tooth during the orthodontic treatment, we must exercise extra special care while making excessive buccal movements because it can produce gingival recession.[4,6,15]

- **Poorly adapted bands.** This lesion is produced by poorly adapted bands, or by an excess of cement or a band that is larger than the one required for the molar. The patient may refer gingival inflammation, pain, food impaction and sometimes tongue ulceration due to cutting edges of the molar band.[15]



Figs. 53 and 54. Band invagination on an upper molar.

Around the bands we can find an increase in:

- Lactobacillus.
- Mobile organisms.
- Anaerobics.
- Intermediate prevotella.
- Facultative anaerobic bacteria diminishment, this results in gingival inflammation and the beginning of enamel decalcification.

Recommendations

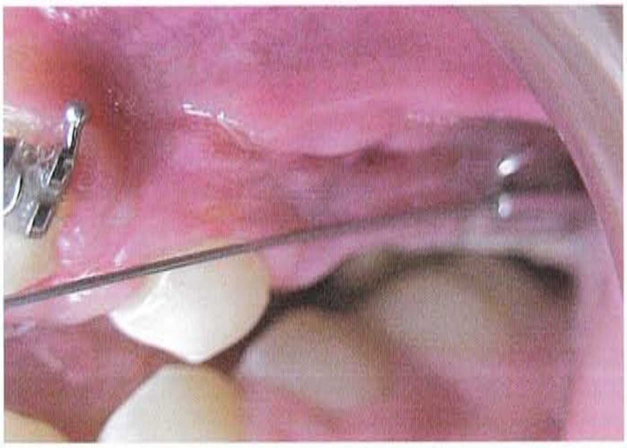
1. Take the bands off immediately and prophy the inflamed zones. In case we do not take the bands off, periodontal abscesses can develop, if this occurs we must refer the patient to a periodontist.
2. Instruct the use of a Chlorhexidine mouth wash twice a day.
3. Adjust or replace the bands after the gums have healed.
4. Adjust the bands as much as possible.
5. Replace the band if a fracture or fissure develops.
6. Substitute molar bands with direct bond molar tubes.

■ **Lesions caused by power chain.** The use of power chain for canine retraction may produce a linear lesion on the gum.(15,18)

Recommendations

1. Immediately remove the power chain or the cause of the irritation.
2. Use topical analgesic and antiseptic gels or ointments. The ointment must contain benzocaine and benzoin in order to accelerate healing, to diminish the buildup of dental plaque and to lessen the inflammation of the affected zone (Kanka). Another alternative is the use of a gingival protector (Bexident Encias gel), it contains 0.20% chlorhexidine and dexpanthenol that has soothing and regenera-

Fig. 58.



Figs. 55-57. Lineal lesion produced by power chain.

tive properties. Both gels must de applied two or three times a day with the tip of a finger or the applier after meals. The patient must not consume liquids or food half an hour after the application of the ointment.

Fig. 59.

3. It can also be combined with a mouth rinse made with monohidrate sodium perborate (69.72%) and anhidrate sodium bitartrate (29.88%); these chemicals set free non-active oxygen that in contact with saliva reduce inflammation (Amosan). The use of the analgesic ointment and the mouth rinse must be bone three times a day until the lesion disappears.[34]

Fig. 60.

4. The use of broad spectrum iodine based microbicides (Iodinepolividone) is an excellent option for intra buccal wounds and lesions (Buccopharyngeal Isodine). This is applied directly with a cotton swab on the affected area or it can be diluted in half a glass of water and used as a mouth wash.

Fig. 61.

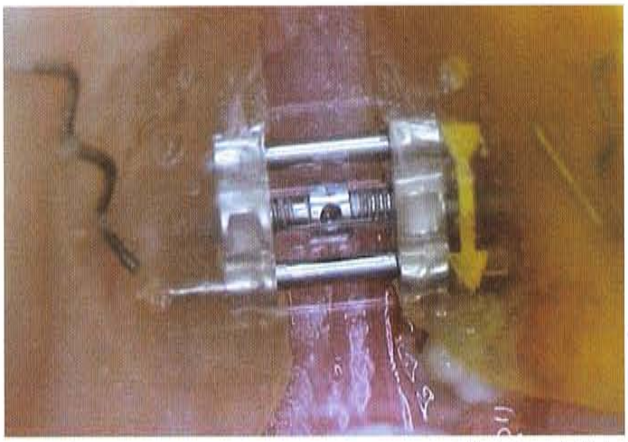
5. Use alternative methods for teeth traction out of the arch wire, like the utility arch.
6. As soon as the lesion is repaired, continue with the treatment.

Lesions caused by fixed or removable appliances. An erroneous or deficient placement of braces, anchorage with bands, expanders, power arms, retainers, etc. combined with a decline in the frequency in tooth brushing and the absence of the patient to their programed appointments, can cause an acute acumulation of dentobacterial plaque, and as a consequence gingival lesions that can occasionally produce bone resorption. This type of lesion becomes an emergency that needs immediate attention for the patient, because the patient can not swallow, it is uncomfortable, stressful and painful.[15]

A rapid expansion appliance that is incorrectly activated (accelerated activation) can result in the impingement of the screw, the acrylic or arms of the appliance, or the cement,

Figs. 62 and 63. Hyrax decementation and impingement.

Figs. 64 and 65. Lesion caused by the Hyrax.



Figs. 66 and 67. Lesion caused by the Hass.

the glass ionomer or the acrylic that binds the appliance to the anchorage teeth can fracture.[4,15]

Recommendations

1. Take the appliance off immediately.
2. Use a topical analgesic and antiseptic in the lesion zone combined with a mouth wash with monohydrate sodium perborate, chlorhexedine or a iodine based broad spectrum microbicide (Iodinepolividone).
3. Suspend the expansion until the lesion has disappeared.
4. Perfectly adjust the new expander.
5. Slow down the rate of expansion.
6. Seek alternative methods of maxillary expansion.

The use of anchorage is common during orthodontic treatment, this can be placed in the upper or lower dental arch, or on both. An incorrect cementation or a faulty design can translate into an orthodontic urgency. [15]
The transpalatine must be separated 1 mm to 2 mm from the mucosa of the palatal vault. In cases where the anchorage lies bellow this marker, due to the palatal anatomy or to a poor design, the tongue can become ulcerated due to the constant pressure that the tongue exerts on the transpalatine.

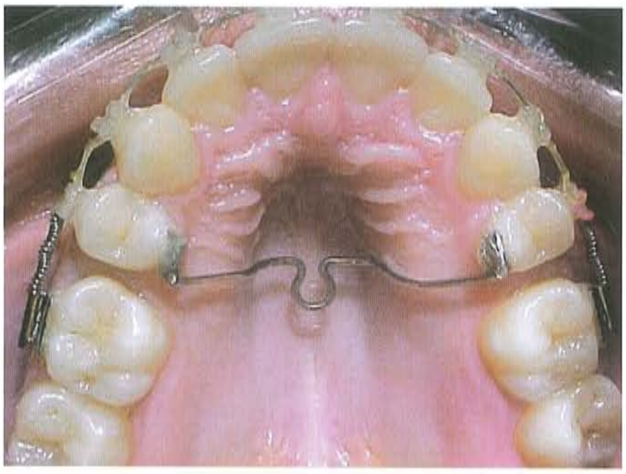


Fig. 68. Incorrect anchorage cementation

Fig. 69. Tongue pressure.

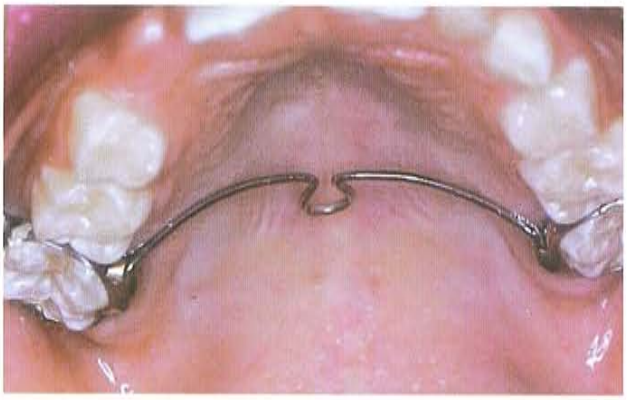
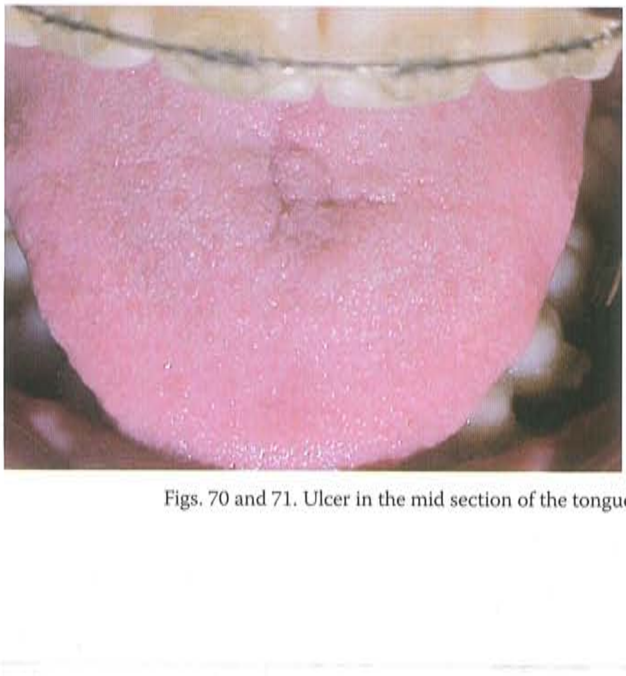
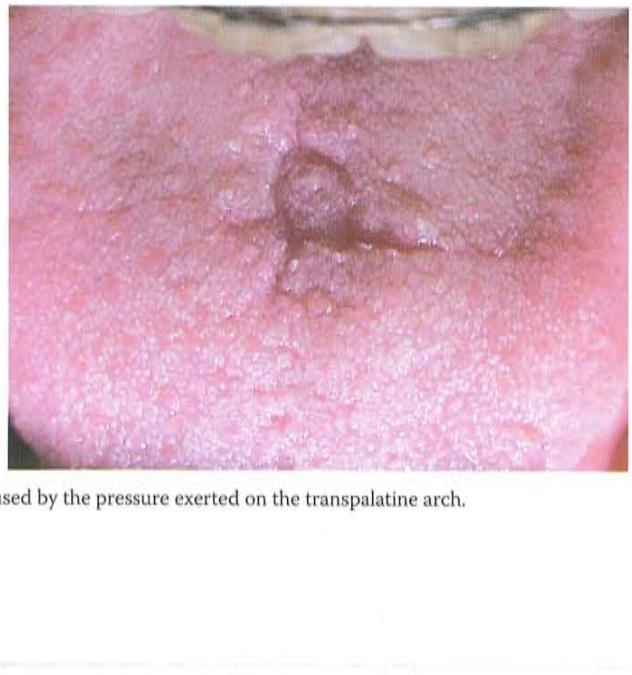


Fig. 72. Incorrect transpalatine cementation.

Recommendations

1. Remove the anchorage immediately and place a minimal anchorage (arch wire bends) during the healing process.
2. Suspend the canine or anterior segment retraction.
3. Use a mouth rinse based on Monohydrate Sodium Perborate or a broad spectrum Iodine microbicide (Iodinepolividone).
4. Adjust as snug as possible the new anchorage appliance to the anatomy of the maxilla.





Figs. 70 and 71. Ulcer in the mid section of the tongue caused by the pressure exerted on the transpalatine arch.

Figs. 73 and 74. Traumatic ulcer caused by the transpalatine arch.

The anchorage of choice in the lower dental arch is the lingual arch. When it dislodges, the bands tend to impinge deep in the mucosa, the same thing happens with the lingual bar. This impingment causes pain to the patient.[4,15]

Fig. 75. Lingual arch decementation.

Fig. 76. Loop invagination.

Recommendations

1. Remove the anchorage immediately and place a minimal anchorage during the healing process.
2. Suspend canine or anterior segment retraction.
3. Use a topical analgesic and antiseptic in the lesion zone combined with a mouth wash with Monohydrate Sodium Perborate, Chlorhexedine or a Iodine based broad spectrum microbicide (Iodinepolividone).
4. Adjust as best as possible the new anchorage appliance to the mandibular anatomy.
5. Contour and cement the bands correctly.

One of the most popular appliances for upper molar distalization is the Pendulum or the Pendex. These appliances are very effective for this dental movement, but we must have strict control over the monthly appointments of our patients. A faulty design or if we do not bond this appliance appropriately can provoke the impingement of the active arms in the mucosa of the palatal vault or

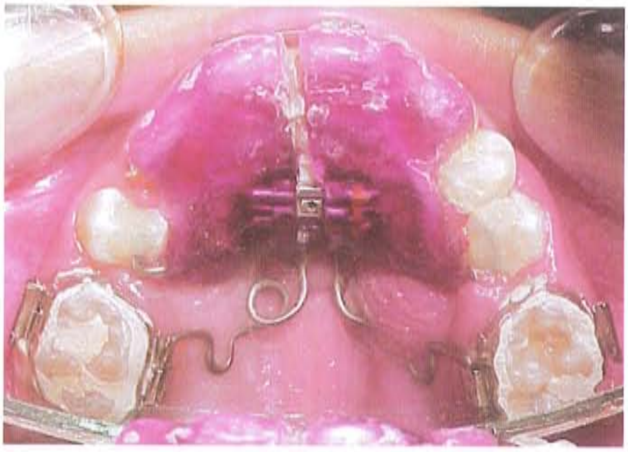


Fig. 77. Ingavinated arms of the Pendex.

Fig. 78. Palatal leasion produced.

Fig. 79. Pendulum on work model.

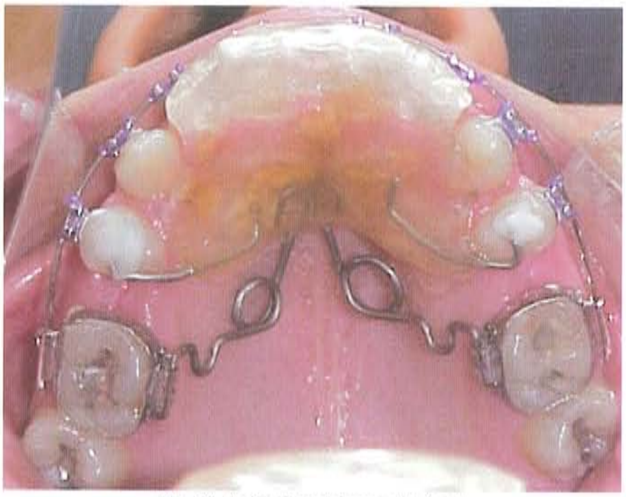


Fig. 80. Active Pendulum with food.

excessive pressure over the anchorage zone. Food may easily accumulate under the acrylic dab, producing gingival inflammation.[4]

Recommendations

1. Remove the distalizer immediately and place minimal anchorage until the lesion is cured.
2. Use a mouth rinse based on monohydrate sodium perborate or chlorhexidine or a broad spectrum iodine microbicide (iodinepolividone).
3. Adjust as best as possible the new distalizer to the anatomy of the maxilla.
4. Activate the arms of the distalizer at 45° degrees.
5. Remove the appliance every month and a half or two months to clean it thoroughly.
6. Cement the distalizer as neatly as possible or the acrylic can impinge into the mucosa.

Fig. 81. Lesions produced by the Pendulum.

Figs. 82-83. Lesions produced by the Pendulum.

Fig. 84. Pendulum out of the mouth with food retention.

7. Rigorously control the appointments of the patient.

After the distalization is complete we must place an anchorage appliance to avoid molar rebound. The anchorage appliances can range from a transpalatine arch, a transpalanance, a Nance button or a Viaro Nance. The major disadvantage of the last three appliances is that they incorporate an acrylic dab, and as mentioned before these appliances retain food particles. We must choose the right size of the dab, because if its too big it will accumulate food, and if its too small it may impinge it self in the palatal mucosa.[4]

Figs. 85 and 86. Viaro Nance impingement due to a small acrylic dab.

Figs. 87 and 88. Lesion produced by the impingment of the Viaro Nance.

Fig. 89. Lesion produced by a Nance button.

The appliances designed for posterior extrusion (which will provoke an anterior open bite) exert an extrusive pressure on the banded molars and a contrary action on the anchorage unit. In the Heisan this unit is built by a mass of acrylic that is supported against the hard palate. An unmeasured activation will provoke the invagination of the acrylic button into the palatine mucosa.

Recommendations

1. Immediately remove the anchorage appliance and place a minimal anchorage until the lesion has disappeared.
2. Suspend canine or anterior segment retraction.
3. Use a mouth rinse based on monohydrate sodium perborate or chlorhexidine or a broad spectrum

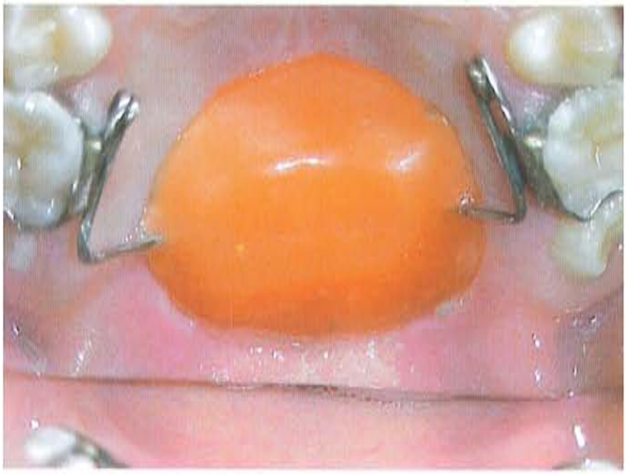


Fig. 90. Active Heisan.

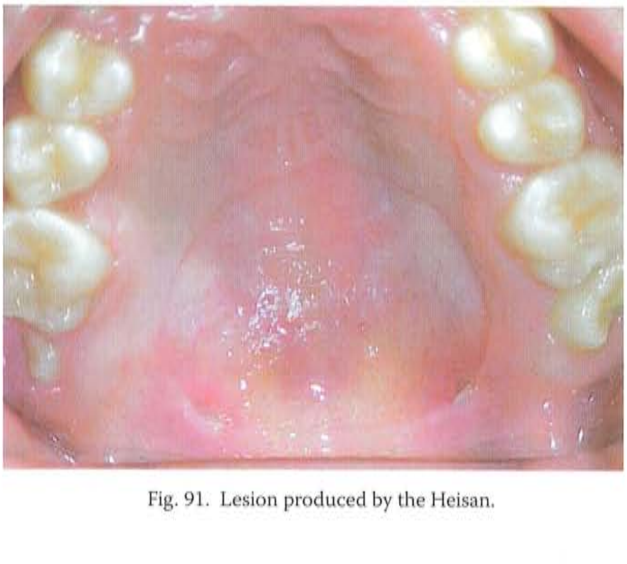


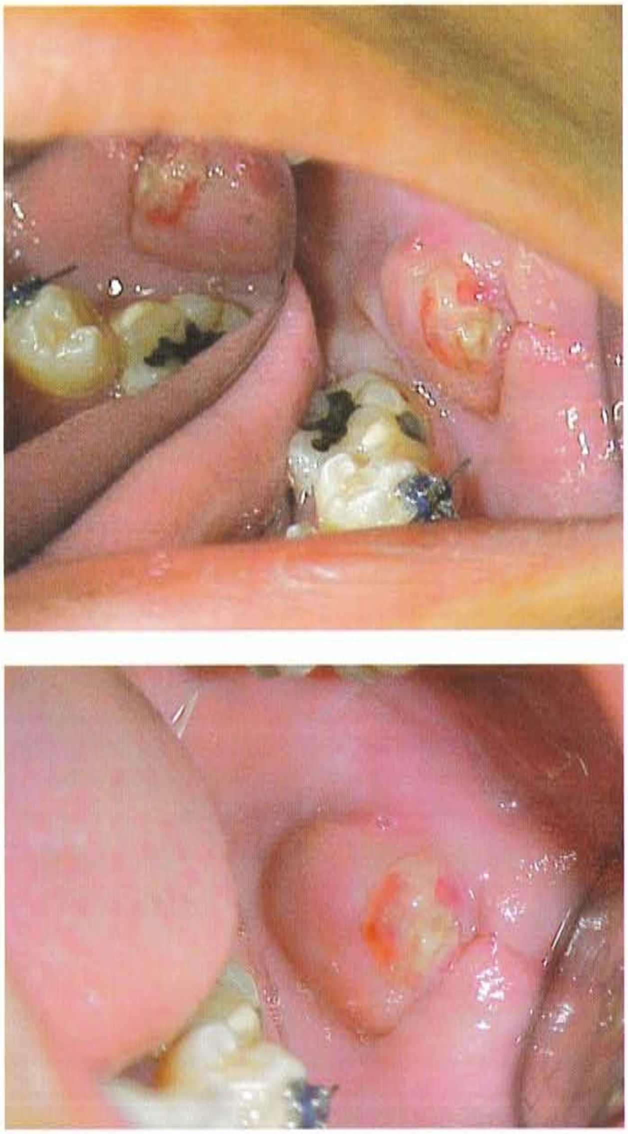
Fig. 91. Lesion produced by the Heisan.

iodine microbicide (iodinepolividone).
4. Adjust as best as possible the new anchorage to the anatomy of the maxilla and make the button of acrylic of 1 cm of diameter. The bigger the button, the greater the anchorage, but we will have more food retention.
5. Cement as the anchorage appliance as best as possible.

The loosening of a molar band, the debonding of a tube or the dislodgment of the arch wire will provoke undesired movements and will lesion the inner lining of the cheeks.[4,15,28]

Fig. 92. "Long" arch wire.

Fig. 93. Molar tube and bracket debonding.



Figs. 94 and 95. Lesion provoked by the debonding of a direct bond molar tube.

Recommendaions

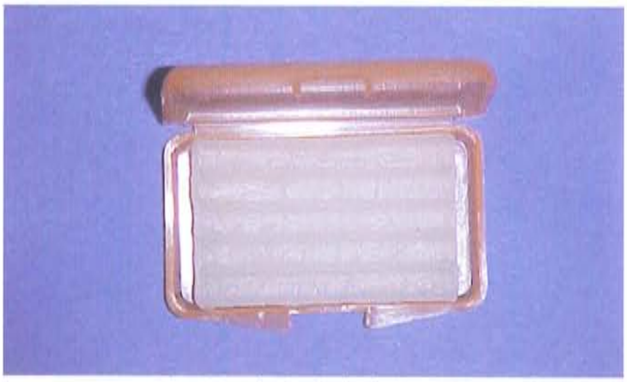
1. Inmediatly remove or cut off the arch wire.
2. Replace the bands with direct bond tubes.
3. Use a topical analgesic and antiseptic in the lesion zone combined with a mouth wash with monohydrate sodium perborate, chlorhexedine or an iodine based broad spectrum microbicide (iodinepolividone).
4. Reinitiate the orthodontic treatment after the lesion has disappeared.

The continuous close contact between the braces and the oral mucosa frequently produces a loss in the continuity of the epithelium in that zone. This loss of epithelium is known as an ulcer. It can produce pain and discomfort during speech.[4,28]

Figs. 96-98. Ulcers produced by the frequent contact between the lip and the braces

Recommendations

1. Use mouth rinses with monohydrated sodium perborate or a topical antiseptic and analgesic or a iodine based broad spectrum microbicide (iodinepolividone).
2. Place orthodontic wax on the brace or wire that is causing the ulcer.[28] The wax can be substituted with Fermit, which is a light cured adhesive that is used as a provisional material in molars and premolars that are going to receive inlay restorations. Cure the material for 40 seconds.



Figs. 99 and 100. Orthodontic wax.

Fig. 101. Wax over braces.

The use of retainers is indispensable at the end of the orthodontic treatment. But, if these are not well designed they can provoke lesions in the gums of the patient, causing pain and discomfort, and, as a consequence, very poor cooperation on behalf of the patient during the retention phase.[15]

Figs. 102 and 103. Maladapted lower Hawley retainer.

Figs. 104 and 105. Lesion caused by a mal adapted retainer.

Recommendations

1. Take off the retainer immediately and place a fixed retention (resin dabs between the teeth).
2. Abrade the acrylic of the retainer in the zone that is provoking the lesion.
3. Use mouth rinses with monohydrated sodium perborate or a topical antiseptic and analgesic or an Iodine based broad spectrum microbicide (iodinepolividone).

During the removal of the braces and the tubes at the end of the orthodontic treatment, the resin or the ionomer tend to remain attached to the enamel of the teeth. This is the moment in which we send the patient back to their general practice dentist to have the adhesive removed, but in some cases the general practice dentist is not trained or does not have the appropriate instruments for the removal of the adhesive only, unfortunately they can scratch the enamel, and sometimes can even eliminate it completely.

Figs. 106 and 107. Enamel erosion due to an inappropriate orthodontic resin elimination technique.

Fig. 108. Comparison between healthy enamel and damaged enamel.

The use of extra oral appliances during orthodontic and/or orthopedic treatment is very common. Among this group of appliances we can find:

- Face masks,
- Face bows,
- Chin cup,
- Tandem,
- Maxilar mini protractor, etc.

In the literature there are cases in which, accidentally, a face bow has dislodged from its position and has penetrated the eye ball; in these cases an ophthalmologist must intervene.[4,11]

The continuous use and friction with the skin cuased by these appliances produce a skin lesion, that is bothersome and anti esthetic for the patient.[1,22]

Fig. 109. Use of the maxillary mini protractor.

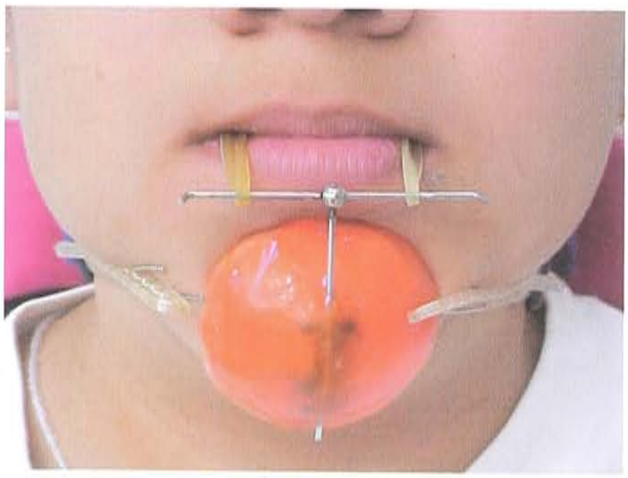


Fig. 110. Use of the maxillary mini protractor.

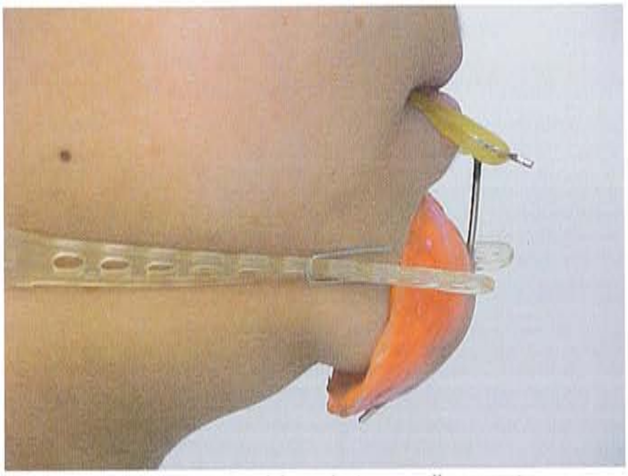


Fig. 111. Unmeasured force during maxillary traction.


Fig.112 Skin lesion.

Recommendations

1. Immediately remove the appliance.
2. Diminish the orthodontic or orthopedic force applied.

Fig.113.

3. Use creams or ointments with zinc oxide.
4. Use Ulcoderma or Fibrase cream with healing action. After the wound has healed, use Mederma or Procicar to vanish the scar.
5. After the lesion has disappeared reinitiate the treatment.
6. Place a pad of absorbing cotton on the inside of the chin cup, this way it will be more hygienic and the skin of the chin will be protected.

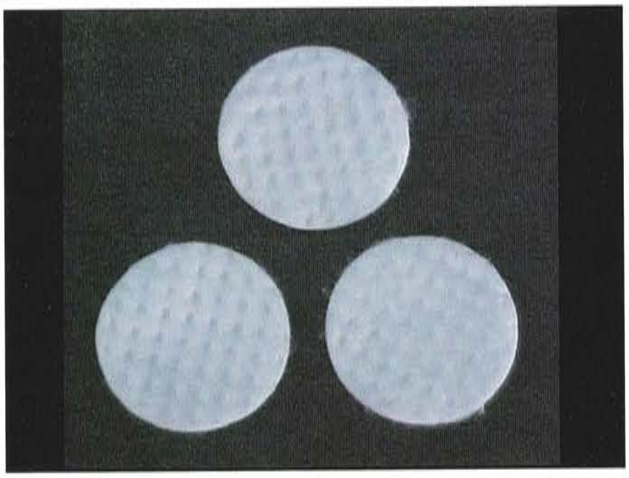


Fig.114.

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Retention in Orthodontics

10

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Introduction

Retention or contention is the prolonged dental detention that is done at the end of an orthodontic treatment with the use of appliances designed for dental stabilization.[26] One of the objectives of retention is to give our patients dental, skeletal and muscular long term stability with the use of fixed and removable retainers.[1,26]

Some authors name retainers in several ways:

- Teeth pajamas (because they are only worn at night).
- Retainers (because they retain teeth in their new position).
- Guarantees (because the results of the treatment are guaranteed as log as the retainers are used).[12]

It is important to remember that one of the greatest problems in orthodontics is rebound, this is why all our efforts, while we diagnose the case, elaborate our treatment plan and detail the occlusion must be directed to counteract rebound, as a fact, retention planning must begin with the diagnosis of the patient because retention will be the continuation of active treatment (braces) and requires analytic thought.[2,5,7,23]

Orthodontic treatment is a cascade of mechanical stimuli over the structures that surround teeth. Once these stimuli disappear when the orthodontic treatment is over and normal function is reestablished, the tissues affected by the dental movements will recuperate their structure in a new position. Teeth must be considered potentially unstable and must be contained in their new position. If the teeth are in equilibrium with the perioral and intraoral muscles and if there is dental, muscular and articular stability, the retention phase should not be a problem.[7,24,26]

Studies of post treatment changes have shown that, with time, certain movements of the treated teeth will occur. The recommendation to use a retainer is based on the possibility that the factors that caused the malocclusion would still present and may affect the alignment and the occlusion of the teeth after the treatment is completed. The cases that show rebound will clinically show a moderate increase of the overbite and the overjet, but the most evident rebound signs will be present in the lower incisor region. This zone has long been considered the "house foundation," especially during the last phases of growth and development. So, we must be very careful with the lower incisor region.[4,16,20,23,34]

In order to reduce rebound of the lower incisors, 13 principles have been enunciated:

1. Allow the lower incisors to align by themselves, through serial extractions or with a lip bumper in the early mixed dentition period.
2. Overcorrect lower incisor rotations as early as possible.
3. Perform stripping on the lower incisors during treatment and again during retention. This improves stability.
4. Avoid incrementing the inter canine width during active treatment.
5. Extract premolars in cases where the discrepancy in the mandible is 4 mm or more, except when facial esthetics impose something else.
6. To more movement more rebound. Because of this we must always overcorrect.
7. Upright the lower incisors to 90° to the mandibular plane, when the facial profile allows it.
8. Create a flat occlusal plane and always overcorrect the overbite.
9. Indicate supracrestal fiberotomy to severely rotated teeth.
10. Contain the lower arch until growth has completed.
11. Place the retainers the same day the braces are removed.
12. We must recognize that sometimes we must compromise with esthetics, and sometimes retention will be for life.

13. We must remind the patient the duration of retention and the time that the retainer must remain in the mouth (24 hours).[21,23]

Following these "principles" will not completely eliminate rebound. The only sure way to obtain it would be to indicate retention for life.

Through time, the reduction of the mandibular arch dimension in treated or non-treated malocclusions appears to be normal physiological phenomena. The contraction and the degree of reduction of the length of the dental arch is variable and unpredictable; but many clinical pointers can be followed to diminish the arch collapse:

1. Try to obtain the best occlusion, health, and oral function as possible.
2. Try avoiding expansion of the lower dental arch, unless otherwise is imposed because of facial profile problems, or to coordinate the occlusion with maxillary expansion in order to correct a cross bite or a constricted maxilla.
3. Use the initial dental arch form of the patient as a guide to conform the arch wires.
4. Maintain the form of the dental arch for a long term and continue supervising the patient until adulthood.
5. Obtain the best pre-treatment and pos treatment registers and continue using them to evaluate the patient in the future.[23]

The most frequent causes for rebound may be the following:

- An incorrect diagnosis and mechanotherapy.
- Incorrect space closure.
- Insufficient rotation correction.
- Lack of root parallelism.
- Incorrect retention methodology.
- Errors or bad technique in the making or bonding of the permanent retainer.
- Influence of growth changes.
- Persistence of habits or bad muscular function.
- Abnormal orofacial activity.
- Decrease in intercanine width.
- Limitant skeletal discrepancies that do not allow case finalization within the clinical and cephalometric parameters that can provide a degree of stability. A dental camouflage for example.
- Incomplete or deficient correction of the malocclusion.
- Lack of dental and mandibular stability.
- Lack of canine protection.
- Premature contacts.
- Unbalanced positions of the eruptive forces.
- Third molar presence (there is much controversy about this fact).
- Periodontal memory or tendency of the teeth to return to their original position (we recommend supracrestal circumferential fiberotomy).
- Inadequate insertion of the buccal frenum, that can cause diastemas (we recommend frenectomy six weeks before the removal of the braces).[11,25,26,28]

Most of the rebound in the upper dental arch occurs in the first 6 months post-treatment. In this case, we can ask the patient to wear an upper retainer full time. Later, this time can be reduced progressively until the retainers are used only at night, meanwhile we must observe if any movement occurs. If these occur the retention period must be longer. Eventually the patient will cease to use the upper retention.

The protocol for long term retention varies among specialists. The degree of patient cooperation after treatment may vary even more. Some specialists believe that if the form of the dental arch is maintained (specially inter-canine width), the contact points are flattened with stripping, and with fiberotomy preformed were needed, retention is almost not necessary. Some other works suggest that if we want to maintain teeth in their position, retention must be permanent. Any of these approaches can be appropriate for certain cases but not for all. Each orthodontist must establish his own protocols to follow.[20]

To understand the retention subject we must be clear about the concept of stability. Drs Mc Nelly, Mc Morris, Echeverri Guzman, Manns, Okesson, speak about two types of stability:

- Dental stability.
- Mandibular orthopedic stability.

Dental stability

It is said that a tooth is stabilized when maintains its position in the dental arch in the three planes of space. This can only be possible if the interproximal contact points (mesial and distal, which will stabilize the tooth in this sense) remain stable. It is also indispensable to have an excellent relation with the antagonist teeth through inter-occlusal contact points, which will maintain the teeth stable in the vertical and bucco-lingual or bucco-palatine sense.

Mandibular orthopedic stability

Its the postural stability of the mandible with the condyles centered in the glenoid fossa and affronted to its anterior wall. This position is induced by the synchronic activity of the elevating muscles and is stabilized by the simultaneous bilateral dental contacts. In this manner, we observe a coincidence of central relation (CR) with the maximum intercuspidation position (MIP). These two concepts, dental stability and mandibular orthopedic stability are closely tied.

Inter-occlusal undesired contacts provoke mandibular instability that will provoke a muscular and dental alteration and a lack of coincidence between CR and MIP. With this lack of coincidence, the mandible will present two closure arches: a centric one, corresponding to CR and an eccentric one that will have a greater quantity of inter occlusal contact points. In these cases, when the mandible closes in CR, inclined contact points are established that will provoke sliding vectors during closure and in this way, the probabilities of dental instability and possible rebound are increased. This frequently results in antero-inferior overcrowding or a buccal movement of an upper incisor. On the contrary, if the treatment was successful and if we obtained an occlusion in which MIP coincides with a mandibular CR position, the closure movements will describe a single arch and the case will have optimal stability conditions.

If we want to study the stability conditions of a finished case, we must mount the case in an articulator that will allow us to easily visualize the compatibility of mandibular MIP and CR. After this evaluation, we have at hand many resources to improve this compatibility. If there is a moderate occlusal alteration, a retainer with elastic additaments can be used (springs, rackets, etc.) to correct the slight rebounds and to improve the stability. Sometimes an occlusal adjustment is necessary at the end of the treatment to improve stability. Occasionally this occlusal adjustment requires selective wear downs or sometimes an occlusal remodeling.

If our treatment creates a MIP with the mandible in CR and if the closure movements describe a single arch, we can avoid many rebounds.

In some cases, the premature contacts in CR will be in the slopes that due to their direction will not produce any mandibular displacement. But the generated forces may dissipate mesially in the upper dental arch provoking movements on the teeth of the dental arch that may cause rebound in the anterior sector.

Without any doubt, the persistence of anomalous inter occlusal contact points produce mandibular instability and generate force vectors that produce dental movement with rebound in the most vulnerable sectors.[11]

One of the main causes that can alter the results of an orthodontic treatment is post-treatment growth. Among these changes, we find lower incisor overcrowding, overbite and overjet rebound and the return to a Class II malocclusion.[6,10,26]

There is no doubt that growth, in particular residual growth, has influence upon post-treatment stability. We must take into account the growth pattern of the patient, and we must make a wise selection of the retention appliance based in the nature and extension of the dento-facial dysplasia (growth pattern). The duration of retention must depend upon the state of maturity of the patient and growth.[13,16]

If we treat a growing child, we must place a bonded lingual retainer and check the patient annually. After growth has been completed, and supposing that we have met all our treatment goals, we can remove the fixed retainer and place a removable one. Parker says:"Teeth move during all our life, like hair changes color through all our life," so he recommends that the retainers must be worn two or three nights a week for an indefinite time. Some authors recommend that retention should last as much as the time required for the correction of the malocclusion (orthodontic treatment), but this time must be increased in patients with periodontal problems. Once this retention time is completed, we gradually liberate the patient from the retainers, until the patient only has to use them at night.[7,19,23]

The rotation rebound of a single tooth or an anterior open bite, dental spacing, etc. can be explained by local factors, including the incapacity of the periodontal fibers to reorganize, narrow airways and lack of adaptability of the soft tissues.[23] Circumferential supracrestal gingival fiberotomy is a useful procedure that diminishes rebound in rotated teeth. But in these cases, a retainer must be worn for several months until the gingival fibers reorient.[4] After the supracrestal fiberotomy, the most notable characteristic is an increment in dental mobility. This mobility is due to the incision of the transeptal fibers that bound teeth with other teeth; this gradually diminishes in 2 to 4 weeks. Teeth that are orthodontically moved, after the extraction of an adjacent tooth, push the gum and create a connective and epithelial tissue fold. After the final closure of the extraction site, this excess of gingival tissue will appear as a vestibular and lingual papilla in between the closed together teeth. The rebound can be diminished with the surgical removal or the excess of gum in between the closed together teeth.[38]

REMOVABLE RETAINERS

Hawley Retainer

It is the most utilized retainer. It has gripping hooks, a buccal arch and an acrylic plate that leans on the lingual or palatal aspect of the teeth and keeps in place the hooks and the vestibular arch.

The gripping elements are the hooks that maintain the appliance in the mouth; these can be Adams, ball, circumferential, Duyzings, and Schwartz hooks (these are introduced in the interdental spaces). The most used are the Adams and the ball hook which are placed in the interproximal spaces.[26,27,28]

Figs. 1 and 2. Buccal arch and ball hooks.

The labial or buccal arch of the Hawley retainer maintains the zone of the six anterior teeth in its place with the contact of the buccal surfaces of the anterior teeth and the buccal wire. This wire is made out of 0.028" or 0.036" round stainless steel wire. The labial wire is also available as preformed flat wire.

The typical buccal arch wire passes through the occlusal plane between the canines and the first premolars to be then embedded in an acrylic plate.[4]

The buccal arch must be perfectly adapted to the incisors and the canines and must pass through the middle third of the crowns. This will provide more retention and will lessen rebound.[4]

Fig. 3. Hawley retainers in mouth.

The buccal arch has two buccal loops at the canine level, which can be adjusted to correct slight rebounds, like pro-

Fig. 4. Loops in the canines.

clination of the anterior teeth. The loops must be separated from the canine gum.[4]

The body of the retainer can be made with methyl methaclylate liquid and powder (acrylic), with light cured resins or thermoplastic materials. The body of the upper acrylic must be 1.5 mm to 2 mm thick and the lower one must be 2 mm to 2.5 mm thick, it must have the appropriate strength without limiting the tongue.[4]

On the anterior region the acrylic must cover the cingulum for added retention.[4]

10. It serves as a guide for the eruption of second and third molars.
11. It is a lasting retainer.[12]

Disadvantages

1. Laboratory time consuming construction.
2. The wires that cross the occlusal surfaces may interfere with the occlusion and impede dental settlement.[4]

Fig. 5. Acrylic adapted to the lingual aspects.

Fig. 6.

3. We depend upon patient compliance.
4. The gripping hooks can be damaged, and modify the occlusion of the patient.
5. Anti esthetic.
6. Speech is impaired.
7. Due to continuous use, the retainer can change color and absorb bad odors.[4,26]

Advantages

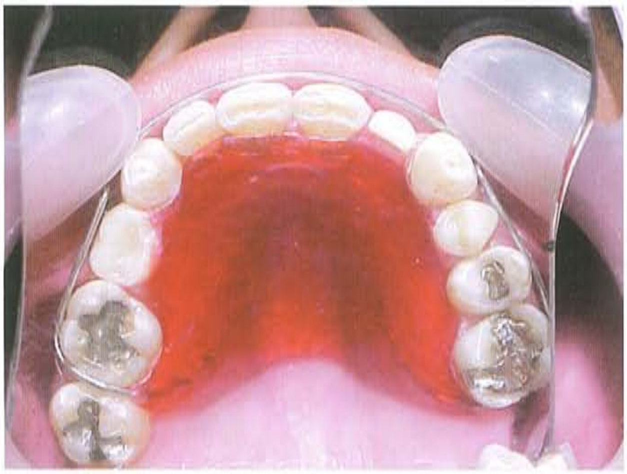
1. Sanitary, because they do not build up tartar.[4]
2. It allows the use of dental floss without impediments.
3. Does not provoke caries or periodontal problems.[12]
4. Well built retainers can maintain teeth in good occlusion for many years.
5. Hawley retainers are excellent long term retainers.
6. Springs, fingers, rackets can be added to correct slight rebound.
7. An anterior bite plane can be added for deep bite patients (please refer to Deep Bite chapter).
8. A posterior bite block can be added for open bite patients (please refer to open bite chapter).[4]
9. It allows syndesmothomy.

Recommendations

1. The parts of acrylic that are going to touch the tongue must be well polished.
2. The acrylic of the upper retainer must extend mesial to the second molars, so the patient does not gag.
3. In the lower arch, the acrylic must not extend beyond the floor of the mouth and must not irritate the tongue.
4. Place an acrylic shield on the buccal arch. This will improve retention and stability in the anterior teeth.[4]

Figs. 7 and 8. Buccal acrylic shields.

5. This type of retainer is not recommended for premolar extraction cases.
6. It must be worn all day and night and must only be removed when the patient is going to eat and when the patient is going to brush his teeth. This must be done for at least the first 6 months after active treatment. After this, night use must be indicated during active growth. For the majority of cases, the night use must be indefinite in order to minimize post treatment rebound.[4,26]
7. For long periods of use, the retainer should be used only during a small period of time during the day and all night.
8. Patients that use retainers with false teeth during day time for esthetic reasons must not wear them during the night to let the soft tissue rest.[4]
9. Place the retainer in a glass with water or mouth wash during meal times. This will decrease foul odor absorption.



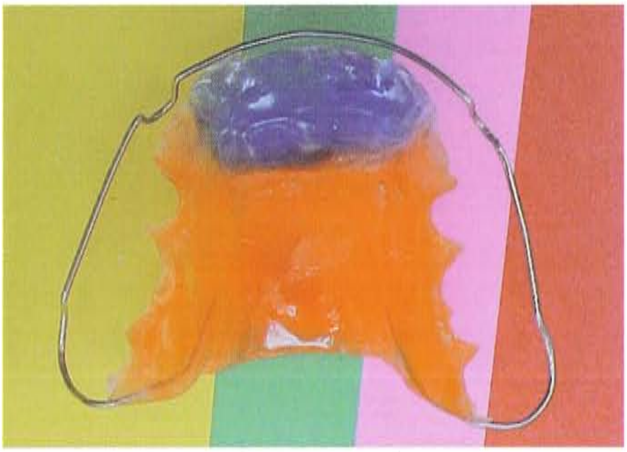
Figs. 9-11. Hawley retainer with false teeth.

Wrap around retainer

This type of retainer is very similar to the Hawley retainer and is used in premolar extraction cases. The basic difference between the Hawley retainer and the wrap around retainer is the buccal arch. In the wrap around retainer the buccal arch embraces all the erupted teeth as to "grasp" them and avoid the reopening of the extraction sites. The width of the acrylic and the diameter of the buccal arch are the same as in the Hawley retainer.[27]

The wire must adapt well to the buccal contours of the incisors, canines, premolars and the cervical surfaces of the molars. This will provide more retention and rebound will diminish.

The buccal arch has two vestibular loops in the canine level, which allow the anteroposterior adjustment of the wire, and this way we can correct small rebounds and the reopening of premolar extraction sites. The wire must be separated from the canine gum.[4,17,36,]



Figs. 12 and 13. Wrap around retainers.

Advantages

1. Sanitary because it does not build up tartar.[4]
2. It allows the use of dental floss without impediments.
3. Does not provoke caries or periodontal problems.[12]
4. Well built retainers can maintain teeth in good occlusion many years.
5. Circumferential retainers are excellent long term retainers.[4]
6. Does not interfere with the occlusion of the patient, because it does not have any occlusal interference.
7. Springs, fingers, rackets can be added to correct slight rebound.[22]
8. An anterior bite plane can be added for deep bite patients (please refer to Deep Bite chapter).
9. A posterior bite block can be added for open bite patients (please refer to Open Bite chapter).[4]
10. It allows syndesmothomy.
11. It is a lasting retainer.
12. If we cut the buccal arch (in the distal portion of the loop) it can be transformed into an elastic wrap around retainer.[12]

Disadvantages

1. Laboratory time consuming.[4]
2. The buccal arch is very long, it distorts easily and adjustments can be difficult.[26]
3. We depend upon patient compliance for its use and clearing.
4. Anti esthetic.
5. Speech is impaired.
6. Due to continuous use, the retainer can change color and absorb bad odors.[4]

Recommendations

1. The parts of acrylic that are going to touch the tongue must be well polished.
2. The acrylic of the upper retainer must extend mesial to the second molars.
3. In the lower arch, the acrylic must not extend beyond the floor of the mouth and must not irritate the tongue.
4. We must cut the interdental acrylic of the extraction site to alleviate pressure and to avoid rebound.
5. In order to have more retention, the acrylic must cover the cingulum of the anterior teeth.

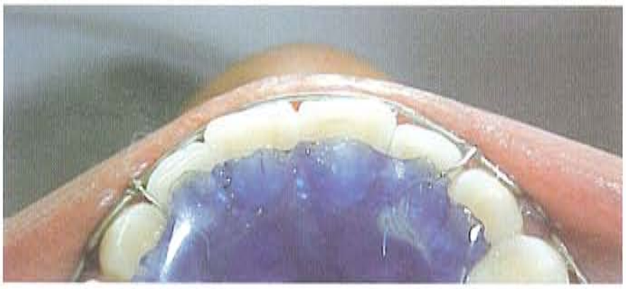
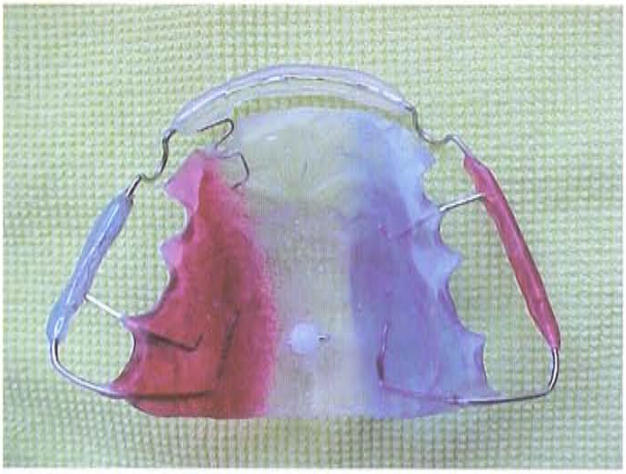


Fig. 14. Stabilizing ligatures.

6. This retainer can be modified by adding retentive ligatures between the lateral incisors and the canines. These ligatures will increase buccal arch stability.[4]
7. This retainer can be modified by adding acrylic shields to the anterior and posterior zones.
8. These shields will increase stability because we will have an acrylic and tooth "sandwich".
9. The retainer will adjust faster and easier with these shields.



Figs. 15 and 16. Upper circumferential retainer with buccal shields and blue grass or pearl of Tucat.

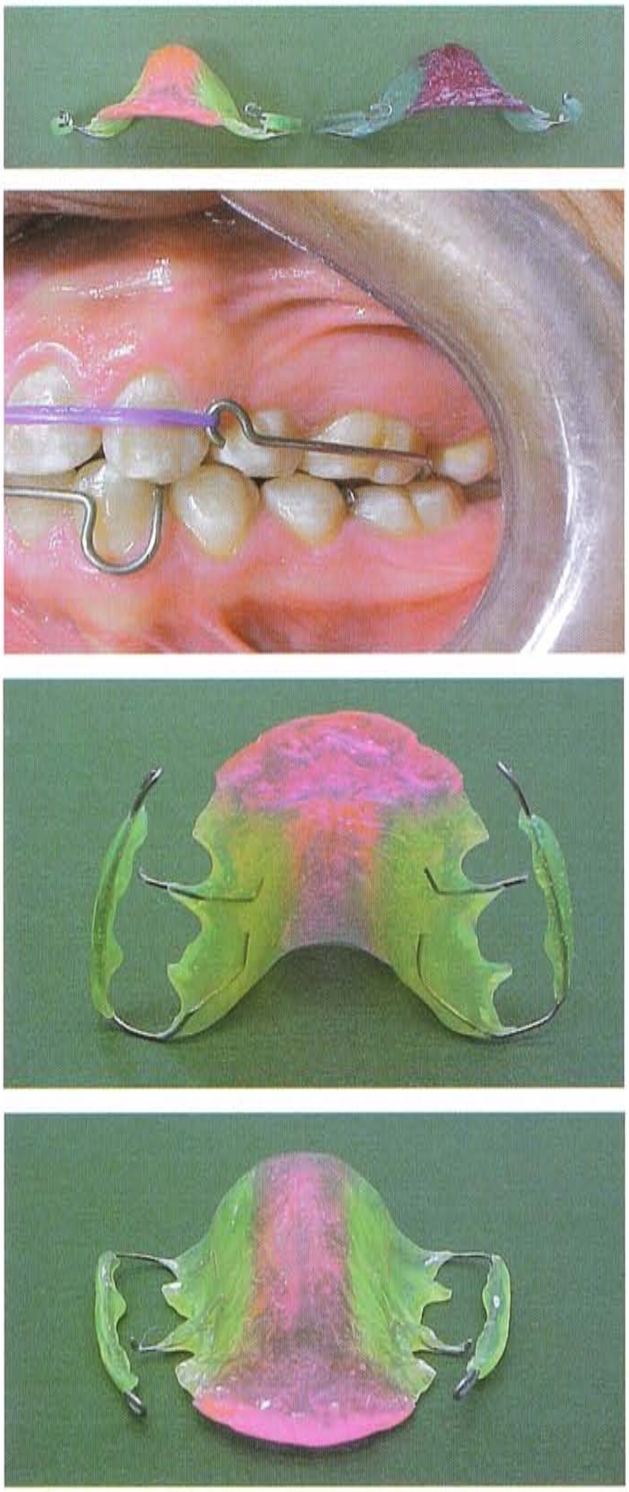
Figs. 17 and 18. Lower circumferential retainer with buccal shields and springs in canines.

Fig. 19. Circumferential retainer in mouth.

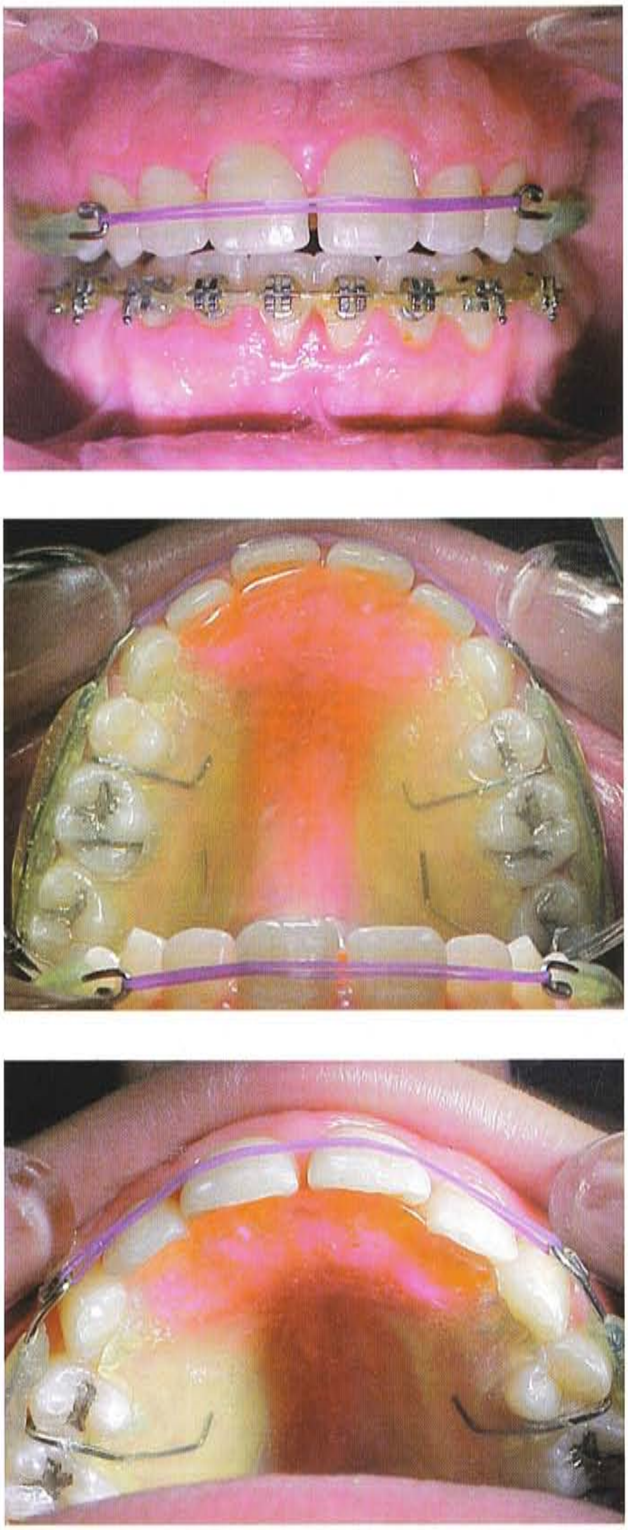
10. Rebound will diminish.[3]
11. It must be worn all day and night and must only be removed when the patient is going to eat and when the patient is going to brush his teeth. This must be done for at least the first 6 months after active treatment.[26]
12. The parts of acrylic that are going to touch the tongue must be well polished.[4]
13. Place the retainer in a glass with water or mouth wash during meal times. This will decrease foul odor absorption.[26]

Elastic wrap around

This retainer has an acrylic plate with two buccal 0.036" steel arms on which an elastic is placed in order to correct small rebounds like anterior proclination and space closure. The terminal part of these arms has a hook at premolar and canine level; an elastic latex band will be placed in the hooks to help us close remnant or recurring spaces.[3,8]



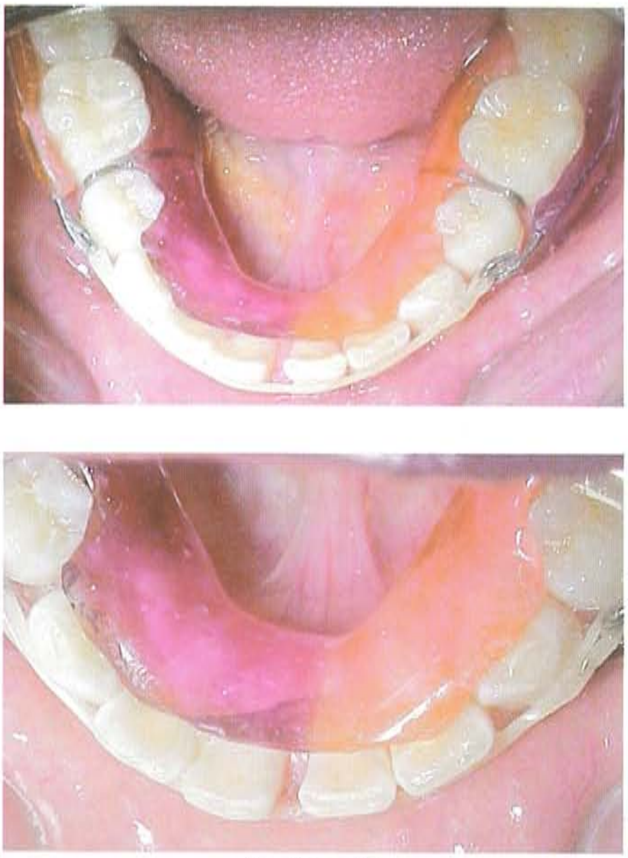
Figs. 20-23. Elastic wrap around retainer.



Figs. 24-26. Elastic wrap around retainer in mouth.

Advantages

1. Sanitary because it does not build up tartar.[4]
2. It allows the use of dental floss without impediment.
3. It allows syndesmothomy.
4. It is a lasting retainer. [11]
5. Well accepted by the patient.
6. It gives us posterior segment stability and closes spaces in the anterior segment.
7. Esthetic. This depends on the color of the elastic chosen by the patient.



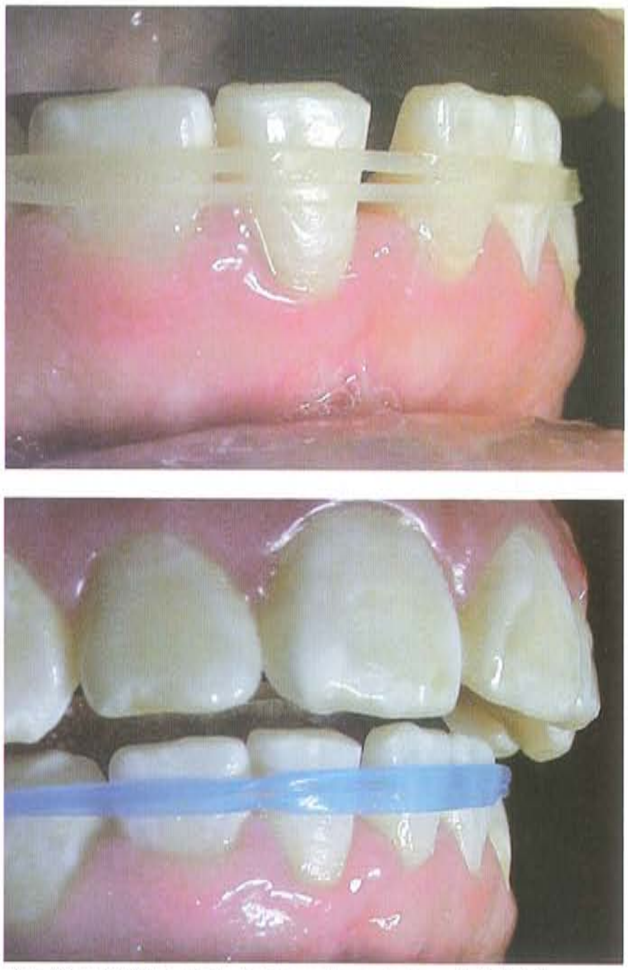
Figs. 27 and 28

Disadvantages

1. We depend upon patient cooperation.
2. We must invest laboratory time.
3. Space closure is difficult to control.
4. During the dental movements we do not have control of tip or torque.
5. Speech is impaired.[11]
6. The retainer can dislodge if the elastic worn is too heavy.

Recommendations

1. The retainer must be used 24 hours a day, except during meals and oral hygiene.
2. Change the elastics every 24 hours.
3. The elastic used must be ¼" in diameter.
4. The force produced by the elastics will be between 4 Oz to 6 Oz.
5. The elastic must distend 3 times its diameter.
6. In case the retainer is dislodged while placing the elastic, we must increase the diameter of the elastic to 5/16".



Figs. 29 and 30 The elastic must pass through the middle third of the dental crowns.

7. The elastics must pass through the middle third of the crowns of the anterior teeth.[26,27,28]
8. In cases where the elastic displaces gingivally we can bend occlusally the arms with a three prong plier or we can place a buccal resin button to avoid the gingival displacement of the elastic.

9. Wear off the palatine aspect of the acrylic plate in order to facilitate closure of spaces between upper teeth.
10. We can use two interlaced elastics or power chain.

Figs. 31 and 32 Interlaced elastics.

Fig. 33 Elastic wrap around with elastic chain.

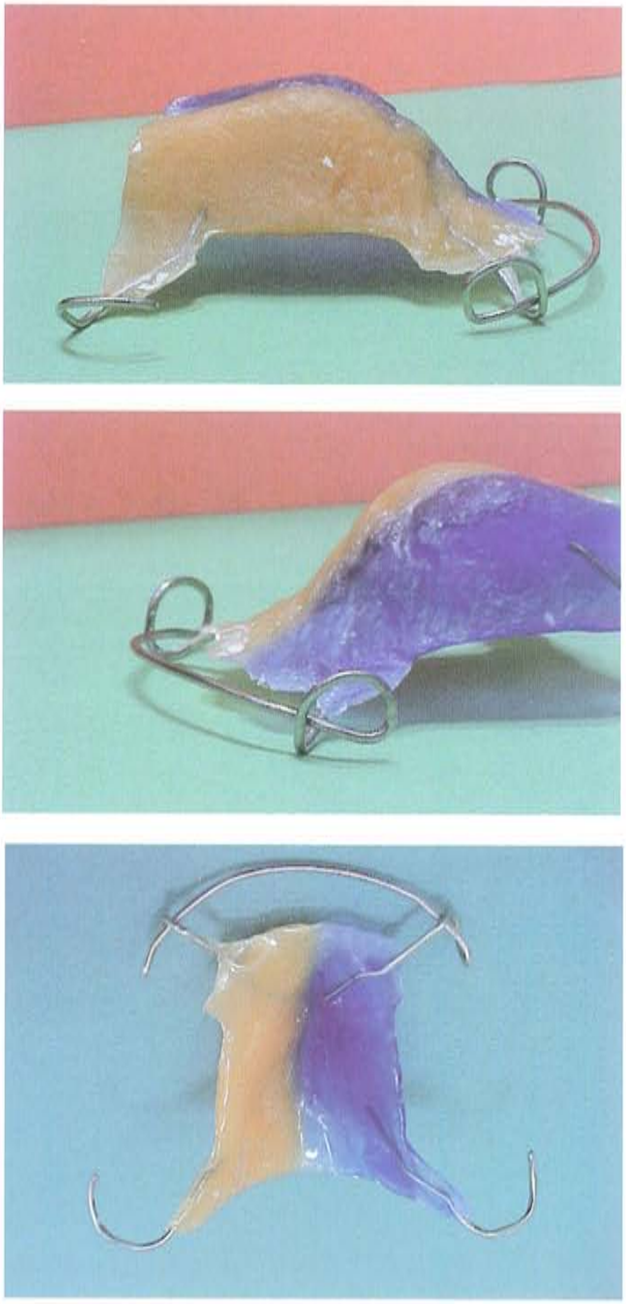
11. Place the retainer in a glass with water or mouth wash during meal times. This will decrease foul odor absorption.

Fig. 34 Elastic wrap around with elastic chain.

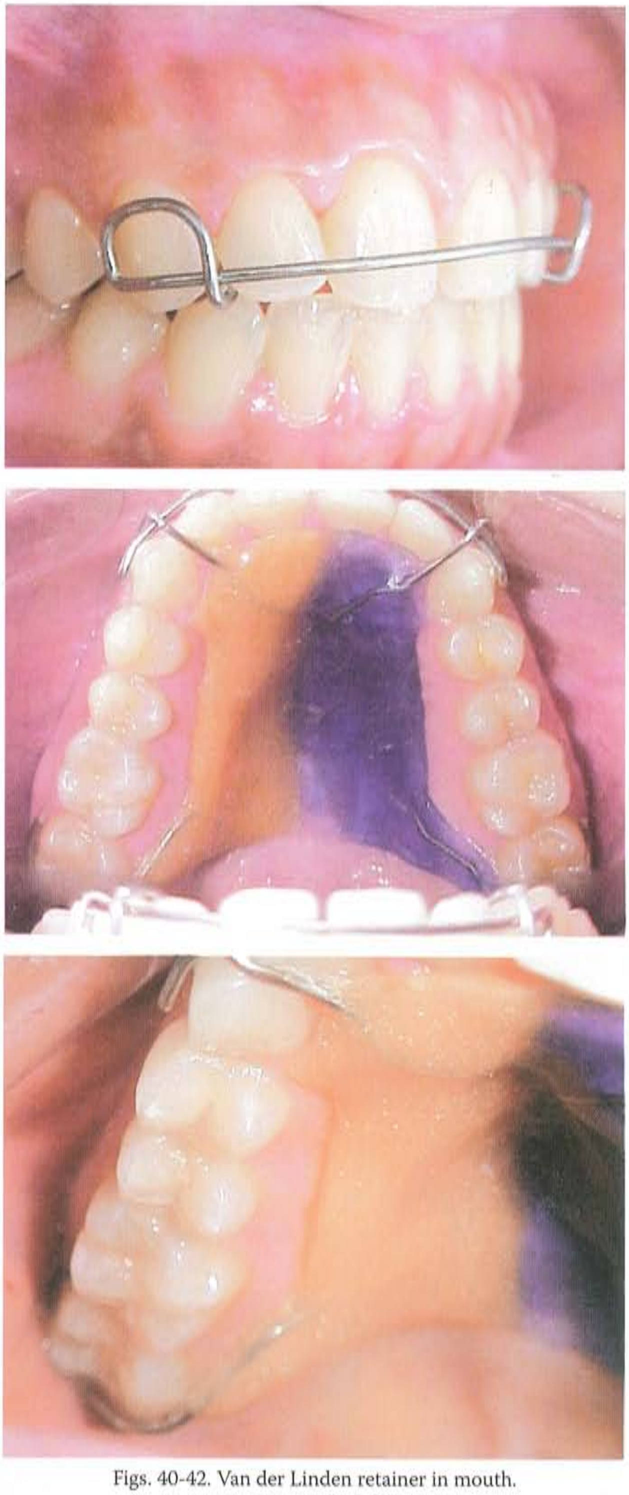
Van der Linden retainer

Developed in 2003 by Dr Frans Van der Linden, it consists of a stainless steel canine to canine 0.028" buccal arch and two 0.032" hooks in the last molars. Premolars and molars are acrylic free because this sector settles with the occlusion, and in normal conditions, retention will only be necessary in the anterior sector.[37]

Figs. 35 and 36. Van der Linden retainer.



Figs. 37-39. Van der Linden retainer.



Figs. 40-42. Van der Linden retainer in mouth.

Advantages

1. The retainer does not interfere with occlusion because the majority of disto-incisal angles of the upper lateral incisors are rounded and there is enough, space to allow the passage of the wire towards the palate.
2. All the teeth are free to occlude.
3. It can be combined with a fixed retainer.
4. Hygienic and it do not accumulate tartar.
5. It allows dental flossing.
6. Does not cause caries or periodontal problems.
7. Well built retainers can maintain teeth in good occlusion and aligned for many years.
8. Springs, fingers, rackets can be added to correct slight rebound.
9. It allows syndesmothomy.
10. It is a durable retainer.

Disadvantages

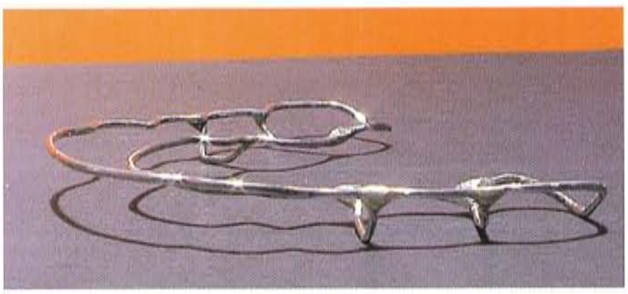
1. We depend upon patient compliance for retention and cleaning.
2. We need to invest time in the laboratory.
3. Anti esthetic.
4. It impairs speech.
5. Because of the continuous use, the retainer can change color and retain foul odors.

Recommendations

1. Molar and premolars must not contact the acrylic or the wires of the retainer.
2. Use the retainer at night time (during sleep).
3. Take off the retainer by pulling it from the loops at canine level.
4. Place the retainer in a glass of water or mouth wash during meals. This will diminish foul odor absorption.

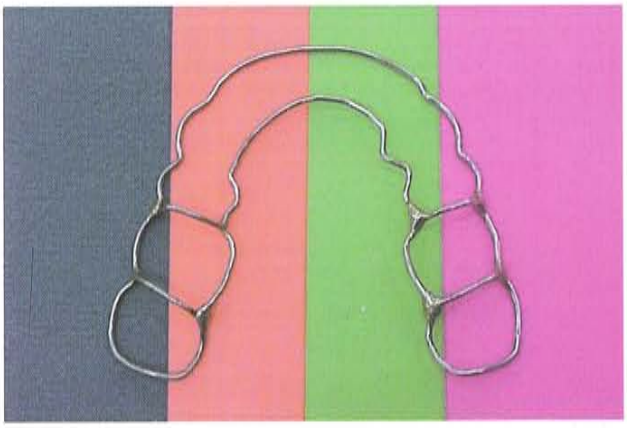
Sarhan or all-wire retainer

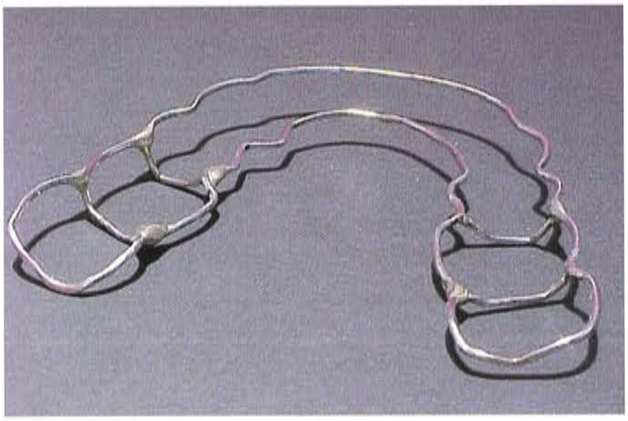
The idea of this retainer was developed by Dr Toshio Harima in 1983. It has the particularity that it does not have any acrylic, it is made of 0.032" stainless steel wire that envelopes all the erupted teeth.[29,41]



Advantages

1. Highly hygienic.
2. It does not affect speech.
3. Confortable.
4. Very cheap.
5. Difficult to fracture.
6. Does not absorb odors.
7. The occlusion of the patient is free.[29,41]





Figs. 43-47. Sarhan type retainer.

Recommendations

1. Pull off the retainer by the canine zone.[41]
2. Use the retainer 24 hours a day.
3. Sometimes it is recommended to place resin buttons on the middle third of the canine crowns. These buttons will act as stops in order to avoid easy dislodgment. [41]
4. Useful in extraction cases, because it envelopes the teeth.

Figs. 48-52. Sarhan retainer in mouth.

Disadvantages

1. It takes a long time to manufacture.
2. It is not esthetic.
3. We depend upon patient compliance for use.
4. Rebound correction like rotations, diastemas, proclination, intrusion, etc. with this retainer are difficult.
5. The retainer can be modified placing retentive ligatures between lateral incisors and canines. This ligature will make the buccal arch more stable.
6. The wire of the retainer must be adapted to the buccal and palatine aspects of the teeth.[29,41]

Spring aligner

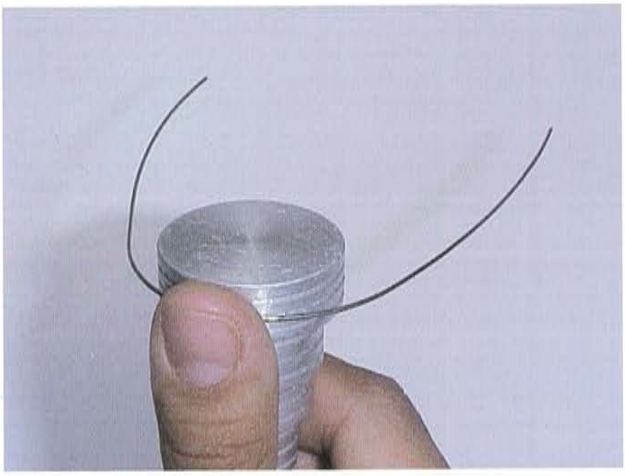
It is a modification of the Lewis retainer, and its objective is to maintain the anterior teeth aligned and/or to correct small rebounds. This retainer is like a circumferential or wrap around retainer, but the main difference is that it only includes the six anterior teeth meanwhile the wrap around retainer includes all the erupted teeth. As mentioned before, the spring aligner corrects small rebounds because the acrylic is placed over a plaster model set-up. The only inconvenience is that it consumes a lot of laboratory time, but a fast solution would be the "place- and-take off technique.[26,30]

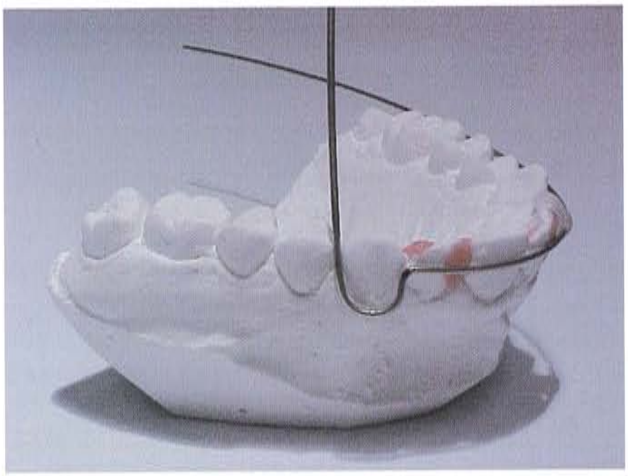
Fig. 53. Right dental incisor and left lateral incisor with rebound problems.

For the correction of rotated teeth, we must apply pink wax or block out over the aspect of the tooth in plaster that we want to rotate, and on the contra-lateral aspect we must wear off the model. If we want to accelerate this movement, we should perform stripping on the tooth we want to rotate.

Fig. 54. Place and take off technique.

Once the teeth are aligned in the plaster model, the spring aligner is done. The body of the retainer is made with 0.030" stainless steel wire.





Figs. 55-57.

Fig. 58.

Fig. 61. Spring aligner in mouth.

Figs. 59 and 60. Spring aligner.

Advantages

1. Hygienic.
2. It allows the use of dental floss.
3. Does not cause caries or periodontal problems.
4. Well made retainers can correct rebound in 2 to 3 months.
5. It allows syndesmothomy.
6. It is lasting.[4,11,26]

Disadvantages

1. Not very esthetic.
2. We depend upon patient cooperation.
3. It can absorb foul odors and change color.
4. We must invest laboratory time.
5. The wires that pass over the incisal edges can interfere with the occlusion and not allow settlement of the posterior teeth.

Recommendations

1. Must be worn all day and night during the first two or three weeks. Later it may be worn only at night.
2. At the moment of insertion of the spring aligner, it will move toward the incisal edge. This is the reason why the patient must bite down on the retainer the first two or three weeks.
3. Perform stripping in the anterior segment to accelerate dental movement.
4. Take off the retainer by pulling the loops on the canines.
5. Put the spring aligner in a glass of water or mouth wash during meal time. This will diminish foul odor absorption.

Coregg (García-Gaitán rebound corrector)

This retention system was designed in 2005 by Drs Víctor García Hernández and Francisco Gaitán Fonseca, both residents of Centro de Estudios de Ortodoncia del Bajío (CEOB), Irapuato, Guanajuato, México.

This appliance is an alternative for the correction of small post treatment rebounds in the anterior and posterior sectors, and in this way we may avoid a retreatment with braces. The Coregg is a combination of three retainers: the circumferential, the Sarhan and the spring aligner.

Fabrication

1. Make a horseshoe shaped metallic skeleton with 0.030" stainless steel wire, which must wrap all the erupted teeth on the lingual and buccal sides (similar to the Sarhan retainer).

Fig. 62. Coregg skeleton.

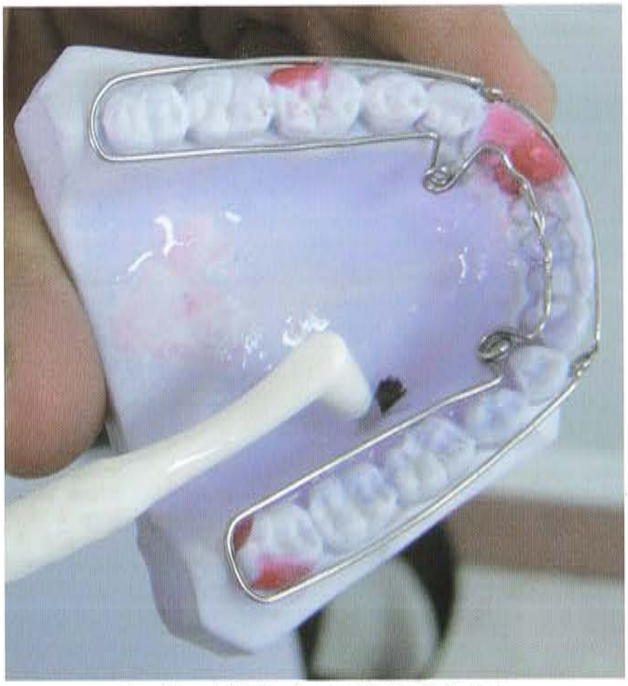
2. At the extraction sites, generally between the canines and second premolars, we must make a pair of closure loops (a buccal and a lingual one on each side). These four loops will help us close the residual spaces; they must be activated each month to produce closure movements in both segments.

Fig. 63. Lingual loops.

3. The anterior portion of the Coregg will act as a spring aligner, so small postreatment rebounds can be corrected.

Fig. 64.

4. Most part of the retainer is covered with acrylic, including the occlusal aspects of the posterior teeth. Only the loops are acrylic-free.



Figs. 65 and 66. Placing acrylic to the Coregg.

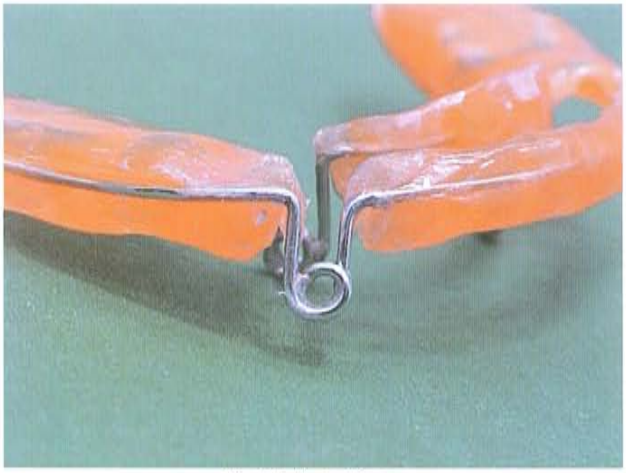


Fig. 67. Buccal loop.

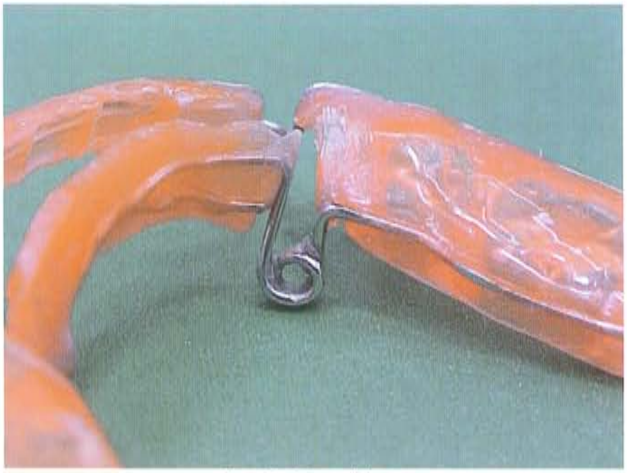
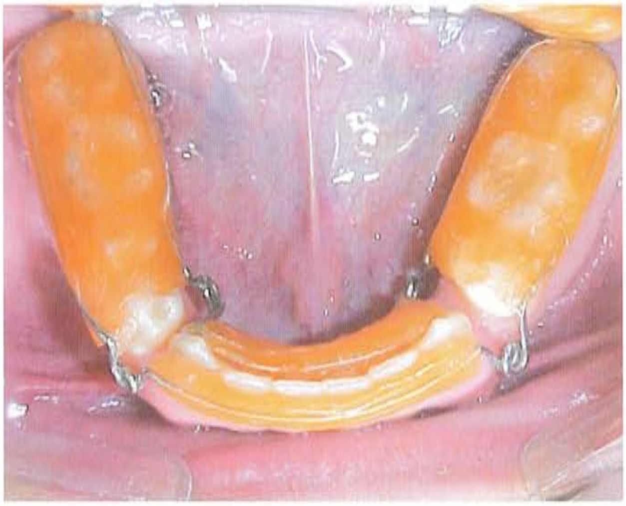


Fig. 68. Lingual loop.

Fig. 69. Finished Coregg.

5. Finally it is placed in the mouth of the patient.

Fig. 70. Rebound between canine and premolar.



Figs. 71 and 72. Coregg placed in the mouth.

Figs. 73-75. Activated Coregg

Advantages

1. Very cheap.
2. Hygienic.
3. Excellent space closure appliance.

Fig. 76. Two months later the spaces are closed.

4. Well done Coregg retainers can maintain teeth well aligned for many years.
5. Teeth tip and torque is maintained.
6. In block space closure is obtained.
7. These are excellent long term retainers.
8. It allows syndesmothomy.
9. It is a lasting retainer.

Disadvantages

1. It takes a long time to make.
2. It is not esthetic.
3. Absorbs foul odors.
4. With continuous use the acrylic changes color.
5. The acrylic can fracture under occlusion pressure.
6. If it is not well made it can provoke an open bite.
7. Unadjusted loops can hurt the oral mucosa.

Recommendations

1. To take off pull the loops by the distal side.
2. The occlusal acrylic must be 0.5 mm to 1 mm thick.
3. The premature contact points of the posterior zone must be eliminated in order to avoid an open bite and to obtain a balanced occlusion.
4. All the antagonist teeth must occlude on all the acrylic.
5. The loops must be placed as close as possible to the center of resistance of the teeth.
6. The loops must be activated each month with a three prong plier.
7. The retainer must be worn 24 hours a day. Except during meal time.
8. As long term retention, we recommend only night use.

9. Helpful in premolar extraction cases, because it surrounds the teeth.

We also use clear plastic retainers made with thermoplastic materials. Many patients prefer these retainers because they are cheap and easy to make, they do not require adjustments and if they are well done, they are comfortable and esthetic.

Invisible retainers cover all the teeth; they do not allow tooth settlement, so they can cause a slight anterior open bite. Some orthodontists use invisible retainers as temporary appliances until definitive retainers can be made.[4,20]

Osamu retainer

This retention system was developed in Japan by Dr. Yoshii Osamu. It consists of a thermoplastic retainer that wraps the whole dental arch and part of the alveolar mucosa. For the elaboration of this retainer, we need two acetate sheets:

1. One soft acetate 1.5 mm thick (0.060").
2. One hard acetate 0.5 mm thick (0.020"). [9,40]

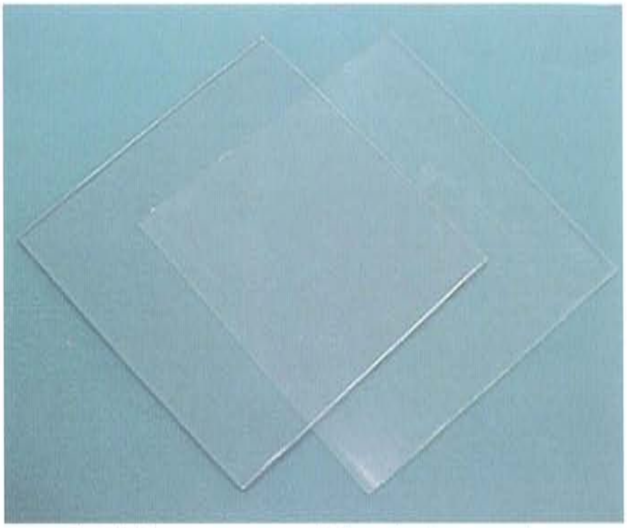


Fig. 77. These two acetates will form the Osamu retainer.

Due to the warming of the acetates, their thickness will diminish:

1. The 1.5 mm soft acetate will turn into a 1.1 mm thick acetate.
2. The 0.5 mm hard acetate will turn into a 0.3 mm thick acetate.

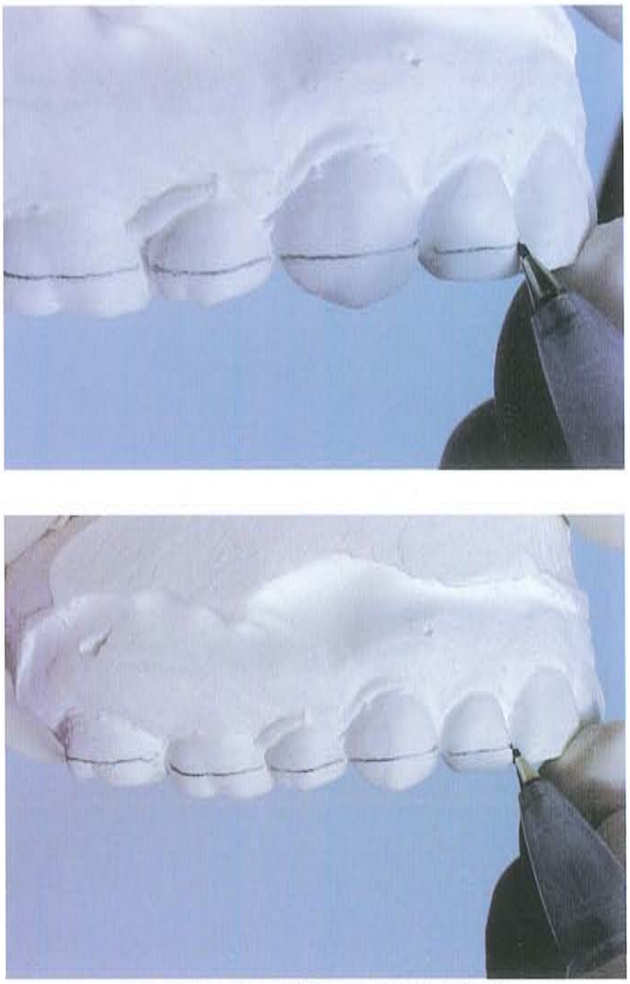
The Osamu retainer can be active (can make slight orthodontic movements) or passive (for retention only).

There are many models of the Osamu retainer, which we can divide in these categories:

1. Osamu type S (standard), this retainer wraps all the erupted teeth.
2. Osamu type M (mini), from canine to canine.
3. Osamu type B (bite raising).
4. Osamu type J (jumping), with a bite plane.
5. Osamu type SU (set-up), to make slight movements.
6. Osamu type F (face-bow), with double upper molar tubes in which we can place a facial arch.
7. Osamu type CL2 and CL3.[42-45]

Fabrication

1. The work model is marked with a pencil; this mark will be 2 mm from the incisal edges and occlusal surfaces and 3 mm to 4 mm over the gingival margin.[40, 42-45]



Figs. 78 and 79. Incisal and occlusal marking.

Fig. 80. Gingival marking.

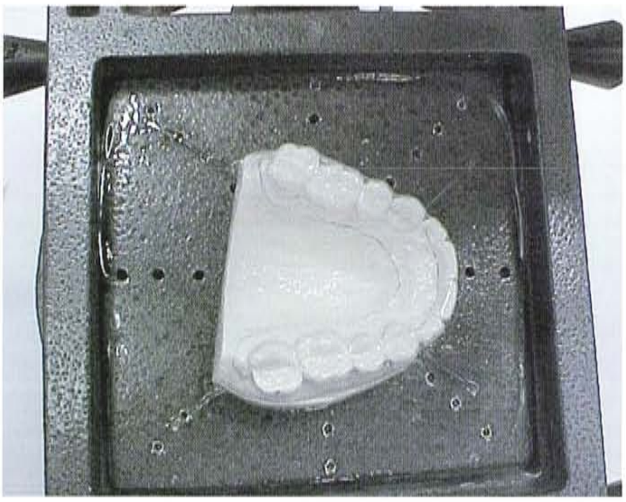


Fig. 82. Soft acetate guard.

2. We make a mouth guard with the 1.5 mm soft acetate sheet over the plaster model.[40]

Fig. 81. Soft acetate guard.

3. We cut with a scalpel the soft acetate on the line marked over the plaster model. In this way we will obtain a soft acetate "belt" that surrounds all the teeth.[40, 42-45]

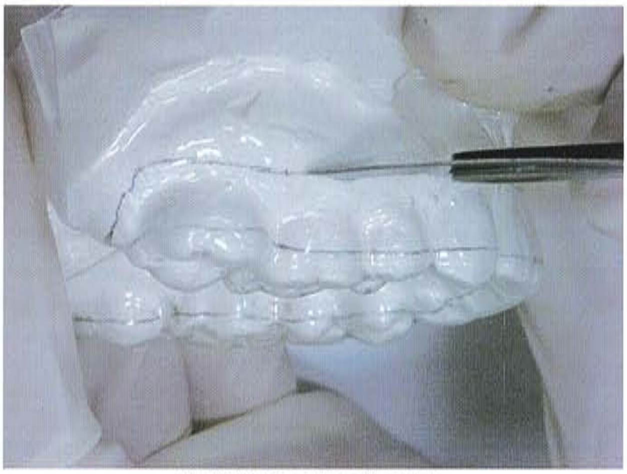
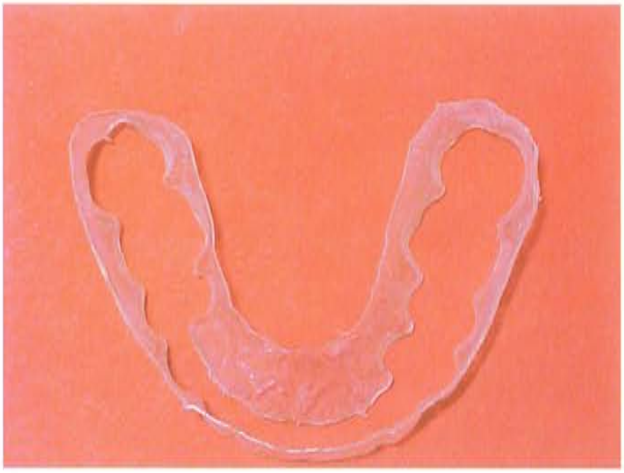
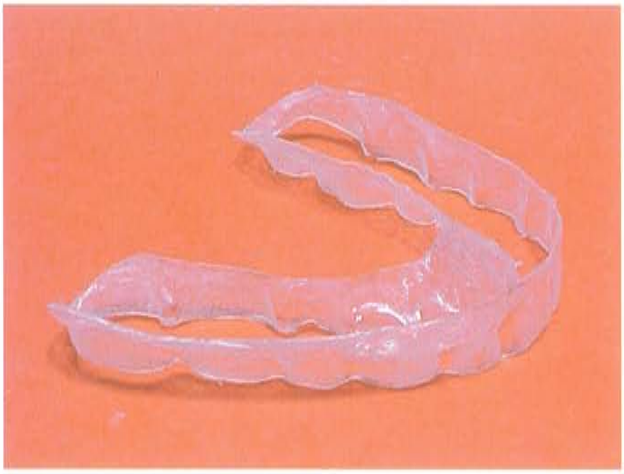


Fig. 83 Cutting the soft acetate.

Fig. 84. Cutting the soft acetate.





Figs. 85 and 87. "Belt" of soft acetate.

Fig. 88. Excess of soft acetate (incisal and occlusal aspects).

4. Place the "belt" of acetate over the work model and varnish the buccal and palatine aspects with monomer.[40, 42-45]

Fig. 89. "Belt" of soft acetate on the plaster model.

5. We make another guard, now with the hard acetate over the work model of the patient with the soft acetate "belt". (40, 42-45)

Figs. 90 and 91. "Belt" of soft acetate on the plaster model.

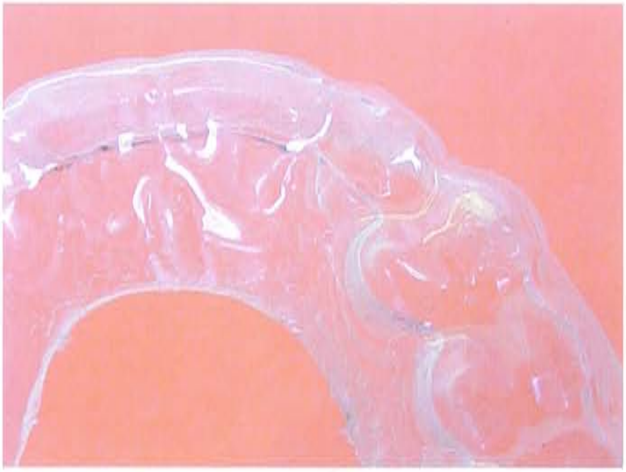
Fig. 92. The soft acetate is varnished with monomer.

Fig. 93 and 94. Acetate over acetate.

Fig. 95. Acetate over acetate.

6. We must cut the hard acetate gingivally, at the terminal level of the soft acetate (on the marked gingival line over the model). We then polish.

Fig. 96. Cut the Osamu gingivally.



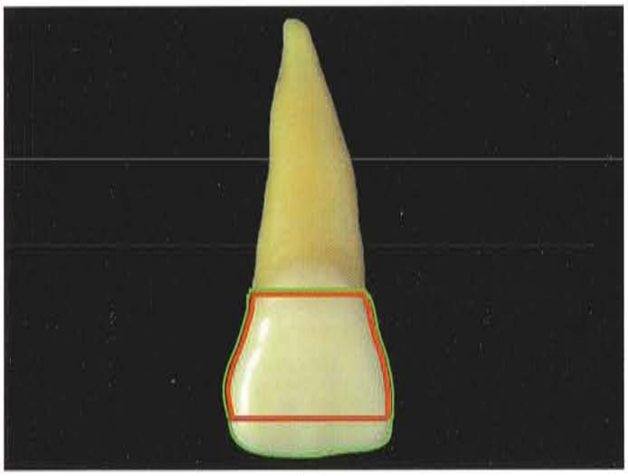
7. Place the Osamu retainer in the mouth.

Figs. 97-100. Osamu out of the mouth. We can observe the double acetate in the retainer.

Figs. 101-103. Osamu in mouth.

Advantages

1. Well accepted by the patient.
2. Esthetic.
3. Hygienic.
4. It has an inner cushion (soft acetate), that does not bother the patient.



Soft acetate.
Hard acetate.

Fig. 104.

5. It has no metal components.
6. It has good retention.[40, 42-45]

Disadvantages

1. It consumes laboratory time.
2. It may fracture under occlusion pressure.
3. Produces a slight open bite.
4. It does not allow bite settlement.
5. We depend upon patient compliance for retention.
6. It lasts about 8 to 12 months.
7. Due to continuous use, it can change color and absorb foul odors.

Recommendations

1. It must be worn 12 hours daily.
2. Place the Osamu retainer in a glass of water or mouth wash during feeding hours. This will diminish foul odor absorption.
3. Recommended in extraction cases.

Essix ®

This is a very esthetic and versatile retainer developed by Dr Jack Sheridan. This retention system is based on acetate or plastic plates, of which there are two types for the fabrication of the Essix®:

- Type "A".
- Types "C+".

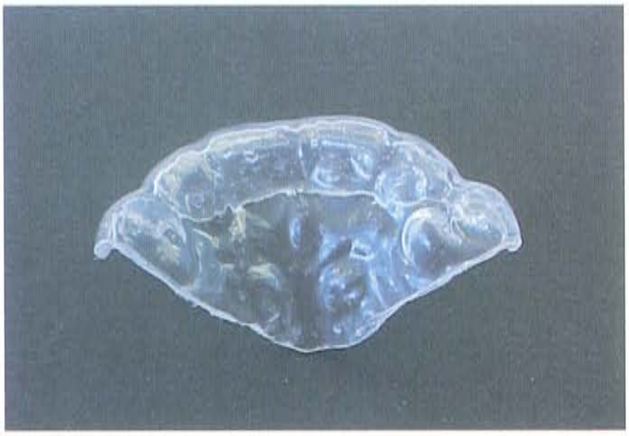
Essix® Type "A" presents several gauges and depending on the vacuum machine on which, going to be made , will depend the time of suction. We can find on the market two vacuum machines: the Vacuum and the Biostar.

Essix "A"	Vacuum	Biostar
0.020" (0.5 mm)	20 seconds.	20 seconds.
0.030" (0.75 mm)	25 seconds.	25 seconds.
0.040" (1 mm)	30 seconds.	30 seconds.
0.060" (1.5 mm)	35 seconds.	40 seconds.
0.080" (2 mm)	40 seconds.	50 seconds.
0.120" (3 mm)	55 seconds.	65 seconds.

Essix® "A" are used for the elaboration of canine to canine retainers. They are very esthetic; they reflect light and maintain the natural brilliance of teeth.

We must remember that after thermoforming, the thickness of the plastic plate will reduce to half the original. 0.030" is recommended for canine to canine retainers, which at the end will have a thickness of 0.015", which corresponds to the resilience of the periodontal ligament. (14,15,18)

Figs. 108 and 109. Essix® "A" in mouth.



Figs. 105-107. Essix® "A"

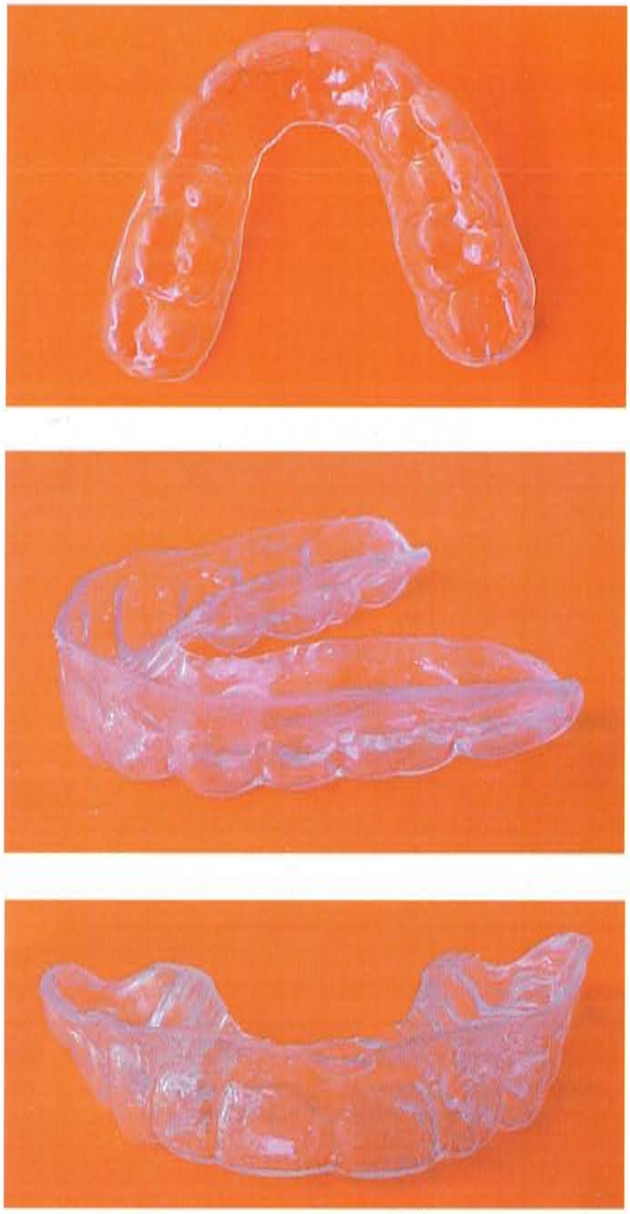
Figs. 110 and 111. Essix® "A" in mouth.

Essix® "C^{+}" is only available in one gauge:

Essix "C^{+}"	Vacuum	Biostar
0.040" (1 mm)	50 seconds.	55 seconds.

These are less esthetic than the type "A", because they do not reflect light as well, but are more resistant, they are used for:

- Night use molar to molar retention.
- To maintain a palatine expansion.
- Useful in patients that grind their teeth.
- As space maintainers.(18,31,32,33)



Figs. 112-114. Essix® "C^{+}".

Fig. 115. Essix® "C^{+}" in mouth.

Figs. 116 -118. Essix® "C+" in mouth.

Advantages

1. Highly esthetic
2. Easy to make.
3. Confortable to the patient.
4. It is cheap.
5. The Essix® "C+"can be used as a tray for dental bleaching.
6. The Essix® "C+" can be sectioned for space closure. (18,31,32)

Figs. 119 and 120. Section the guard in the rebound space, place buttons and elastics to close the space.

7. The Essix® "C+" can be used for dental intrusion.
8. Articular stabilizer.
9. We can add acrylic to the Essix® type "A", like a bite plane, for example.
10. Slight movements (2 mm to 3 mm) like rotations, tip and torque can be done with both retainers. In order to correct slight rebounds we can place a resin button on the affected tooth (2 mm to 3 mm in diameter and 1 mm to 3 mm in height), and we can open a window on the Essix® (on the opposite side) to allow movement. In order to accelerate this movement, we must do some stripping on the tooth we want to move.[18,31,32,33]

Figs. 121 and 122. Section the guard in the rebound space, place buttons and elastics to close the space.

Figs. 125 and 126. Rebound corrections in a canine and a lower central incisor.

Figs. 123 and 124. Rebound correction in an upper lateral incisor.

Fig. 127. Rebound corrections in a canine and a lower central incisor.

For rotated teeth correction, we must apply Block Out resin on the buccal aspect of the plaster tooth that we want to rotate, meanwhile we must place a 2 mm to 3 mm in diameter and 1mm to 3 mm in height resin button on the opposite side of the tooth. In order to accelerate this movement, we must do some stripping on the tooth we want to rotate.[18,31]

Fig. 128. Rotated teeth.

Fig. 129. Block out resin application.

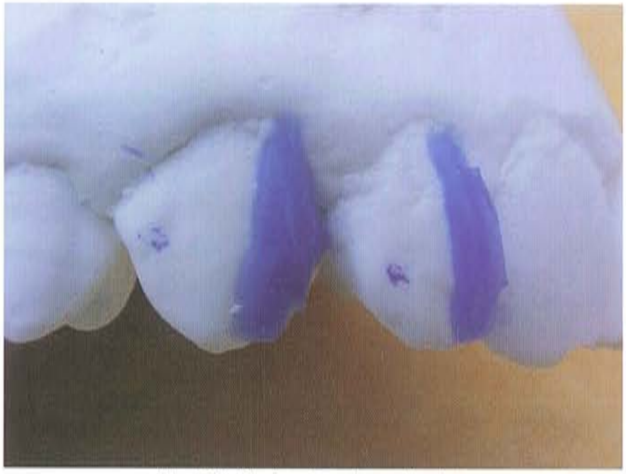


Fig. 130. Block out resin application

Fig. 131. Curing of the block out resin.

Disadvantages

1. The Essix® type "A" lasts about 6 months.
2. The Essix® type "C+" lasts about 12 months.
3. The Essix® type "A" is not recommended for palatal expansion maintenance.
4. We cannot add acrylic to the Essix® Type "C+".[18,31]

Recommendations

1. Take off the Essix® by pulling it from its distal section.
2. We recommend the continuous use of these retainers the first 15 days. After this period the retainer must be worn two hours in the afternoon and all night long.

Figs. 132 and 133. Plaster model with the cured resin. The resin buttons will be placed on the blue dots in order to "push" the rotated teeth.

Fig. 134 Model with the guard.

3. Not recommended in cases with dental rotations. In these cases place a fixed retainer.
4. With the Essix® "C+" (from molar to molar) we recommend the elimination of premature points in the posterior zone in order to obtain an equilibrated occlusion and to avoid an open bite.
5. Do not clean the Essix® with tooth paste because this paste can scratch the retainer.
6. Wash the Essix® with neutral soap.
7. While the patient is in our office for a routine check up, the Essix® can de submerged in the ultrasonic bath to be cleaned.[14,15,18,31,39]

Reinforced Essix®

This is an esthetic retainer developed by Dr Kevin Theroux. This retention system is based on two plastic plates or acetates to provide greater support and stiffness to the retainer.[35]

Fabrication:

1. Over a plaster model we outline with a pencil the palatine contour of premolars and molars.

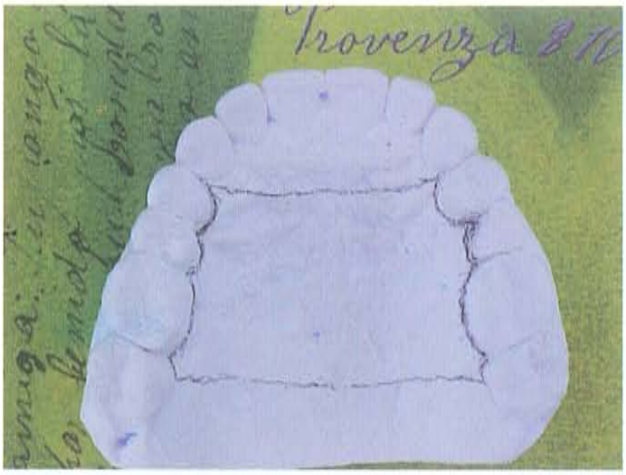


Fig. 135. Palatal outlining of the patient.

2. We vacuum a 0.030" mouth guard acetate over the work model of the patient.

Fig. 136. 0.030" mouth guard acetate over the work model of the patient.

3. We cut out the plastic plate that we previously outlined with diamond discs and steel burs following the contour marked in the work model, obtaining an acrylic plate with the shape of the palate.

Fig. 137. Plastic plate contoured to the palate. It does not cover occlusal surfaces or incisal edges.

4. This "plastic palate" is varnished with monomer and over this we place an acrylic horseshoe. This horse shoe will have a height of 4 mm and a width of 5 mm approximately. We must wait 5 minutes to allow the acrylic to adhere to the "plastic palate". This horseshoe will reinforce the palatal zone.

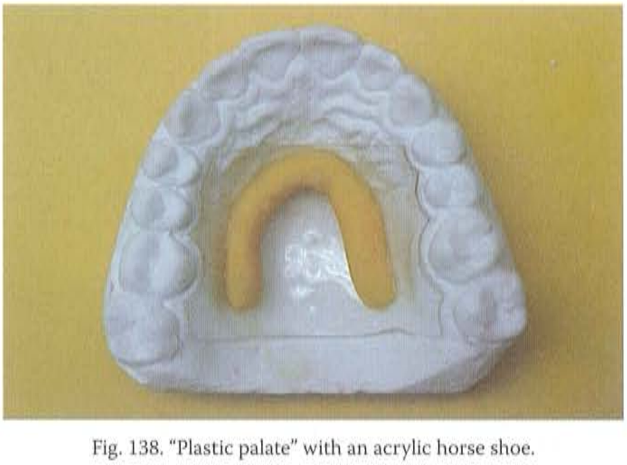


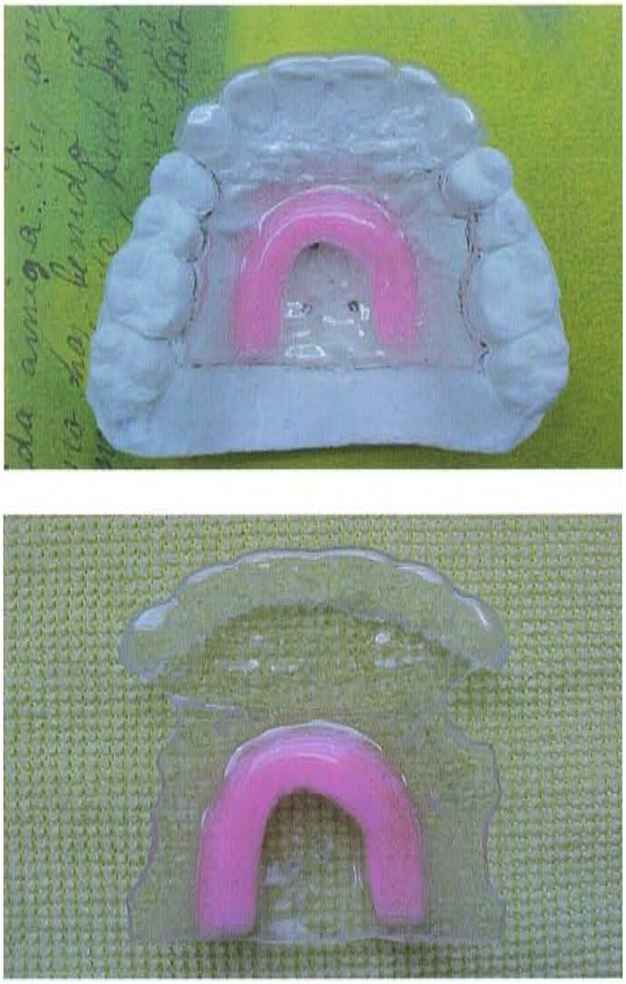
Fig. 138. "Plastic palate" with an acrylic horse shoe.

5. Once the horse shoe is adhered to the "plastic palate" we must place another 0.030" acetate over it. This way we will end up with an acrylic horseshoe "sandwich" and all the occlusal and incisal aspects will be covered with a 0.030" acetate.[35]

Fig. 139. Second guard elaboration.

Fig.140. Horse shoe acrylic "Sandwich".

6. Cut the second guard with diamond discs and steel burs. In this occasion all the occlusal surfaces of the posterior sector will be eliminated following the anatomy of the first plastic plate, but we will maintain the buccal and incisal aspects of the anterior segment.



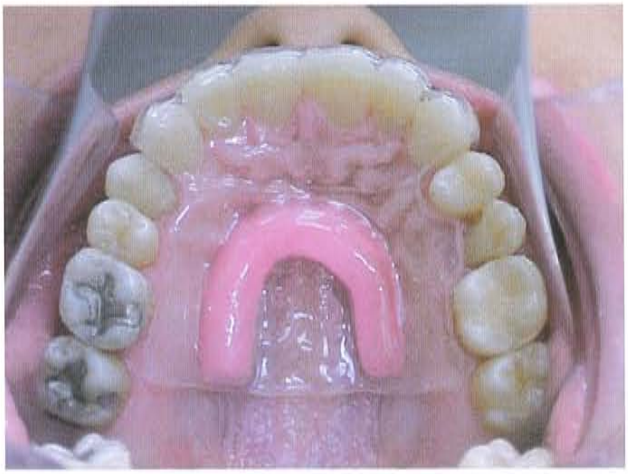
Figs. 141 and 142. Reinforced Essix®.

7. Polish, adapt and then place the reinforced Essix® in the mouth.

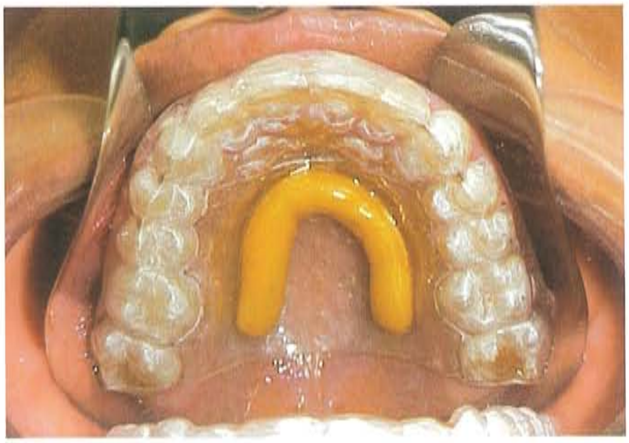
Fig. 143. Reinforced Essix® in mouth.

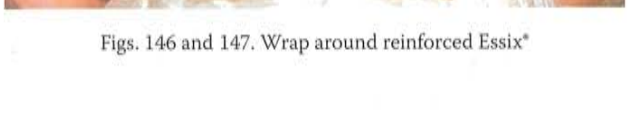
Recommendations

1. Take the reinforced Essix® off by pulling it from the distal canine section.
2. We recommend the continuous use of the retainer for the first 15 days, only taking it off during food consumption. Later on, two hours in the afternoon and nightly use is enough.
3. Not recommended in cases of dental rotations. Instead use a fixed retainer.
4. This reinforced Essix® can be modified and include the occlusal and buccal aspects of the posterior segment.[18,31,35]



Figs. 144 and 145 Reinforced Essix® in mouth.





Figs. 146 and 147. Wrap around reinforced Essix®

Advantages

1. Esthetic.
2. Hygienic.
3. Cheap.
4. Easy to elaborate.
5. Well tolerated.
6. Due to its rigidity, it can maintain any palatal expansion.
7. It does not have any metallic additaments that might interfere with the occlusion.[35]

Disadvantages

1. It lasts about 6 to 8 months.
2. The anterior segment can fracture.[35]

5. In order to avoid an open bite and to obtain a balanced occlusion, the premature contact points must be eliminated from the wrap around reinforced Essix®.
6. Do not wash the reinforced Essix® with dental paste because it can erode the surface of the retainer.

7. Wash the reinforced Essix® with neutral soap.
8. The reinforced Essix® can be ultrasonically cleaned in the dental office.[18,31,35]

Fixed retainers

This type of retention is used when a prolonged retention is planned or when we fear that teeth alignment is instable.[26,27,28]

As mentioned before, the anteroinferior sector is the most vulnerable to rebound. Fixed retention is used to avoid or minimize this situation, but this type of retention can be used in the anterosuperior sector or in any other sector of the dental arch.[11]

Lower inferior retainers can be left until growth is completed and for two years in adults. After this, an individual decision must be taken for its removal.[20]

There are two types of additaments for fixed retention:

- Prefabricated.
- Adapted to the patient (made to fit).

Prefabricated

There is a great variety of brands and models. Some of these lingual bars have two metal bases soldered to a 0.036" wire. These bases are bonded to the lingual aspects of the canines, this is the reason there are different lengths.[11,26,27,28]

Fig. 148. Different lengths of the prefabricated retainers.

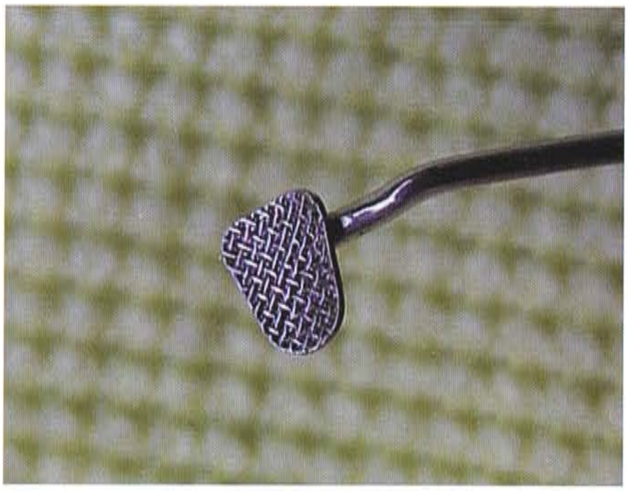


Fig. 149. Mesh of the base that is bonded to the lingual aspect of the canines.

Figs. 150 and 151. Different lenghts of the retainers.

Bonding of the lingual bar:

1. Prophy the lingual aspect of the the anteroinferior sector teeth.

2. Isolate the anteroinferior sector with cotton rolls and cheek retractors. Sometimes we must use rubber dam.
3. Place adhesive on the lingual aspects of the anteroinferior teeth.
4. Place adhesive and resin on the bases of the lingual bar.[11,20]

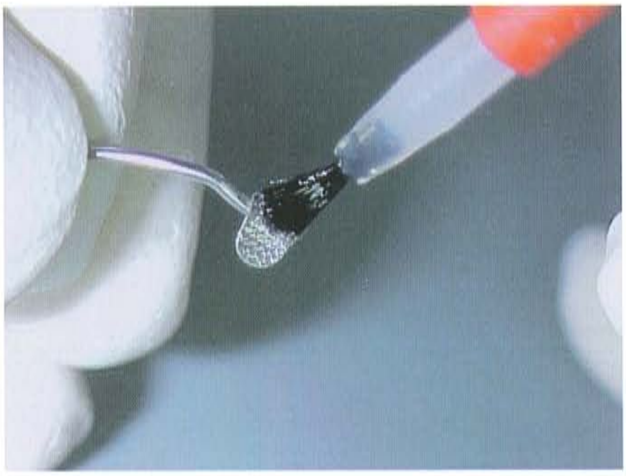


Fig. 152. Adhesive and resin on the base of the lingual bar.

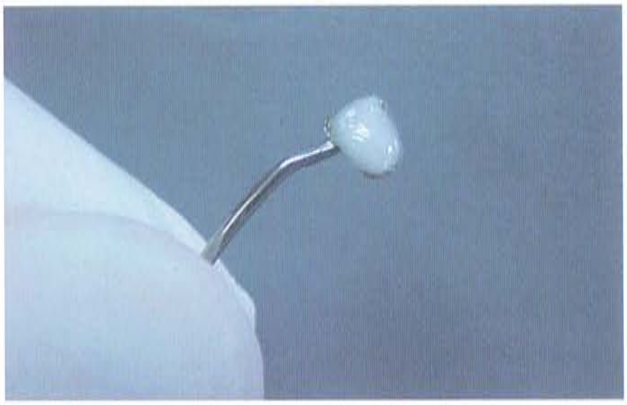


Fig. 153. Adhesive and resin on the base of the lingual bar.

5. The lingual bar is fixed with metal ligature.

Fig. 154. Lingual bar fixed with metallic ligature.

6. The resin on the canines is polymerized.
7. We can add resin to the lingual aspects of the four incisors. This will give us better retention, less rebound and more stability.

Fig. 155. Placing resin on the four lower incisors.

Adapted on the patient (made to fit)

It consists of a length of wire, generally twisted and of medium caliber that is bonded to the lingual aspects of the teeth localized in the anteroinferior segment of the dental arch.

The bonding procedure for this type of retention is very similar to the prefabricated fixed retainers.[11]

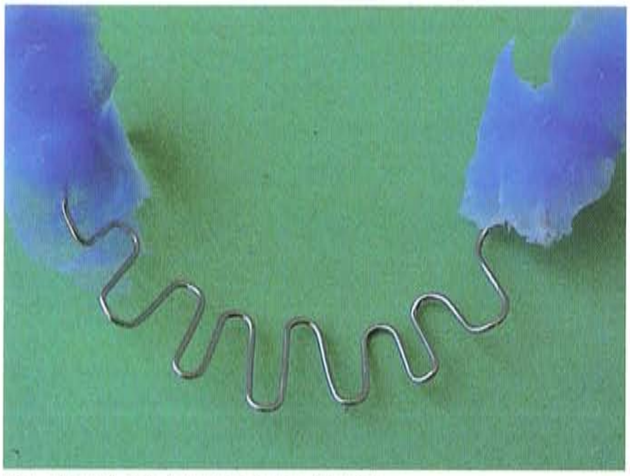
Bonding:

1. Take an impression of the anterior segment with alginate. It is important to verify that the lingual aspects of the teeth are copied perfectly and without distortion. Pour plaster and make a work model.

2. Adapt a length of twisted wire or a small caliber round wire on the lingual aspects of the incisors and the canines. Once this length of wire is conformed, treat it thermally eliminating the temper to avoid any type of dental movement that derives from the manifestation of the tensions that develop in these wires. The wire can be conformed directly on the patient, but we can obtain more precision conforming it on a work model.[11,20]

Fig. 156. Wire in the form of a "serpent", perfectly adapted to the lingual aspects of the anteroinferior segment. The use of dental floss will be easier with this conformation.

3. In order to obtain more stability during bonding, we can pour some acrylic on the occlusal surfaces of the premolars and the molars, this way we will obtain a occlusal guide that will help us bond the retainer.



Figs. 157 and 158. Acrylic between the wire and the occlusal surfaces.

4. Then we place the wire and the acrylic in the mouth and we bond the retainer. If we want a stronger bond we can sand blast the areas of the wire that are going to be covered with the dabs of resin.

Fig. 159. Thanks to the acrylic guides the placement and bonding is easy.

Fig. 160. Retention with twisted wire.

Upper fixed retainers are not as frequently used as lower ones, because they are prone to fracture because of the occlusal contact. But in some adult cases they are essential if we want to assure good retention.

Some patients present persistent spacing (especially in the midline) or other movements of the upper incisors. In these cases, the advantages of the upper fixed retainers surpass the risk of fracture. Before placing them we must evaluate the overbite and overjet of the patient. We must be careful not placing the wire near the incisal contact area. We can use twisted wire or preformed bars from central incisor to central incisor (1 to 1) and it is placed in a similar way as a fixed lower retainer. We must tell the patient to be careful with the wire to avoid fractures. With the proper care they can stay in the mouth a long period of time.[20]

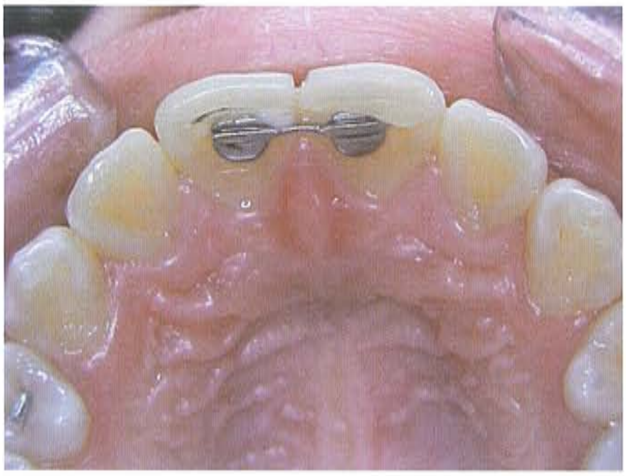


Fig. 161. Fixed 1 to 1 retainer.

The consideration of the use of retainers placed on the buccal aspect of upper incisors is now frequent. They can be useful in the short term for adult patients that want the braces taken off rapidly. In a few months this can be replaced with traditional retention methods. In adolescents a vestibular fixed retainer can be useful during the mixed dentition period, while we wait the eruption sequence. In other cases it may be necessary to use fixed buccal retainers to contain certain teeth, for example, in cases with extreme rotations or in premolar extraction sites or in impacted canine cases. This is a way to avoid the high rebound tendency in these cases.[20]

Fig. 162. Buccal Fixed retention from the canine to a second premolar.

Removable retainers vs fixed retainers

Dr. Interlandi suggests that retention should be indefinite, for this reason he recommends that retainers should be removable. He states that the fixed mandibular retainer from canine to canine is not the ideal retainer for several reasons:

1. Being fixed, it needs frequent supervision.
2. It does not control premolar and molar alignment.
3. It does not impede space reopening in the extraction sites, unless it is bonded from premolar to premolar or molar to molar.
4. It does not maintain perfect alignment of the incisors unless the lingual wire is bonded to every incisor, which can make proper hygiene difficult with the subsequent accumulation of calculus.
5. This retainer is not recommended in patients with bad oral hygiene or patients that accumulate calculus easily.
6. If any incisor debonds from the retainer it will misalign, and the orthodontist will be obligated to realign it again.

Fig. 163. Rebound of the left lateral incisor due to the fracture of the resin dab.

7. Likewise, if a canine debonds (which happens in 20% of the cases in the first 3 years (the incisors will misalign and the orthodontist will be obligated to align it again.
8. The fixed retainer makes use of dental floss difficult so the general practice dentist or the patient, sooner or later will request its removal.
9. The fixed retainer makes syndesmotomy difficult, in case it is indicated.

10. The chair time to bond a fixed retainer is greater than the time to adjust a removable appliance.[11]

Dr Interlandi recommends the use of a fixed mandibular retainer only when the patient does not want a removable retainer.

A removable mandibular retainer has many advantages over a fixed retainer:

1. Being from molar to molar, it maintains the entire arch aligned, not only inter-canine width.
2. The removable retainer does not allow extraction site reopening, and does not allow incisors, premolars or molars to rotate.
3. The removable retainer serves as a space maintainer (in patients that are going to receive a prosthetic replacement).
4. We can test dental stability with the removable retainer, just tell the patient not to use the retainer.
5. If the patient does not use the retainer for weeks or months and if he can place it again without difficulty, it will indicate that there is stability; in this case we can suggest to the patient the intermittent use of the retainer.
6. If the patient does not use the retainers (without interacting with the orthodontist) and if there was a slight rebound we might revert it by asking the patient to use the retainer full time until it fits properly (because there is a guided dental movement by the retainer).
7. If there was a lot of rebound it will be the responsibility of the patient, because he did not use the retainers, and maybe a new treatment may be needed.
8. It is almost impossible to aspirate, eat or suffocate with a retainer that goes from molar to molar, but with a fixed retainer all this is possible, in case it debonds because of its size.
9. Another advantage of a removable retainer is that in case the third molars are erupting, if these are erupting in a bucco-lingual inadequate position we can add springs to the retainer so these can act as eruption guides to either lingual or buccal direction.
10. And finally, the emergency appointments during retention with removable appliances are very short because we only have to take an impression for a new retainer.[11]

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