

TRABAJO DE FIN DE GRADO

Grado en Odontología

**ORTHODONTIC TREATMENT
OPTIONS FOR ANTERIOR OPEN BITE
CORRECTION**

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Acknowledgment

A mes parents, pour leur amour inestimable, leur soutien et l'encouragement constant qui m'ont été d'un grand réconfort et ont contribué à l'aboutissement de ce travail.

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Abbreviations

AOB	Anterior Open Bite
BLS	Bonded Lingual Spurs
CVL	Conventional Lingual Spurs
MBB	Magnetic Bite Block
RMI	Rapid Molar Intruders
RPC	Removable Palatal Crib
FPC	Fixed Palatal Crib
PBB-VPC	Posterior bite block-vertical pull chin cup
PBB-HPH	Posterior bite block-high pull headgear
MEAW	Multiloop Edgewise Archwire

Resumen

Introducción: En el campo de la ortodoncia, la mordida abierta anterior sigue siendo una de las maloclusiones más complicadas de tratar, aunque se presenta como uno de los problemas más frecuentes. Debido a la presencia de una etiología multifactorial, envolviendo factores como los malos hábitos, la respiración bucal crónica o la hiperactividad de la lengua entre muchos otros, aumentan la dificultad del diagnóstico, la elección del tratamiento y afectan a la estabilidad a lo largo plazo de esta maloclusión.

Objetivos: A través la realización de una revisión de la literatura de los últimos años, este trabajo tiene como objetivo ofrecer un plan de tratamiento estándar para acercarse y tratar esta maloclusión. Se enfocará en la descripción de los diversos tratamientos (interceptivo y camuflaje) disponibles en la literatura, concentrándose en los cambios cefalométricos para últimamente analizar la estabilidad a lo largo plazo.

Materiales y métodos: Se realizó una investigación exhaustiva utilizando bases de datos científicas confiables como PubMed y Medline, utilizando palabras clave como “Ortodoncia”, “Mordida abierta anterior”, “Recaída”, “Etiología”, “Tratamiento”. Fueron seleccionado artículos incluidos en los criterios de búsqueda.

Resultados y discusión: Varias opciones de tratamientos están disponibles, tal como las espuelas, las rejillas palatinas, la mentonera, los microtornillos, las extracciones o también la técnica de multiloop edgewise archwire, ofreciendo todos resultados favorables con respecto a la corrección de la maloclusión. Finalmente, la comparación de los múltiples estudios clínicos permitió identificar que existe poca evidencia científica dedicada a la estabilidad a lo largo plazo del tratamiento de esta maloclusión.

Conclusión: El tratamiento de la mordida abierta anterior depende en gran medida del diagnóstico y de la terapéutica. Aunque hay muchas opciones de tratamientos diferentes, la

estabilidad de ellos sigue siendo un tema crítico, ya que se carece de evidencia sobre la estabilidad a largo plazo de varias opciones de tratamiento.

Abstract

Introduction: In the field of orthodontics, the anterior open bite persists as one of the most complicated malocclusions to treat, despite its high frequency. Due to its multifactorial aetiology, involving factors such as bad habits, chronic mouth breathing or tongue hyperactivity among many others, they increase the difficulty of diagnosis, the choice of treatment and mainly the control of stability throughout term of this malocclusion.

Objectives: Through the conduction of a recent literature review, this work aims to offer a gold standard treatment plan to approach and treat the anterior open bite malocclusion. It will focus on the description of the various treatment options available in the literature, differentiating interceptive from camouflage therapy, through the emphasis of the cephalometric changes. Finally, an analysis of the long-term stability of the therapies will be carried in depth.

Materials and methods: An exhaustive investigation was carried out using reliable scientific databases such as PubMed and Medline, using keywords such as "Orthodontics", "Anterior open bite", "Relapse", "Aetiology", and "Treatment". Articles presenting the inclusion criteria were selected and studied in depth.

Results and discussion: Several treatment options are available, such as spurs, palatal cribs, magnetic bite blocks, chin cup, skeletal anchorage, dental extractions or even the multiloop edgewise archwire technique, offering all favourable results regarding the correction of this malocclusion. The comparison of multiple scientific studies found to identify that there is little evidence dedicated to the stability throughout the treatment of the anterior open bite.

Conclusion: The treatment of the anterior open bite is highly dependent on the diagnosis and the therapy, therefore a gold standard treatment plan cannot be offered. Although there are many different treatment options, their stability remains a critical issue, as evidence on the long-term stability of the various treatment options is lacking.

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I. INTRODUCTION

a. Definition

As C. Gugino exclaimed, « *The greatest success of orthodontic treatment is the achievement of the balance between form and function* » (1).

The 1960s decade was an era acknowledged under the name of “the tongue thrusts era” due to the drastic existence of the anterior open bite malocclusion (2). Its treatments usually consisted of a dentoalveolar change and an additional alteration of the existing habit (3).

Over the past 20 years, the anterior open bite (AOB) has been one of the most challenging malocclusions to treat due to the high degree of instability, its great recurrence and to the multiple treatment plans available in the literature (4).

It is therefore crucial to define it in order to achieve the most accurate diagnosis; it is a malocclusion of the dental arches resulting in an anterior open vertical dimension. This opening takes place amongst the incisal edges of the maxillary and mandibular anterior teeth whilst the posterior teeth are occluding (3). It is eventually depicted by a posterior overgrowth of the maxilla and the mandible dentoalveolar heights (5).

Consequently, AOB is a diminution of the overbite, considering the ideal overbite as of 1-2mm overlap of maxillary incisors over mandibular incisors. A lower overbite could be considered as a type of mild anterior open bite, a vertical gap between 0-2mm is reflected as a moderate anterior open bite. However, an open bite of 3-4 mm is said to be severe and values higher than 4mm are called extreme (6).

Early diagnosis is therefore decisive as this prevalent malocclusion can lead to severe aesthetic changes, provoking damages to the articulations and to the mastication therefore favouring psychological conditions.

b. Epidemiology

The anterior open bite should be considered as the most widespread malocclusion amongst primary, mixed and permanent dentition. Thus, its prevalence varies between 1.4 to 3.5% in the Caucasian population and around 9.1 to 16.5% in the African American population. Although these values may seem low, the proportion of patient treated for anterior open bite represents 17% of the orthodontic patients (7). This discrepancy can appear due to the various cultural and economic standards present in between countries, thus affecting the habits and behaviours of the population (8,9).

c. Aetiology and etiopathogeny

As we emphasized, the anterior open bite presents multifactorial aetiologies which regroup the interaction of environmental factors. In AOB patients, 36% of them entertain parafunctional habits therefore, Dawson (10) underlines the consequence of habits such as thumbsucking, finger sucking or pacifier sucking which are said to be non-nutritive suction. Additionally, chronic mouth breathing, labial aspiration, lingual pulsing and atypical deglutition are reflected as the principal factors of anterior open bite. Moreover, other factors such as macroglossia, upper airway obstruction, hypertrophic tonsils, temporomandibular joint disorders and supernumerary teeth must be considered amongst others. It is frequently observed a hyperactivity of the tongue in patients with anterior open bite present during swallowing or even at rest, thus producing a buccal inclination of the incisors (particularly upper ones) (10).

The cause of this malocclusion varies also depending on the patient's age, for instance, some habits such as thumb sucking are more prevalent in patients with deciduous or mixed dentition than in adults. Besides, it is assumed that soft tissues are important actors in the apparition of the malocclusion; thus incompetent lips added with a lack of lip seal accelerates

the course of the AOB (3).

Anterior open bite is usually accompanied by anteroposterior and transversal discrepancies, therefore clinicians need to combine several treatment options in order to solve this three-dimensional issue (11). Finally, it is important to underline the possibility of an abnormal growth pattern as an aetiology of the anterior open bite. Through Fig 1, one can analyse the four various growth pattern that could possibly originate an anterior open bite (12):

- A. Maxillary rotation in anticlockwise sense
- B. Mandibular clockwise rotation
- C. Anticlockwise rotation of the maxillary arch combined with a clockwise rotation of the mandibular arch
- D. Maxillary vertical excess

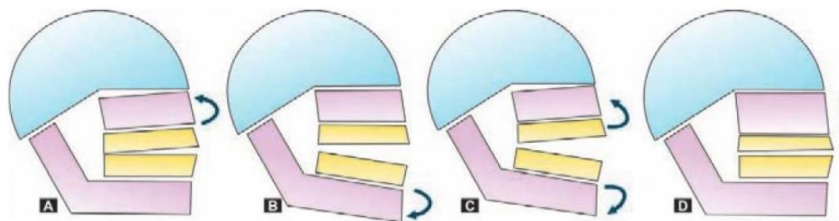


Fig 1.Different growth patterns causing AOB (12)

d. Types of anterior open bite

Besides, we should classify the three major types of anterior open bites; emphasizing the distinction between dental (Fig 2), dentoalveolar and skeletal anterior open bite (Fig 3).

The first one results from an obstructive eruption of the upper anterior teeth that could be due to an ankylose for instance (13). The second category is the one in which both teeth and skeletal changes produce an effect on the alveolar process. A mechanical obstruction of the incisors development can produce both dental and dentoalveolar open bites. Finally, the skeletal open bite is illustrated by an essential vertical skeletal discrepancy (13,14). It offers

characteristics such as an intensification of the growth of the lower facial height and the gonial angle, a mandibular clockwise rotation and finally an increased posterior dentoalveolar height in both maxillary and mandibular arches (15). In patients with systemic diseases (e.g. craniofacial dysplasia), AOB presents a greater severity (16). In most cases, the distinction between the three various types is not clearly made since the aetiology of this malocclusion often involves a combination of dental and skeletal components (7).



Fig 2. Dental AOB (12)

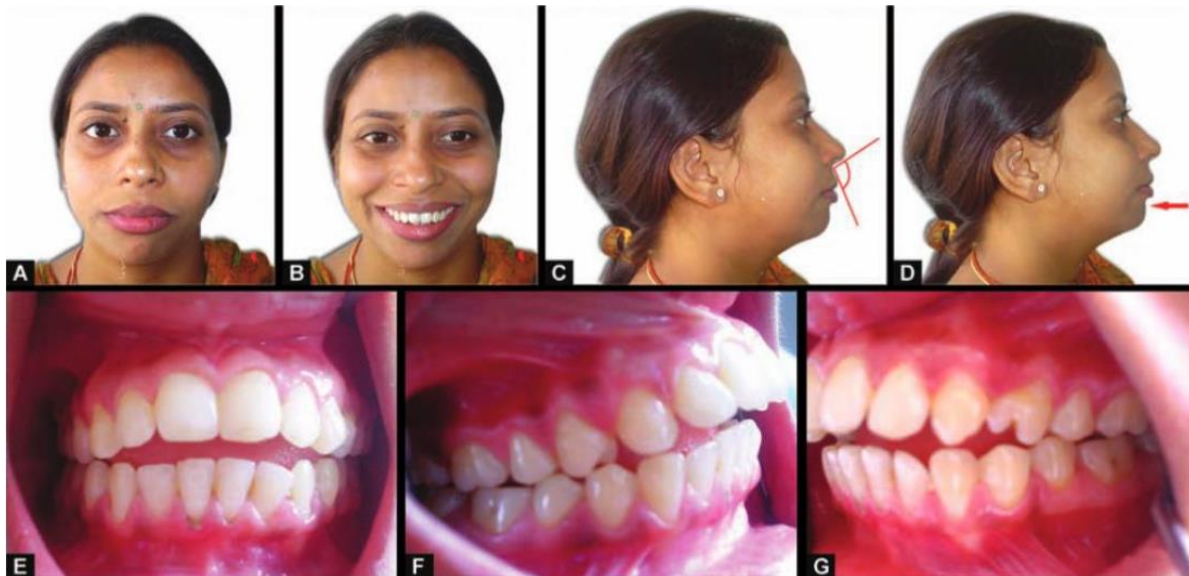


Fig 3. Skeletal AOB (12)

An accurate and detailed early diagnosis should be performed in order to classify the patient's malocclusion as an anterior open bite. For instance, BS. Phulari (12) underlines the importance of a detailed clinical examination and radiologic study in order to assume if the patient presents a dental or a skeletal AOB. Skeletal open bites present a high Frankfort plane, which makes the professional assume it is a vertical growth problem (12). Through the analysis of Fig. 4 and 5, one can analyse the various clinical and radiographic features that could present in a patient with skeletal AOB.

For all of the above reasons, the anterior open bite can provoke major problems in terms of function on the mastication and phonation, but also aesthetic issues that could produce a

severe impact on the patient's confidence.



- A. Everted lower lip
 - i. Increased lower anterior facial height
- B. Decreased upper anterior facial height
- C. Decreased nasolabial angle
- E. Anterior open site
- F. Right lateral intra-oral view showing open bite
- G. Left lateral intra-oral view showing open bite

Fig 4. Characteristics of a skeletal AOB malocclusion (12).

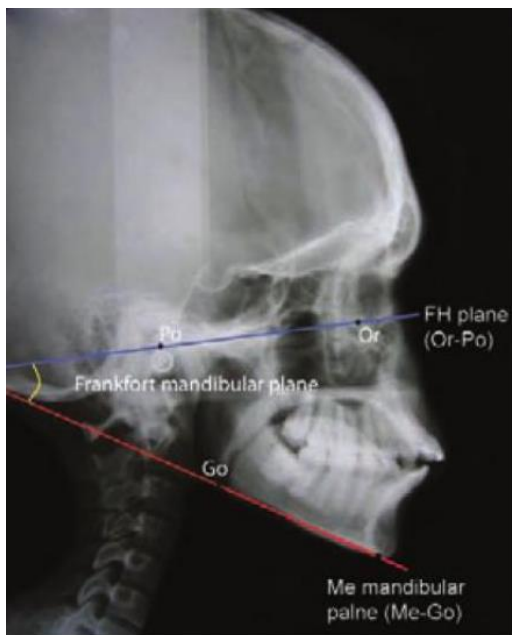


Fig 5. Lateral cephalogram of a patient indicating vertical growth; there is an increase of the Frankfort (blue) mandibular plane (red) angle (yellow) (12).

e. Treatment possibilities

Multiple treatment options are available in the literature depending on the patient's age and on the severity of the open bite.

Firstly, early management could be accomplished during primary dentition, although many parents take consideration of their child's anterior open bite once he or she is already in mixed dentition. As it was previously stated, many of the anterior open bites are related to habits; therefore, withdrawing this bad habit could help in the amelioration of the malocclusion.

Multiple literature reviews highlight that the early diagnosis of this malocclusion in the deciduous and mixed dentition can be cured easily, even through self-correction, therefore avoiding heavy orthodontic treatments (17). On the other side, if these habits are maintained they might provoke the necessity to use complex therapeutic approaches such as the need to intrude the posterior teeth, or extrude the anterior teeth, extract multiple teeth or even in the most severe cases, perform orthognathic surgery (18,19). For instance, authors such as McNamara, Brudo or even Subtely assessed that the early recognition and treatment of etiologic factors of AOB could reduce and possibly eradicate future dentoalveolar abnormalities (20,21). Multiple orthodontic approaches are available in order to complete it. This can be achieved using various appliances such as passive or active bite blocks (with or without magnets, springs), high-pull headgear, fixed appliance therapy, vertical elastics or even spurs. The spurs produce an adjustment in the tongue's rest position, thus permitting the incisors to erupt correctly therefore closing the AOB. It is essential to understand that palatal cribs produce dentoalveolar changes, for example the extrusion of the upper and lower incisors. Furthermore, the use of spurs during orthodontic treatment ameliorates the post

Treatment options	Result	Decrease of anterior open bite
Rapid Molar intruder	Intruding molars Rotation of the mandible	Yes
Magnetic Bite blocks	Extrusion of the incisors, intrusion of the molars, control of the posterior dental height, rotation of the mandible	Yes
Quad-Helix	Decreases suction habits, extrusion of the incisors and lingual retrusion, anticlockwise rotation of the palatal plane and an amelioration of the intermaxillary vertical dimension	Yes
Spurs	Dentoalveolar effect mainly	Yes
Palatal crib (fixed vs removable)	Best: fixed ones and not removable ones due to patient compliance, does not control molar extrusion	Yes
Vertical Chin cup	Decreases anterior open bite but does not control molar extrusion	Yes
Bionator	Good in class II malocclusion in patients with AOB, molar extrusion and improves the vertical intermaxillary relation	Yes

treatment stability and provides the patient with a more stable tongue rest position (22,23).

(24)

Besides, some authors assume that the intrusion of molars cannot be achieved in all adult patients (5). Others include the possibility of extraction treatment in the permanent dentition.

One of the key functions drawn by interceptive orthodontics is the importance on the ending of the harmful habits, thus resulting in a restitution of the normal occlusion (25,26). Interceptive orthodontics will allow professionals to perform an easier treatment towards their patient, reducing the obligation to execute dental extraction of permanent teeth or traumatic treatments. This will decrease the possibility of producing root resorptions, gingival recession or other psychological effects on the patient. However, it is significant to underline that many authors state the difficulty in achieving a good control in the dentofacial growth of their

patient compared to conventional orthodontics. Many writers emphasize the possibility of providing patients with mild to moderate skeletal discrepancies treatment when there is no longer the possibility to alter their growth pattern. The anterior open bite in these patients can be treated without the necessity to perform invasive or even surgical procedures.

Thus, in cases of non growing adult patients, the skeletal anterior open bite is known as the hardest treatable malocclusion. For instance, a vertical control is hard to be made and therefore treatment is usually done through dental movements (27). As practitioners cannot condition growth, they will perform a “camouflage of the anterior open bite”, meaning that through dental movements, they will close the anterior open bite. This will not produce any change in the skeletal profile or in osseous characteristics unless orthognathic surgery is performed (28). Various treatment possibilities exist in these cases including the use of mini implants or mini plates, extractions of teeth, the use of orthodontic elastics, dental extraction, or even multiloop edgewise archwire therapy (11). The treatment of choice will depend on the patient’s age, the skeletal class the patient presents and also on the orthodontist’s preference regarding the treatment plan. Although many articles can depict stable results regarding the handling of this malocclusion, the majority of these studies are based on small samples, inconstant variables and errors in measurements (29).

As we stated, scientific literature offers multiple treatment plans, yet most of them do not achieve a complete favourable result, therefore relapse is recurrently present. Thus, it is known that relapse after an AOB orthodontic treatment must be assessed at least 1 year after the end of the therapy; the vertical correction can be problematic to preserve once the orthodontic treatment is finished. However, multiple factors act on the long-standing stability of the AOB; for instance, the seriousness of the open bite malocclusion prior to therapy, the type of Angle’s malocclusion prior to therapy, the age of the patient and the moment at which

the treatment started. Moreover, values such as mandibular plane angle and anterior facial height are relevant in order to consider a stability for this treatment. Finally, the stability will vary according to the healing therapy, if it included surgery or extractions for example (30).

II. OBJECTIVES

Consequently, this work aims to clearly describe and analyse the numerous treatment plans available including both dental and non-dental managements of patients. As a primary objective, we will describe the various treatment options available in order to treat this malocclusion, aiming in achieving a gold standard treatment plan therapy. As secondary objectives, we will goal:

- To assess the cephalometric changes achieved thanks to the different treatment options, focusing on the overbite correction, as well as the incisors' movements, the molars' position and the skeletal alterations.
- To appraise the stability of various anterior open bite treatments.

Altogether, the work will aim to answer the following question: is it always necessary to undergo radical fixed orthodontic and surgical treatments in order to treat an anterior open bite? We will guide the protocol towards the elimination of the factors that intervene in its development, with the idea of reducing the chances of recurrence.

The controversy that exists between the multiple authors has encouraged the research on this section of Orthodontics and as a result, the performance of this literature review.

III. MATERIALS AND METHODS

To carry out the following literature review, an exhaustive research was carried out using reliable scientific data bases such as PubMed and Medline using keywords as “Orthodontic” “Anterior Open Bite”, “Relapse”, “Aetiology”, “Treatment” “Therapy”. By means of the combination of the previous keywords mentioned, the following search strategies emerged:

- Anterior Open bite AND Treatment
- Anterior Open bite AND Relapse AND Orthodontics
- Anterior Open bite AND Aetiology

Inclusion criteria:

- Those that could be provided by the university’s library
- Articles including functional therapy
- Cases treating AOB with and without the use of fixed appliance
- AOB in mixed dentition
- Articles written in French, English, Italian and Spanish
- Articles with human experimentation have been included

Exclusion criteria:

- Articles that did not underline the treatment of anterior open bite
- Cases that were not followed up for a minimum of 2 years post treatment
- Articles with animal experimentation have been discarded

- Articles older than 15 years
- Languages that were neither in English, Spanish, Italian or French.
- Studies in which patients' age was not included

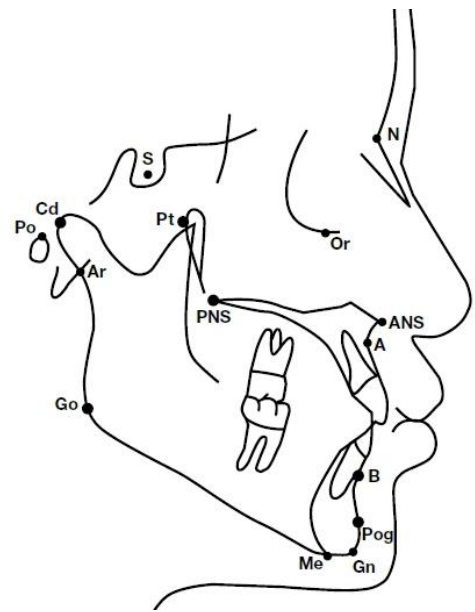
IV. RESULTS AND DISCUSSION

a. Interceptive Orthodontics

Interceptive orthodontics has been defined by the American Association of Orthodontists as *“That phase of the science and art of orthodontics employed to recognize and eliminate potential irregularities and malpositions in the developing dentofacial complex”*(31).

The vertical growth of the mandible is persistent during puberty, which as previously stated could generate an anterior open bite (32). Therefore, interceptive orthodontic treatment could reduce the possible future complications specially when they are due to parafunctional habits. AOB is usually accompanied by anteroposterior and transversal discrepancies, consequently clinicians need to use a combination of treatment options in order to solve this three-dimensional issue (11). We will therefore analyse four main cephalometric outcomes of the various interceptive orthodontic treatments present in the literature in order to close the anterior open bite:

1. The open bite correction
2. The position of the incisors
3. The position of the molars
4. Alteration of hyper divergent growth pattern



It is therefore of drastic to have knowledge of the basic cephalometric landmarks in order to analyse their changes.

Fig 6. Cephalometric landmarks (33)

(**S**-Sella; **N**-Nasion;
Po-Prion; **Cd**-Condylion; **Pt**-Pterygomaxillary fissure; **Or**-Orbitale;
Ar-Artiulare; **PNS**-Posterior nasal spine; **ANS**-Anterior nasal spine;
A-A point; **B**-B point; **Pog**-Pogonion; **Gn**-Gnathion; **Me**-Menton).

1. Open bite correction

The correction of the overbite is one of the practioner's major aim regarding the treatment of the anterior open bite.

Thus, in 2016, L. Canuto, G. Janson, N. De Lima *et al.* (23) performed a study in which they compared the use of bonded and conventional lingual spurs. They appreciate that patients having received bonded lingual spurs (BLS) accepted better the therapy than the patients with a conventional lingual spurs (CLS) (23). The initial overbite of the patients undergoing treatment with bonded lingual spurs was -4.01mm (SD 3.1 mm) and it achieved an augmentation of 4.26mm once the treatment was finished. On the other hand, patients undergoing therapy with conventional lingual spurs went from an early overbite of -3.04mm to an increase of 3.41mm (SD 2.01mm). Therefore, the difference in open bite correction is statistically similar with the use bonded lingual spurs (Fig 6) compared to the conventional ones (Fig 7). Consequently, it can be expressed that both bonded and conventional spurs provide a significant augmentation of the overbite, thus providing the patient with an open bite correction.

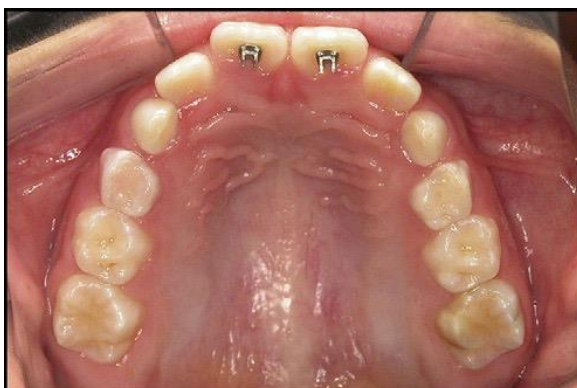


Fig 7. Bonded spurs (22)

Fig 8. Conventional spurs (23)

Through the prospective clinical study of Michelle Alonso Cassis, *et al.* in 2012 (22), research was made concerning the cephalometric variations induced by palatal and lingual bonded spurs coupled through high pull chin-up therapy. The patients were children presenting an average age of 8.14 years, offering an Angle class I malocclusion accompanied with AOB (22). In the group of patients treated, effectiveness in the correction of the AOB was present in 86.7% of them offering an average overbite increase of 5.23 mm, only one case presented a lowered effectiveness to 54%. This was achieved in a period of 12 months (22). Whereas in the article debated by L. Canuto *et al.* (23) mentioned previously, the protocol of both therapies lasted 12 months as well; and the improvement of the open bite was achieved in 80% of the patients with bonded lingual spurs, and in 76,2% of patients treated with conventional lingual spurs (23). Therefore, both articles state that interceptive treatment needs an average of 12 months to achieve good results. Besides, the treated patients in MA. Cassis *et al.* (22) longitudinal study went from a mean initial overbite of -3.93mm to a final increase of the overbite of an average of 5.23mm (SD 1.69mm). On the other side, the control group



Fig 9. High pull chin cup (34)

presented an increase of 1.98mm (SD. 1.41) in the mean overbite (22). Therefore, through the analysis of these articles, the treatment of the anterior open bite is shown to be statistically more effective while combining it with both bonded spurs and high-pull chincup therapy (Fig 8) rather than only using bonded or conventional spurs.

The chin cup therapy is one of the oldest appliances used; it can be associated as previously mentioned with other therapeutic options in order to achieve an ideal incisal coverage of the upper arch over the lower one (22).

Furthermore, fixed or removable palatal cribs can be used in order to remove lingual habits (suction and pulsing) thus encouraging a normal development of the anterior sector of the oral cavity. For this reason, F. Torres, R. Almeida, R. Almeida-Pedrin, F. Pedrin and L. Paranhos, in 2010 (15) performed a longitudinal study aiming to relate the dentoalveolar effects on growing patients (presenting similar anterior open bite patterns) using two distinct sorts of palatal crib: a removable one (RPC) and a fixed one (FPC), combining their study using chin cup (15). In the RPC group, the increase in the mean overbite was of 3.86mm after 1 year of treatment. In the FPC group, the overbite (in mm) improved of 5.44mm; this indicates us that the malocclusion was effectively corrected in all patients, however it produced a greater statistical result in patients undergoing treatments with fixed palatal crib and chin cup rather than with removable palatal crib (15). Therefore, numerous articles highlight that the combined use of the previous appliances with the chin cup therapy provides much more effective results.

For the same purpose, in 2008, V. Giuntini *et al.* proposed a study in which they compared the effects of two distinct appliances being the quad helix and a removable appliance. They expressed that both appliances were able to offer a correction in the overbite, yet highlighting that fixed appliances produced a higher overbite correction compared to removable therapies (29,35). Therefore, treatment compliance presents drastic consequences on therapeutic results and should be taken into consideration.

Naturally, it can be underlined that fixed palatal cribs have a higher efficiency as they do not depend on the child's cooperation. However, different authors highlight that the association of removable palatal crib with high pull chin cup therapy offered a better incisal correction due to the multiple activations and frequent adjustments that were made on the appliance (35). Finally, if the removable appliances depend on the patient's cooperation, yet they allow a gradual adaptation and a higher comfort as they can be removed during meals and while the patient brushes his or her teeth (29).



Fig 10. Removable palatal crib(15)



Fig 11. Fixed palatal crib(15)

Likewise, in a study conducted by Leite *et al.* in 2016 (36), the authors compare the treatment results obtained through the use of the palatal crib and the bonded spurs in the ending of the sucking habits aiming the closure of the anterior open bite. They showed that the overbite was corrected in both subjects treated under the use of palatal crib and bonded spurs. For instance, the subjects which were part of the palatal crib group went from an initial overbite of -1.45mm (SD 2.22mm) to a final overbite of 2.50mm (SD 1.01mm) 12 months later. Patients that were part of the spurs group went from an initial overbite of -2.38 (SD 1.43mm) to a final overbite of 0.69mm (SD 1.8) 12 months after. Nevertheless, the increase in the overbite was higher in patients undergoing treatment with the palatal crib compared to the spurs, but this difference is not said to be statistically significant. Thus, both techniques

helped in keeping the tongue in its correct position, hence decreasing the possibility of the anterior open bite in growing patients (36). Besides, even though the overbite values were not statistically significant to assume which treatment was best, the authors state that the fixed palatal crib method provided a correction of the anterior open bite in all the patients (100%), whereas the spurs achieved a positive overbite in nearly 54% of the subjects 12 months post-therapy (36).

Several other authors highlight the effectiveness of spurs in removing various habits including tongue thrust or even anterior tongue posture (37–40), although many of them specify the risk of them being un-cemented and potentially swallowed by the patient (36). On the other hand, the fixed palatal crib presents the drawback of the necessity of a laboratory work (36).

At an older age, starting the period of mixed dentition, movements of anterior teeth extrusion and intrusion of molars can be considered. Therefore, the use of active or passive bite blocks has been recommended in order to obtain a relative intrusion of the posterior teeth. Thus, in 2014 Albogha *et al.* (41) completed a longitudinal clinical investigation in which they underlined the discrepancies between two therapeutic options for the correction of the AOB in growing subjects with a class II Angle's malocclusion (41). The two treatments consisted of the use of rapid molar intruders (RMI-[Fig 11](#)) compared to the use of magnetic bite blocks (MBB-[Fig 12](#)), both applied with posterior bite blocks. The initial overbite of patients before the treatment with MBB was of -3.9mm (SD 1.6mm) and with RMI -3.8mm (SD 1.9mm), therefore both groups of patients had similar overbites (a difference of 0.1 mm) prior to the therapy. The authors state that at the end of the treatment, both groups showed no major difference regarding the increase in the overbite: the appliances produced an increase of respectively 3.3mm (SD 1.3mm) for MBB, and 3.1mm (SD 1.4mm) for RMI. Therefore, it can be said that both appliances conceived an essential amelioration in the overbite and that

no critical difference is found between these appliances regarding the increase of the overbite (41).



Fig 12. Rapid Molar Intruder(41)



Fig 13. Magnetic Bite Block(41)

However, in 2017, H. Turkkahramam, E. Cetin's article defines the different effects of two therapeutic approaches in the correction of AOB: the association of the posterior bite block with the vertical pull chin cup (PBB-VPC) and on the other hand the combination of both the posterior bite block with the high pull headgear (PBB-HPH) (42). The 14 patients in their study presented with an average age of 9.13 years without any habits and had at least a 2 mm anterior open bite (42). The overbite increased of 3.68mm and of 3.79 respectively in PBB-VPC (Fig 13) and PBB-HPH (Fig 14) (42). Both groups of patients showed an open bite correction with an important increase in the overbite; nevertheless, there was no statistical noteworthy difference in between both groups. Therefore, it can be expressed that thanks to this scientific article, regardless of the use of vertical chin cup or high pull headgear, both appliances achieve an improvement of the overbite. However, the association of both posterior bite blocks with VPC or HPH helped achieve a bigger increase of the overbite compared to the use of only molar intruders alone.

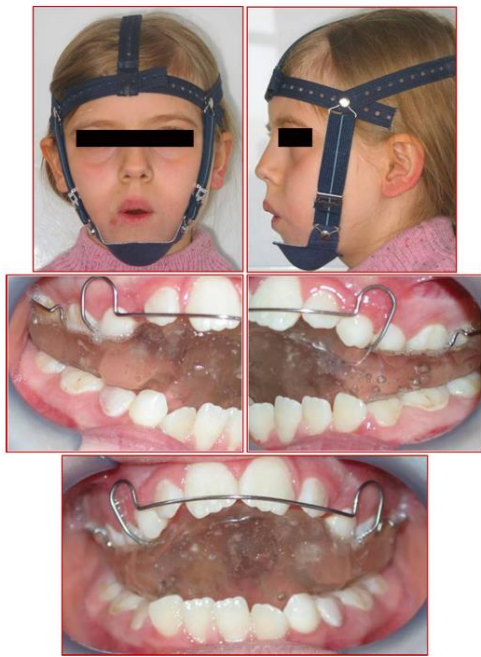


Fig 14. Patient with PBB-VPC (42)

(42)

2. Incisors' position

Multiple orthodontic treatments aim in the retroclination of the incisors in order to provide the patient with a correct closure of the anterior open bite.

Michelle Alonso Cassis *et al.* in 2012 (22), Luiz Filipe Gonçalves Canuto and G. Janson (23) studied in their distinct articles the changes in the incisors' position after their trials. Thus, MA. Cassis *et al.* found a retroclination of -3.86° (SD 5.29°) in the subjects treated with bonded spurs with high-pull chin cup therapy. On the other hand, LF Canuto *et al.* achieved a palatal inclination of the patients' incisors treated with bonded lingual spurs of -3.71° (SD 4.97°) compared to an inclination of -1.58° (SD 5.77°) in patients under conventional lingual spurs. However, both studies used distinct measuring techniques on a different group of subjects presenting variable anterior open bite. Yet, it can be stated that the patients treated in these scientific studies with bonded spurs and high pull chin cup therapy



Fig 15. Patient with PBB-HPH

offered a greater retroinclination of their maxillary incisors compared to patients only treated with bonded lingual spurs (18,17). This important change in the maxillary incisors' position is attributable to the effect of a decreased or even an elimination of the tongue thrusting habit. Both articles state that the change in the tongue's position thanks to the use of the spurs has encouraged the retroinclination as well as the extrusion of the incisors; thus favouring a correction in the anterior open bite (40).

Also, in the prospective study of F. Torres, R. Almeida *et al.* in 2010 (15) in which they compared removable (RPC) and fixed palatal crib (FPC) (associated with the use of high pull chin cup therapy), the authors reported that there was an extrusion and a verticalization of the incisors of both maxilla and mandible; the patients treated with fixed palatal crib and chin cup showed an extrusion of 1.3mm on average compared to the patients with a removable palatal crib and chin cup. Therefore, through the analysis of cephalometric data, it makes us conclude that the fixed palatal crib was 50% more efficient in producing an extrusion of the incisors than the removable one (15). Nevertheless, both appliances were able to correct the anterior open bite thanks to the palatal movement of the incisors. For instance, the authors reported that $U1.NA^\circ$ was of -6.13° in subjects undergoing treatment with the removable palatal crib compared to -3.01° in the other group treated with fixed palatal crib. Therefore, the patients treated with removable palatal crib showed twice more palatal tipping in their maxillary incisors than patients with fixed palatal crib. However, even if the removable palatal crib produced a greater palatal tipping, the overbite closure was higher in patients with fixed palatal crib thanks to the extrusion of the incisors (15). Therefore, this scientific article states that the fixed palatal crib associated to chincup was more advantageous in the closure of the overbite compared to the removable palatal crib. However, the RPC offered a greater retrusion of the incisors thus correcting the patients' overjet (43).

The magnetic bite block (MBB) and the rapid molar intruder (RMI) that were previously discussed were both successful in the retrusion of the maxillary incisors. Thus, the authors underline that the angulation of the incisors decreased of -4.1° (SD 2.3°), going from 105.6° (U1[^]SN) (SD 5.7°) in the magnetic bite block (MBB) group to 101.5° after the treatment. This reduction was more important in patients with MBB rather than rapid molar intruder (RMI): for instance, the retrusion of the incisors was of -1.2° (SD 4.5°). Consequently, it can be stated that the MBB group presented a difference of 2.8° in their retrusion compared to the RMI group. Both appliances produced an effective retrusion of the incisors, however patients treated with MBB presented a retrusion of more than twice the amount of RMI patients (41,44). Thus, this article suggests that MBB would be preferred in patients presenting an anterior open bite accompanied with an important protrusion of their maxillary incisors, therefore needing a higher retrusion of them (41).

H. Turkkahraman and E. Cetin (42) showed that the retrusion of the upper incisors was greater in patient with the use of posterior bite block and high pull headgear therapy compared to the use of posterior bite block and vertical pull chin cup (PBB-VPC); for instance, in patients treated with high pull headgear, the incisors retruded (U1PP[°]) of -7.40 (SD 5.72°) compared to -3.19° in patients treated with vertical pull chincup (SD 6.06°) (42). This might be due to the action of the high pull headgear, the authors describe it as having an action of distalisation and retrusion on the anterior teeth due to the labial bow of the appliance (42). Therefore, retrusion of the maxillary incisors is achievable in a greater way through the combined use of posterior bite blocks and high pull headgear. Consequently, both authors agreed on the positive effect of the bite block therapy in the correction of the anterior open bite, although both used different measuring methods on a distinct group of patients.

3. Molars' position

Molars' movement present a drastic importance in the correction of the anterior open bite; thus, their intrusion can provide an ending of the malocclusion. However, not all appliances act on the posterior teeth.

This is why in M.A Cassis, RR Almeida's article (22), the perpendicular distance from the maxillary first molar mesial point to the palatal plane (U6-PP) and from the mandibular first molar mesial point to the GoMe line (L6-GoMe) showed similar values in treated patients and in the control group (22); for instance, the distance from the upper first molar to the palatal plane (U6-PP) was of 0.90 mm (SD 0.95mm) in the treated group and of 0.66 mm (SD 1.14 mm) in the control group, and L6-GoMe was of 0.75 mm (SD 0.61 mm) in the treated group compared to 0.54 mm (SD 0.58 mm) in the control group. Therefore, the authors state that the combination of bonded spurs and high pull chin cup therapy does not produce a statistically relevant change regarding the vertical intrusion of upper and lower molars. However, Luiz Filipe Gonçalves Canuto, and G. Janson analysed a development of the vertical maxillary molars in patients treated with conventional spurs compared to bonded spurs; for instance, they found that Mx6-PP was of 0.61 mm (SD 0.71 mm) in patients treated with bonded spurs compared to 1.20 mm (SD 0.83 mm) in the subjects undergoing conventional spurs (23). Yet extra investigations must be clarified in order to assume if this is a standard effect of the conventional spurs (23). Logically, as the spurs are being located on the incisal region, their action on the molars' position will not be relevant compared to appliances acting directly on the posterior teeth.

In order to confirm that the fixed palatal crib could produce a higher anterior movement of the first maxillary molars, F. Torres *et al.* in 2010 (15) decided to measure the anteroposterior transposition of the maxillary molar. Hypothetically, one could think that the steady force of the tongue on the fixed palatal crib would generate a mesialization of the

molars, thus ending into a class II malocclusion, nevertheless this did not happen. Thus, U6-PP varied on a mean of 0.88 mm in patients treated with removable palatal crib, and of 0.92 mm in patients undergoing treatment with fixed palatal crib 1 year after the ending of the treatment. Therefore, the displacement of the first maxillary molars was not suggestive between both groups. The same authors conducted other studies in which they stated that the use of removable palatal crib did not promote a higher mesialization of the molars in comparison to patients without any treatment (15,45).

Other reviews focus on appliances acting primarily on the posterior sector, thus providing the reader with relevant results regarding the molars' change in its position.

In Albogha *et al.* scientific article (41), they reported data regarding the position of the maxillary molars compared to the palatal plane; patients undergoing treatment with MBB presented a more important intrusion of their maxillary molars compared to patients with RMI. The mean U6-PP decreased of -0.4mm in MBB patients before treatment, compared to a change of 0.1mm in RMI group. Therefore the intrusion of the upper maxillary molar was more important in patients treated with MBB than RMI (41). Magnetic bite block appliances present more efficacy both at the dentoalveolar level and at the skeletal level compared to rapid molar intruders. This is probably due to the deformability and the elastic modulus of the rapid molar intruders, as they decrease with time. However, the force offered by magnetic bite block system is constant (41).

In 2016, Insabralde *et al.* (46) performed a cephalometric study on 107 school children in order to affirm the dentoskeletal effect of the various therapies comparing the following appliances: the removable palatal crib, the bonded spurs and the high pull chin cup therapy in growing subjects presenting AOB. They analysed that patients undergoing treatment with the chin cup therapy presented a maxillary molar intrusion (U6-PP) of -0.35 mm (SD 1.01 mm)

and a mandibular molar intrusion (L6-PM) of -0.12 mm (SD 0.97 mm). On the other hand, in patients treated with spurs or with removable palatal crib, they ended with an extrusion of both their maxillary and mandibular molars: the values were respectively of U6-PP: 0.40 mm (SD 1.05 mm), 0.65 mm (SD 1.41 mm), and L6-MP: 0.11 mm (SD 0.96 mm), and 0.73 mm (SD 1.21 mm). They determined that the removable palatal crib and spurs corrected the dental AOB and additionally, the chin cup controlled the vertical intrusion of maxillary molars thus producing an important decrease in the vertical facial height. Thus it can be understood, through the analysis of this scientific article, that chin cup therapy should be used with other appliances in order to benefit from both dental and skeletal effects (46).

4. Alteration of the hyper divergent growth pattern

Finally, changes in the growth pattern are usually present in patients treated for an anterior open bite malocclusion. In the treated group of Michelle Alonso Cassis, Renato Rodrigues de Almeida, Guilherme Janson, Renata Rodrigues de Almeida-Pedrin and Marcio Rodrigues de Almeida (22), the Ar.GoMe (°) diminished of -1.23° (SD 2.13°), but it increased of 0.22° (SD 1.62°) in the control group. The decrease in the gonial angle was more important in the treated group than in the control group; this could have possibly happened due to the better fulfilment of the patients.

Besides, we previously mentioned that anterior open bite is frequently associated with an increase in the vertical growth (29). Therefore, the second article conducted by Luiz Filipe Gonçalves Canuto, and G. Janson in which they compared the effects of bonded and conventional lingual spurs, clearly states that these patients require another treatment

approach coordinated at the vertical control of the facial growth. This is why chin cup treatment is demonstrated by many authors as an important appliance in the control of the vertical growth pattern (22,23,47).

The authors F. Torres, R. Almeida, R. Almeida-Pedrin, F. Pedrin and L. Paranhos, in 2010 (15) in the study of the fixed and removable palatal crib revealed that the points SN.GoGN, SN.PP and NS.Gn did not exhibit critical modification between both groups. This was also the case for cephalometric data such as SNA, Co-A, SNB, Ar-Go, Ar.GoMe, CO-Gn and ANB; they were not described by the authors as significant regarding the changes in maxillary and mandibular skeletal component. Therefore, palatal cribs, as previously mentioned, produce an effect more focused on dentoalveolar components, thus not affecting skeletal elements (15).

In the study comparing the magnetic bite blocks versus the adjusted rapid molar intruders (41), the majority of the patients presenting hyper divergent growth problems also have a high posterior dentoalveolar height (48). The SN-PP° in patients undergoing treatment with MBB decreased of -0.6° (SD 1.1°) compared to patients treated with RMI in which the decrease was of -1.4° (SD 1.3°). Therefore, through the study of this scientific paper, it can be highlighted that RMI presents a greater effect on the palatal plane; producing a larger rotation of the occlusal plane in comparison to the MBB.

b. Camouflage treatment of anterior open bite

In advanced cases in which interceptive treatment cannot provide a sufficient correction of the anterior open bite malocclusion, camouflage therapy can be considered as an additional option. For instance, multiple mild cases of anterior open bite can be corrected

through the use of fixed appliances that could provide dental movements without acting on the skeletal characteristics. This is why treatments that include the use of mini implants/miniplates, dental extractions, or even multiloop edgewise archwire appliance can provide the clinician with an adequate camouflage therapy. We will therefore analyse and discuss the various options available regarding non-surgical treatments in the correction of the anterior open bite.

1. Skeletal anchorage system

The skeletal anchorage system which consists of miniplates made of titanium, are provisionally implanted into the upper or the lower jaw, serving as an anchorage; thus, helping in the achievement of posterior teeth intrusion. The AOB closure can be achieved through the intrusive movement of the molars and the extrusion of the incisors. Moreover, it is known that the intrusion of the dentoalveolar elements is more stable than its extrusion (49).

Therefore, Chunlei Xun *et al.* in 2007 (5), through the use of microscrew anchorage aimed in closing the skeletal anterior open bite. In their study, patients were aged 18.7 years old as a mean, and presented a class II malocclusion associated with an anterior open bite. For instance, the overbite was increased by 4.2mm compared to the initial overbite which was - 2.2mm, thus allowing a closure of the AOB (5).

Moreover, Shingo Kuroda *et al.* in 2005 (50) performed a comparison between skeletal anchorage and orthognatic surgery in adults in order to treat the anterior open bite (50–52). Their study consisted of 23 non growing subjects with a mean age of 21.6 years old, presenting an anterior open bite of more than 3.0mm. They showed through their study that the closure of the anterior open bite can be achieved in a agreeable way with skeletal anchorage implants. The overbite was increased of 6.8mm (SD 1.7mm) in patients treated

with implants, and 7.0mm (SD 2.5mm) in patients treated surgically; therefore statistically, both groups of patients achieved a similar increase in their overbite. However, treatment duration was shorter and more pleasant for patients going through skeletal anchorage implants rather than surgery (50); treatment lasted 27.6 months in the implant group whereas it was extended to 33.5 months in patients treated surgically. Thus, these literature studies depict that microscrew skeletal anchorage is preferred in comparison to orthognatic surgery in the increase of the overbite (5,50).

On the other hand, mutiple authors in Hiroshima in 2019 (53) performed a case report in which they underlined the therapeutic possibility in order to cure a patient presenting an open bite through the use of miniscrews and the extraction of molars. In this case, the patient additionally presented a temporomandibular joint disorder. After 36 months, the overbite increased from an initial of -6.0mm to 1.5mm (53). In agreement with the previous papers, it can be said that the use of miniscrew and dental extractions are efficient in the treatment of severe cases in non growing patients with anterior openbite.

Nevertheless, it is of a big importance to underline the movements that occur regarding the incisors' position. Thus, in Chunlei Xun's paper (5), the authors showed that the upper maxillary incisors had an extrusion of 1.3mm (SD 1.0mm) and a retroinclination of 5.0° (SD 5.1°) without any elastics (5). S. Kuroda, Y. Sakai, N. Tamamura *et al.* in 2007 (50) exposed that in patients treated with skeletal anchorage implants, the incisors were not elongated compared to the patients treated surgically; nevertheless both treatments provided a closure of the anterior open bite (50). Moreover, patients presenting an anterior open bite usually present an elongated face, thus the extrusion of the anterior teeth can accentuate this condition. This is a supplementary reason why Shingo Kuroda *et al.* (50) preferred using implant screw in order to close the anterior open bite rather than performing surgery.

Convincingly, it can be understood that both scientific articles agreed on the statement that incisors can be certainly retruded without the need of performing orthognatic surgery (5,50).

As previously mentioned, the intrusion of maxillary and mandibular molars is a complex mission for the practitioners in the closure of the AOB; this is mostly due to the lack of vertical anchorage. This is the reason why many authors were able to provide an intrusion of the posterior dentoalveolar region through the use of miniscrew anchorage (5,50,54). For instance, upper molars were intruded on a mean of -1.8mm and mandibular molars of -1.2mm, according to Chunlei Xun *et al.* (5). Additionally, S. Kuroda *et al.* (50) showed a great intrusion of maxillary and mandibular molars through the application of the skeletal anchorage compared to surgery; the molars intruded of -2.3mm (SD 2.0mm) whereas with surgery they did not present such great intrusion, leading to a change in the U6/PP from 29.0mm pre-treatment to 29.02mm post-treatment. Therefore, statistically talking, skeletal anchorage is accordingly more efficient in performing intrusion of the molars compared to surgical procedures (5,50), thus producing an anticlockwise rotation of the mandible.

Consequently, both authors agreed on the use of skeletal anchorage systems in order to achieve a proper intrusion of maxillary and mandibular molars.

Besides, studies conducted by Lee TC *et al.* in 2008 (54) also underlined how the use of titanium miniplates and miniscrews can promote an important application in the treatment of the anterior open bite (3). It is depicted through their work that the application of titanium L-shaped miniplates for anchorage can produce a rapid intrusion of mandibular molars (49,3). This intrusion was rapidly achieved through 5 months (3), which was slightly faster than Chunlei Xun's study whom completed it in a mean of 6.8 months (5). Additionally, the case report of M. Kaku *et al.* (53) described the molars' intrusion using microscrew anchorage therapy and extraction in order to correct the anterior open bite. The upper molars were

intruded by 1mm (53). Therefore, just as C. Xun *et al.* (5) mentioned beforehand, the use of microscrew anchorage can produce an intrusion of maxillary and mandibular molars; closing the AOB, through the counterclockwise rotation of the mandible (5,53).

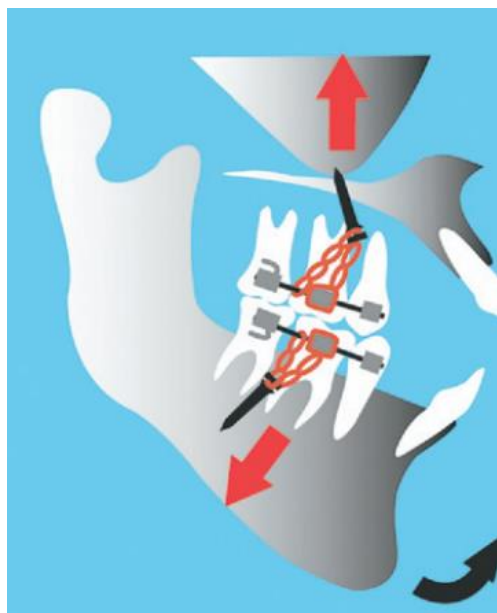


Fig 16.
Representation
of molar
intrusion(51)



Fig 17.

Implants used as anchorage system(51)

2. Skeletal anchorage vs. Surgery

Nevertheless, it is important to underline that through the performance of surgery by S. Kuroda, Y. Sakai, N. Tamamura *et al.* (50), the authors were not able to decrease the mandibular plane angle, however this could be achieved while using implants for skeletal anchorage. Thus, the mandibular plane angle decreased of -3.3° (SD 1.5°) in patients treated with implants for skeletal anchorage (28). This skeletal change was also present in ChunLei Xun *et al.* (5) study; the mandibular plane angle reduced considerably by a mean of -2.3° (SD 0.8°) (5), therefore statistically talking, the use of microscrew anchorage and implants provide a greater reduction of the mandibular angle plane in comparison to surgical procedures. Also, M.Kaku *et al.* (53) stressed that the intrusion of the molars produced a counterclockwise rotation of the mandible.

3. Extraction

Multiple orthodontists took into consideration dental extractions in order to treat the anterior open bite.

G.P Cortez *et al.* performed a case report in 2015 in which they analysed the AOB treatment outcomes after the extraction of the first molar (56). The patient was a women of 18 years presenting a skeletal AOB with a negative overbite of -1mm. After performing a multidisciplinary therapy a 2 mm positive overbite was achieved 2 years later. K.F Oliveira *et al.* (57) also completed an article report in which they studied the case of a 19 years old patient presenting a skeletal AOB and a class II intermaxillary relationship. The authors performed the extractions of the first molars both in the upper and lower maxilla. Results favoured the closure of the AOB after the application of this protocole: thus, the overbite increased from an initial value of -5.0 mm to a final positive overbite of 0.7 mm, incisors were retroclined (1.NA°) from 21.9° initially to a post therapy value of 18.2° (57). It is significant to take into consideration the changes that occurred in the posterior dentoalveolar region; the posterior teeth were not extruded and the mandibule achieved an anticlockwise rotation. Therefore, it can be stated that regardless of their measuring methods, both authors agreed on the application of this treatment protocol in the closure of the anterior open bite.

Even though molars may present a drastic role in Angle's relationship, the correct pre-extraction diagnosis and treatment plan can be favourable for the patient and help achieve agreeable esthetic results (56,57). Nevertheless, this treatment option cannot be applied to all patients, there are conditions that make patients more or less favourable to undergo extractions; thus in 1995, Sarver and Weissman (58) stated that patients could undergo dental extraction if they present the following criteria:

- Proclined maxillary and mandibular incisors

- Small gingival exposure while smiling
- Physiologic craneofacial relationship
- A maximum of 2-3 mm of upper incisor exposure while being at rest

4. Multiloop Edgewise Archwire Therapy (MEAW)

Finally, an alternative treatment option can be stated for the treatment of the anterior open bite; the multiloop edgewise archwire therapy (MEAW). In 1987, Kim presented the following therapy which consists in the use of a rectangular arch associated with multiple loops and combined with intermaxillary vertical elastics in the anterior sector (2).

In a study performed by Gerson Luiz Ulema Ribeiro *et al.* in 2010, the authors aimed in describing the treatment results achieved thanks to the application of the MEAW protocol (59). The patient was a 14 years old female, presenting a class III intermaxillary malocclusion and an anterior open bite of 3.5 mm. The clinicians achieved a closure of the AOB after 3 years of therapy, and the following results were obtained; the patient achieved a positive overbite, the incisors were retroclined from an initial angle of 19° to 11° and the incisor mandibular plane angle reduced from 97° to 83° meaning that the lower incisors were retroclined (59). Additional studies are needed in order to clarify molar intrusion thanks to this treatment (2,28).

Moreover, Toshiya Endo *et al.* performed a study in which they analyzed the cephalometric modifications observed in subjects presenting AOB and treated with MEAW therapy (60). The patients overbite increased considerably going from an initial negative value of -0.8mm (SD 1.3 mm) to a final post-treatment overbite of 1.6 mm (1.1 mm). Therefore, positive overbite was achieved, however this was also thanks to the extrusion of the incisors; for instance the lower mandibular incisors L1-ML extruded by 1.5 mm (SD 2.3

mm) (60).

Therefore, both authors agreed that the use of MEAW therapy could provide an adequate correction of the anterior open bite, even though their active treatment technique was different; for instance Ribeiro *et al.* used a stainless steel archwire of 0.019" X 0.026", whereas Toshiya *et al.* used an appliance of stainless steel archwire made of 0.016" X 0.022" (59,60).

Therefore, through the study of this scientific article, it can be stated that MEAW can be used in the treatment of the AOB. Nevertheless, this therapy presents various disadvantages: for instance the clinician needs an important compliance from the patient as the elastics need to be worn for a big amount of time daily (59).



Fig 18. Multiloop Edgewise Archwire Therapy with vertical elastics placed (61)

c. Stability of Open bite correction

One of the main concerns of the clinician is the longstanding stability of the correction of the anterior open bite. As previously discussed, many treatment possibilities are available in the literature in order to treat the anterior open bite, nevertheless, very few of them assure the orthodontics with a long-term stability (62).

For instance, G. Janson, FP Valarelli *et al.* (63) found that in their patients treated with extraction revealed a stability of 74.2% compared to the patients treated without extractions

(61.9%) (63). On the other hand, authors such as D. Remmers *et al.* (62), P. Salehi *et al.* (64), S. Geron *et al.* (65), performed studies in which they did not conclude with statistical difference concerning the stability of the AOB in patients treated with or without extraction therapy (62,64,65).

Besides, in 2012, M. Teittinen *et al.* (66) affirmed that patients presenting class II malocclusions and long face appearances had a higher tendency to relapse compared to patients presenting a class I or a class II intermaxillary relationship. This is probably due to a need of an important mandibular increase in these patients thus ending in a drastic anterior open bite relapse. Also, the same authors displayed in their study that patients with class II malocclusion but with low facial heights had less relapse compared to class III patients presenting increase mandibular plane angles (66).

Y. Al-Thomali *et al.* (30) declared that LeFort I osteotomy in order to reposition the maxilla presented a higher stability in regard to mandibular sagittal split osteotomy (30). Thus, in the three distinct studies performed by L. Espeland *et al.* (67) , M. Teittinen *et al.* (66) and K. Swinnen *et al.* (68), the authors carried out surgical LeFort I osteotomy alone, and the stability of the anterior open bite correction varied between 87.9% to 100% (66–68). On the other side, studies that conducted multiple LeFort I osteotomy and surgeries of both maxillae showed a lower stability (70-75%) compared to the patients treated with one single LeFort I Osteotomy (65,66,69).

In the work of MA Cassis *et al.* (34), the authors evaluate the stability of the AOB treatment of patients treated with bonded spurs and high pull chin cup and the therapy offer a stability of 96% after 3 years post treatment (34).

Zuroff *et al.* (70) performed a study in which they assessed the post non-surgical treatment stability of AOB after using 10 years of retention. They underlined that prediction

could not be done regarding which patients would present a higher post treatment stability while assessing pre-treatment information (70).

Therefore, little evidence is available on the stability of the results and only a few studies have reported therapeutic stability over time.

d. Limitations

Through this literature study, a lack of standardization can be noticed; for instance, each article studies different ranges of age. Additionally, each author will depict cases of anterior open bite with a diverse open bite value (in mm). Also, every study will take into consideration a specific number of patients, for example C. Xun *et al.* evaluated 12 patients (5), whereas H. Albogha performed their study through 15 patients (41). Besides, multiple comparative study did not make any differentiation regarding skeletal or dental anterior open bite; for instance, this was the case for LFG. Canuto's *et al.* report (23). Moreover, it can be analysed that some articles (23) took into consideration habits such as for instance tongue sucking or tongue thrusting, nevertheless other authors such as H. Turkkahraman *et al.* (42) did not.

This lack of standardisation could bring a significant error therefore leading to a decreased reliability and less consistency in the quality of this literature review.

V. CONCLUSION

1. Current orthodontics highlight that the treatment of the anterior open bite is not restricted to one single treatment protocol or to a specific appliance; for instance, multiple treatment plans are advised for its correction.

As described, clinicians can choose between an interceptive or a camouflage technique

depending on their patient's age, the cephalometric characteristics and on the anterior open bite severity. Thus, treatments can include the use of spurs (bonded or conventional), magnetic bite blocks, fixed or removable palatal cribs, all possibly combined with vertical chin cup therapy. Moreover, these interceptive treatments last on an average of 12 months in order to achieve acceptable results.

Additionally, the orthodontist could also choose to perform dental extraction, or use a skeletal anchorage technique, or even apply the multiloop edgewise archwire therapy in order to treat the subjects' malocclusion. Temporary anchorage devices are considered to be highly effective options when compared to surgical therapeutic alternatives. Therefore, it is not compulsory to undergo radical fixed orthodontic and surgical treatment in order to treat an anterior open bite.

Although numerous approaches are available, the majority of them are based on small samples and important discrepancies between the variables exist, thus a statistically evidenced based review recommending a gold standard treatment option is absent.

2. Cephalometric variations have been distinguished in the scientific studies and it can be stated that respectful to the overbite changes; the literature review noted an average increase ranging from 3.1 mm to 5.44 with interceptive treatment. Besides, patients undergoing treatment with temporary anchorage device experienced a mean increase of their overbite ranging between 4.2 and 6.8mm, therefore offering a very good option in anterior open bite correction. On the other hand, incisors were retruded in the majority of the scientific reviews, ranging from -2.8° to -3.86° , maxillary molars were intruded in an average of 0.83 mm and mandibular molars of 0.75mm. Retrusion and extrusion of incisors achieved greater cephalometric changes compared to posterior teeth

intrusion, although this last treatment option seems to be more stable and help reduce facial height. Finally, it can be highlighted that most of the changes are localized on the dentoalveolar region; skeletal improvement is tougher to achieve and happens usually in small increments (such as mandibular plane changes for instance).

3. One of the fundamental issue of the anterior open bite treatment is its stability. This last one is linked not only to the treatment choice, but also to the management of the various variables which intervene in the aetiology of this malocclusion. Indeed, the rest position of the tongue is an important parameter, as well as other habits, presenting a significant impact in the long-term stability of the treatment. Only a few studies have drawn a therapeutic stability over time, underlying that relapse is present in approximately 20-25% of the treatments. Insufficiency regarding a long-term posterior treatment stability in anterior open bite relapse is present, thus, leading to various conclusions.

Social Responsibility

Nowadays, a vast number of the population will present various habits such as digit sucking habit, tongue thrusting or chronic mouth breathing amongst many others, which could produce apical base alteration, thus leading to an anterior open bite malocclusion. The

anterior open bite treatment has received insufficient attention in the literature despite its great social implication. In spite of its universal variability, it is a highly frequent malocclusion provoking multiple complications for the patient, being not only aesthetic but also functional. For instance, it is known that the anterior open bite can render the occlusion less physiological, leading to postural problems. Additionally, patients will present mastication and phonation abnormalities which will decrease their quality of life.

This issue is of great importance since the unsatisfactory results and the relapse of the treatment are common in the orthodontic sector.

This thesis reviews the relevant existing literature, insisting particularly on the anterior open bite prevalence and aetiological factors. The analysis of the cephalometric variations as well as the treatment modalities are highlighted with the aim of offering clinicians a gold standard treatment plan in order to decrease the prevalence of this malocclusion.

VI. BIBLIOGRAPHY

1. Cardarelli F, Dentaria P. Elastodontic Therapy with A . M . C . O . P . CASE REPORT _ 4 DDS Filippo Cardarelli • Odontoiatra Specialista in Ortognatodonzia.
2. Kim YH. Anterior openbite and its treatment with multiloop edgewise archwire. Angle Orthod. 1987;

3. Reichert I, Figel P, Winchester L. Orthodontic treatment of anterior open bite: a review article--is surgery always necessary? *Oral Maxillofac Surg.* 2014;18(3):271–7.
4. Byte O, Classe II. Correzione delle Open Byte in pazienti in crescita con bioattivatore elastodontico OPEN Amcop : un caso clinico. :1–3.
5. Xun C, Zeng X, Wang X. Microscrew anchorage in skeletal anterior open-bite treatment. *Angle Orthod.* 2007;77(1):47–56.
6. Karacay S, Akin E, Ortakoglu K, Bengi AO. Dynamic MRI evaluation of tongue posture and deglutitive movements in a surgically corrected open bite. *Angle Orthod.* 2006;
7. Caprioglio A, Fastuca R. Etiology and treatment options of anterior open bite in growing patients: a narrative review. *Orthod Fr.* 2016;87(4):467–77.
8. de Sousa RV, Ribeiro GLA, Firmino RT, Martins CC, Granville-Garcia AF, Paiva SM. Prevalence and associated factors for the development of anterior open bite and posterior crossbite in the primary dentition. *Braz Dent J.* 2014;25(4):336–42.
9. Grabowski R, Stahl F, Gaebel M, Kundt G. Zusammenhang von Okklusionsbefunden und orofaziale myofunktionellem Status im Milch- und frühen Wechselgebiss: Teil I: Häufigkeit von Gebissanomalien. *J Orofac Orthop.* 2007;68(1):26–37.
10. Tavares CAE, Allgayer S. Open bite in adult patients. *Dental Press J Orthod.* 2019;24(5):69–78.
11. McGRATH C, PANG HN, LO ECM, KING NM, HÄGG U, SAMMAN N. Translation and evaluation of a Chinese version of the Child Oral Health-related Quality of Life measure. *Int J Paediatr Dent.* 2008;18(4):267–74.
12. BS P. Management of Open Bite. In: *Orthodontics: Principles and Practice.* 2017.
13. Cangialosi TJ. Skeletal morphologic features of anterior open bite. *Am J Orthod.* 1984;
14. Ngan P, Fields HW. Open bite: a review of etiology and management. *Pediatr Dent.* 1999;
15. Torres FC, de Almeida RR, de Almeida-Pedrin RR, Pedrin F, Paranhos LR. Dentoalveolar comparative study between removable and fixed cribs, associated to chincup, in anterior open bite treatment. *J Appl Oral Sci.* 2012;20(5):531–7.
16. McSherry PF. Aetiology and treatment of anterior open bite. *J Ir Dent Assoc.* 1996;42(2):20–6.
17. Rijpstra C, Lisson JA. Ätiologie des frontalen offenen Bisses: Ein Review. *J Orofac Orthop.* 2016;77(4):281–6.
18. Garrett J, Araujo E, Baker C. Open-bite treatment with vertical control and tongue reeducation. *Am J Orthod Dentofac Orthop.* 2016;
19. Nascimento MHA, De Araújo TM, Machado AW. Severe anterior open bite during mixed dentition treated with palatal spurs. *J Clin Pediatr Dent.* 2016;
20. Bearn D. Orthodontics and Dentofacial Orthopedics. *J Orthod.* 2002;
21. J.D. S, S. K. Retrospective revelations: twenty orthodontically treated individuals with unilateral cleft lip and palate. *World J Orthod.* 2004;
22. Cassis MA, De Almeida RR, Janson G, De Almeida-Pedrin RR, De Almeida MR. Treatment effects of bonded spurs associated with high-pull chincup therapy in the treatment of patients with anterior open bite. *Am J Orthod Dentofac Orthop.* 2012;142(4):487–93.
23. Canuto LFG, Janson G, De Lima NS, De Almeida RR, Cançado RH. Anterior open-bite treatment with bonded vs conventional lingual spurs: A comparative study. *Am J Orthod Dentofac Orthop.* 2016;149(6):847–55.
24. Pisani L, Bonaccorso L, Fastuca R, Spina R, Lombardo L, Caprioglio A. Systematic

- review for orthodontic and orthopedic treatments for anterior open bite in the mixed dentition. *Prog Orthod* [Internet]. 2016;17(1). Available from: <http://dx.doi.org/10.1186/s40510-016-0142-0>
25. Heimer MV, Katz CRT, Rosenblatt A. Anterior open bite: A case-control study. *Int J Paediatr Dent*. 2010;
 26. Regina C, Katz T, Rosenblatt A. Nonnutritive sucking habits and anterior open bite in brazilian children: A longitudinal study. *Pediatr Dent*. 2005;
 27. Deguchi T, Kurosaka H, Oikawa H, Kuroda S, Takahashi I, Yamashiro T, et al. Comparison of orthodontic treatment outcomes in adults with skeletal open bite between conventional edgewise treatment and implant-anchored orthodontics. *Am J Orthod Dentofac Orthop*. 2011;
 28. Kim YH, Han UK, Lim DD, Serranon MLP. Stability of anterior openbite correction with multiloop edgewise archwire therapy: A cephalometric follow-up study. *Am J Orthod Dentofac Orthop*. 2000;
 29. Cozza P, Baccetti T, Franchi L, Mucedero M, Polimeni A. Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition. *Am J Orthod Dentofac Orthop*. 2005;128(4):517–9.
 30. Al Thomali Y, Basha S, Mohamed RN. The Factors Affecting Long-Term Stability in Anterior Open-Bite Correction - A Systematic Review. *Turkish J Orthod*. 2017;
 31. Ashish K, Kumar M, Avinash J, Shailesh T. Introduction to interceptive orthodontics. 2017. p. 118–20.
 32. P. S, A. A, A. V. Age changes of jaws and soft tissue profile. *Sci World J* [Internet]. 2014;2014. Available from: <http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L600647855%0Ahttp://dx.doi.org/10.1155/2014/301501%0Ahttp://wx7cf7zp2h.search.serialssolutions.com/?sid=EMBASE&issn=1537744X&id=doi:10.1155/2014/301501&atitle=Age+changes+of+jaws+and+>
 33. Hlongwa P. Cephalometric analysis : manual tracing of a lateral cephalogram. *South African Dent J*. 2019;74:318–22.
 34. Cassis MA, de Almeida RR, Janson G, Aliaga-Del Castillo A, de Almeida MR. Stability of anterior open bite treatment with bonded spurs associated with high-pull chin cup. *Orthod Craniofac Res*. 2018;
 35. Giuntini V, Franchi L, Baccetti T, Mucedero M, Cozza P. Dentoskeletal changes associated with fixed and removable appliances with a crib in open-bite patients in the mixed dentition. *Am J Orthod Dentofac Orthop*. 2008;
 36. Leite JS, Matiussi LB, Salem AC, Provenzano MGA, Ramos AL. Effects of palatal crib and bonded spurs in early treatment of anterior open bite: A prospective randomized clinical study. *Angle Orthod*. 2016;
 37. Huang GJ, Justus R, Kennedy DB, Kokich VG. Stability of anterior openbite treated with crib therapy. *Angle Orthod*. 1990;
 38. McRae EJ. Bondable lingual spur therapy to treat anterior open bite. *ProQuest Diss Theses*. 2010;
 39. Proffit W, Fields H, Sarver D. *The Orthodontic Problem*. Contemporary Orthodontics. St Louis. 2013.
 40. Justus R. Correction of anterior open bite with spurs: long-term stability. *World J Orthod*. 2001;
 41. Albogha MH, Takahashi I, Sawan MN. Early treatment of anterior open bite: Comparison of the vertical and horizontal morphological changes induced by magnetic

- bite-blocks and adjusted rapid molar intruders. *Korean J Orthod.* 2015;45(1):38–46.
42. Turkkahraman H, Cetin E. Vergleich von zwei Strategien zur Frühbehandlung des skelettal offenen Bisses: PBB-VPC (“posterior bite block-vertical pull chin cup”) vs. PBB-HPH (“posterior bite block-high pull headgear”). *J Orofac Orthop.* 2017;78(4):338–47.
 43. Rodrigues de Almeida R, Ursi WJ. Anterior open bite. Etiology and treatment. *Oral Health.* 1990;
 44. Carano A, Machata W, Siciliani G. Noncompliant treatment of skeletal open bite. *Am J Orthod Dentofac Orthop.* 2005;
 45. Torres F, Almeida RR, De Almeida MR, Almeida-Pedrin RR, Pedrin F, Henriques JFC. Anterior open bite treated with a palatal crib and high-pull chin cup therapy. A prospective randomized study. *Eur J Orthod.* 2006;28(6):610–7.
 46. Insabralde NM, De Almeida RR, Castanha Henriques JF, Freire Fernandes TM, Flores-Mir C, De Almeida MR. Dentoskeletal effects produced by removable palatal crib, bonded spurs, and chincup therapy in growing children with anterior open bite. *Angle Orthod.* 2016;
 47. Sithole N, Khan M, Sethusa M. Skeletal morphologic features of Anterior Open Bite Malocclusion amongst black patients visiting the Medunsa oral health centre file:///Users/jasminemot/Desktop/JAS 5/THESE/SOURCE/THESE/sourcedesourcedealemida.pdf. *South African Dent J.* 2020;75(8):425–31.
 48. Buschang PH, Jacob H, Carrillo R. The morphological characteristics, growth, and etiology of the hyperdivergent phenotype. *Semin Orthod.* 2013;
 49. Umemori M, Sugawara J, Mitani H, Nagasaka H, Kawamura H. Skeletal anchorage system for open-bite correction. *Am J Orthod Dentofacial Orthop.* 1999;
 50. Kuroda S, Sakai Y, Tamamura N, Deguchi T, Takano-Yamamoto T. Treatment of severe anterior open bite with skeletal anchorage in adults: Comparison with orthognathic surgery outcomes. *Am J Orthod Dentofac Orthop.* 2007;132(5):599–605.
 51. Kuroda S, Sugawara Y, Deguchi T, Kyung HM, Takano-Yamamoto T. Clinical use of miniscrew implants as orthodontic anchorage: Success rates and postoperative discomfort. *Am J Orthod Dentofac Orthop.* 2007;
 52. Deguchi T, Takano-Yamamoto T, Kanomi R, Hartsfield JK, Roberts WE, Garetto LP. The use of small titanium screws for orthodontic anchorage. *J Dent Res.* 2003;
 53. Kaku M, Yamamoto T, Yashima Y, Izumino J, Kagawa H, Ikeda K, et al. Correction of skeletal class II severe open bite with temporomandibular joint disorder treated by miniscrew anchorage and molar extraction: A case report. *J Med Case Rep.* 2019;13(1):1–9.
 54. Lee TCK, Leung MTC, Wong RWK, Rabie ABM. Versatility of skeletal anchorage in orthodontics. *World J Orthod.* 2008;9(3):221–32.
 55. Umemori M, Sugawara J. CONTINUING EDUCATION ARTICLE Skeletal anchorage system for open-bite correction. *Am J Orthod Dentofac Orthop.* 1999;166–74.
 56. Qh O, Gzvtcevkqpu TUVO, Cpqocn U, Ku V, Kp H, Gvkqnqi VJG, et al. 1RGP DKVG VTGCVOPV YKVJ İTUV OQNCT GZVTCEVKQP % CUG TGRQTV. 2016;264–70.
 57. Fernanda Mendes Oliveira K, Maria Salvatore Freitas K DE, Pinelli Valarelli F, Hermont Caңado R, Carmo Menezes C DE. Molar Extraction in Severe Open Bite Treatment. *J Surg Clin Dent – JSCD JSCD [Internet].* 2015;6(1):11–6. Available from:

- <http://www.mastereditora.com.br/jscd>
58. Sarver DM, Weissman SM. Nonsurgical treatment of open bite in nongrowing patients. *Am J Orthod Dentofac Orthop.* 1995;108(6):651–9.
 59. Ribeiro GLU, Regis S, Da Cunha TDMA, Sabatoski MA, Guariza-Filho O, Tanaka OM. Multiloop edgewise archwire in the treatment of a patient with an anterior open bite and a long face. *Am J Orthod Dentofac Orthop.* 2010;
 60. Endo T, Kojima K, Kobayashi Y, Shimooka S. Cephalometric evaluation of anterior open-bite nonextraction treatment, using multiloop edgewise archwire therapy. *Odontology.* 2006;94(1):51–8.
 61. Basukala DL. Multiloop Edgewise Arch-wire Technique for Skeletal Class III Openbite: A Case Report. *Orthod J Nepal.* 2018;7(2):56–9.
 62. Remmers D, Van’T Hullenaar RWGJ, Bronkhorst EM, Bergé SJ, Katsaros C. Treatment results and long-term stability of anterior open bite malocclusion. *Orthod Craniofacial Res.* 2008;11(1):32–42.
 63. Janson G, Valarelli FP, Beltrão RTS, de Freitas MR, Henriques JFC. Stability of anterior open-bite extraction and nonextraction treatment in the permanent dentition. *Am J Orthod Dentofac Orthop.* 2006;129(6):768–74.
 64. Salehi P, Pakshir HR, Hoseini SAR. Evaluating the Stability of Open Bite Treatments and Its Predictive Factors in the Retention Phase during Permanent Dentition. *J Dent (Shiraz, Iran).* 2015;
 65. Geron S, Wasserstein A, Geron Z. Stability of anterior open bite correction of adults treated with lingual appliances. *Eur J Orthod.* 2013;
 66. Teittinen M, Tuovinen V, Tammela L, Schätzle M, Peltomäki T. Long-term stability of anterior open bite closure corrected by surgical-orthodontic treatment. *Eur J Orthod.* 2012;
 67. Espeland L, Dowling PA, Mobarak KA, Stenvik A. Three-year stability of open-bite correction by 1-piece maxillary osteotomy. *Am J Orthod Dentofac Orthop.* 2008;
 68. K. S, C. P, G. W, I. DB, S. F, K. H, et al. Skeletal and dento-alveolar stability after surgical-orthodontic treatment of anterior open bite: a retrospective study. *European journal of orthodontics.* 2001.
 69. Fontes AM, Joondeph DR, Bloomquist DS, Greenlee GM, Wallen TR, Huang GJ. Long-term stability of anterior open-bite closure with bilateral sagittal split osteotomy. *Am J Orthod Dentofac Orthop.* 2012;
 70. Zuroff JP, Chen SH, Shapiro PA, Little RM, Joondeph DR, Huang GJ. Orthodontic treatment of anterior open-bite malocclusion: Stability 10 years postretention. *Am J Orthod Dentofac Orthop.* 2010;

VII. ANNEXES

“Treatment effect of bonded spurs associated with high pull chin-up therapy in the treatment of patients with anterior open bite”

Authors & Date	Description of the study	Materials	Results	Conclusion
Michelle Alonso Cassis, Renato Rodrigues de Almeida, Guilherme Janson, Renata Rodrigues de Almeida Pedrin, Marcio Rodrigues de Almeida <i>October 2012 - AJO-DO</i>	Longitudinal investigation: study the cephalometric changes due to bonded spurs + high pull chin-up therapy in children with Angle class I + AOB - HPC of 450-500g of force per side/patients 14-16 hrs a day for 12 months	- 30 patients, - mean age: 8.14, - AOB -3.93 mm, TT duration: 12 months - untreated control group of 30 patients with a mean age of 8.36 and mean AOB of -3.93 was followed for comparison with t test	Treated group: <ul style="list-style-type: none"> • ↓ of gonial angle • ↑ overbite • palatal tipping of max.Inc • vertical dentoalv. development of the upper and lower incisors • Vertical dentoalveolar development of the upper and lower molars was similar in treated & control group → chin cup was not effective for vertical control in this sample of patients • No ≠ btw the 2 groups for sex distribution nor for the initial and final ages • Overbite correction was produced by dental effect (not skeletal) <ol style="list-style-type: none"> 1. <u>Iscan & Sankey</u>: VCC: good for skeletal OB, ↓ gonial A° 2. <u>Torres & Pedrin</u> RPC + high pull chin-up therapy did NOT produce favorable skeletal effect on the A°. 	Use of BLS + high pull chin-up therapy was efficient in the treatment of the AOB in 86.7% of patients with 5.23mm OB ↑

« Orthodontic and orthopedic treatment for anterior open bite in children »

Authors & Date	Description of the study	Materials	Results	Conclusion
Debora A Lentini Oliverira Fernando R Carvalho Clarissa Garcia Rodrigues Qingsong Ye Rongdang Hu Hideko Minami Sugaya Luciane BC carvalho Lucila BF Prado Gilmar F Prado 2014	Randomised controlled trials of orthodontic or orthopedic TT or both to correct AOB Main actions: <ul style="list-style-type: none"> • orthopaedic functional appliance: SN2, SN3 FR4 • <u>fixed</u> appliances: multi-loop edgewise archwire, Mcloughlin, Bennett, Trevisi • <u>Removable</u> appliances: tongue crib, fixed intraoral habit appliance, removable habit breaker 	Children/adolescent, over 80% are 16 years old or younger at the start of the TT - present AOB, - have stopped sucking habits >1 year before the TT, - do not have class III or cleft lip/palate or both or other craniofacial syndrome	<ul style="list-style-type: none"> • FR4 + lip sealing vs no treatment Open bite correction: ↑ of overbite from -3.9 mm to 1.1 mm Position of the incisors: 4 degrees in the treated and 0.3 in the control group	Poor evidence that Frankel's function regulator-4 (FR-4) with lip-seal training + removable appliance with palatal crib associated with high-pull chin cup are able to correct open bite in children. Poor standardization of diagnostic criteria, inclusion criteria, validity measures to evaluate outcomes and important methodological limitations.

Effect of molar intrusion with temporary anchorage devices in patients with anterior open bite: a systematic review

Authors & Date	Description of the study	Materials	Results	Conclusion
Ahmad Saleem Alsafadi , Mohannad M. Alabdullah , Humam Saltaji , Anas Abdo and Mohamed Youssef 2016	Assess the effect of molar intrusion with temporary anchorage devices on the vertical facial morphology and mandibular rotation during AOB treatment in the permanent dentition	-Systematic review -inclusion effects of posterior teeth intrusion on the vertical facial morphology with open bite malocclusion in the permanent dentition. Meta-analysis was not possible due to dissimilarity and heterogeneity among the included studies.	5/12 studies used miniplates and 7 studies used miniscrews. Mandibular counterclockwise rotation: 2.3° and 3.9° in 6 studies while it was less than 2° in the remaining studies.	Poor evidence show that intrusion with TAD may cause mandibular anticlockwise autorotation. Randomized controlled trials that include a non-treatment control group are needed to make robust recommendations regarding the amount of mandibular rotation during open bite treatments.

“Microscrew anchorage in skeletal anterior open-bite treatment”

Authors & Date	Description of the study	Materials	Results	Conclusion
Chunlei Xun;Xiangl ong Zeng; Xing Wang <i>Angle Orthodontis t, Vol 77, No 1, 2007</i>	Assess effectiveness of miniscrew anchorage for intrusion of the posterior dentoalveolar region to correct skeletal AOB.	12 patients (aged 14.3 to 27.2 years - Class II skeletal pattern, excessive posterior growth. Self-drilling miniscrew implants in the posterior mid-palatal area and the buccal alveolar bone between the lower molars. Force of 150 g was applied to the microscrews on each side to intrude the posterior teeth. Lateral cephalograms of all 12 patients were taken preintrusion and post intrusion, then measured and compared	AOB in 12 patients were corrected in a mean of 6.8 months. Overbite ↑ by a mean of 4.2 mm ($P \leq .001$), from 2.2 mm in preintrusion to 2.0 mm in postintrusion Upper and lower first molars were intruded for an average of 1.8 mm Mandibular plane angle was ↓ by 2.3° ($P \leq .001$), leading to counterclockwise rotation of the mandible with a significant ↓ in the anterior facial heights (mean of 1.8 mm; $P \leq .001$)	Miniscrew anchorage is a simpler procedure, minimally invasive, requiring low patient cooperation.

“Early treatment of anterior open bite: Comparison of the vertical and horizontal morphological changes induced by magnetic bite-blocks and adjusted rapid molar

intruders”

Authors & Date	Description of the study	Materials	Results	Conclusion
Mhd Hassan Albogha, Ichiro Takahashi, and Mhd Naser Sawan 2014	Determine the ≠ between 2 treatment modalities: MBB or RMI both with PBB, in growing patients with AOB	15 patients with a mean age of 11.2 and a mean open bite of -3.9mm were treated with MBB. Other 15 patients with a mean age of 10.9 and a mean open bite of -3.8 mm were treated with RMI applied on bite blocks Cephalometric radiographs were obtained prior and after appliance removal The TT lasted 4 months	The MBB group showed a big ↓ in SNA, ANB, overjet & maxillary incisor angle (p<0.05). The MBB had bigger effect on the maxilla and its teeth: avoiding maxillary forward growth and retracted the maxillary incisor more than RMI did. Changes in intermaxillary relationship and overate were more distinct in MBB group.	TT of patients with class II AOB and maxillary incisor protrusion was preferred with MBB.

“Anterior open-bite treatment with bonded vs conventional lingual spurs: A comparative study”

Authors & Date	Description of the study	Materials	Results	Conclusion
Luiz Filipe Goncalves Canuto, Guilherme Janson, Niedje Siqueira de Lima, Renato Rodrigues de Almeida, and Rodrigo Hermont Cancado 2016	Relate the isolated effects of BLS and CLS on the craniofacial and dentoalveolar centers of patients in the mixed dentition with AOB.	68 subjects with AOB (equal or > than 1mm) and Class I malocclusion, 6 and 11 years Group 1: 20 patients treated with BLS with a mean initial age of 9.31 years (SD, 1.17). Group 2: 21 patients treated with CLS with a mean initial age of 9.22 years (SD, 1.62). The control group (group 3): 27 untreated subjects. One-way analysis of variance tests followed by Tukey tests were used for intergroup cephalometric comparisons. After 1 month of treatment, patient acceptance of the spurs was evaluated with a questionnaire	There were significantly greater overbite ↑ in the experimental groups than in the control group. Subjects with BLS showed significantly better acceptance than patients with CLS during chewing and eating.	The 2 appliances offered overbite ↑ during early open-bite treatment. After a week of TT, 92.5% of the children had adjusted to the spurs.

“Dentoalveolar comparative study between removable and fixed cribs, associated to chincup, in anterior open bite treatment”

Authors & Date	Description of the study	Materials	Results	Conclusion
Torres, Fernando César de Almeida, Renato Rodrigues de Almeida-Pedrin, Renata Rodrigues Pedrin, Fernando Paranhos, Luiz Renato 2012	Compare the dentoalveolar effects due to RPC+C and FPC+C, combined with chincup in growing patients with AOB.	Groups of 30 patients, mixed dentition with similar age and cephalometric criterias <u>Group 1 (RPC+C)</u> initial mean age of 8.3 years + mean AOB of 4.0 mm. <u>Group 2 (FPC+C)</u> initial mean age of 8.54 years + mean AOB of 4.3 mm. The evaluation period: 12 months between initial (T1) and second lateral radiograph (T2). The T2-T1 were compared cephalometrically in the 2 groups using the non-paired t-test.	Vertical changes in the posterior dentoalveolar region were similar between the groups (about 1 mm) and no significant differences were found in molar mesialization. The FPC+C group had in average 1.6 mm more improvement of the overbite as a result of greater maxillary incisor extrusion (1.3 mm). Patients in this group also presented less lingual tipping of maxillary incisors and more mandibular incisors uprighting.	The FPC+C combination was more efficient in the correction of the negative overbite mainly due to greater extrusion of the maxillary incisors. However, the RPC+C gave better upper and lower incisor inclination, and so more adequate overjet.

“Effects of palatal crib and bonded spurs in early treatment of anterior open bite: A prospective randomized clinical study”

Authors & Date	Description of the study	Materials	Results	Conclusion
Leite, Juliana S. Matussi, Luciano B. Salem, Anne C. Provenzano, Maria G.A. Ramos, Adilson L.	Evaluate the overbite correction of FPC and BLS in the early TT of AOB in mixed dentition analyzing the dental + skeletal cephalometric measurements	<p>Patients with AOB and a mean age of 8.23 years.</p> <p>Divided in 3 groups:</p> <ol style="list-style-type: none"> 1. control 2. palatal crib 3. spur <p>Data from the lateral telerradiography was obtained at the beginning, at 6 months, and after 1 year.</p> <p>The cephalometric analysis through Cef-X program, studying values of SNA, SNB, ANB, SnG oGn, 1.PP, IMPA, nasolabial angle, overbite, and overjet. Intergroup and intragroup comparisons were obtained via one-way analysis of variance.</p>	<p>Similar initial AOB. At 6 months and then after 1 year all groups showed better overbite.</p> <p>Only the crib and spur groups had positive overbite. No cephalometric measurements changed significantly over the period analyzed.</p>	FPC and BLS are simple + effective for the treatment of AOB with the advantage given to the FPC.

“Dentoskeletal changes associated with fixed and removable appliances with a crib in open-bite patients in the mixed dentition”

Authors & Date	Description of the study	Materials	Results & Conclusion
Giuntini, Veronica Franchi, Lorenzo Baccetti, Tiziano Mucedero, Manuela Cozza, Paola 2008	Aim: compare the effects of the Q-H/C appliance and a removable plate with a crib (RP/C) in patients with dentoskeletal AOB	Samples: 20 subjects. Lateral cephalograms were analyzed pre-treatment (T1) and post-treatment (T2). T1 age: 8.4 years, and the mean duration of TT was 1.5 years in both groups. The T2-T1 changes in the 2 groups were compared with a nonparametric test for independent samples	Both the Q-H/C and the RP/C appliances produced favorable dental effects. However, Q-H/C being a non-compliant appliance, produced more favorable vertical skeletal changes.

“Treatment of severe anterior open bite with skeletal anchorage in adults: Comparison with orthognathic surgery outcomes”

Authors & Date	Description of the study	Materials	Results	Conclusion
Kuroda, Shingo Sakai, Yuichi Tamamura, Nagato Deguchi, Toru Takano-Yamamoto, Teruko 2007	Aim: compare TT outcomes in patients with severe AOB treated with molar intrusion by using TAD or with orthognathic surgery.	23 subjects with OB < -3.0 mm were treated with TAD or with LeFort I osteotomy combined with mandibular osteotomy Pre + posttreatment lateral cephalograms were compared.	Incisors were elongated in the surgically treated subjects 4.6 mm No important differences in the TT between TAD and surgery, with reduced facial heights of 4.0 and 3.8 mm, and ↑ OB of 6.8 and 7.0 mm	Molar intrusion with TAD is easier and more useful than surgery in the TT of patients with severe AOB.

PBB-VPC (“posterior bite block-vertical pull chin cup”) vs. PBB-HPH (“posterior bite block-high pull headgear”)

Authors & Date	Description of the study	Materials	Results	Conclusion
Turkkahraman, Hakan Cetin, Ebru	Aim: compare the results of PBB-VPC and PBB-HPH in the early TT of AOB	Retrospective study - use pre and post TT (T1) and (T2) lateral cephalometric Xray of 28 patients treated with PBB-VPC or PBB-HPH and 14 age-matched control patients with AOB. TT changes were calculated with 20 measurements Intergroup comparisons with ANOVA, & post hoc Tukey done.	No \neq in AOB closure between the 2, but both had \uparrow in overbite than the controls. The PBB-HPH group showed more upper incisor retraction than the control group The 2 TT groups had less lower incisor retraction than the controls, and more retraction in the PBB-HPH group was found	Both PBB-VPC and PBB-HPH were efficient in the initial TT of AOB. Retrusion of the upper/lower incisors + the \uparrow of the upper anterior dentoalveolar height were obvious findings in the PBB-VPC group. In the PBB-HPH group, forward maxillary growth was \downarrow , ANB and overjet were \downarrow , and the upper + lower incisors were significantly retruded.

“Dentoskeletal effects produced by removable palatal crib, bonded spurs, and chincup therapy in growing children with anterior open bite”

Authors & Date	Description of the study	Materials	Results	Conclusion
Insabralde, Natalia Martins De Almeida, Renato Rodrigues Castanha Henriques, Jose Fernando Freire Fernandes, Thais Maria Flores-Mir, Carlos De Almeida, Marcio Rodrigues 2016	Assess dentoskeletal effects of different AOB TTs in children	-cephalometric study observing changes from various TTs on 77 growing children with AOB. -control group used for comparison. - Lateral cephalograms were available pre/post treatment -sample was divided into 4 groups: 1. RPC + chincup 2. BLS + chincup 3. chincup 4. nontreated control Statistical comparisons between 4 groups were performed on T1 and the TT changes using analysis of variance with Tukey's post hoc tests.	No significant changes in skeletal variables were present in the groups, except for LAFH ↑ in G1. Overall, effects in all of the treated groups were exclusively dentoalveolar. Big OB ↑ was present in G1 & G2 in comparison to G3 & G4. The maxillary incisors in G1: ↑ palatal tipping, retrusion, and vertical dentoalveolar development + ↑ lingual tipping among mandibular incisors.	-RPC provided a development in OB (97.5%), followed by BLS (84.5%). -chincup-only group no positive OB effects.

« Stability of anterior open-bite extraction and nonextraction treatment in the permanent dentition »

Authors & Date	Description of the study	Materials	Results	Conclusion
Janson, Guilherme Valarelli, Fabrício Pinelli Beltrão, Rejane Targino Soares de Freitas, Marcos Roberto Henriques, José Fernando Castanha 2006	Aim: compare the long-term stability of AOB extraction and nonextraction TT in the permanent dentition, through cephalometric study.	<u>Group 1</u> : 21 patients TT without extractions, <u>Group 2</u> 31 patients TT with extractions who had orthodontic treatment with fixed appliances. Cephalometric studies were done pretreatment, posttreatment, and postretention. -independent t tests were performed. The n° of patients significant relapse AOB was compared between the groups with chi-square tests.	Upper incisors had better retraction, and the mandibular incisors had higher retraction and lingual tipping, and less extrusion in the extraction group. In the posttreatment period, the extraction group demonstrated statistically greater stability of the overbite. -No statistical difference in the % of patients with clinically significant relapse of the OB between the groups.	OB through the extraction treatment had higher stability of the overbite than open-bite nonextraction treatment.

CASE REPORT_4

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Specialista in Ortognatodonzia**



Dr. Filippo Cardarelli. Laureato con Lode in Odontoiatria e Protesi Dentaria. Specializzata con Lode in Ortognatodonzia presso l'Università degli Studi di Milano. Cultore della materia in Odontoiatria Pediatrica presso l'Università degli Studi di Milano. Tiene corsi e conferenze in Italia ed all'estero dove presenta il suo metodo di lavoro. Autore di una nuova tecnica ortodontica in età evolutiva: Elastodontic Therapy. Libero professionista in Isernia, Firenze, Bologna, Milano e Chiasso(CH). Si occupa esclusivamente di Ortognatodonzia ed Odontoiatria estetica. Collabora con il Dr. Lorenzo Vanini alla risoluzione di casi ortodontici particolarmente complessi da trattare con la Terapia Elastodontica.

**D.E di sesso femminile, anni 9,5, presenta una malocclusione di II Classe scheletrica.
Il Classe molare e canina Dx e Sx, deep bite.**



L'occlusione, l'estetica e l'odontoiatria minimamente invasiva sono i principali argomenti di discussione della moderna odontoiatria. Le tecniche miniinvasive e quindi biologiche rivestono un ruolo importante nell'aiutare gli odontoiatri ad ottenere un'estetica eccellente ed una funzionalità predicibile per i nostri pazienti.

Il massimo del successo del trattamento ortodontico è la realizzazione dell'equilibrio tra forma e funzione " (C. GUGINO). L' Elastodontic Therapy semplifica o addirittura elimina un eventuale e successivo intervento ortodontico, perché facilita la crescita armoniosa, riduce il numero delle estrazioni, aumenta la stabilità nel tempo del trattamento. Se si modifica la funzione, tramite la rieducazione del comportamento/i, si modificherà anche la forma. L'educazione funzionale consente di prendere in carico l'insieme delle funzioni alterate per neutralizzare e creare le condizioni di una occlusione funzionale ideale ed idonea per ogni paziente in crescita. Quello che caratterizza i dispositivi elastodontici dai normali apparecchi funzionali è la capacità di lavorare tridimensionalmente all'interno di una struttura tridimensionale qual è la cavità orale a differenza dei normali attivatori con docce di resina e metallo che invece agiscono per lo più bidimensionalmente.

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ARCO DE CANTO MULTIANASAS (MULTILOOP EDGEWISE ARCHWIRE: MEAW) ¿POR QUÉ MULTILOOP? ASPECTOS CLÍNICOS Y BIOMECÁNICA

• Autor: Prof. Dr. Ricardo Voss*

RESUMEN

La utilización del *loop* en los tratamientos con aparatología fija, usando alambres rectangulares, en el contexto de una filosofía de diagnóstico y tratamiento basada en el crecimiento dinámico del complejo maxilofacial, ha provocado un creciente interés entre los clínicos y los investigadores. Se destacan en este campo, el profesor Youg Kim, presidente de *Meaw Foundation* con sede en Boston (USA), y el profesor *Sadao Sato* de la Universidad de Kanagawa (Japón). En el presente artículo se discute su biomecánica, y su uso clínico en diferentes tipos de maloclusiones, especialmente en el tratamiento de mordidas abiertas y Clases II y III, a través del manejo eficiente del plano oclusal.

PALABRAS CLAVE: MULTILOOP, EDGEWISE, LOOP, MEAW.

SUMMARY

The use of the *loop* in treatments with fixed appliances, using rectangular wires, in the context of a diagnostic philosophy and treatment based on the dynamic growth of the maxillary facial complex, has caused a growing interest among clinics and researchers. Professor Youg Kim, the president of the *Meaw Foundation*, whose main office is located in Boston, USA and Professor *Sadao Sato* from the University of Kanagawa in Japan are the leading academics in this field. This article discusses biomechanics and its clinical use with different types of malocclusions, especially in the treatment of open bite and Classes II and III, through efficient management of the occlusal plane.

INTRODUCCIÓN

La técnica Arco de Canto multiansas (*multiloop edgewise archwire*), fue desarrollada en los años 60 por Young H. Kim, quien enseña Ortodoncia Clínica en las Universidades de Boston, Tufts, y Harvard, en Massachusetts (USA). La técnica MEAW ha tenido un fuerte desarrollo en los países de Asia, especialmente en Japón y Corea, y su inserción internacional se ha producido a través de la Fundación MEAW (*MEAW Foundation*), cuyo presidente es el Prof. Young Kim.¹ Por otro lado, se ha destacado la labor de investigación y la impresionante casuística expuesta por el Prof. Sadao Sato de la Universidad de Kanagawa, Japón. Autor de dos importantes libros, el doctor Sato ha revolucionado las bases científicas del diagnóstico en Ortodoncia, con sus demostraciones acerca de la importancia del plano oclusal en la etiopatogenia de las maloclusiones.^{2,3} El objetivo de este artículo es presentar las bases biomecánicas y las aplicaciones clínicas de MEAW.

FILOSOFÍA MEAW

La filosofía de tratamiento de la Fundación, incluye un proceso de diagnóstico integral, en el que se destaca el diagnóstico cefalométrico desarrollado por Kim, con especial énfasis en la determinación de los patrones de crecimiento vertical y anteroposterior y su relación con el plano oclusal. El *ODI* (*overbite deep indicator*) indicador de la profundidad del entrecruzamiento y el *APDI* (*anteroposterior dysplasia indicator*) indicador de la displasia anteroposterior, conjugados a través del *CF* (*combination factor*) factor de combinación, proporcionan

valores muy importantes para la planificación del tratamiento, especialmente en lo concerniente a la necesidad o no de realizar extracciones, o a la posibilidad de plantear un tratamiento quirúrgico.^{4,5,6} (Fig. 1).

Las medidas mencionadas son complementadas con el análisis de los arcos dentarios y de los planos oclusales. El contexto de diagnóstico integral de la filosofía MEAW incluye, cuando es necesario, el montaje en articulador, el uso de *splints* de reposición, la reconstrucción oclusal, una axiografía de ATM, etc.

TEORÍAS Y FUNCIÓN OCLUSAL

Es destacable que, en la experiencia de la filosofía MEAW, se ha dado particular importancia al tratamiento no quirúrgico de aquellas Clases III y mordidas abiertas esqueléticas de tipo "borderline", anomalías con gran prevalencia en los países asiáticos.

De acuerdo con las teorías e investigaciones ampliamente desarrolladas por Sato, en la ontogénesis del humano moderno, el complejo maxilar crece, como se sabe, fundamentalmente en sentido vertical y, de la misma manera, lo hace el proceso alveolar y la erupción dentaria. De esta forma, el modo de erupción de los dientes superiores va estableciendo el plano de oclusión, sobre el cual se deben ir adaptando los dientes en erupción del maxilar inferior. Así, se produce una continua adaptación mandibular rotacional, la cual puede derivar en cualquier momento en una maloclusión esquelética, de acuerdo con la aparición de factores ambientales potencialmente patogénicos, tales como alteraciones de la erupción y / o el recambio dentario. Ya en 1970, investigaciones desarrolladas por McNamara,

Correzione delle Open Bite in pazienti in crescita con bioattivatore elastodontico OPEN Amcop: un caso clinico

Introduzione

L'occlusione è un processo evolutivo, dinamico e continuo, modellata dalle funzioni neurovegetative della bocca. Studi scientifici hanno dimostrato come problemi disfunzionali associati a dismorfosi, più o meno gravi, siano alla base della malocclusione. Il termine *Open Bite* anteriore, in seguito AOB, si utilizza per indicare un'alterazione morfologica delle arcate dentarie, in senso verticale, dei normali rapporti occlusali, caratterizzata da una beanza anteriore tra i denti antagonisti.

Le diverse classificazioni proposte di AOB hanno preso spunto, sia dall'eziologia, sia dalle caratteristiche morfo-strutturali della malocclusione. (1) Il morso aperto anteriore può derivare da fattori estrinseci di tipo parafunzionale (abitudine alla suzione), intrinseci parafunzionali (deglutizione atipica, ostruzione delle vie aeree), complesso parafunzionali (presenza contemporanea di abitudini viziate e parafunzioni intrinseche), scheletrico strutturale (*pattern* di crescita verticale determinato geneticamente); morfologico-strutturale (macroglossia, tono e orientamento dei muscoli masticatori), dentale (anomalie di permuta); dunque un AOB può essere correlato a cause di tipo scheletrico, dentale e funzionale, o come succede frequentemente, ad una combinazione fra loro. Le abitudini di suzione e la respirazione orale sono i fattori di rischio ambientale più significativi per la malocclusione poiché possono interferire con l'occlusione e il normale sviluppo cranio-facciale(2).

L'AOB è diffuso tra i bambini piccoli, con una prevalenza che va dal 17% al 18% in dentizione mista. Se associata alle abitudini di suzione, la prevalenza aumenta del 36,3% ed è dimostrato che, se l'AOB persiste durante lo scatto di crescita puberale cranio-facciale, raramente si autocorregge o addirittura peggiora e che, con il progredire della crescita e il mancato intervento precoce, può trasformarsi in un AOB di tipo scheletrico, potendo sviluppare una post-rotazione mandibolare con tendenza alla crescita in II Classe. (3)

L'educazione funzionale aiuta a creare le condizioni di una occlusione ideale ad ogni paziente, neutralizzando l'insieme delle funzioni alterate. A differenza dei classici apparecchi funzionali, i dispositivi elastodontici presentano il vantaggio di poter essere utilizzati nei pazienti dai 3 anni, scegliendo quello adatto, senza la necessità della presa d'impronta(6). Inoltre, la loro morfologia consente di guidare la lingua nella corretta posizione sul palato, favorire la respirazione nasale e rilassare la muscolatura oro-facciale con un netto miglioramento respiratorio e fonetico. Questi dispositivi sono realizzati con materiale polimero/elastomero, che conferisce termoelasticità ed elasticità, procurando una sensazione piacevole, assai gradita dai pazienti più piccoli, perché morbidi tali da consentire la *compliance* del paziente, senza traumatizzare la mucosa orale e le mascelle ed, allo stesso tempo, abbastanza resistenti ai carichi occlusali(4). La possibilità di mantenere una forma rigida ma, allo stesso tempo, elastica, permette di raggiungere un equilibrio muscolare, tale da consentire ai denti di posizionarsi in un corridoio neutro, regolato dall'azione della lingua (forza centrifuga) e da quella delle guance e delle labbra (forza centripeta).

Ad oggi, seguendo gli attuali orientamenti d'ortodonzia pediatrica, visto che il processo alveolare è in continuo *turnover*, è di fondamentale importanza riconoscere, il prima possibile, le situazioni di allontanamento dalla linea ideale di sviluppo della bocca e del terzo medio-inferiore del viso, per eliminare forze disfunzionali che agiscono sull'*imprinting* dentale e sul *pattern* scheletrico in condizioni di equilibrio muscolare (5).

La terapia elastodontica rappresenta una tecnica ortodontica in grado di ottenere cambiamenti scheletrici, dentali e posturali in età precoce, lavorando in una realtà tridimensionale, grazie a forze leggere e biologiche di tipo elastico in grado di eliminare i disturbi funzionali, correggendo la posizione dei denti (7).

Infine, la funzione riabilitativa di questi dispositivi si riflette su tutto il sistema stomatognatico, rimodellando persino l'articolazione temporo-mandibolare con ottimi risultati estetici, posturali, ortopedici e osteopatici.

Bioattivatore Open

Il bioattivatore Open è un dispositivo elastodontico della gamma Amcop. Ha un piano basale piatto che consente una maggiore crescita verticale in corrispondenza della premaxilla e scudi vestibolari alti che eliminano le interferenze linguali e labiali. Il Bioattivatore Open è indicato per il trattamento delle malocclusioni di carattere scheletrico del tipo morso



Fig.1 Dispositivo Open

(4)

Microscrew Anchorage in Skeletal Anterior Open-bite Treatment

Chunlei Xun^a; Xianglong Zeng^b; Xing Wang^c

ABSTRACT

Objective: To evaluate the effectiveness of miniscrew anchorage for intrusion of the posterior dentoalveolar region to correct skeletal open bite.

Materials and Methods: The study was comprised of 12 patients (aged 14.3 to 27.2 years; mean 18.7 years) with anterior open bites. All the patients presented a Class II skeletal pattern and excessive posterior growth. Self-drilling miniscrew implants were inserted into the posterior mid-palatal area and the buccal alveolar bone between the lower molars. A transpalatal and a lingual arch were used to maintain the molars on each side in order to avoid overrotation during intrusion. A force of 150 g was applied to the microscrews on each side to intrude the posterior teeth. Lateral cephalograms of all 12 patients were taken preintrusion and immediately after completion of the intrusion. The cephalometric films were measured and compared.

Results: The results showed that the anterior open bites in 12 patients were all corrected in a mean of 6.8 months. Overbite increased by a mean of 4.2 mm ($P < .001$), from -2.2 mm in preintrusion to 2.0 mm in postintrusion. The maxillary and mandibular first molars were intruded for an average of 1.8 mm ($P < .001$) and 1.2 mm ($P < .001$), respectively. The mandibular plane angle was reduced by 2.3° ($P < .001$), which led to a counterclockwise rotation of the mandible with a significant decrease in the anterior facial heights (mean of 1.8 mm; $P < .001$).

Conclusion: Miniscrew anchorage has the advantages of being a simpler procedure, being minimally invasive, and requiring minimal patient cooperation.

KEY WORDS: Orthodontic anchorage; Microscrew anchorage

INTRODUCTION

Skeletal anterior open bite is a complicated malocclusion characterized mainly by overgrowth of the maxillary and mandibular posterior dentoalveolar heights, resulting in a longer vertical facial dimension and a steeper mandibular plane.^{1,2} It is difficult to de-

crease the heights of posterior dentoalveolar regions in the treatment of anterior open bite. Many methods have been introduced to intrude the posterior teeth, such as passive bite blocks,³ active bite blocks with magnets^{4,5} or springs,⁶ high-pull headgear,⁷ fixed appliances, and vertical elastics.⁸⁻¹¹ However, these traditional techniques often cannot intrude the molars, especially in adult patients. Thus, surgical impaction of the maxilla is often the only way to obtain counterclockwise rotation of the mandible and a reduction of anterior facial height in adult patients with severe skeletal open bite.¹²

Specially-designed implants,¹³⁻¹⁵ miniscrews,¹⁶⁻²¹ and miniplates²²⁻²⁶ have been developed recently to obtain a stationary anchorage source. Several studies²³⁻²⁵ have reported the successful treatment of anterior open bite by intruding the mandibular or maxillary molars with miniplate anchorage. However, the surgical procedure of miniplate placement is relatively complicated.

Compared with the miniplate, the microscrew implant has the advantages of lower cost, simpler inser-

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Case Report

Dynamic MRI Evaluation of Tongue Posture and Deglutitive Movements in a Surgically Corrected Open Bite

Seniz Karacay^a; Erol Akin^b; Kerim Ortakoglu^c; A. Osman Bengi^d

Abstract: Tongue thrust usually develops in the presence of anterior open bite in order to achieve anterior valve function. In the literature, tongue thrust is described both as the result and the cause of open bite. If it is an adaptation to malocclusion, then tongue posture and deglutitive tongue movements should change after treatment. In this case report, an adult who had skeletal open bite and Class II malocclusion caused by mandibular retrusion was treated surgically. The mandible was advanced in a forward and upward direction with a sagittal split osteotomy. The open bite and Class II malocclusion were corrected and an increase in the posterior airway space (PAS) was observed. Pretreatment and posttreatment dynamic magnetic resonance imaging (MRI) revealed that tongue tip was retruded behind the incisors and contact of the tongue with the palate increased. It was also determined that the anterior and middle portions descended, whereas the posterior portion was elevated at all stages. Advancement of the mandible, correction of open bite, and an increase in PAS affected not only the tongue posture and deglutitive movements, but also the breathing pattern of the patient.

KEY WORDS: Open bite; Tongue thrust; Posterior airway space; Dynamic MRI; Deglutition; Sagittal split osteotomy

INTRODUCTION

Overbite is defined as vertical overlap of incisors. In normal occlusion, the lower incisal edges contact the lingual surface of upper incisors or at above the cingulum. An overbite of 1–2 mm is defined as normal. In an open bite malocclusion, there is no vertical overlap. Vertical separation of 0–2 mm is accepted as moderate open bite, whereas 3–4 mm is severe and more than 4 mm is extreme.¹

Forces from the lips, cheeks, tongue, fingers, or other objects can influence tooth position both vertically and horizontally if the pressures are maintained for enough time. Prolonged sucking habits until the eruption of permanent teeth, tongue thrust swallowing, and mouth breathing because of chronic respiratory obstruction caused by inflammation of nasal mucosa associated with allergies or chronic infection are some of the essential etiological factors in development of open bite.^{2–5}

In the presence of open bite it is difficult to seal off the front of the mouth during swallowing. Some authors accept tongue thrusting as an adaptation to open bite rather than the cause of it.⁶ According to Proffit,⁶ the tongue thrusts forward to achieve anterior valve function in order to prevent food or liquids from escaping. We hypothesized that, if this is so, then the tongue should adapt to a new occlusion by changing its posture and deglutitive movements after correction of an open bite.

Abnormal tongue function and posture in patients with open bite has been investigated in some previous studies, but none have presented the effects of open bite treatment on the movement and posture of the tongue. The aim of this report was to compare pretreatment and posttreatment tongue movements of an open bite patient during deglutition by using real-time

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Étiologie et traitements des béances antérieures chez les patients en croissance : une étude narrative

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MOTS CLÉS :

Traitement précoce /
Revue narrative /
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Supraclusion /
Stabilité

KEYWORDS:

Early treatment /
Narrative review /
Open bite /
Overbite /
Stability

RÉSUMÉ – Introduction : Le sujet des béances antérieures mérite d'être approfondi. Il n'existe pas en effet de preuves suffisantes concernant l'étiologie ni de consensus sur les meilleures options thérapeutiques (taux de réussite et stabilité). L'étiologie recouvre l'interaction de facteurs fonctionnels tels que les habitudes prolongées de succion, la respiration buccale, la pulsion linguale ou l'aspiration labiale, la taille de la langue, les troubles de l'éruption et une croissance faciale verticale génétiquement déterminée. Les options de traitement précoce des béances antérieures sont encore controversées. **Objectifs :** Le but de cette étude sur les béances est d'évaluer l'efficacité des différentes options thérapeutiques en denture mixte, de déterminer celle qui semble la plus efficace et d'analyser la stabilité des résultats.

ABSTRACT – Etiology and treatment options of anterior open bite in growing patients: a narrative review. Introduction: Anterior open bite represents a malocclusion that is still under study because of the still lacking evidence about etiology and best treatment options in growing subjects according to success rate and stability. Etiology involves the interaction of environmental factors such as prolonged sucking habits, mouth breathing, tongue or lip thrusting, tongue dimension, eruption disturbances with a genetically determined vertical facial growth pattern. The treatment options for the early treatment of anterior open bite are still controversial. **Objectives:** The aim of this study was to evaluate the actual available evidence on treatments of anterior open bite in the mixed dentition in order to assess the effectiveness of the early treatment in reducing open bite, the most efficacious treatment strategy and the stability of the results.

1. Introduction

1.1. Définition

Depuis 1842 [41], le terme « béance » a été associé à la malocclusion correspondante ; il a été défini de différentes manières. Selon certains auteurs, le terme béance est caractérisé par un recouvrement incisif inférieur à celui des patients présentant un guidage antérieur normal : soit un rapport incisif en bout à bout, soit une absence de contact incisif. Selon la plupart des auteurs [27, 49], la béance antérieure est aujourd'hui définie comme une

malocclusion caractérisée par une insuffisance de recouvrement incisif lorsque les dents postérieures sont en occlusion [49]. Sa prévalence est d'environ 1,4 à 3,5 % dans la population caucasienne, 9,1 à 16,5 % dans la population afro-américaine [44]. Même si ce pourcentage peut sembler faible, surtout dans la population blanche, la proportion de patients traités pour béance est élevée puisqu'elle représente 17 % des patients orthodontiques [22].

1.2. Béances dentaires et squelettiques

L'étiologie des béances est liée à des interférences lors de l'éruption dentaire normale et de

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Prevalence and Associated Factors for the Development of Anterior Open Bite and Posterior Crossbite in the Primary Dentition

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The aim of the study was to verify the prevalence of anterior open bite (AOB) and posterior cross-bite (PC) in the primary dentition and the association with sociodemographic factors, presence and duration of nutritive and non-nutritive habits. A cross-sectional study was carried out with 732 preschoolers in Campina Grande, PB, Brazil. Clinical exams were performed by three calibrated examiners (Kappa: 0.85-0.90). A questionnaire addressing sociodemographic data as well as nutritive and non-nutritive sucking habits was administered to parents/caregivers. Data analysis involved descriptive statistics and Poisson regression analysis ($\alpha=5\%$). The prevalence of AOB and PC was 21.0% and 11.6%, respectively. AOB was significantly associated with the three-year-old age group (PR: 1.37; 95%CI: 1.24-1.52), enrollment in public school (PR: 1.09; 95%CI: 1.01-1.17) and duration of pacifier sucking ≥ 36 months (PR: 1.41; 95%CI: 1.30-1.53). PC was associated with pacifier use (PR: 1.11; 95%CI: 1.05-1.17) and duration of breastfeeding < 12 months (PR: 1.05; 95%CI: 1.00-1.10). Socioeconomic factors appear not to be related to AOB or PC in the primary dentition, except type of preschool. Breastfeeding should be encouraged for longer periods and the use of pacifier beyond 3 years of age represents a predisposing factor for both types of malocclusion, especially AOB.

Key Words: malocclusion, preschool child, sucking behavior, socioeconomic factors.

Introduction

Malocclusions in the primary dentition may be considered a public health problem due to the high rates of prevalence and treatment needs as well as the social impact such conditions may cause (1). Knowledge of malocclusion etiology is essential for the success of orthodontic treatment, since eliminating the cause is a prerequisite for correction of the problem. In view of the increasing interest in early diagnosis and corresponding emphasis on preventive procedures, further information on factors associated with malocclusion is needed (2).

Anterior open bite (AOB) and posterior crossbite (PC) are the most prevalent forms of malocclusion in the primary dentition (3,4). AOB develops at an early age, but may self-correct spontaneously in subsequent years (5). In contrast, PC is believed to be transferred from the primary to the permanent dentition (2). Malocclusion is the result of the interaction of genetic and environmental factors (3). Non-nutritive sucking habits (NNSH) are the main etiological factors associated with AOB (6). Heredity, mouth-breathing pattern, nutritive sucking habits (NSH) and hypertrophy of the adenoids and tonsils are the main etiological factors associated with PC (7,8). While a number of studies have associated NNSH and other environmental factors with malocclusion (3,6,7,9), few investigations have sought to

establish associations between sociodemographic factors and malocclusion (2,3), especially in children less than 5 years old. Moreover, most studies analyze predisposing factors separately, without measuring concurrent impact or assessing potential interactions (3). Clinical interest in the etiology and early diagnosis of malocclusion justifies epidemiological investigations focused on the main types of malocclusion found in preschool children (2).

The aim of the study was to verify the prevalence of anterior open bite (AOB) and posterior cross-bite (PC) in the primary dentition and the association with sociodemographic factors, presence and duration of nutritive and non-nutritive habits.

Material and Methods

Sample Characteristics

A population-based cross-sectional study was carried out involving a random sample of 732 male and female children aged 3 to 5 years enrolled at private and public preschools in the city of Campina Grande, PB, Brazil. The participants were selected from a total population of 12,705 children in this age group, corresponding to 6.6% of the population (10).

A two-phase sampling method was used to ensure representativeness. Preschools were randomly selected

Relationship between Occlusal Findings and Orofacial Myofunctional Status in Primary and Mixed Dentition

Part I: Prevalence of Malocclusions

Zusammenhang von Okklusionsbefunden und orofaziale myofunktionellem Status im Milch- und frühen Wechselgebiss

Teil I: Häufigkeit von Gebissanomalien

Rosemarie Grabowski¹, Franka Stahl¹, Manja Gaebel¹, Günther Kundt²

Abstract

Aim: The aim of this study is to provide basic data on the prevalence of malocclusions and orofacial dysfunctions in the primary and early mixed dentition, to examine occlusal relationships in their functional context, and to analyze the need for and potential of orthodontic prevention.

Subjects and Methods: Occlusal relationships and myofunctional status were evaluated in 766 children in the primary dentition and in 2,275 children in the early mixed dentition. Orthodontic findings in single jaws and intermaxillary occlusal relationships were clinically analyzed in all three dimensions.

Results: Normal occlusal relationships were found in 25.3% of children in the primary dentition. Frequency of children with normal dentitions fell significantly in the mixed dentition (7.3%). Prevalence of bilateral distocclusion increased significantly from the primary to the mixed dentition. Increased maxillary overjet was diagnosed in 49.3% and 59.0% of the children in the primary and mixed dentition, respectively. Prevalence of lateral crossbites increased significantly from primary to mixed dentition (7.2% vs. 12.0%). Deep bites and edge-to-edge bites were found significantly more often in the early mixed dentition.

Conclusions: The significant increase in the prevalence of malocclusions between the primary and mixed dentition – distocclusion and lateral crossbite, and the impairment of vertical occlusal relationships in the mixed dentition in particular – reveal the need for orthodontic prevention. They highlight the absence of applied interceptive and early treatment measures in orthodontics. The indication system in current use for early orthodontic treatment here in Germany fails to fulfill the requirements for prevention-oriented dental care.

Zusammenfassung

Ziel: Ziel der Studie ist es, repräsentative Basisdaten über die Verbreitung von Gebissanomalien und orofazialen Fehlfunktionen im Milchgebiss und im frühen Wechselgebiss zu liefern und die Okklusionsbeziehungen in ihrem funktionellen Kontext zu überprüfen. Erfordernisse und Möglichkeiten kieferorthopädischer Prävention und Frühbehandlung sollten geprüft werden.

Probanden und Methodik: Bei 766 Kindern mit Milchgebissen und 2275 Kindern mit Wechselgebissen wurden die Okklusionsbefunde und der Funktionsstatus erhoben. Die kieferorthopädischen Befunde wurden als sagittale, transversale und vertikale Einzelkiefer- und Okklusionsbefunde klinisch erhoben.

Ergebnisse: Im Milchgebiss wiesen 25,3% der Kinder regelrechte Okklusionsbeziehungen auf. Im Wechselgebiss reduzierte sich dieser Anteil statistisch signifikant auf 7,3%. Die Häufigkeit beidseitiger Distalokklusionen nahm vom Milch- zum Wechselgebiss statistisch signifikant zu. Bei 49,3% bzw. 59,0% der Kinder mit Milch- und Wechselgebissen wurde eine vergrößerte sagittale Frontzahnstufe registriert. Vom Milch- zum Wechselgebiss stieg die Häufigkeit der seitlichen Kreuzbisse von 7,2% auf 12,0% statistisch signifikant an. Tiefbisse und Kantenbisse traten im frühen Wechselgebiss statistisch signifikant häufiger auf.

Schlussfolgerungen: Die signifikante Zunahme der Gebissanomalien vom Milch- zum Wechselgebiss, insbesondere der Distalokklusion und des seitlichen Kreuzbisses, und die Verschlechterung der vertikalen Okklusionsverhältnisse im Wechselgebiss weisen die Notwendigkeit einer kieferorthopädischen Prävention nach und zeigen den mangelnden Einsatz kieferorthopädischer Interzeptiv- und Frühbehandlungsmaßnahmen. Die gegenwärtig angewandten kieferorthopädischen Indikationsgruppen zur kieferorthopädischen Frühbehandlung erfüllen den Anspruch einer präventionsorientierten Zahnmedizin nicht.

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Open bite in adult patients



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Anterior open bite (AOB) is characterized by the lack of overlap or contact between maxillary and mandibular incisors, while the posterior teeth are in occlusion. Correction of this malocclusion is challenging due to difficulties in determining and addressing the etiologic factors, and the high relapse rate. A multidisciplinary approach may be necessary, with participation of Orthodontics, Surgery and Speech Therapy, to achieve adequate esthetic and functional results for long term stability. The present paper discusses the treatment options for AOB, their advantages and implications.

Keywords: Open bite. Orthodontic anchorage procedures. Malocclusion. Tongue.

A mordida aberta anterior (MAA) é caracterizada pela falta de cobertura ou contato entre os incisivos superiores e inferiores, enquanto os dentes posteriores estão em oclusão. A correção dessa má oclusão é considerada desafiadora, devido à dificuldade em se determinar e lidar com os fatores etiológicos e à alta taxa de recidiva. Uma abordagem multidisciplinar pode ser necessária, envolvendo a participação da Ortodontia, Cirurgia e Fonoaudiologia, a fim de que adequados resultados estéticos e funcionais sejam alcançados e se obtenha estabilidade em longo prazo. No presente artigo, o objetivo foi discutir as modalidades de tratamento da MAA, suas vantagens e implicações.

Palavras-chave: Mordida aberta. Procedimentos de ancoragem ortodôntica. Má oclusão. Língua.

INTRODUCTION

The etiology of anterior open bite (AOB) is multifactorial, including unfavorable growth patterns, digit-sucking habits, enlarged lymphatic tissue, heredity and oral functional matrices.¹⁻⁵ It can impair the speech, swallowing, mastication and esthetics,¹ thus creating unfavorable conditions for normal social life.^{4,5} Depending on the duration, frequency, intensity and age, non-nutritive sucking habits and mouth breathing may cause deformities on the dentofacial complex as a response to the continuous pressure.^{2,6}

Several treatment options are presented in the literature,^{1,7,8} aiming to inhibit the mechanical factors that maintain the anterior open bite and/or limit the excessive vertical growth of facial skeletal components.^{2,4,9,10} The removal of harmful habits is a complex therapy with psychological, emotional and family involvement.

Nevertheless, when a patient reaches adulthood without any preventive or interceptive previous treatment, the literature suggests temporary anchorage devices (TADs) or orthognathic surgery associated with orthodontic treatment of severe open bite.¹¹

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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Orthodontic treatment of anterior open bite

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International Journal of Paediatric Dentistry 2008; 18: 78–83

Objective. To review the currently available treatment options of anterior open bite.

Methods. Search all major dental journals and literature on treatment and management of anterior open bite. Medline search (1960–2006). Literature and data on treatment and management of anterior open bite with keywords ‘open bite’, ‘anterior open bite’, ‘orthodontic treatment’, ‘long face’, ‘vertical dentoalveolar problem’ and ‘vertical skeletal problem’.

Results. Over 50 articles were found and relevant information and data were reviewed by the

authors. It was found that the multifactorial nature of anterior open bite makes its management difficult and various treatment modalities are being used. Clinicians must be able to diagnose the problem and choose the best treatment.

Conclusion. Successful treatment of anterior open bite greatly relies on both diagnosis and therapeutics. Although there are many different treatment modalities available, stability after treatment is still a critical issue as evidence on long term stability of various treatment options is lacking. Thus, clinicians should pay more attention during retention phase and long-term studies on post-treatment changes and stability should be encouraged.

Introduction

In the standard textbook *Contemporary Orthodontics*¹, anterior open bite is defined as ‘no vertical overlap of incisors’. The prevalence of anterior open bite ranges from 1.5% to 11% and varies between ethnic groups and by age and dentition (Table 1). In general, four treatment modalities are used by surgeons and orthodontists in the treatment of anterior open bite: (i) advice on early problems and observation; (ii) interceptive treatment; (iii) camouflage treatment by orthodontics only; and (iv) a combined orthodontic and surgical approach.

The major clinical challenge that clinicians often encounter when treating anterior open bite is how to address patients’ concerns about function and facial aesthetics. Orthognathic surgery is commonly used for managing these problems and its effectiveness and stability were well documented and reviewed^{2–5}. There are, however, various nonsurgical treatment modalities being used by orthodontists as

well and they are often not being completely included in review papers. This article will discuss the diagnosis of and nonsurgical treatments for anterior open bite (i.e. the first three methods in the list).

Advice on early problems and observation

Tongue thrusting

Tongue thrusting has been postulated to be the cause of anterior open bite⁶, but it has also been described as a result of open bite⁷. Because spontaneous correction occurs in 40–80% of cases of mixed-dentition open-bite and because interceptive treatments are of little or no value⁸, myofunctional therapy for anterior tongue position may not be warranted before adolescence⁹.

Non-nutritive sucking

Classically, asymmetrical open bite is localized to a few anterior teeth and fits snugly around the offending agent such as a thumb. Sucking habits during the years of primary dentition have little, if any, long-term effect, and sucking by itself does not create severe malocclusion unless the habit persists well into the years of

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Skeletal morphologic features of Anterior Open Bite Malocclusion amongst black patients visiting the Medunsa oral health centre

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ABSTRACT

Introduction

Anterior open bite (AOB) malocclusion presents as lack of vertical overlap of anterior teeth. It is viewed to be unaesthetic and may affect speech and mastication.

It develops due to the interaction of hereditary and environmental etiological factors and these usually affect the vertical growth of the face. This study describes the vertical changes of South African black people presenting with AOB.

Aims and objectives:

The aim was to determine skeletal morphological features of patients with AOB malocclusion.

Design

The design was a retrospective, cross-sectional study.

Materials

Archived pre-treatment lateral cephalographs of 181 patients who consulted between 2007 and 2014 were divided into four groups: control group of 62 patients with skeletal Class I pattern without AOB; test groups of patients with AOB (119) divided into 35 Class I, 43 Class II, and 41 Class III malocclusions. Records of each group were divided according to gender. Descriptive statistics, the Pearson correlation coefficient, t-test and

Wilcoxon test were employed to analyze the data, and p values of ≤ 0.05 were considered statistically significant.

Results and conclusions

Patients with AOB had a larger vertical facial pattern in all classes of malocclusion. Males presented with larger Sn-GoGn angles than females. The PFH/AFH ratio was lower across all classes of malocclusion compared to the control group.

INTRODUCTION AND LITERATURE REVIEW

Malocclusion can occur in three planes of space, namely sagittal, transverse and in the vertical plane. The lack of dental occlusion in the oral cavity occurs in the vertical plane as either an open bite in the anterior area, an open bite in the lateral areas, or as a combination of the two.¹

Open bite malocclusion is considered as an abnormality in the vertical relationship of maxillary and mandibular arches. It is characterized by a lack of contact between opposing segments of teeth.^{2,3} The term "open bite" was first introduced by Caravelli in 1842.⁴ The incidence of AOB varies between races and ranges from 1,5% to 11%. Differences also occur with age as some AOB close spontaneously with increasing age.⁵

The clinical and radiological evaluation of AOB is complex and exhibit dental or skeletal components, or a combination of the two in some cases.¹ The dental open bite is associated with a normal craniofacial pattern of growth on the cephalometric radiograph and labial tipping of both upper and lower anterior teeth. The skeletal open bite shows vertical disharmony of craniofacial skeleton on the cephalometric radiograph and over eruption of posterior teeth.

A dental open bite can also affect the alveolus and has also been referred to as dento-alveolar, when there is a change in the vertical growth of the alveolar component. A skeletal open bite has features such as clock-

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Open bite: a review of etiology and management

Peter Ngan, DMD Henry W. Fields, DDS, MS, MSD

Abstract

Diagnosis and treatment of open bite malocclusion challenges pediatric dentists who attempt to intercept this malocclusion at an early age. This article updates clinicians on the causes and cures of anterior open bite based on clinical data. Patients with open bite malocclusion can be diagnosed clinically and cephalometrically, however, diagnosis should be viewed in the context of the skeletal and dental structure. Accurate classification of this malocclusion requires experience and training. Simple open bite during the exchange of primary to permanent dentition usually resolves without treatment. Complex open bites that extend farther into the premolar and molar regions, and those that do not resolve by the end of the mixed dentition years may require orthodontic and/or surgical intervention. Vertical malocclusion develops as a result of the interaction of many different etiologic factors including thumb and finger sucking, lip and tongue habits, airway obstruction, and true skeletal growth abnormalities. Treatment for open bite ranges from observation or simple habit control to complex surgical procedures. Successful identification of the etiology improves the chances of treatment success. Vertical growth is the last dimension to be completed, therefore treatment may appear to be successful at one point and fail later. Some treatment may be prolonged, if begun early. Long-term clinical outcomes are needed to determine treatment effectiveness and clinicians should consider the cost-effectiveness of these early initiated and protracted plans. (*Pediatr Dent* 19:91-98, 1997)

Open bite was defined by Subtelney and Sakuda¹ as open vertical dimension between the incisal edges of the maxillary and mandibular anterior teeth, although loss of vertical dental contact can occur between the anterior or the buccal segment. Because different etiologic factors are involved when the open bite occurs in the anterior, as opposed to the

buccal segments,² our discussion will be restricted to anterior open bite.

Diagnosis of open bites should be viewed first in the context of skeletal structures. Sassouni³ classified open bites into skeletal and dental open bites. The latter have no significant skeletal abnormality. When the skeletal morphology in the vertical dimension has been classified successfully, it can be determined whether or not

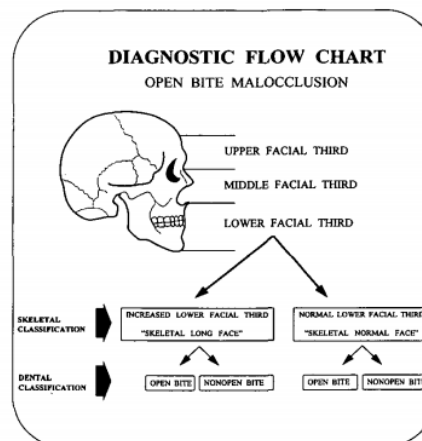


Fig 1. This diagnostic flow chart demonstrates the possibilities and relationships between skeletal and dental relationships in open bite malocclusion.

TABLE. CLINICAL AND CEPHALOMETRIC CHARACTERISTICS OF SKELETAL OPEN BITE

Clinical Characteristics	Cephalometric Characteristics
1. Excess anterior face height, particularly in the lower third	1. Steep palatal plane and increased percentage lower facial height
2. Lip incompetence (resting lip separation ≥ 4 mm)	2. Excess eruption of the maxillary posterior teeth
3. Anterior open bite (but not always, some incisors supraerupt)	3. Downward and backward rotation of the mandible
4. Tend to exhibit class II malocclusion and mandibular deficiency	4. Excess eruption of maxillary and mandibular incisors
5. Tend to exhibit crowding in the lower arch	
6. Tend to exhibit a narrow maxilla and posterior cross bite	

Dentoalveolar comparative study between removable and fixed cribs, associated to chincup, in anterior open bite treatment

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ABSTRACT

Objective: The aim of this prospective study was to compare the dentoalveolar effects produced by two types of palatal crib, removable (Rpc+C) and fixed (Fpc+C), combined with chincup in growing patients with anterior open bite. **Material and Methods:** Each group comprised 30 patients, in the mixed dentition phase, with similar cephalometric characteristics and skeletal ages. Group 1 (Rpc+C) presented initial mean age of 8.3 years and mean anterior open bite of 4.0 mm. Group 2 (Fpc+C) presented initial mean age of 8.54 years and mean anterior open bite of 4.3 mm. The evaluation period comprised 12 months between initial (T1) and second lateral radiograph (T2). The T2-T1 changes were compared cephalometrically in the 2 groups using the non-paired t-test. **Results:** Vertical changes in the posterior dentoalveolar region were similar between the groups (about 1 mm) and no significant differences were found in molar mesialization. The Fpc+C group had in average 1.6 mm more improvement of the overbite as a result of greater maxillary incisor extrusion (1.3 mm). Patients in this group also presented less lingual tipping of maxillary incisors and more mandibular incisors uprighting. **Conclusions:** The Fpc+C combination was more efficient in the correction of the negative overbite mainly due to greater extrusion of the maxillary incisors. However, the Rpc+C appliance promoted better upper and lower incisor inclination, resulting in a more adequate overjet.

Key words: Open bite. Malocclusion. Orthodontics. Mixed dentition.

INTRODUCTION

Open bite is defined as a deficiency in the normal vertical overlap between antagonist teeth during occlusion^{3,25}, and it is more frequently present in the among incisors, being its prevalence about 17% in the mixed dentition¹⁹. Besides the high prevalence, anterior open bite is a major cause of masticatory and phonatory function impairment. This malocclusion also causes considerable aesthetic issues and may impact in the self-esteem of the affected patient.

According to the structures affected, anterior

open bite can be divided into three main categories: dental, dentoalveolar and skeletal². Dental and dentoalveolar open bite develop as a result of prolonged mechanical blockage of the normal vertical development of anterior teeth and alveolar process. The skeletal form, in turn, is characterized by a significant vertical skeletal discrepancy, with features such as counter-clockwise rotation of the palatine process, increased lower anterior facial height and gonial angle, short mandibular ramus and increased posterior dentoalveolar height in both mandible and maxilla¹⁸.

There are several etiological factors associated

Etiology and treatment of anterior open bite

Etiologia e tratamento da mordida aberta anterior

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Abstract

The term anterior open bite, which means no contact between anterior teeth, stands out in current orthodontic by the complexity of the treatment, associated with high levels of instability and recurrence. The purpose of this study is to emphasize that early etiological diagnosis is essential to the successful outcome of the technical intervention. The bibliographical study shows that, once the malocclusion in deciduous and mixed dentition is diagnosed, it simplifies the apparatus that is used, decreases the treatment time and conditions are created for a possible self-correction. In the permanent dentition, the authors recommend the removal of the etiological factor and the control of the vertical growth. The diversity of causes requires a multidisciplinary therapeutic approach.

Descriptors: Open bite; Malocclusion; Mouth breathing; Dentition, primary; Dentition, permanent

Resumo

A expressão mordida aberta anterior, que designa ausência de contato entre os dentes anteriores, destaca-se na ortodontia atual pela complexidade do tratamento, associada a altos níveis de instabilidade e recidiva. O objetivo deste trabalho é enfatizar que o diagnóstico etiológico precoce é fundamental para o bom resultado da intervenção técnica. O estudo bibliográfico mostra que, diagnosticada a maloclusão na dentadura decídua e mista, simplifica-se a aparatologia utilizada, diminui-se o tempo de tratamento e criam-se condições para uma possível autocorreção. Na dentadura permanente, os autores recomendam a remoção do fator etiológico e o controle do crescimento vertical. A diversidade de causas requer abordagem terapêutica multidisciplinar.

Descritores: Mordida aberta; Má oclusão; Respiração bucal; Dentição primária; Dentição permanente

Introduction

Anterior open bite can be defined as a malocclusion without contact in the anterior region of the dental arches, being the posterior teeth in occlusion. When it extends to the posterior segment, it is called combined open bite¹.

Among the malocclusions which were found in the orthodontic clinic, the open bite is one of the most prevalent and has the most difficult treatment. From multifactorial etiology, the pathology causes aesthetic changes, damage to the articulation of certain phonemes and unfavorable psychological conditions²⁻³.

In early ages, the open bite can undergo self-correction by the growth and elimination of harmful habits. However, those that persist after the growth may have an unfavorable prognosis, if it is associated with the abnormal facial pattern or an atypical behavior of the tongue in swallowing or phonation. The early diagnosis and treatment are crucial, especially in deciduous and mixed dentitions, due to the relationship with the period of growth and development. In this sense, the use of preventive therapeutic measures allows to normalize the development of dental-facial structures⁴.

This bibliographical review aims to study the main etiological factors of the anterior open bite in the deciduous, mixed and permanent dentition. Moreover, the most suitable treatments are approached, aiming to contribute to the diagnosis, prognosis and treatment of this pathology.

Literature review

Concepts

In the normal dentition there is a vertical trespass between the incisors, from about 1 to 2 mm, making the edges of the inferior incisors touch the lingual surface of the upper incisors at or below the cingulum⁵.

The open bite is characterized by a lack of this vertical contact, in both the anterior and posterior region, between the opposite segments of the teeth, or between the teeth and the gums, in a limited region, rarely occurring in throughout the dental arch, when in centric occlusion. The authors emphasize that a top to top relationship

or a slight degree of overbite could not be characterized as open bite^{1,3} (Figure 1).



Figure 1. Open bite

Classification

The open bites can be classified into three anatomical components: dental component, when the problem is only the absence eruption of the incisors; alveolar, when the commitment of the dental element occurs due to a change in the growth of the alveolar component (caused by the lack of anterior teeth eruption and by the excess of the posterior ones); and basal, caused by a pattern of unfavorable vertical growth of the bone bases, not offset by the alveolar increase².

The open bite can be the simple type, without abnormal measures to the vertical cephalometric analysis; and complex, when the cephalometry shows disharmony in the skeletal components of the anterior facial height¹.

The open bites can be classified in dental, which results from the obstruction of the normal eruption of the anterior teeth, without

Etiology of anterior open bite: a review Ätiologie des frontalen offenen Bisses: Ein Review

Christina Rijpstra¹ · Jörg Alexander Lisson¹

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Abstract

Objectives Presentation of different causes described in the literature for development of anterior apertognathia.

Methods A review about data referring to patients limited in their anterior tooth function through the positioning of their teeth has been performed. Electronic data bases, two libraries have been searched for information. Of the identified titles 357 articles and chapters were selected. 43 of these were considered.

Results Aetiology classifications are inconstant and author dependent, but mostly differentiated into genetic and environmental causes. Specifically named are: habit, tongue, airway obstruction, neuromuscular deficiency, trauma, rheumatoid disease, posture and posterior discrepancy.

Conclusions Many different factors can be relevant for the development of apertognathia and have to be considered. Further research could help differentiating which of the partially contradictory statements are true.

Keywords Open bite · Etiology · Tongue · Neuromuscular deficiency · Rheumatoid disease · Posterior discrepancy

Zusammenfassung

Ziel Die Darstellung der verschiedenen in der Literatur

beschriebenen Ursachen für das Entstehen von anterioren Apertognathien.

Methode Es erfolgte eine systematische Suche von Veröffentlichungen zu Patienten, die durch ihre Zahnstellung in der Funktion der Schneidezähne eingeschränkt sind. Elektronischer Datenbanken und zwei Bibliotheken wurden zur Datensammlung herangezogen. Von den gefundenen Titeln wurden 357 genauer bearbeitet und 43 letztendlich verwendet.

Ergebnisse Die Einteilung der Ursachen kann je nach Autor unterschiedlich sein, lässt sich aber generalisiert in genetisch und umweltbedingt einteilen. Genannt werden dabei: Habits, die Zunge im Speziellen, neuromuskuläre Defizite, Atemwegsobstruktionen, Haltung, posteriorer Platzmangel, Trauma und rheumatoide Erkrankungen.

Schlussfolgerung Viele verschiedene Faktoren können bei der Entwicklung dieser Dysgnathie relevant sein und müssen bei der Diagnose in Betracht gezogen werden. Weitere Forschung in diesem Bereich könnte zeigen, welche der zum Teil widersprüchlichen Aussagen zutreffend sind.

Schlüsselwörter Offener Biss · Ätiologie · Zunge · Neuromuskuläre Defizite · Rheumatoide Erkrankungen · Posteriorer Platzmangel

Introduction

Apertognathia is a malocclusion on which authors only agree that it is difficult to treat [5, 7, 9, 15, 18, 19, 23, 25, 27, 34, 38, 39]. Sagittal and transverse deviations have been researched, defined and successfully treated for a longer time, leaving less questions, than in the vertical plane [42]. Origins of open bites are especially important in

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Open-bite treatment with vertical control and tongue reeducation

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An open-bite malocclusion with a tongue-thrust habit is a challenging type of malocclusion to correct. A 12-year-old girl came for orthodontic treatment with a severe anterior open bite, extruded posterior segments, a tongue-thrust habit, and lip incompetency. Her parents refused surgical treatment, so a nonextraction treatment plan was developed that used palatal temporary skeletal anchorage devices for vertical control and mandibular tongue spurs to reeducate the tongue. Interproximal reduction was also used to address the moderate to severe mandibular crowding. An abnormal Class I occlusion was achieved with proper overbite and overjet, along with a pleasing smile and gingival display. (*Am J Orthod Dentofacial Orthop* 2016;149:269-76)

The etiology of open bites remains controversial and in some cases unanswered. However, there is agreement about the difficulties of treating patients with the dental and skeletal characteristics associated with this vertical discrepancy. Dental open bites are a specific type of malocclusion caused primarily by local or environmental factors. Often local etiology is correlated with habits or trauma. When a skeletal component is present, the etiology menu incorporates heredity and other health-related issues including allergies, hypertrophy of the lymphatic tissues, muscular hypotonicity, syndromes, and neurologic problems as possible contributors to the malocclusion. The literature cites causes and effects of inherited skeletal patterns (eg, vertical maxillary excess) caused by a digit-sucking habit, a tongue-thrust habit, supererupted posterior teeth, and an airway obstruction among the most prevalent causes of an open bite.^{1,2}

Many treatment modalities have been tested, some with varying degrees of success. Often, a treatment option is highly correlated with the severity of the malocclusion. Some less complex open bites may resolve by themselves during the transition from the mixed to the permanent dentition.³ Others require complex

modalities, including extraction of permanent teeth, intrusion of the posterior dentition, extrusion of the anterior dentition, or orthognathic surgery (predominately maxillary impaction).⁴⁻⁶

Most recently, the use of temporary anchorage devices (TADs) has supported treatment options without surgery or extractions. At present, many complex types of malocclusions can be treated orthodontically with TADs. TADs can provide skeletal anchorage to move teeth in all directions, giving clinicians minimally invasive treatment modalities that were not possible previously.^{7,8} They can also aid in the treatment of open bites by providing adequate anchorage for the intrusion of posterior teeth with a transpalatal arch (TPA). The TPA is attached to palatally placed TADs with power chains or closed-coil springs.^{9,10} Intrusion of the posterior maxillary dentition allows autorotation of the mandible and therefore closure of the anterior open bite. Depending on a comprehensive diagnostic protocol including the severity of the malocclusion, this technique allows for a treatment option that eliminates the need for surgical impaction of the maxilla.¹¹

DIAGNOSIS AND ETIOLOGY

A 12-year-old female came to the orthodontic clinic with chief complaints of a severe open bite and a history of speech problems. She was in myofunctional therapy at that time. The clinical examination showed an infantile swallowing pattern, anterior resting tongue posture, and a history of mouth breathing. The radiographic and clinical examinations of the temporomandibular joint showed no symptoms. She had normal joint function and joint structure (Figs 1-3).

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Severe Anterior Open Bite during Mixed Dentition Treated with Palatal Spurs

Mauro Henrique Andrade Nascimento */Telma Martins de Araújo **/Andre Wilson Machado ***

Deleterious oral habits, such as non-nutritive sucking or tongue thrusting, if not intercepted at an early stage can cause complex malocclusions. This manuscript describes a clinical case report of a successful interception of a severe anterior dental open bite caused by thumb sucking and tongue thrusting habits. The case involved a six-year-old female patient treated with the use of palatal spurs and maxillary removable crib followed by monitoring the development of dental occlusion. At the end of the interceptive phase acceptable results were achieved, showing the efficacy of the treatment undertaken as well the importance of an early intervention to remove harmful oral habits.

Key Words: Finger sucking, open bite, interceptive orthodontics.

INTRODUCTION

Sucking habits and associated occlusal anomalies have been well studied in the literature. Although these habits do not pose a problem from an orthodontic standpoint during early childhood if they persist throughout the period of transitional and permanent dentition, serious malocclusion may develop characterized by anterior open bite with upper incisor protrusion, lower incisor retroclination and posterior crossbite.^{1,2} The presence of an anterior open bite may facilitate the development of other harmful habits such as tongue and lip thrusting.²

Although deleterious oral habits are etiological factors of malocclusion, it should be pointed out that the severity of the latter will be directly related to the classical, so-called "Graber's triad" regarding the duration, frequency and intensity with which the habits are performed as well as individual predisposition relative to facial growth pattern.^{1,2}

The cessation of harmful habits and the re-establishment of normal occlusion are among the key roles played by interceptive orthodontics. For instance, anterior open bite tends to self-correct when the habit is dropped.^{3,4} Conversely, if not intercepted early, non-nutritive sucking habits can render relatively simple malocclusion treatment extremely complex.^{3,5}

The literature describes different approaches to intercept finger sucking and tongue thrusting habits as well as correcting anterior open bite.⁷⁻¹¹ Noteworthy among these are the use of palatal or lingual spurs and palatal crib. These two treatment options have yielded satisfactory results in some cases as they can interfere with the habits while fostering tongue posture reeducation.¹¹

This article aims to describe a successful clinical case involving the interception of a severe anterior dental open bite caused by finger sucking and tongue thrusting in a patient in the initial transitional dentition.

Clinical Case

A six-year-old female with no notable medical history presented to our orthodontic department with the chief complaint, as reported by her mother that she "desires to bring the anterior teeth together".

The patient reported a non-nutritive thumb sucking habit and during the clinical examination she was also found to have the habit of tongue thrusting at rest and during swallowing.

The intraoral examination showed that the patient was in the initial phase of the transitional dentition with a Class I molar relationship, anterior 9 mm open bite and 6 mm overjet. She also had unerupted maxillary lateral incisors (Figure 1).

An analysis of the panoramic radiograph indicated the presence of all permanent teeth except the third molars (Figure 2). Cephalometrically, according to the analysis of Steiner, the sagittal and vertical skeletal patterns were within normal limits while deviations were restricted to incisors positioning (Figure 3 and Table 1).

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Reporting of clinical trials in the orthodontic literature from 2008 to 2012: observational study of published reports in four major journals

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School of Dentistry, University of Dundee, Park Place, Dundee, UK

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Retrospective Revelations: Twenty Orthodontically Treated Individuals With Unilateral Cleft Lip and Palate

J.D. Subtelny, DDS, MS, DDS¹/ Stephanos Kyrkanides, DDS, PhD²

Aim: Twenty patients with unilateral cleft lip and palate, orthodontically treated from the full primary or early transitional dentition stages until retention and dismissal, were recalled later in adult life to evaluate the status of their occlusion and facial appearance. **Methods:** Cephalometric radiographs, photographs, and casts were attained as final records. In several instances, final records were obtained by orthodontic colleagues at the patient's current residence. Evaluation of the longitudinal records provided retrospective insight pertinent to the growth and positional relationships of the jaws' contiguous structures and the dentition. **Results:** Orthodontic results are linked with observations related to the nasomaxillary complex: the anterior cranial base, tissue deficiency, the maxillary and mandibular dentition, and time modifications in skeletal facial growth. At adult ages, the patients with unilateral cleft lip and palate had acceptable facial profiles and acceptable alignment of the anterior dentition. Variances noted in mandibular pattern of growth explain attainment of acceptable relationships. In many cases, tissue deficiency in the anterior cleft region was compensated for with fixed partial dentures and removable prosthetic appliances. Posterior crossbites, although few in number, were proportionately more prevalent in this unilateral cleft lip and palate patient population than was anticipated; possible reasons are presented, taking into consideration congenital contingencies and therapeutic overlays. *World J Orthod* 2004;5: 152–163.

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Patients with unilateral cleft lip and palate (UCLP) in whom orthodontic treatment was initiated at the primary or early transitional dentition stages of development and had completed treatment by the

later teen years or beyond, were recalled for more current records as adults, ranging from 25 to 51 years of age. Twenty patients were located: 15 male patients and 5 female patients. The surgeons and surgical procedures were not uniformly the same; however, in all cases, surgical closure of the cleft lip was performed by 12 weeks of age and palatal closure, reportedly, occurred between 18 and 24 months of age. It was difficult to precisely define extent and numbers in which vomer flap surgery was performed to achieve palatal closure. Orthodontic treatment in a majority of these cases was initiated after full eruption of the primary dentition; start of orthodontic treatment was highly dependent on the time of referral to the orthodontist. Residual UCLP malocclusions were referred and initially treated in the early transitional dentition stage, when the maxillary central incisors were in partial eruption and noticeably malposed. In all of these 20 UCLP cases,

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Presented at the 9th International Congress on Cleft Palate and Related Craniofacial Anomalies, Goteborg, Sweden.

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(20)



Treatment effects of bonded spurs associated with high-pull chincup therapy in the treatment of patients with anterior open bite

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Renata Rodrigues de Almeida-Pedrin,^d and Márcio Rodrigues de Almeida^e
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Introduction: The aim of this prospective clinical study was to investigate the cephalometric changes produced by bonded spurs associated with high-pull chincup therapy in children with Angle Class I malocclusion and anterior open bite. **Methods:** Thirty patients with an initial mean age of 8.14 years and a mean anterior open bite of -3.93 mm were treated with bonded spurs associated with chincup therapy for 12 months. An untreated control group of 30 subjects with an initial mean age of 8.36 years and a mean anterior open bite of -3.93 mm and the same malocclusion was followed for 12 months for comparison. Student *t* tests were used for intergroup comparisons. **Results:** The treated group demonstrated a significantly greater decrease of the gonial angle, and increase in overbite, palatal tipping of the maxillary incisors, and vertical dentoalveolar development of the maxillary and mandibular incisors compared with the control group. **Conclusions:** The association of bonded spurs with high-pull chincup therapy was efficient for the correction of the open bite in 86.7% of the patients, with a 5.23-mm (SD, ± 1.69) overbite increase. (Am J Orthod Dentofacial Orthop 2012;142:487-93)

The prevalence of anterior open bite in the mixed dentition is 17.7%,^{1,2} and the etiology is multifactorial, including oral habits, abnormal size or function of the tongue, oral breathing, vertical growth pattern, and congenital or acquired diseases.³ Among the most frequent habits are finger sucking, pacifiers, altered labial postures, and tongue habits.⁴

Several treatments have been proposed to correct this malocclusion. Although many treatment modalities are available, effectiveness and stability after treatment are still critical issues because evidence on long-term stability of these options is lacking.⁵

Many authors have emphasized that a skeletal open bite should be treated early in the mixed dentition.⁶⁻⁸ The spurs might be an excellent treatment option to allow normal development of the anterior dentoalveolar region, since they prevent thumb or dummy sucking, tongue thrusting, and anterior tongue rest posture.^{5,7,8} For a long time, they were considered extremely traumatic and dropped for fear of provoking psychologic problems and alienating parents and patients.⁷ However, it has already been concluded that no psychologic problems arose from using spurs, and this appliance was considered the most effective means for arresting finger habits and correcting an anterior open bite.⁹ Recently, Nogueira et al¹⁰ developed the Nogueira lingual bonded spurs (3M Unitek, Monrovia, Calif) based on the principles of traditional spurs. This appliance has some apparent advantages, such as small size (about 3 mm), low cost, esthetics, no laboratory preparation, easy installation, and reduced clinical time for bonding (about 2 minutes per spur). No study with bonded spur appliances was found.

Although some studies^{11,12} have concluded that most subjects with a high angle malocclusion have a normal overbite, or even a deep bite, from a compensatory eruption mechanism, others suggest that most cases of anterior open bite are related to a long face pattern with an increase in lower anterior face height and

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Anterior open-bite treatment with bonded vs conventional lingual spurs: A comparative study

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Recife, Pernambuco, Bauru, São Paulo, and Maringá, Paraná, Brazil

Introduction: The purpose of this study was to compare the isolated effects of bonded and conventional spurs on the craniofacial and dentoalveolar complexes of patients in the mixed dentition with anterior open bite. **Methods:** The sample included 68 subjects with anterior open bite and Class I malocclusion. Group 1 comprised 20 patients treated with bonded lingual spurs with a mean initial age of 9.31 years (SD, 1.17). Group 2 consisted of 21 patients treated with conventional lingual spurs with a mean initial age of 9.22 years (SD, 1.62). The control group (group 3) consisted of 27 untreated subjects. One-way analysis of variance tests followed by Tukey tests were used for intergroup cephalometric comparisons. After 1 month of treatment, patient acceptance of the spurs was evaluated with a questionnaire. **Results:** There were significantly greater overbite increases in the experimental groups than in the control group. The group with bonded lingual spurs showed significantly better acceptance than did the group with conventional lingual spurs during chewing and eating. **Conclusions:** The 2 appliances resulted in similar overbite increases during early open-bite treatment. After a week or less of treatment, 92.5% of the children had adjusted to the spurs. (*Am J Orthod Dentofacial Orthop* 2016;149:847-55)

Anterior open bite is a common malocclusion in growing patients. The incidence of anterior open bite varies with age¹ and has a high prevalence (17.7%) in the mixed dentition.^{2,3} The etiology is multifactorial, including oral habits, abnormal size or function of the tongue, oral breathing, vertical growth pattern, and congenital or acquired diseases.⁴ Among the most frequent habits are finger sucking, pacifiers, altered labial postures, and tongue habits.⁵

Treatment of an anterior open bite is a great challenge in orthodontics. After treatment, patients can benefit from an improved ability to incise and chew

food, and improved esthetics and speech. Several early approaches to treat anterior open bite have been developed. Frequently, early anterior open-bite treatment is performed with fixed and removable palatal cribs and lingual spurs that may be associated with a chin cup or high-pull headgear in patients with a vertical facial pattern.⁶⁻⁹ Although many treatment modalities are available, the effectiveness and the stability after treatment are still critical issues because evidence on the long-term stability of these options is lacking.⁸⁻¹⁰

Investigators have cited tongue position or activity as reasons for difficulty in achieving long-term stability of anterior open-bite treatment.^{9,11} It was concluded that banded-spur appliances correct anterior tongue posture and maintain long-term stability of open-bite correction. Lingual-spur therapy results in closure of the anterior open bite by successfully keeping tongue pressure away from the anterior teeth and serving as a reminder to the patient to discontinue oral habits. Spur appliance effects include palatal tipping of the maxillary incisors, increases in overbite, and increases in dentoalveolar development of the maxillary and mandibular incisors.^{6,9} Also, when associated with a chin cup, they can lead to a significant decrease of the gonial angle.⁶ However, some clinicians are wary of using banded spur appliances because of expected negative patient or parent reactions. The use of this appliance has faced resistance from patients, parents, speech pathologists, and psychologists, as well as

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REVIEW

Open Access



Systematic review for orthodontic and orthopedic treatments for anterior open bite in the mixed dentition

Lucia Pisani^{1*}, Laura Bonaccorso², Rosamaria Fastuca¹, Raffaele Spena², Luca Lombardo² and Alberto Caprioglio¹**Abstract**

Background: The treatment options for the early treatment of anterior open bite are still controversial. The aim of this study was to evaluate the actual available evidence on treatments of anterior open bite in the mixed dentition in order to assess the effectiveness of the early treatment in reducing open bite, the most efficacious treatment strategy and the stability of the results.

Materials and methods: A literature survey was done on November 15, 2015, by means of appropriate Medical Subject Headings (MeSH) using the following databases: PubMed, EMBASE, Cochrane Library, LILACS, VHL, and WEB OF SCIENCE.

Randomized clinical trials and studies with a control group (treated or untreated) were then selected by two authors. Trials including patients with syndromes or in the permanent dentition and studies concerning treatment with extractions, full-fixed appliances, or surgery were not considered.

Full articles were retrieved for abstracts or titles that met the initial inclusion criteria or lacked sufficient detail for immediate exclusion.

Results: Two thousand five hundred sixty-nine studies about open bite were available; the search strategy selected 240 of them.

Twenty-four articles have been judged suitably for the final review, and their relevant data were analyzed.

Discussion: Although this review confirms the effectiveness of early treatment of open bite, particularly when no-compliance strategies are employed, meta-analysis was unfeasible due to lack of standardization, important methodological limitations, and shortcomings of the studies.

Conclusions: A more robust approach to trial design in terms of methodology and error analysis is needed. Besides, more studies with longer periods of follow-up are required.

Keywords: Early treatment, Open bite, Systematic review, Quality analysis

Review**Background**

Anterior open bite is a malocclusion characterized by a deficiency in the normal vertical overlap between antagonist incisal edges when the posterior teeth are in occlusion [1].

Dental and dentoalveolar open bite is the result of a mechanical blockage of the vertical development of the incisors and the alveolar component while skeletal relationships are normal; skeletal open bite is determined by a vertical skeletal discrepancy [2]. However, in most cases, the distinction is not clear since malocclusion presents both dental and skeletal components [3].

Skeletal open bite is characterized by increased lower anterior facial height and gonial angle, short mandibular ramus, and increased posterior dentoalveolar height. Concomitant transverse discrepancies may also be present [4]. Additional features are lip incompetence, profile convexity,

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Anterior open bite: a case-control study

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International Journal of Paediatric Dentistry 2010; 20: 59–64

Objective. The aim of this study was to assess the influence of sucking habits and facial pattern measurements on the development of anterior open bite (AOB).

Methods. A case-control study was carried out on 60 children aged 7 and 8 years attending municipal public schools in the city of Recife, Brazil. Data collection included interviews with guardians, oral examinations, and facial growth pattern analysis using cephalometric radiographs. The following cephalometric measurements were assessed: SN.Gn, SN.GoGn, FMA, and Facial Axis. Statistical

analyses were performed using the Student's *t*-test and Pearson's chi-square test at a 5% level of significance.

Results. The percentage of children with sucking habits in the case group was much higher than in the control group (53.3% vs 16.7%) ($P = 0.003$). Children with sucking habits were six times more likely to develop AOB. Regarding the measurements assessed, no statistically significant differences were observed between groups.

Conclusion. This study found no evidence that variations in cephalometric angles (SN.Gn, FMA, SN.GoGn, and facial axis) are risk factors for AOB. Only sucking habits demonstrated a positive correlation with an increased AOB.

Introduction

Anterior open bite (AOB) is a malocclusion that considerably compromises aesthetics and function. It is characterised by dental and/or skeletal alterations that have an impact on quality of life¹. AOB can be defined as the presence of a negative vertical relationship between the incisor margins of the upper and lower anterior teeth². Prevalence ranges from 13% to 46.3% and is related to age, occurrence of oral habits and genetic inheritance, although no scientific evidence has yet been produced to corroborate the influence of this last factor^{3–5}.

Despite the close relationship between sucking habits and AOB, this type of malocclusion may also be present among those without such habits^{2,6–8}. A full understanding of the aetiological factors is necessary for the establishment of an individualised treatment plan. According to a number of authors, AOB may develop as a result of inherited skeletal

patterns that exercise a decisive influence over the growth and development of orofacial structures^{2,5,9}. Thus, individuals with an inherited predisposition to this malocclusion are likely to present it and the degree of manifestation may be influenced by favourable or unfavourable environmental factors.

Although cephalometric parameters have been valuable in determining patterns, most patients with open bite do not have the cephalometric criteria suggestive of the condition, whereas most patients who have cephalometric measures considered to be suggestive of open bite do not, in fact, present it. Moreover, far more people have sucking habits than have open bite^{10,11}.

The aim of this case-control study was to determine the influence of risk factors (sucking habits and facial growth pattern) on the aetiology of AOB among a group of children aged 7 and 8 years enrolled in municipal public schools in the city of Recife-PE (Brazil).

Material and methods

This case-control study was conducted in public schools in the city of Recife, the state

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Non-Nutritive Sucking Habits, Anterior Open Bite and Associated Factors in Brazilian Children Aged 30-59 Months

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The aim of the present study was to investigate the prevalence of non-nutritive sucking habits and anterior open bite as well as their main causes (associated factors) in Brazilian children aged 30-59 months. A cross-sectional study was carried out during the National Immunization Day for polio in the city of Recife in the northeastern region of Brazil. The sample was made up of 1,308 children. Data were collected from interviews with mothers or guardians as well as from clinical examinations carried out by previously trained dental students. The chi-square test was used for statistical analysis at 5% significance level. The prevalence of non-nutritive sucking habits was 40%, and the habits were associated with gender ($p=0.001$), age ($p=0.003$) and feeding type ($p<0.001$). Anterior open bite was detected in 30.4% of children, and it was significantly associated with feeding type ($p<0.001$) and non-nutritive sucking habits ($p<0.001$). The variables found to be associated factors in the present study for the occurrence of non-nutritive sucking habits and anterior open bite emphasize the need to establish strategies that include orientation regarding health promotion based on the "common determining factors" approach. Public health policies should be adopted to encourage a longer duration of breastfeeding, thereby contributing towards reducing the prevalence of non-nutritive sucking habits and anterior open bite.

Key Words: epidemiology, habits, prevalence, child.

INTRODUCTION

Non-nutritive sucking is a common behavior among young children in various populations (1-3). Its prevalence is quite variable and depends on several factors, including gender, age, feeding method and socioeconomic status (1). There is an agreement among a number of authors that non-nutritive sucking habits can be a consequence of industrialization and modernization, with more women working and a shorter breastfeeding period, which favors the adoption of digital and pacifier sucking (1).

Recent studies on determining factors of anterior open bite reveal that non-nutritive sucking habits (pacifier and finger) are the main reasons for this type of malocclusion (2,3). Other factors associated to

anterior open bite include breathing pattern (4), skeletal patterns (5), early weaning and dental caries (3). It is important to obtain knowledge of the consequences of non-nutritive sucking habits, anterior open bite, as well as their prevalence and associated factors.

The aim of the present study was to investigate the prevalence of non-nutritive sucking habits and anterior open bite as well as the associated determining factors in Brazilian children aged 30-59 months.

MATERIAL AND METHODS

A cross-sectional study was conducted in the city of Recife, the state capital of Pernambuco in the northeastern region of Brazil. The study received approval from the Human Research Ethics Committee

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Cochrane Central Register of Controlled Trials

Comparison of orthodontic treatment outcomes in adults with skeletal open bite between conventional edgewise treatment and implant-anchored orthodontics

PubMed

American journal of orthodontics and dentofacial orthopedics, 2011, 139(4 Suppl), S60-8 | added to CENTRAL: 31 July 2011 | 2011 Issue 3

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Deguchi T, Kurosaka H, Oikawa H, Kuroda S, Takahashi I, Yamashiro T, Takano-Yamamoto T

Links: [PubMed](#)

Abstract

INTRODUCTION: Open bites are known to be difficult malocclusions to treat. Generally, with conventional edgewise treatment, incisor extrusion rather than molar intrusion is observed. Recently, the use of miniscrews as anchorage has markedly increased. In this study, orthodontic treatment outcomes after conventional edgewise treatment and implant-anchored treatment were investigated by cephalometric analysis and several occlusal indexes. In addition, the stability of these patients 2 years after the retention phase was also analyzed.

METHODS: Thirty adults (15 for nonimplant treatment [non-IA group] and 15 for implant-anchored treatment [IA group]) were our subjects. Cephalometric analysis, peer assessment rating, discrepancy index, and objective grading system were used.

RESULTS: From the cephalometric values in the non-IA group, open-bite patients were generally treated by extrusion of the maxillary and mandibular incisors that resulted in clockwise rotation of the mandibular plane angle. In the IA group, intrusion of the maxillary and mandibular molars that resulted in counterclockwise rotation was noted. Furthermore, in the IA group, the soft-tissue analysis showed decreases in the facial convexity and the inferior labial sulcus angle that resulted in the disappearance of incompetent lips. In the retention phase, extrusion of the mandibular molars was observed in the IA group. From the objective grading system evaluation, significant reductions of overbite in canines and premolars were observed in both groups. Furthermore, less stability was observed in the IA group compared with the non-IA group according to the total objective grading system score.

CONCLUSIONS: Ideal occlusion can be achieved in adults with severe open bite with both conventional edgewise and implant-anchored orthodontic treatment. However, absolute intrusion of the molars and improvement in esthetics might be achieved more effectively by using miniscrews as an anchorage device. In addition, since a significant amount of tooth movement occurs with miniscrews, careful attention is required during the retention phase.

ORIGINAL ARTICLE

Stability of anterior openbite correction with multiloop edgewise archwire therapy: A cephalometric follow-up study

(28)

Young H. Kim, DMD, M
Ma. Laarni P. Serrano,
Weston, Mass

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(29)

SHORT COMMUNICATION

Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition

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Rome and Florence, Italy

Introduction: The aim of this study was to evaluate sucking habits and hyperdivergency as risk factors for anterior open bite in mixed-dentition subjects. **Methods:** Anamnestic and pretreatment cephalometric records of 1710 mixed-dentition subjects were assessed for sucking habits, dental open bite, and facial hyperdivergency. **Results:** The rate of anterior open bite was 17.7%. Multiple logistic regression showed that both prolonged sucking habits and hyperdivergent vertical relationships significantly increased the probability of an anterior dentoalveolar open bite, with a prevalence rate of 36.3%. This was 4 times the prevalence of sucking habits and facial hyperdivergency in subjects without anterior open bite (9.1%). **Conclusions:** Prolonged sucking habits and hyperdivergent facial characteristics are significant risk factors for anterior open bite in the mixed dentition. (Am J Orthod Dentofacial Orthop 2005;128:517-9)

Sucking habits at a very early age (until 3 years) are normal, but persistence of these habits beyond 3 significantly increases the probability of developing undesirable dental arch and occlusal traits at the end of the deciduous dentition stage.¹ Prolonged sucking habits create a mechanical obstacle for the eruption of anterior teeth, in association with tongue-thrust swallowing. These alterations often result in an anterior open bite.²⁻⁵ However, studies on the extent to which sucking habits impact dental occlusion and lead to open bite are contradictory. A few clinical contributions from the past affirm that digit sucking cannot cause skeletal malocclusions, but it can add dentoalveolar problems to existing skeletal problems.^{6,7} Fukuta et al⁸ also investigated the relationship between sucking habits and malocclusion in the deciduous dentition, demonstrating a higher prevalence of open bite in the

thumb- or finger-sucking group compared with age-matched controls without oral habits. Farsi and Salama⁹ studied the effect of sucking habits in Saudi Arabian children aged 3 to 5 years and found a strong correlation between the oral habit and open bite.

Many of the studies that focus on the analysis of anterior open bite report a high prevalence of the hyperdivergent phenotype.¹⁰ There is no univocal appraisal of facial hyperdivergency in the development of dental open bite. Through the use of cephalometric parameters, it has been shown that most anterior open bite subjects do have traits of both dentoalveolar and skeletal increased vertical dimensions.¹¹⁻¹³ Vice versa, skeletal open bite subjects do not necessarily have negative overbite.^{14,15} The influence of skeletal characteristics on overbite has been calculated to be less than 25% in the mixed dentition.¹⁶

The aim of this investigation was to test the hypothesis, by means of a prevalence study of a large orthodontic population in the mixed dentition, that sucking habits and a hyperdivergent facial pattern predispose a child to anterior open bite.

MATERIAL AND METHODS

The parent sample for this study consisted of 1827 subjects in the mixed dentition (intertransitional and second transitional periods of the mixed dentition)¹⁷ who had been observed from 1990 to 2005 at the orthodontic departments of the University of Florence and the University of Rome "Tor Vergata," as part of an ongoing multicentric clinical investigation on the prevalence of dentoskeletal open bite. The exclusionary

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REVIEW

The Factors Affecting Long-Term Stability in Anterior Open-Bite Correction - A Systematic Review

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ABSTRACT

Objective: The present systemic review was conducted with the main purpose to evaluate the quantitative effects of orthognathic surgeries, extraction versus non-extraction treatment, and the type of malocclusion in the stability of anterior open-bite (AOB) correction over the long-term.

Methods: The systematic search for studies was conducted through MEDLINE, CINAHL, EMBASE, Scopus, PsychINFO, various key journals, and review articles; November 30, 2016, was the last date for the search. The Quality Assessment Tool for Quantitative Studies was used to grade the methodological quality of the studies.

Results: The present review included 14 studies. Stability of the corrected AOB ranged from 61.9% to 100%. The studies with orthognathic surgeries showed a stability of 70–100%. The studies without orthognathic surgeries showed the stability of 61.9–96.7%. All of the studies were retrospective. The mean change in AOB before (T1) and after treatment (T2-T1) was 0.1 mm to 6.93 mm and the mean change in overbite from T2 to T3 (T3-T2) was -0.06 mm to 2.5 mm.

Conclusion: Studies with orthognathic surgeries presented with high amount of long-term stability in corrected AOB. No significant difference was noticed in relation to the type of malocclusion and extraction or non-extraction cases.

Keywords: Anterior open-bite, systematic review, stability

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INTRODUCTION

Anterior open-bite (AOB) is a malocclusion that is characterized by decrease in the normal vertical overlap between upper and lower incisal edges when the molars are in occlusion (1). It may be either dentoalveolar open-bite resulting from mechanical blockage of vertical development of the anteriors and alveolar component or skeletal open-bite resulting from vertical skeletal discrepancy (1,2). Along with AOB, subjects may also present with incompetence of lips, convex facial profiles, marked labial inclinations, and crowding of the incisors, leading to impairment of mastication and phonetics with considerable esthetic problems (2). Many treatment modalities have been developed to treat both dental and skeletal open-bites. Treatment ranges from functional appliances to fixed appliances with or without surgical correction. The treatments like vertical chin cup therapy, chewing exercises, bite blocks, extractions, and mesialization of posterior teeth were used to achieve relative and true molar intrusion (3-5). Palatal cribs or spurs are recommended when thumb sucking or tongue thrusting is noticed (6). Although these treatments increase vertical overlap of the incisors, it is still not clear which treatment modality is more efficient and effective than others. Additionally, various factors determine the long-term stability of corrected AOB malocclusion (3-5). They include severity of AOB malocclusion prior to treatment, extractions of premolars, correction of open-bite with or without orthognathic surgery, or different methods of retention (4,5). Recently, many studies have been conducted to check the long-term stability of corrected AOB malocclusion (7-24). When we searched the literature, we came across two systematic reviews of case series studies conducted to assess the effectiveness of orthodontic and orthopedic treatment in AOB correction (4,5). No systematic reviews have been conducted recently to check the long-term stability of AOB correction. The present systematic review was conducted to evaluate the factors affecting long-term stability in open-bite correction.

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Short Communication

AN INTRODUCTION TO INTERCEPTIVE ORTHODONTICS

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Abstract

Interceptive orthodontic treatment is used to eliminate or reduce the need for major treatment in the permanent dentition. It is technically simple and relatively cheap, compared to comprehensive treatment with full fixed appliances. The early loss of primary molars and non-nutritive sucking habits may lead to develop a malocclusion in permanent dentition and interceptive measures are used to avoid adverse occlusal and dental consequences. Early assessment is the key of interceptive orthodontics. The purpose of this article to discuss briefly about interceptive orthodontics.

Key words: Interceptive Orthodontic, Habit, Malocclusion, Development stage.

Introduction

Interceptive orthodontics deals to intercept a malocclusion that has already developed or is developing & the goal is to restore a normal occlusion. The word "orthodontics" was coined, it was known that teeth moved in response to pressure. Primitive (and surprisingly well-designed) orthodontic appliances have been found with Greek and Etruscan artifacts.¹ The first treatment of an irregular tooth was recorded by Celsus (25 BC-50 AD), a Roman writer, who said, "If a second tooth should happen to growing children before the first has fallen out, that which ought to be shed is to be drawn out and the new one daily pushed toward its place by means of the finger until it arrives at its just proportion." A clear mechanical treatment was advocated by Pliny the Elder (23-79 AD), who suggested filing elongated teeth to bring them into proper alignment. This method remained in practice until the 1800s.² Malocclusions were called "irregularities" of the teeth, and their correction was termed "regulating." It remained for the Enlightenment to reawaken the spirit of scientific thought necessary to advance dentistry and other disciplines.

Pierre Fauchard "repositioned" teeth with a forceps, called a "pelican" because of its resemblance to the beak of that bird, and ligated the tooth to its neighbors until healing took place. At that time, little attention was to anything other than the alignment of teeth and then almost exclusively to the maxilla. Moreover, he was the first to recommend serial extraction by extracting premolars to relieve crowding.³

However, before the time of Edward Angle, the treatment of malocclusions was chaotic, with little understanding of normal occlusion and even less understanding of the development of the dentition. Appliances were primitive, not only in design but also in the metals and materials used. There was no rational basis for diagnosis and case analysis. It was Edward Hartley Angle (1855 -1930), early in the 20th century, who dominated the emergence of "orthodontia as a science and a specialty".⁴

Definitions of interceptive orthodontics

Interceptive orthodontics deals to intercept a malocclusion that has already developed or is developing, & the goal is to restore a normal occlusion.¹

According to American Association of Orthodontics (1969), interceptive orthodontics has been defined as "that phase of science & art of orthodontics employed to recognize & eliminate potential irregularities & malpositions of the developing dentofacial complex".⁵ According to Proffit & Ackerman (1980), interceptive orthodontics is defined as "elimination of existing interferences with the key factors involved in the development of the dentition".⁵

According to Shetty & Tandon (2001), it is defined as an early intervention in the developing dentition to minimize the developing malocclusion or elimination of potential factors which interfere with normal occlusion.

Difference between Preventive & Interceptive Orthodontics

The terms preventive and interceptive orthodontics are sometimes used synonymously. But it should be understood that preventive orthodontic procedures are undertaken when dentition and occlusion are perfectly normal, while the interceptive procedures are carried out when the signs and symptoms of malocclusion have appeared. In interceptive orthodontics, the orthodontist is dealing with malocclusion as a "fait accompli" at least to a minor degree. If he renders the proper service with dispatch, autonomous adjustments will restore normal growth but if he waits for too long he is left with no other alternative than to resort to corrective orthodontics which might be a compromise most of the times.¹

Thus preventive orthodontics is the prevention of potential interferences with occlusal development while interceptive orthodontics basically refers to measures undertaken to prevent a potential malocclusion from progressing into a more severe one.

Maturational development & facial form relative to treatment timing

It is important for the clinician to be able to reveal the developmental uniqueness of an individual, especially at a young age, so that the timing and design of treatment modalities can be most advantageously facilitated. Correlation of information integrating a child's

Review Article

Age Changes of Jaws and Soft Tissue Profile

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Age-related changes of jaws and soft tissue profile are important both for orthodontists and general dentists. Mouth profile is the area which is manipulated during dental treatment. These changes should be planned in accordance with other components of facial profile to achieve ultimate aim of structural balance, functional efficacy, and esthetic harmony. Through this paper, the authors wish to discuss age changes of the hard and soft tissues of human face which would help not only the orthodontists but also oral surgeons, prosthodontists, pedodontists, and general dentists.

1. Introduction

Age-related changes of jaws and soft tissue profile are important both for orthodontists and general dentists. Behrents [1] reported that craniofacial growth does not stop in young adulthood but is a continuous process even into later ages. The units of change are small but change in the craniofacial skeleton has become the operational concept rather than termination of the process.

The increasing demand for adult orthodontics and orthognathic surgery increases the need to understand the facial aging process.

2. Growth and Profile Change: A Historical Background

The physical anthropologists in earlier days worked with dry skull. Keith and Campion [2] studied human facial growth from childhood to adulthood, using immature and mature skulls and 32 living individuals.

Hellman [3] made over 45,000 measurements of external dimensions of the face after studying 705 males and 988 females ranging from 3 to 22 years of age. He concluded that, "the infant face is transformed into that of the adult not

only by increases in size, but by changes in proportion and adjustment in position as well."

Broadbent [4] instrumented a longitudinal study of over 4000 subjects in 1929 at Case Reserve University in Ohio. The findings were presented in the form of superimposed tracings of serial cephalograms made at several stages from 1 month to adulthood. This study is known as *Bolton Brush growth study*.

Behrents [5] did an extensive adult follow-up research of subjects in the original Bolton study, analyzing 163 subjects in the age range of 17 to 83 years. He concluded that craniofacial size and shape changes continue past 17 years to the oldest ages studied. He summarized that significant sexual dimorphism existed: men are larger at all ages, they grow more, and their adult growth is more apt to persist along the same vectors of adolescent growth. On the other hand, women showed periods of increased rates of craniofacial growth, apparently related to the time of pregnancies.

3. Child Face

The child has a high intellectual-like forehead without coarse eyebrow ridges, with prominent cheekbones, large and wide-set eyes, and a flat face. It has a short nose, low nasal bridge, and a concave nasal profile. The face is vertically short

(32)

Cephalometric analysis: manual tracing of a lateral cephalogram

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P Hlongwa

ABSTRACT

Cephalometric analysis remains a preferred tool in the diagnosis and treatment planning of orthodontic and of orthognathic surgical cases. A cephalometric tracing can be prepared and analysed manually or by a computer using cephalometric tracing software. A number of software programmes on cephalometric analyses have been introduced but their widespread use has been restricted by cost factors, especially in situations having a constraint on resources. This report will give a step-by-step procedure to enable the identification of cephalometric points and planes used in orthodontic diagnosis and treatment planning and to facilitate the manual tracing of a lateral cephalogram.

INTRODUCTION

Cephalometrics ...literally "head measuring"... is the recording and interpretation of measurements of the skull made on standardized radiographs of the living head. Since the introduction of cephalometry by Broadbent and Hofrath in the 1930s,^{1,2} the cephalometric technique has been regarded as a most important tool for orthodontists and maxillo-facial surgeons engaged in studying dental malocclusions and the underlying skeletal discrepancies. Applications for cephalometric analysis include case diagnosis, treatment planning, prediction of growth and the evaluation of treatment results.³ Manual tracing of cephalometric films is performed by identifying radiographic landmarks on acetate overlays and using these reference points to construct lines, planes and angles to enable the measurement of linear and angular values, using a millimetre scale and a protractor. This manual process can be time-consuming and the measurements obtained may be subject to error. Whilst advances in computer science have led to the widespread application of computers in cephalometry,⁴ offering enhanced accuracy, nevertheless, the skills of manual analysis are still required.

AIMS AND OBJECTIVES

To enable the manual tracing of a cephalogram showing a true lateral view of the skull, and the identification of many of the cephalometric points and planes used in orthodontic diagnosis and treatment planning.

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MATERIALS AND METHODS

Materials required for manual cephalometric tracing

- Acetate tracing paper: a sheet 210mm x 160mm.
- Viewing box
- Protractor
- 300 mm ruler
- Tracing template
- Adhesive tape
- Eraser
- HB lead pencil
- 4H lead pencil
- Blue, red and green coloured pencils

Step-by step procedure

Step 1: Aligning the tracing paper on the lateral cephalogram radiograph

- 1.1. Draw two crosses about 3 cm apart on the top left hand corner of the radiograph.
- 1.2. Overlay the sheet of acetate tracing paper on the radiograph and attach the top edge with adhesive tape.
- 1.3. Trace the crosses onto the tracing paper for ease of subsequent superimposition of the tracing.
- 1.4. Write the patient's name, age and date of radiograph above the crosses on the tracing paper.

Step 2: Identify and trace hard tissue (HT) structures and identify the following hard tissue landmarks (Fig. 1)

- 2.1. Trace the cranial base.
- 2.2. Trace upper and lower central incisors, following the correct long axes.
- 2.3. Trace upper and lower first permanent molars in relationship to each other.
- 2.4. Trace the mandible and maxilla.
- 2.5. Sella (**S**): Mid-point of sella turcica.
- 2.6. Nasion (**N**): Midpoint of frontonasal suture.
- 2.7. Porion (**Po**): Top of external auditory meatus.
- 2.8. Orbitale (**Or**): Inferior border of orbit.
- 2.9. Pterygomaxillary fissure (**Pt**): most posterior and superior point on the outline of the pterygomaxillary fissure.
- 2.10. Condylion (**Cd**): Most superior point on the head of the condyle.
- 2.11. Articulare (**Ar**): a point on the posterior border of the ramus at the intersection with the basilar portion of the occipital bone.
- 2.12. Posterior nasal spine (**PNS**): Posterior point of bony hard palate.
- 2.13. Anterior nasal spine (**ANS**): Anterior point of maxilla.

Stability of anterior open bite treatment with bonded spurs associated with high-pull chin cup

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Structured Abstract

Objective: To evaluate the stability of anterior open bite (AOB) treatment with bonded spurs associated with high-pull chin cup (BS/HPCC).

Methods: The experimental group consisted of 25 Class I AOB patients (15 female, 10 male) treated with BS/HPCC for 1 year. Cephalograms were analysed at pre-treatment (T1), post-treatment (T2) and at the 3-year post-treatment (T3) stage with the patients mean ages of 8.10, 9.14 and 12.18 years, respectively. The control group consisted of 23 subjects (13 female, 10 male) with normal occlusion, with comparable ages at the 3 stages (8.45, 9.45 and 12.50 years at T1, T2 and T3, respectively). T tests were used for intergroup comparisons at T1 and to compare the changes during the 3-year post-treatment period (T2-T3). Intragroup comparison in the treated group was evaluated with dependent t tests between T1 and T2. Correlations between the overbite changes in the T2-T3 period, the pre-treatment AOB severity and the amount of correction achieved during treatment were evaluated with Pearson's correlation coefficient.

Results: No statistically significant relapse of the AOB was found at T3. Only 1 patient had a clinically significant AOB relapse. Neither the pre-treatment AOB severity nor the amount of correction was related to overbite changes during the 3-year post-treatment period.

Conclusions: There was no statistically significant relapse of the AOB, and the clinical stability of AOB correction 3-year post-treatment was of 96%.

KEYWORDS

bonded spurs, cephalometrics, chin cup, interceptive orthodontics, open bite

1 | INTRODUCTION

Anterior open bite (AOB) has a multifactorial aetiology and results from interactions of genetic and environmental factors.^{1,2} The most important factors in the mixed dentition are deleterious oral habits such as pacifier, thumb sucking, anterior tongue posture, tongue thrusting and mouth breathing.^{1,2}

Several early treatment approaches for AOB have been described, and they focused on the interruption of deleterious habits allowing anterior dentoalveolar development without

interference.³⁻¹³ However, stability has been reported by few studies involving only crib³ or quad-helix associated with crib therapies.^{6,14} Some treatment protocols involve bonded spurs and might be excellent treatment options because they prevent thumb sucking, anterior tongue posture and tongue thrusting.^{4,7,9-12}

AOB is commonly related to a long face pattern with lower anterior face height increase and clockwise mandibular rotation.^{4,15} Dental compensations produced by conventional orthodontics may not lead to satisfactory results, requiring another treatment

Dentoskeletal changes associated with fixed

Original Article

Effects of palatal crib and bonded spurs in early treatment of anterior open bite:

A prospective randomized clinical study

Juliana S. Leite^a; Luciano B. Matiussi^b; Anne C. Salem^c; Maria G. A. Provenzano^d; Adilson L. Ramos^e

ABSTRACT

Objective: To evaluate the overbite correction of fixed palatal crib (FPC) and bonded lingual spur (BLS) in the early treatment of anterior open bite (AOB) in mixed dentition (primary outcome) as well as its influence on dental and skeletal cephalometric measurements (secondary outcome).

Materials and Methods: The selected patients had AOB and a mean age of 8.23 years. They were divided into the following three groups by casting lots: control (n = 13), palatal crib (n = 13), and spur (n = 13). Data from the lateral telerradiography was obtained at the beginning, at 6 months, and after 1 year. The cephalometric analysis was performed by Cef-X program, recording the values of SNA, SNB, ANB, SnG oGn, 1.PP, IMPA, nasolabial angle, overbite, and overjet. Intergroup and intragroup comparisons were obtained via one-way analysis of variance.

Results: The degree of AOB was similar at baseline ($P > .05$). At 6 months and then after 1 year all groups showed improvement in the overbite. However, only the crib and spur groups showed positive overbite. No cephalometric measurements changed significantly over the period analyzed.

Conclusions: We conclude that the FPC and BLS are simple and effective for the treatment of anterior open bite, with the advantage given to the FPC. (*Angle Orthod.* 2016;86:734–739.)

KEY WORDS: Open bite; Orthodontic appliances

INTRODUCTION

An anterior open bite (AOB), one of the malocclusions with the greatest esthetic and functional impairment, is characterized by the presence of negative overbite between the incisal edges of the upper and lower front teeth when the posterior ones are in occlusion.^{1–3} Habits of sucking objects like a pacifier and a finger can cause or worsen AOB in predisposed

patients. Most children grow out of the habit, but if they continue with it through mixed dentition they might need orthodontic intervention.⁴ Available data have shown that 12.1% of children past the age of 7 years maintain a digit- or pacifier-sucking habit, but general studies show that the prevalence of AOB decreases with age.⁵ It was reported that 17.7% of children from 6 to 8 years old, among those with malocclusion evaluated by the Index of Orthodontic Treatment Need, had anterior open bite.⁶

From the age of 5 years, if the habit is interrupted and the patient has a good facial growth pattern, correction of AOB may occur spontaneously.⁷ Self-correction of dental AOB may occur in up to 80% of patients when the negative habit is eliminated up until the phase of mixed dentition.²

In a systematic review, Borrie et al.⁴ showed that orthodontic appliances were beneficial in stopping the sucking habit compared with no treatment, and that the palatal crib was beneficial for occlusion compared with no treatment. The palatal crib works as an obstacle in nonnutritive sucking and maintains the tongue in a more retruded position, preventing its interposition between the incisors.

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Stability of anterior openbite treated with crib therapy

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Malocclusions characterized by anterior openbite are often difficult to treat successfully. Numerous theories have been proposed for the etiology of openbite, including heredity,^{1,2} unfavorable growth patterns,³⁻⁶ digit habits,^{3,7,8} enlarged lymphatic tissue^{3,9} and tongue function and posture.^{7,10,11-16} Orthodontic treatment of openbite before the 1970s consisted mainly of dentoalveolar changes and/or modification of oral habits. While this treatment was appropriate if the problem was due to a dental malrelationship, it was often inadequate for addressing openbites which were due to skeletal imbalance. Fortunately, these unfavorable skeletal patterns can now be corrected with orthognathic surgery. However, correcting the openbite is only part of the challenge. Lopez-Gavito¹⁷ reported that more than 35 percent of openbite patients treated with conventional orthodontic appliances relapsed more than three millimeters ten years after treatment. Sim-

ilarly, Denison¹⁸ has reported that openbites treated surgically also exhibit significant relapse posttreatment. One possible explanation for these findings is that anterior openbite may be caused and/or maintained by tongue function or posture, and that this etiologic factor may be ignored in both conventional and surgical treatment. If this is true, then modification of tongue behavior might increase the stability of corrected openbite. Crib therapy has been used to modify tongue behavior, but there have been no studies of posttreatment stability. Therefore, the purpose of this study is to determine if crib therapy has an effect on the stability of anterior openbite correction.

Materials and methods

Sample selection and characteristics

Sample selection was based upon the following criteria: 1) a crib was used for modification of tongue and/or thumb habit; 2) cephalometric

Abstract

The records of 33 openbite patients treated with cribs were collected. The sample was divided into two groups with group one comprised of 26 growing patients and group two comprised of seven nongrowing patients. There was a significant increase in overbite for both groups during treatment. The nongrowing group also showed a significant increase in overbite during the posttreatment period. During the posttreatment time interval 17.4 percent of the growing sample and zero percent of the nongrowing sample exhibited relapse. However, all patients who achieved a positive overbite during treatment maintained a positive overbite posttreatment. These findings suggest that patients who achieve a positive overbite with crib therapy have a good chance of maintaining this correction after orthodontic treatment is completed. This statement appears to be true for both growing and nongrowing patients. The reason for this increased stability may be due to a modification of tongue position or posture.

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Key Words

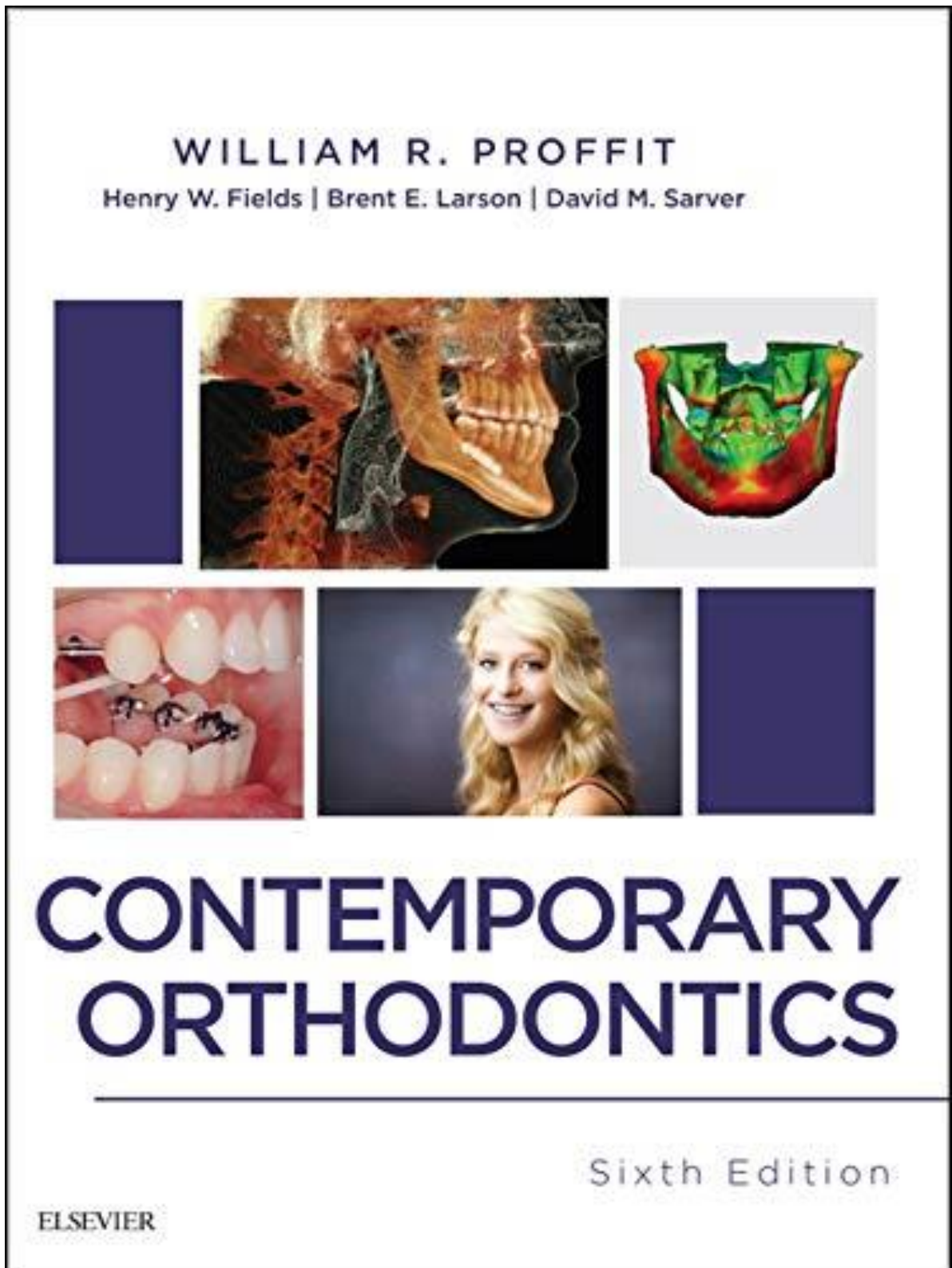
Crib • Openbite • Stability • Relapse • Cephalometric

Bondable Lingual Spur Therapy to Treat Anterior Open Bite

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Correction of Anterior Open Bite with Spurs: Long-Term Stability

Roberto Justus, DDS, Fis, MSD¹

Aim: To show that the high relapse incidence of malocclusion characterized by anterior open bite is frequently due to an anterior tongue rest posture, an etiologic factor that has been largely overlooked both in conventional orthodontic treatment and in surgical treatment. **Method:** A maxillary fixed intraoral appliance with spurs was used to modify anterior tongue posture. **Results:** Research with this appliance in a large sample of anterior open bite patients demonstrated long-term stability postretention. **Clinical cases using this method are presented.** **Conclusion:** In the overall scheme of open bite treatment, therapy with intraoral spurs for the correction of anterior open bite has a wide range of application. *World J Orthod* 2001;2:219-231.

Psychologic problems and difficulties related to function, health, and stability may occur with anterior open bite. These difficulties may include diminished dental esthetics during speech and when smiling, lack of incisal guidance and canine disclusion resulting in molar cuspal wear, exacerbation of temporomandibular dysfunction, lisping and involuntary spitting when speaking, posterior cross-bite with functional shift of the mandible related to a posterior collapse of the maxilla, and maxillary incisor root resorption.¹ If relapse of anterior open bite occurs after orthodontic treatment, the aforementioned problems may cause patient dissatisfaction and possibly result in litigation.

Orthodontists have long recognized that anterior open bite is difficult to treat and tends to relapse posttreatment.^{2,3} These malocclusions do exhibit significant relapse posttreatment whether the correction was achieved with conventional orthodontic treatment or with orthodontic treatment combined with surgery. Lopez-Gavito et al² reported that more

than 35% of anterior open bite patients treated with conventional orthodontic appliances relapsed 3 mm or more at 10 years postretention. Lopez-Gavito et al concluded that neither the magnitude of the pretreatment open bite, the mandibular plane angle, nor any other single parameter of dentofacial form was a reliable predictor of posttreatment stability or relapse.

A 20% to 40% relapse of anterior open bite has been reported with maxillary surgical impaction in hyperdivergent patients.³⁻⁶ Hyperdivergency is considered the main risk factor for anterior open bite malocclusion and for its relapse. However, once hyperdivergency is successfully eliminated with orthognathic surgery it cannot be postulated as an etiologic factor in open bite relapse. This is particularly true for adults because they have minimal subsequent growth.⁷ To further complicate matters, some authors^{8,9} have shown that most individuals with a high-angle malocclusion have a normal overbite or a deep bite due to a compensatory eruption mechanism. Thus, skeletal pattern alone is not sufficient to identify those patients with an open bite or open bite tendency.

Joondeph and Riedel,¹⁰ citing various authors, explain that open bite malocclusion may be secondary to mouth breathing resulting from nasopharynx obstruction. The obstruction could be due to anatomic blockage, allergic disease, or adenoid

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Early treatment of anterior open bite: Comparison of the vertical and horizontal morphological changes induced by magnetic bite-blocks and adjusted rapid molar intruders

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Abstract

Objective

This prospective clinical study aims to determine the differences between two treatment modalities for anterior open bite in growing patients. The treatment modalities involved the use of magnetic bite-blocks (MBBs) or rapid molar intruders (RMIs) applied with posterior bite-blocks.

Methods

Fifteen consecutive patients with a mean age of 11.2 (standard deviation [SD] = 1.6) years and a mean open bite of -3.9 mm were treated with MBBs. Another 15 consecutive patients with a mean age of 10.9 (SD = 1.8) years and a mean open bite of -3.8 mm were treated with RMIs applied on bite-blocks. Cephalometric radiographs were obtained before (T1) and immediately after appliance removal (T2). The treatments lasted four months, during which the appliances were cemented to the teeth. The morphological changes were measured in each group and compared using logistic regression analysis.

Results

(41)

Comparison of two treatment strategies for the early treatment of an anterior skeletal open bite

Posterior bite block-vertical pull chin cup (PBB-VPC) vs. posterior bite block-high pull headgear (PBB-HPH)

Vergleich von zwei Strategien zur Frühbehandlung des skelettal offenen Bisses

PBB-VPC (“posterior bite block-vertical pull chin cup”) vs. PBB-HPH (“posterior bite block-high pull headgear”)

Hakan Turkkahraman^{1,3} · Ebru Cetin²

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Abstract

Purpose Aim of the present study was to compare the effects of posterior bite block-vertical pull chin cup (PBB-VPC) and posterior bite block-high pull headgear (PBB-HPH) in the early treatment of anterior open bite.

Methods This retrospective study was carried out using pretreatment (T1) and posttreatment (T2) lateral cephalometric radiographs of 28 patients treated with either PBB-VPC or PBB-HPH and 14 age-matched control patients with anterior open bite. The treatment changes were evaluated with 20 measurements (7 angular and 13 linear). Intergroup comparisons of the cephalometric measurements were performed by ANOVA, and a post hoc Tukey test was used to perform multiple comparisons.

Results There was no significant difference in the open bite correction between the two treatment groups, but both groups showed significantly greater increases in overbite than the controls ($P < 0.01$). The PBB-HPH group showed more upper incisor retraction than the control group

($P < 0.01$). The two treatment groups both showed significantly more lower incisor retraction than the controls, and more retraction in the PBB-HPH group was found ($P < 0.001$).

Conclusions Both PBB-VPC and PBB-HPH were effective in the early treatment of anterior open bite. Retrusion of the upper/lower incisors and a slight increase in the upper anterior dentoalveolar height were the most evident findings in the PBB-VPC group. In the PBB-HPH group, forward maxillary growth was significantly restricted, ANB and overjet were reduced, and the upper and lower incisors were significantly retruded.

Keywords Anterior open bite · Early treatment · Chin cup · High pull headgear · Posterior bite block

Zusammenfassung

Ziel Verglichen werden sollten die Effekte von zwei Methoden zur Frühbehandlung des frontal skelettal offenen Bisses: mit posteriorem Aufbiss und einer Kinnkappe mit vertikalem Zugverlauf („posterior bite block-vertical pull chin cup“, PBB-VPC) bzw. einem posterioren Aufbiss und Headgear mit okzipitalem Zugverlauf („posterior bite block-high pull headgear“, PBB-HPH).

Methoden Diese retrospektive Studie wurde anhand von Fernröntgenseitenaufnahmen von 28 Patienten vor (T1) und nach (T2) Behandlung mit PBB-VPC oder PBB-HPH durchgeführt. Als Kontrollgruppe dienten 14 altersgemachte Patienten mit frontal offenem Biss.

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Orthodontic and orthopaedic treatment for anterior open bite in children (Review)

Lentini-Oliveira DA, Carvalho FR, Rodrigues CG, Ye Q, Hu R, Minami-Sugaya H, Carvalho LBC, Prado LBF, Prado GF

Lentini-Oliveira DA, Carvalho FR, Rodrigues CG, Ye Q, Hu R, Minami-Sugaya H, Carvalho LBC, Prado LBF, Prado GF.
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Noncompliant treatment of skeletal open bite

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Ferrara, Italy, and Sheboygan, Wis

The purpose of this article is to illustrate the effects of the rapid molar intrusion appliance, a treatment alternative that does not require patient compliance, for counteracting excessive vertical dimensions in growing patients and adults. The rapid molar intrusion appliance has 2 elastic modules that are secured on the maxillary and mandibular first-molar tubes. It is used in combination with maxillary and mandibular soldered lingual arches. Patient acceptance is good, and the patient's only responsibilities are to keep the appliance clean and avoid breakage. (*Am J Orthod Dentofacial Orthop* 2005;128:781-6)

Skeletal hyperdivergent open bite is among the most challenging clinical situations facing orthodontists today.¹⁻⁴

Anterior dental open bite is, on average, a dental condition characteristic of, and resulting from, backward-rotating mandibular growth patterns. The molars overerupt, causing further rotation of the mandible away from the maxilla. This leaves the already erupted anterior teeth in a position of open bite. The most appropriate treatment for skeletal open bite is to intrude the molars.

A passive system achieves relative intrusion of the posterior teeth either by interfering with or reducing the potential of molar eruption during growth.⁵⁻⁹ An active system, on the other hand, attempts to physically intrude the molars into their bony support.¹⁰⁻¹⁷

Recently, a new device for rapid molar intrusion (RMI[™] [American Orthodontics, Sheboygan, Wis]), the RMI appliance, was proposed.¹⁸ The purpose of this article is to illustrate its clinical effects in growing patients and adults.

MATERIAL AND METHODS

Appliance design

The RMI appliance (Fig 1) has previously been described.¹⁸ Briefly, it has 2 elastic modules that are secured on the first molars with L-shaped pins. The straight terminal end attaches into a maxillary molar tube, and the angulated terminal end attaches into a mandibular tube (Fig 2). When the patient closes his or

her mouth, the modules are flexed and deliver an immediate intrusive force of 800 g on each side. This force level decays to 450 g by the end of the first week and 250 g by the end of the second week. Because the intrusive forces on the labial side of the molars generate moments that tip the crowns buccally, the RMI appliance is always placed with soldered lingual arches.

Our sample comprised 19 patients (11 in the mixed dentition; 7 girls, 4 boys; average age, 11.9 years, SD 1.8 years; and 8 in the permanent dentition; 5 women, 3 men; average age, 19.9 years, SD 3.9 years) consecutively treated by the authors with the RMI.

In the growing patients, the RMI was combined with maxillary and mandibular soldered stabilization arches; in 8 of the 11 growing patients, a spring-jet* appliance¹⁰ (American Orthodontics, Sheboygan, Wis) was used to expand the maxillary unit with a constant force of 470 g. In 9 of the 11 growing patients, the deciduous teeth interfered with the treatment objectives. While the maxillary and mandibular first permanent molars were intruded, the deciduous molars maintained their positions and, when they came in contact with their opposing tooth, did not allow the mandible to close further. Because the rapidity of molar intrusion during RMI activation could not have been balanced by enamel reduction, the teeth were extracted. The only objective for extracting the deciduous teeth was to eliminate occlusal interferences as the permanent molars intruded to allow the mandible to close and the open bite to correct. When the second molars erupted during the intrusive phase, they were banded and

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*In the spring-jet, the transpalatal arch of the traditional expander is replaced with a telescopic unit, formed by 2 components: a tube and a wire inserted into the tube. On the transverse telescopic assembly, a nickel-titanium coil spring and a screw lock are positioned. The expansive force is produced by the total compression of the coil spring (450 g) simply moving the screw lock toward the side of the spring. The telescopic unit is high on the roof of the palate, approximately 5 mm up from the center of the molar bands. This design allows the line of action of the force to pass close to the center of resistance of the maxillary teeth; it is a comfortable design for the patient's tongue.

Anterior open bite treated with a palatal crib and high-pull chin cup therapy. A prospective randomized study

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SUMMARY The aim of this prospective randomized clinical study was to cephalometrically investigate the dentoalveolar and soft tissue changes produced by a removable appliance with a palatal crib associated with high-pull chin cup therapy in children with an Angle Class I anterior open bite (AOB) malocclusion. Thirty children (8 males and 22 females) with an initial mean age of 8.3 years and a mean AOB of 4.1 mm were treated with a removable appliance composed of a palatal crib associated with chin cup therapy for 12 months. A control group of 30 individuals (7 males and 23 females) closely matched for age, initial mean age 8.6 years, gender, and ethnicity with a mean AOB of 4.6 mm was followed without treatment. The measurements (means and standard deviations) were statistically analysed using a paired *t*-test.

The results showed no significant differences in the level of molar eruption or in lower anterior face height, suggesting that the vertical control expected from the chin cup therapy did not occur. Dentoalveolar changes at the anterior region were evident, with statistically significant extrusion, retrusion, and lingual tipping of the maxillary and mandibular incisors ($P \leq 0.05$). However, these hard tissue changes did not imply soft tissue changes and the variables related to the soft profile were not statistically significantly different between the groups. The dentoalveolar changes at the anterior region of the dental arches were mainly responsible for closure of the AOB in patients treated in the mixed dentition.

Introduction

An anterior open bite (AOB) may be defined as a negative overbite between the incisal edges of the maxillary and mandibular anterior teeth, with the posterior teeth in occlusion (Worms *et al.*, 1971; Almeida *et al.*, 1998). In the mixed dentition period, the prevalence of an AOB is approximately 17 per cent (Worms *et al.*, 1971). This malocclusion affects nearly 16 per cent of the North American black population and 4 per cent of the white population (Ngan and Fields, 1997).

Several factors are involved in the aetiology of AOB (Huang *et al.*, 1990; Insoft *et al.*, 1996; Almeida *et al.*, 1998; Chevitaress *et al.*, 2002). When there is only dental and dentoalveolar involvement, there is predominance of environmental causes such as thumb or dummy sucking habits, mouth breathing, and tongue or lip thrusting in addition to some local factors such as tooth ankylosis and eruption disturbances. However, the larger the skeletal involvement, the more the aetiology is related to genetic factors, which are restricted to an unfavourable growth tendency of the individual, i.e. a predominantly vertical pattern.

The diagnosis and treatment of this malocclusion are still controversial. Many authors agree that the clinician should be able to distinguish an open bite of dental and dentoalveolar origin from a skeletal open bite so that treatment is directed at the cause of the problem. However, in most cases, the distinction is not clear (Insoft *et al.*, 1996), since malocclusion

presents both dental and skeletal components in its aetiology (Almeida and Ursi, 1990). Thus, to allow normal development of the anterior dentoalveolar region, the palatal crib may be an excellent treatment option, since it prevents thumb or dummy sucking and avoids tongue thrusting. According to Haryett *et al.* (1970), the palatal crib is effective for the elimination of a thumb sucking habit in 85 to 90 per cent of subjects.

However, most cases of AOB are related to a long face pattern (English, 2002), with an increase in lower anterior face height (LAFH), clockwise mandibular rotation and a resulting greater profile convexity (Kuster and Ingervall, 1992). In these patients, dental compensations produced by conventional orthodontic treatment may not lead to satisfactory outcomes (Cangialosi, 1984; Ngan and Fields, 1997; Hering *et al.*, 1999), thus requiring another treatment approach directed at vertical control of facial growth and/or 'real' or relative intrusion of the posterior teeth. Thus, the aim is to achieve counterclockwise mandibular rotation for closure of an open bite, especially if there is remaining growth of the mandibular ramus, in order to control the increase in anterior face height and achieve improved occlusal outcomes and a balanced profile (Sankey *et al.*, 2000).

Several approaches have been proposed for improved vertical control, such as the use of the high-pull headgear (Kuhn, 1968), bite-blocks (Kuster and Ingervall, 1992), magnets (Woods and Nanda, 1991), a palatal bar, and

(45)

Dentoskeletal effects produced by removable palatal crib, bonded spurs, and chincup therapy in growing children with anterior open bite

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ABSTRACT

Objective: To evaluate the dentoskeletal effects of different anterior open bite treatment modalities in children.

Materials and Methods: This cephalometric study assessed changes resulting from different treatment approaches on 77 growing children with anterior open bite. A control group (n = 30) was used for comparison. Lateral cephalograms were available before treatment and after 12 months. The sample was divided into four groups: removable palatal crib associated with a chincup (G1), bonded spurs associated with a chincup (G2), chincup (G3), and nontreated control (G4). Statistical comparisons among the four groups were performed on T1 and the treatment changes using analysis of variance with Tukey's post hoc tests.

Results: No statistically significant changes in skeletal variables were found among the groups, except for lower anterior face height (LAFH) increase in G1. Overall, effects in all of the treated groups were exclusively dentoalveolar. A larger overbite (OB) increase was observed in G1 and G2 when compared with G3 and G4. The maxillary incisors in G1 showed increased palatal tipping, retrusion, and more vertical dentoalveolar development as well as increased lingual tipping among mandibular incisors. There was less vertical development of maxillary and mandibular molars in G3.

Conclusions: A removable palatal crib provided an improvement in OB (97.5%), followed by the bonded spurs (84.5%). Conversely, the chincup-only group did not have positive OB effects. (*Angle Orthod.* 2016;86:969–975)

KEY WORDS: Open bite; Orthodontic appliances; Early treatment

INTRODUCTION

The prevalence of anterior open bite (AOB) malocclusion in the mixed dentition is about 20%.¹ In most of the cases, a multifactorial etiology is presumed, which

includes oral deleterious habits such as mouth breathing, abnormal tongue posture, tongue thrust, and/or a vertical facial growth pattern.^{2,3} It can be manifested as a dentoalveolar and/or skeletal open bite.

Early intervention with habit-interception appliances may resolve or improve the AOB in growing patients.^{4–9} The use of a palatal crib or spurs have been advocated to encourage discontinuation of such habits, thus facilitating anterior dentoalveolar changes.^{10–19}

Because AOB malocclusion is common in some vertical facial patterns,^{20–23} treatment objectives in these patients could include the prevention of further vertical dentoalveolar development of the posterior occlusion and/or a decrease of the gonial angle.^{9,24}

The chincup therapy has been used as a supplementary device in the early treatment of AOB. It has been claimed that the use of chincup alone is effective in treating skeletal open bite,^{7,8,9} but the actual evidence behind this claim is low. No studies were found comparing the use of crib, spurs, and chincup therapies.

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Skeletal morphologic features of Anterior Open Bite Malocclusion amongst black patients visiting the Medunsa oral health centre

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ABSTRACT

Introduction

Anterior open bite (AOB) malocclusion presents as lack of vertical overlap of anterior teeth. It is viewed to be unaesthetic and may affect speech and mastication.

It develops due to the interaction of hereditary and environmental etiological factors and these usually affect the vertical growth of the face. This study describes the vertical changes of South African black people presenting with AOB.

Aims and objectives:

The aim was to determine skeletal morphological features of patients with AOB malocclusion.

Design

The design was a retrospective, cross-sectional study.

Materials

Archived pre-treatment lateral cephalographs of 181 patients who consulted between 2007 and 2014 were divided into four groups: control group of 62 patients with skeletal Class I pattern without AOB; test groups of patients with AOB (119) divided into 35 Class I, 43 Class II, and 41 Class III malocclusions. Records of each group were divided according to gender. Descriptive statistics, the Pearson correlation coefficient, t-test and

Wilcoxon test were employed to analyze the data, and p values of ≤ 0.05 were considered statistically significant.

Results and conclusions

Patients with AOB had a larger vertical facial pattern in all classes of malocclusion. Males presented with larger Sn-GoGn angles than females. The PFH/AFH ratio was lower across all classes of malocclusion compared to the control group.

INTRODUCTION AND LITERATURE REVIEW

Malocclusion can occur in three planes of space, namely sagittal, transverse and in the vertical plane. The lack of dental occlusion in the oral cavity occurs in the vertical plane as either an open bite in the anterior area, an open bite in the lateral areas, or as a combination of the two.¹

Open bite malocclusion is considered as an abnormality in the vertical relationship of maxillary and mandibular arches. It is characterized by a lack of contact between opposing segments of teeth.^{2,3} The term "open bite" was first introduced by Caravelli in 1842.⁴ The incidence of AOB varies between races and ranges from 1,5% to 11%. Differences also occur with age as some AOB close spontaneously with increasing age.⁵

The clinical and radiological evaluation of AOB is complex and exhibit dental or skeletal components, or a combination of the two in some cases.¹ The dental open bite is associated with a normal craniofacial pattern of growth on the cephalometric radiograph and labial tipping of both upper and lower anterior teeth. The skeletal open bite shows vertical disharmony of craniofacial skeleton on the cephalometric radiograph and over eruption of posterior teeth.

A dental open bite can also affect the alveolus and has also been referred to as dento-alveolar, when there is a change in the vertical growth of the alveolar component. A skeletal open bite has features such as clock-

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(47)

The Morphological Characteristics, Growth, and Etiology of the Hyperdivergent Phenotype

Peter H. Buschang, PhD, Helder Jacob, DDS, PhD, and Roberto Carrillo, DDS, MS

Due to the skeletal complexity of the problem, hyperdivergent retrognathic patients are among the most difficult for orthodontists to treat. It is imperative to treat these patients for both esthetic and functional reasons. Hyperdivergent growth patterns are generally established early and most do not improve over time. The etiology appears to be environmental, due to postural adjustments related with compromised airways and weak masticatory musculature. If a lowered mandible posture is maintained in growing subjects, the dentition, dentoalveolar complex, and the mandible should be expected to compensate. Dentoalveolar heights should be expected to be excessive (i.e., supraeruption of the teeth), the ramus is shorter, the gonial angle is larger, the mandibular symphysis is taller and thinner, the mandibular plane is steeper, the mandible is retrognathic, and anterior lower face height is increased. Moreover, the jaws, especially the upper, are narrow. The most important factor underlying these developmental adaptations is true mandibular rotation. Rotation is important because it is the major determinant of the anteroposterior (AP) chin position. The detrimental skeletal changes that characterize hyperdivergent patients are ultimately due to backward or less than average true forward rotation. Theoretically, a therapeutic treatment that mimics normal growth (i.e., one that builds in true forward rotation) is desirable because it might be expected to correct not only the anteroposterior (AP) and vertical position of the chin, but also many of the other morphological maladaptations associated with the hyperdivergent retrognathic phenotype. (Semin Orthod 2013; 19:212–226.) © 2013 Published by Elsevier Inc.

Introduction

Hyperdivergent retrognathic patients are among the most difficult for orthodontists to treat because their malocclusion is multifaceted and complex. Hyperdivergent retrognathic patients were initially categorized as having vertical dysplasia¹ and have since been called by a variety of names (Table 1). Most investigators have referred them as skeletal open

bites.^{2,3} Schudy⁴ was the first to characterize them as hyperdivergent, which more accurately reflects their skeletal phenotype.

While the prevalence of the problem has not been precisely quantified, many of the subjects with open-bite malocclusions, who have been estimated to comprise approximately 3.5% of the population,⁵ might be expected to be hyperdivergent and retrognathic. More importantly, at least half of Class IIs, who comprise approximately 15% of the population,⁵ are retrognathic and hyperdivergent. Children with Class II molar relationships show a slightly—but not statistically significant—greater tendency toward hyperdivergence than Class Is (Fig. 1). Average pretreatment mandibular plane angles of Class II patients reported in the literature fall both above and below age- and sex-specific reference data (Fig. 2). Based on the prevalence of open-bite and Class II malocclusions, it can be

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CONTINUING EDUCATION ARTICLE

Skeletal anchorage system for open-bite correction

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A skeletal anchorage system was developed for tooth movements. It consists of a titanium miniplate that is temporarily implanted in the maxilla or the mandible as an immobile anchorage. In this article, we introduce the skeletal anchorage system to intrude the lower molars in open-bite malocclusion and evaluate the results of treatment in two severe open-bite cases that underwent orthodontic treatment with the system. Titanium miniplates were fixed at the buccal cortical bone around the apical regions of the lower first and second molars on both the right and left sides. Elastic threads were used as a source of orthodontic force to reduce excessive molar height. The lower molars were intruded about 3 to 5 mm, and open-bite was significantly improved with little if any extrusion of the lower incisors. No serious side-effects were observed during the orthodontic treatment. The system was also very effective for controlling the cant and level of the occlusal plane during orthodontic open-bite correction. (*Am J Orthod Dentofacial Orthop* 1999;115:166-74)

It is very important for vertical correction of skeletal open-bite to control the height of the posterior dentoalveolar regions. However, traditional biomechanical techniques, such as the use of a multibracket appliance, an extraoral anchorage, an active vertical corrector with magnets, a vertical-pull chin cap, etc, cannot effectively control intrusion of the molars, especially in adult patients. This is because it is extremely difficult to establish a rigid anchorage for molar intrusion in such

cases. To obtain a rigid anchorage, dental implants and bone screws have been reported as orthodontic and orthopedic anchors.¹⁻²⁰ Some new types of implants have been designed to provide anchorage for orthodontic tooth movements.^{21,22} For example, Jenner and Fitzpatrick²³ reported a clinical case in which surgical bone plates were used to provide skeletal anchorage.

Recently, as a result of advances in biocompatible medical materials, osteointegrated titanium implants have been developed and used in bone screws and miniplates for rigid fixation in orthognathic surgery. This application leads to the hypothesis that a titanium miniplate^{24,25} might also be used as a source of stationary anchorage for tooth movements. Therefore we developed a skeletal anchorage system (SAS) in our clinic using a titanium miniplate that is temporarily implanted in the maxilla and/or mandible as an immobile intraoral anchorage, particularly for intrusion of the molars.

The purpose of this study was to use the SAS for open-bite correction. This article presents the results of

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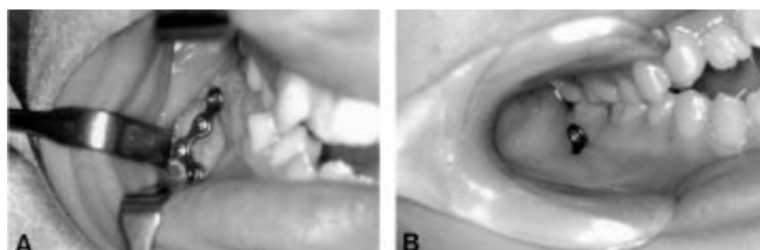


Fig 1. Implantation of a titanium miniplate. **A**, Surgical procedure, **B**, after healing of the wound.



Treatment of severe anterior open bite with skeletal anchorage in adults: Comparison with orthognathic surgery outcomes

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Introduction: Skeletal anterior open bite is a difficult problem to correct in orthodontic treatment. In adults, treatment of severe skeletal anterior open bite consists mainly of surgically repositioning the maxilla or the mandible. Recently, molar intrusion by using skeletal anchorage has been developed as a new strategy for open-bite treatment. In this study, we compared treatment outcomes in patients with severe anterior open bite treated with molar intrusion by using skeletal anchorage and with orthognathic surgery. **Methods:** Twenty-three subjects with overbite less than -3.0 mm were treated with skeletal anchorage ($n = 10$) or with LeFort I osteotomy combined with mandibular osteotomy ($n = 13$). Pretreatment and posttreatment lateral cephalograms were compared. **Results:** Incisors were significantly elongated in the surgically treated subjects (4.6 mm, $P < .01$). There were no significant differences in the treatment results between skeletal anchorage and surgery, with reduced facial heights of 4.0 and 3.8 mm, and increased overbites of 6.8 and 7.0 mm, respectively. **Conclusions:** These results suggest that molar intrusion with skeletal anchorage is simpler and more useful than 2-jaw surgery in the treatment of patients with severe anterior open bite. (*Am J Orthod Dentofacial Orthop* 2007;132:599-605)

Skeletal anterior open bite is considered a difficult problem in orthodontic treatment. In adults, treatment of severe skeletal anterior open bite consists mainly of surgically repositioning the maxilla or the mandible. These procedures have acceptable treatment results and long-term stability.¹⁻⁴

Recently, dental implants,⁵⁻⁷ screws,⁸⁻¹³ and miniplates¹⁴⁻¹⁹ have been used for skeletal anchorage. Even without the cooperation of patients, these materials can provide stationary anchorage for various tooth movements. We previously reported on severe skeletal anterior open-bite patients treated with molar intrusion using titanium screws for skeletal anchorage.^{11,13} In addition, there are several reports of molar intrusion with miniplates in anterior open-bite patients.¹⁵⁻¹⁸ Molar intrusion with skeletal anchorage has now become a strategy for treating these patients.

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However, it is unknown which method is better for treating severe anterior open bite—intrusion of molars with skeletal anchorage or orthognathic surgery. We have used skeletal anchorage to treat severe open-bite patients who would previously have required surgical-orthodontic treatment, with satisfactory improvement.^{11,13}

In this study, we demonstrate the advantages of treatment with skeletal anchorage for molar intrusion in severe anterior open-bite patients, compared with surgical maxillary and mandibular repositioning by LeFort I osteotomy and mandibular osteotomy.

MATERIAL AND METHODS

Our subjects were 23 nongrowing patients (ages, 16-46 years; mean, 21.6 years; SD 7.3 years) with anterior open bite more than 3.0 mm (mean, 5.2 mm; SD 2.3 mm) with skeletal Class I or Class II (ANB angle $>1.5^\circ$) jaw-based relationships (Table I).²⁰

Ten female patients were orthodontically treated with molar impaction by using skeletal anchorage (implant group). One patient had a temporomandibular disorder (TMD) before treatment. Mean overbite at pretreatment was -5.2 mm (SD 1.8 mm), and the mandibular plane angle was 38.8° (SD 6.4°). The miniplates (SAS system; Dentsply-Sankin, Tokyo, Japan) or the titanium screws (intermaxillary fixation screw, Keisei Medical Industrial, Tokyo, Japan; diameter, 2.3 mm; length, 11 mm) were placed under local anesthesia



Clinical use of miniscrew implants as orthodontic anchorage: Success rates and postoperative discomfort

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Introduction: In this study, we evaluated the clinical usefulness of miniscrews as orthodontic anchorage. We examined their success rates, analyzed factors associated with their stability, and evaluated patients' postoperative pain and discomfort with a retrospective questionnaire. **Methods:** Seventy-five patients, 116 titanium screws of 2 types, and 38 miniplates were retrospectively examined. Each patient was given a questionnaire that included a visual analog scale to indicate discomfort after implantation. **Results:** The success rate for each type of implant was greater than 80%. The analysis of 79 miniscrews with a 1.3-mm diameter showed no significant correlations between success rate and these variables: age, sex, mandibular plane angle, anteroposterior jaw-base relationship, control of periodontitis, temporomandibular disorder symptoms, loading, and screw length. Most patients receiving titanium screws or miniplates with mucoperiosteal-flap surgery reported pain, but half of the patients receiving miniscrews without flap surgery did not report feeling pain at any time after placement. In addition, patients with miniscrews reported minimal discomfort due to swelling, speech difficulty, and difficulty in chewing. **Conclusions:** Miniscrews placed without flap surgery have high success rates with less pain and discomfort after surgery than miniscrews placed with flap surgery or miniplates placed with either procedure. (*Am J Orthod Dentofacial Orthop* 2007; 131:9-15)

Anchorage control in edgewise treatment is an important factor affecting treatment results. In the traditional approach, appliances such as headgear and intraoral elastics are used to reinforce anchorage, but it is difficult to obtain stationary anchorage even when the patients show excellent cooperation. In the past, dental implants,¹⁻⁴ miniplates,⁵⁻⁷ and titanium screws⁸⁻¹⁰ were used as skeletal anchorage. These materials can provide stationary anchorage for various tooth movements without requiring patient cooperation.

Dental implants and miniplates have high success rates and are strong enough to resist the reciprocal forces of various orthodontic tooth movements.¹⁻⁷ However, implantation of these devices requires com-

plicated surgery, leading to higher medical costs. In contrast, titanium screws have advantages: the ability to provide the same rigid anchorage against orthodontic loads as dental implants or miniplates, minimal anatomic limitations on placement, lower medical costs, and simpler placements with less traumatic surgery.⁸⁻¹⁰ Recently, miniscrews less than 1.5 mm in diameter have been used for various orthodontic indications.¹¹⁻¹³ However, few human studies have examined factors associated with the stability of titanium screws used for orthodontic anchorage.^{14,15} In addition, there have been few human reports about the success rates of miniscrews.

Fear of pain is a problem because it contributes to patients' avoidance of orthodontic treatment.¹⁶ Most patients report pain and discomfort during orthodontic treatment.¹⁷⁻²¹ Because of the surgical procedure, many patients are also concerned about pain and discomfort after implantation. For patients, an appealing feature of skeletal anchorage might be the minimal surgical invasion. However, there are few reports about postoperative pain and discomfort after implantation of orthodontic anchorage.

Our aim in this study was to evaluate the clinical usefulness of miniscrews as orthodontic anchorage. We examined their success rates, analyzed the factors

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RESEARCH REPORTS

Biomaterials & Bioengineering

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ABSTRACT

The use of conventional dental implants for orthodontic anchorage is limited by their large size. The purpose of this study was to quantify the histomorphometric properties of the bone-implant interface to analyze the use of small titanium screws as an orthodontic anchorage and to establish an adequate healing period. Overall, successful rigid osseous fixation was achieved by 97% of the 96 implants placed in 8 dogs and 100% of the elastomeric chain-loaded implants. All of the loaded implants remained integrated. Mandibular implants had significantly higher bone-implant contact than maxillary implants. Within each arch, the significant histomorphometric indices noted for the "three-week unloaded" healing group were: increased labeling incidence, higher woven-to-lamellar-bone ratio, and increased osseous contact. Analysis of these data indicates that small titanium screws were able to function as rigid osseous anchorage against orthodontic load for 3 months with a minimal (under 3 weeks) healing period.

KEY WORDS: implant, orthodontic, anchorage, dog.

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The Use of Small Titanium Screws for Orthodontic Anchorage

INTRODUCTION

Anchorage control is fundamental to successful orthodontic treatment. Because of their rigid stability in bone, implants are osseous anchorage units that are not dependent on patient compliance. Prosthetic implants have been utilized for anchorage in animal (Roberts *et al.*, 1989) and clinical studies (Roberts *et al.*, 1990), but are limited in range of application by their relatively large size. When the size of the implants is decreased by about 50%, more host sites are available, the surgery is relatively less traumatic, and the duration of the healing period prior to loading may be diminished or eliminated altogether.

Kanomi (1997) introduced a miniature implant (5.0 mm x Ø1.0 mm titanium screw, Leibinger®, Freiburg, Germany) that is a variation of a mini-bone screw used to fix bone plates in plastic and reconstructive surgery. For orthodontists, the potential advantage to such a small implant is that it increases the number of sites where anchorage implants can be placed. A preliminary study demonstrated that similar mini-implants (4.0 mm x Ø1.0 mm, 99.5% titanium, Sankin®, Tokyo, Japan) in dog mandibles were successfully used to intrude premolars (Ohmae *et al.*, 2001). However, the bone healing reaction and response to applied loads are unknown.

The purpose of this study was to assess, histomorphometrically, the osseous support of small titanium screws and to determine clinical guidelines for healing prior to orthodontic loading.

MATERIALS & METHODS

Experimental Design

Ninety-six small titanium screws (5.0 mm x Ø1.0 mm; titanium screw, Stryker® Leibinger, Kalamazoo, MI, USA; Fig. 1a) were equally divided among 8 eight-month-old male dogs. Within each jaw, both force-applied (FA) and healing control (HC) implants were further divided into 3 groups (three-, six-, 12-week), with 8 implants *per* group (Fig. 1b). It is important to note that the HC implants were placed in the jaw for 3, 6, or 12 wks *prior* to termination of the experiment so that bone could be assessed at the initiation of loading (Fig. 1c). The FA implants remained in the jaw for an additional 12 wks of force application. In the FA, a force of 200-300 g was applied for 12 wks with an elastomeric chain attached from the implant to a hook on the crowns of the premolars. Every 4 wks, the force was checked with a force gauge and adjusted to be maintained within the 200- to 300-g range. The study protocol was reviewed and approved by the Indiana University Review Committee for animal care and use.

Surgical Procedure

A 1-mm pilot hole was drilled through the soft tissue and into the cortical bone. After insertion of the implants, a two-hole titanium plate was attached to serve as a hook for the application of the orthodontic force. At 3 days and 10 days before tissue sampling, a sequence of fluorochrome labels with calcein green (Sigma Chemical Co., St. Louis, MO, USA) and tetracycline (Lederle

CASE REPORT

Open Access

Correction of skeletal class II severe open bite with temporomandibular joint disorder treated by miniscrew anchorage and molar extraction: a case report



Masato Kaku , Taeko Yamamoto, Yuka Yashima, Jin Izumino, Haruka Kagawa, Kazutaka Ikeda and Kotaro Tanimoto

Abstract

Background: Little information is available on the treatment of open bite with temporomandibular joint disorder by intrusion of molars using miniscrews.

Case presentation: This case report describes a 42-year-old Japanese woman with a skeletal class II severe anterior open bite and temporomandibular joint disorder. The pretreatment magnetic resonance imaging of both temporomandibular joints revealed osteoarthritis and anterior disc displacement without reduction in both temporomandibular joints. A stabilization splint was used before orthodontic treatment and bilateral upper and lower premolars were extracted. Miniscrews were inserted into the palatal region to intrude the maxillary molars and avoid loss of anchorage. The maxillary left first molar was also extracted to improve the molar relationship and the dental midline. Normal overjet and overbite with Angle class I molar relationship were achieved, and the upper and lower midlines coincided. Our patient's teeth continued to be stable and her temporomandibular joint was asymptomatic after a retention period of 2 years.

Conclusions: Intrusion of molars by miniscrews is available for skeletal class II severe open bite.

Keywords: Open bite, Skeletal class II, Steep mandible, TMD, DDwoR, Stabilization splint, Orthodontic treatment, Miniscrew

Background

Temporomandibular joint disorder (TMD) is a comprehensive term and is characterized by the clinical presentation of: pain in the masticatory musculature and in the temporomandibular joint (TMJ), limited range of mandibular movement, and clicking or crepitus during jaw movement [1]. The etiology of TMD is suggested to be multifactorial, with malocclusion being a potential risk factor [2]. Numerous treatment methods have been described for anterior disc displacement without reduction (DDwoR) of TMJ. Among them, orthodontic treatment along with an occlusal splint is considered quite effective for managing TMD with anterior disc displacement [3].

In open bite cases, overgrowth of the maxillary and mandibular posterior dentoalveolar heights is often observed [4, 5], and cases of skeletal class II open bite with a steep mandible are more difficult to treat because of the increased vertical facial height [6, 7]. Therefore, high-pull headgear with a transpalatal arch [8] is traditionally used to correct the over-erupted posterior molar regions. However, this approach of reducing the posterior dentoalveolar height using headgear is not always effective as the treatment outcome is greatly influenced by the patient's cooperation. Therefore, nowadays, miniplate [9–12] and miniscrews [13–18] are used currently for absolute anchorage. Cases of anterior open bite are often associated with TMD, and only a few reports describe the management of open bite and TMD by molar intrusion using miniscrew anchorage [19–22].

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VERSATILITY OF SKELETAL ANCHORAGE IN ORTHODONTICS

The purpose of this article is to update clinicians on the current concepts and versatile uses and clinical applications of skeletal anchorage in orthodontics. Topics discussed include clinical indications, implant types, surgical sites, biomechanics, treatment time, and treatment outcomes. World J Orthod 2008;9:221–232.

Orthodontics is bound by biological and physical constraints. Biologically, the response of periodontium surrounding the teeth to be moved has limits; physical constraints can be largely summed up by Newton's third law, which states that for every action, there is an equal but opposite reaction. When a tooth is moved, an unwanted movement in the anchorage unit resulting from the reaction force must be considered. Thus, skeletal anchorage is increasingly being favored over tooth anchorage. This trend represents an important paradigm shift in orthodontics.

Since the publication of a case report of the intrusion of maxillary incisors with a bone screw by Creekmore and Eklund,¹ there have been numerous reports concerning implant anchorage. In the 1980s, conventional osseous dental implants were the focus of the skeletal anchorage system.^{2–4} Recently, skeletal anchorage systems, such as onplants,^{5–7} miniplates,^{8–10} and microimplants,^{11–13} have been developed, and many ongoing research studies on skeletal anchorage are beginning to show its versatility. Clinical applications of skeletal anchorage in orthodontics can be divided into 3 main groups (Fig 1):

1. Procedures in which the results could be achieved by conventional orthodontics without implants, but the application of skeletal anchorage would

minimize compliance concerns and may achieve a better outcome. These include retraction of anterior teeth, lingual orthodontics, orthopedics, and expansion.

2. Procedures in which the results cannot or can hardly be achieved with conventional orthodontics, including retraction of the whole dentition and distalization of molars, intrusion of posterior teeth, intrusion of anterior teeth, and protraction of molars or the whole dentition.
3. Procedures in which the orthodontic movement of a single tooth is difficult to achieve and the use of an implant is adjunctive, including insufficient tooth anchorage and/or periodontal disease in adulthood, uprighting of molars and disimpaction, and extrusion and intrusion of individual teeth.

In this literature review, the available studies on skeletal anchorage in 11 applications are collected and tabulated to provide orthodontists a concise summary of achievable treatment results.

RETRACTION OF ANTERIOR TEETH

Although the first report of the application of a microimplant described the intrusion of maxillary anterior teeth, retraction of anterior teeth is still the principal orthodontic procedure that involves

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CONTINUING EDUCATION ARTICLE

Skeletal anchorage system for open-bite correction

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A skeletal anchorage system was developed for tooth movements. It consists of a titanium miniplate that is temporarily implanted in the maxilla or the mandible as an immobile anchorage. In this article, we introduce the skeletal anchorage system to intrude the lower molars in open-bite malocclusion and evaluate the results of treatment in two severe open-bite cases that underwent orthodontic treatment with the system. Titanium miniplates were fixed at the buccal cortical bone around the apical regions of the lower first and second molars on both the right and left sides. Elastic threads were used as a source of orthodontic force to reduce excessive molar height. The lower molars were intruded about 3 to 5 mm, and open-bite was significantly improved with little if any extrusion of the lower incisors. No serious side-effects were observed during the orthodontic treatment. The system was also very effective for controlling the cant and level of the occlusal plane during orthodontic open-bite correction. (*Am J Orthod Dentofacial Orthop* 1999;115:166-74)

It is very important for vertical correction of skeletal open-bite to control the height of the posterior dentoalveolar regions. However, traditional biomechanical techniques, such as the use of a multibracket appliance, an extraoral anchorage, an active vertical corrector with magnets, a vertical-pull chin cap, etc, cannot effectively control intrusion of the molars, especially in adult patients. This is because it is extremely difficult to establish a rigid anchorage for molar intrusion in such

cases. To obtain a rigid anchorage, dental implants and bone screws have been reported as orthodontic and orthopedic anchors.¹⁻²⁰ Some new types of implants have been designed to provide anchorage for orthodontic tooth movements.^{21,22} For example, Jenner and Fitzpatrick²³ reported a clinical case in which surgical bone plates were used to provide skeletal anchorage.

Recently, as a result of advances in biocompatible medical materials, osteointegrated titanium implants have been developed and used in bone screws and miniplates for rigid fixation in orthognathic surgery. This application leads to the hypothesis that a titanium miniplate^{24,25} might also be used as a source of stationary anchorage for tooth movements. Therefore we developed a skeletal anchorage system (SAS) in our clinic using a titanium miniplate that is temporarily implanted in the maxilla and/or mandible as an immobile intraoral anchorage, particularly for intrusion of the molars.

The purpose of this study was to use the SAS for open-bite correction. This article presents the results of

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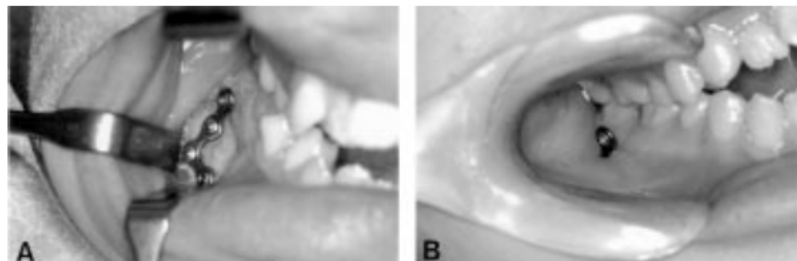


Fig 1. Implantation of a titanium miniplate. **A**, Surgical procedure, **B**, after healing of the wound.



Open bite treatment with first molar extraction. Case report

Tratamiento de mordida abierta con extracciones de primeros molares. Reporte de caso

Guillermo Pérez Cortez,* Tely Adriana Soto Castro,[§] Nancy Ivette Gallardo Alfaro,^{||} Idalia Selene Isais Peña^{||}

ABSTRACT

The extraction of first permanent molars is a viable option for the treatment of mild to moderate discrepancies of the maxillary structures in patients with open bite. The therapeutic goal is to correct the malocclusion while trying to camouflage the skeletal problem. A case report is presented of a patient who was treated with extractions of first permanent molar in order to correct the moderate skeletal open bite through mandibular rotation thus achieving a functional occlusion and favorable cosmetic results. The aim of this report is to show that after proper case selection and a good diagnosis, first molar extractions are a suitable alternative treatment for skeletal open bites.

Key words: Open bite, first molar extractions, vertical discrepancy.

Palabras clave: Mordida abierta, extracción de primeros molares, discrepancia vertical.

RESUMEN

La extracción de primeros molares permanentes es una alternativa viable para el tratamiento de discrepancias leves o moderadas de las estructuras maxilares en pacientes con mordida abierta; el objetivo terapéutico es corregir la maloclusión al tiempo que se intenta disimular el problema esquelético. Se presenta caso clínico de una paciente tratada con extracciones de primeros molares permanentes, para corrección de mordida abierta esquelética moderada, logrando rotación mandibular, una oclusión funcional y resultados estéticos favorables. El objetivo de este artículo es demostrar que después de una adecuada selección del caso, por medio de un buen diagnóstico, las extracciones de primeros molares resultan una buena alternativa de tratamiento en el caso de mordidas abiertas de origen esquelético.

INTRODUCTION

Canut defined open bite as the obvious lack of contact between the upper and lower teeth of dental or skeletal origin; the latter, due to its multifactorial etiology and consequences represents a great challenge for the orthodontist because despite the fact that extensive research has been conducted on this anomaly, there is fear in the etiology identification and in the proper treatment selection that delivers stable functional and aesthetic results.

Currently the orthodontist has a number of treatment options and/or mechanics to treat this anomaly: extra-oral appliances, bite block, intraoral anchorage appliances, mini-implants, orthognathic surgery and bicuspid or first molar extractions.

Orthodontic treatments where extractions of first permanent molars have been suggested are often considered as difficult to handle, with extended treatment time, reserved prognosis and where the final result may be affected. However there are several

case reports in the literature of patients with open bites treated by means of first molar extractions. Arvystas in 1977 reported one of the first cases, followed by Vaden in 1988, and Aras in 2002, among others. These cases were treated under the principle that by eliminating posterior contact points (possible fulcrums) and moving the posterior segment mesially, a mandibular anterior rotation would occur, thus closing the anterior open bite. However, for this treatment alternative to be successful with stable functional results, it is necessary to do a proper case selection.

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MOLAR EXTRACTION IN SEVERE OPEN BITE TREATMENT

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ABSTRACT

Treatment of anterior open bite in adults is a great challenge to the orthodontist. When the open bite is skeletal, it increases the difficulty of its correction and stability of the results at the end of treatment. Surgical-orthodontic treatment may be an option for the correction of this malocclusion, although many patients refuse this treatment option and prefer the compensatory treatment. This work aims to report a case of severe open bite, treated with orthodontic compensation, extraction of four first molars and use of anterior intermaxillary elastics.

KEYWORDS: Teeth extraction, Class I malocclusion, case report.

1. INTRODUCTION

Anterior open bite malocclusion represents a great challenge to orthodontist in relation to its treatment and stability. This is even more observed in the adult patient because they do not have the potential for growth modification. In these cases, orthognathic surgery is often required for the correction¹. The etiology of anterior open bite is multifactorial^{2,3}, i.e., several factors interacting and operating within a potential and growth inherent to each subject cause this malocclusion, such as skeletal pattern, backward rotation of the mandible, vertical maxillary excess, abnormalities in dental eruption and tongue posture problems⁴. It is one of the most compromising esthetic and functional malocclusions, besides the dental and skeletal alterations.

In adults, the treatment of this malocclusion is very difficult, as much to the closure of anterior open bite as to the stability of the results at the end of the treatment⁵⁻⁷. In these patients, the orthopedic treatment presents a big restriction because of the lack of growth potential, suggesting this way, that the treatment is performed mainly by orthodontic camouflage (dental balance) or, in severe cases, aided by orthognathic surgery⁸. Nowadays, several authors have worried about preconizing non-surgical methods to the treatment of anterior open bite in adult

patients^{5,6,9-11}. However, when the skeletal factors are associated to the problem, the most suitable treatment is the surgical-orthodontic¹. Many patients do not accept this treatment option, due to financial problems, or “horror to surgical procedures”, or even for not wishing to change the facial appearance¹². In these patients, the option is the compensatory treatment (camouflage) of the anterior open bite, and for this there are some factors described by authors which the orthodontic mechanical benefits the treatment and the final stability^{1,6,10}.

The present article reports a clinical case of a hyperdiverging adult patient who manifested an anterior open bite with skeletal compromising, whose first treatment option was surgical-orthodontics (maxillary impaction). However the patient was reluctant to this treatment option and chose the compensatory treatment, with the extraction of the first permanent molars and a different bonding protocol of orthodontics accessories in the maxillary and mandibular anterior teeth and in the mandibular posterior teeth.

HISTORY and DIAGNOSIS

A 19-year-old female presented to the private clinic with the main complaint of an unpleasant and anesthetic smile due to the presence of severe anterior skeletal open bite. The patient had a pleasing facial esthetics (Figure 1) and a Class I malocclusion, with the mandibular molars with mesial tipping.



Figure 1. Pretreatment extraoral photographs.

CASE REPORT

Nonsurgical treatment of open bite in nongrowing patients

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Successful treatment of the adult patient with an open bite dental or skeletal pattern often presents a difficult challenge. While the causes of open bite may be multifactorial in nature, there are specific diagnostic criteria that may allow for an orthodontic treatment modality incorporating extraction therapy with retraction of incisors. Two case presentations illustrate treatment of adult patients with open bites due to proclined incisors. The diagnostic criteria and mechanics for appropriate and successful treatment are discussed. Although the selection of extraction therapy for correction of anterior open bite has a narrow range of application in the overall scheme of open bite treatment, this treatment method has certain areas of application in which success may be anticipated. (AM J ORTHOD DENTOFAC ORTHOP 1995;108:651-9.)

Open bite dental and skeletal pattern often represents one of the more difficult malocclusions to treat to a successful and stable result. This statement is even more true in the adult patient because they do not have the potential for growth modification that is available in adolescent patients. Since this redirection of growth and dentoalveolar eruption is not a treatment option available in the adult population, orthognathic surgery is often required for correction of open bite in nongrowing persons.

Like most orthodontic problems, the cause of open bite is often multifactorial. Etiologic factors most often cited in the literature include "open bite skeletal pattern," vertical maxillary excess, abnormalities in dental eruption, and tongue posture problems.¹⁻¹⁰ As Isaacson¹¹ and Richardson¹² described in 1970, anterior open bite might also be a result of increased axial inclination of maxillary and mandibular incisors. The treatment of any particular open bite problem naturally would be dependent on the particular problem list evolved with the assessment of each individual patient. The purpose of this article is to present treatment of the adult patient with open bite due to proclined incisors with the diagnostic criteria and mechanics for appropriate and successful treatment.

The effect of mesiodistal movements of the

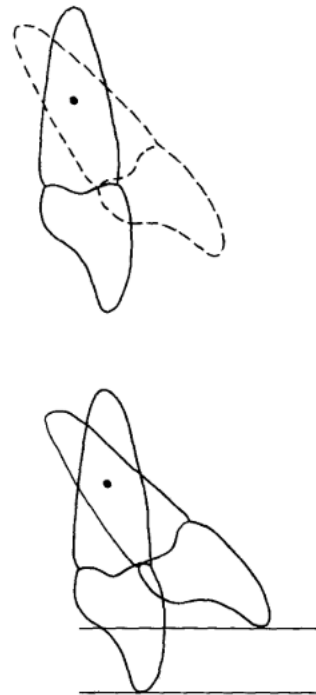


Fig. 1. Retraction of maxillary anteriors can result in extrusive movement as crown is rotated around center of rotation.

molar teeth on the mandibular plane has been well documented. Premolar extraction and orthodontic space closure has been cited as a possible option in the treatment of open bites by two basic mecha-

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Multiloop edgewise archwire in the treatment of a patient with an anterior open bite and a long face

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An adolescent girl with an Angle Class III malocclusion, excessive lower facial height, and anterior open bite sought nonsurgical treatment. She was treated with a multiloop edgewise archwire (MEAW). In association with a chin cup, MEAW mechanics allowed the successful correction of the anterior open bite and the molar relationship, without major alterations of the patient's profile. Combined orthodontic and surgical treatment should be considered for patients with skeletal anterior open-bite malocclusion. For patients who do not want surgery, however, MEAW treatment is an alternative that can have excellent results. (*Am J Orthod Dentofacial Orthop* 2010;138:89-95)

An anterior open bite malocclusion is a difficult problem in orthodontic treatment.^{1,2} Because of separate occlusal planes for the maxillary and mandibular dentitions, the open bite would be configured by the anterior divergence of these planes, instead of the overlap seen in normal occlusion.³ This malocclusion is usually associated with internal derangement of the temporomandibular joint.⁴

Most patients with anterior open bites have both a dentoalveolar component and increased skeletal vertical dimension.^{5,6} The true skeletal open-bite patient would require a combination of orthodontic treatment and orthognathic surgery to achieve a stable occlusion, acceptable esthetics, and improved function.⁷ However, surgery can be too expensive for some patients, and others refuse to consider such an invasive intervention.⁸ The orthodontist's only choice will be to deny treatment or try to resolve as much of the malocclusion as possible with orthodontic treatment alone.

The multiloop edgewise archwire (MEAW) was introduced by Kim³; he had already been using it for almost 2 decades. This technique has been successfully applied for treatment of severe open-bite malocclusions. The objectives of treatment include proper vertical positioning of the maxillary incisors, compatible cant of the maxillary and mandibular occlusal planes, and uprighted inclination of the posterior teeth. The form of the MEAW is primarily that of an ideal edgewise archwire with the addition of boot loops.³ The vertical loop component serves as a break between the teeth, gives flexibility to the archwire, and allows horizontal control of the tooth positions.⁹ The horizontal component gives more flexibility and provides vertical control. It is 2.5 times the length of wire in ordinary archwires and provides a 10-fold reduction in the load-deflection rate. The use of MEAW requires completion of all leveling and alignment, elimination of all poorly positioned brackets, and constant use of vertical elastics on the anterior teeth. It was originally prescribed for brackets with .018-in slots and .016 × .022-in archwires, allowing more flexibility for intrusive forces.³

This article shows a successful treatment result in a growing patient with an Angle Class III subdivision malocclusion and an anterior open bite.

CASE REPORT

A girl, aged 14 years 8 months, was referred by her clinician to a private office after consulting 2 other orthodontists, with the complaint of an anterior open bite. She had a pleasant profile, although there was

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ORIGINAL ARTICLE

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Cephalometric evaluation of anterior open-bite nonextraction treatment, using multiloop edgewise archwire therapy

Received: September 21, 2005 / Accepted: May 10, 2006

Abstract There are very few reports of extensive and detailed cephalometric investigations of nonextraction treatment changes for patients with anterior open bite. The purpose of this study was to evaluate changes in dentomaxillofacial morphology by way of lateral and oblique cephalograms of patients who had undergone multiloop edgewise archwire (MEAW) therapy for anterior open-bite correction. The subjects consisted of 21 Japanese female patients who received MEAW therapy without premolar extraction. The mean pre- and posttreatment ages were 16 years 9 months and 19 years, respectively. Lateral and oblique cephalograms were taken before and after treatment. Fifteen angular and 29 linear measurements were obtained from the lateral cephalograms; 17 angular and 20 linear measurements were obtained from the oblique cephalograms. Treatment changes were evaluated by the paired *t*-test. The upward and forward rotational changes of the mandible consequent to the use of the MEAWs and anterior vertical elastics were larger than the downward and backward rotational changes of the mandible, due to the extrusion of the posterior teeth by leveling and alignment. The uprighting and retrusion of the premolars and molars, and the extrusion, uprighting, and/or retrusion of the incisors and canines played important roles in the anterior open-bite nonextraction treatment by dint of the MEAW technique.

Key words Open bite · Multiloop edgewise archwire therapy · Lateral cephalogram · Oblique cephalogram

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Introduction

Treatment of anterior open bites is regarded as one of the most challenging areas in orthodontics, as malocclusions of this type develop due to the interaction of various etiological factors^{1–11} and have strong relapse tendencies.^{11–14} Etiological factors are said to include digit-sucking habits,^{1–3} orofacial muscle activity,^{2–9} lymphatic tissue,^{1,2,4,6} unfavorable growth patterns of the maxilla and mandible,^{5,6,10–11} and heredity.^{3,5} Previous lateral cephalometric studies have shown that skeletal open-bite malocclusions are generally characterized by a steep mandibular plane,^{1,5,7,12–17} an obtuse gonial angle,^{1,5,14,16} an anteriorly upward-tipped palatal plane,^{5,12,14–16} a long lower anterior facial height,^{1,5,12,15–17} a short (lower) posterior facial height,^{1,5,14,16,17} a retrusive mandible,^{1,12,14} proclined and/or protruded maxillary incisors,^{1,12–14} and mandibular incisors,^{1,5,7,12,14} and extruded maxillary incisors^{1,5,12,17} and molars.^{1,5,12} The evaluation of orthodontic treatment outcomes from only lateral cephalograms is complicated by the superimposition of radiographic images on the left and right sides of the jaw at the canine, premolar, and molar segments.¹⁸ Therefore, previous lateral cephalometric analyses of dentoalveolar components have generally been restricted to the linear and angular measurements of incisors and the linear measurement of first molars.^{1,5,7,12–14,16,17} Kim et al.¹⁹ made linear and angular measurements of the central incisors and first molars, stating that, for delineating bilateral images, lateral cephalometric studies were problematic. The linear and angular measurements of each segment of the entire dentition are important,² but, unfortunately, the oblique cephalogram, introduced by Cartwright and Harvold,²⁰ can bring only one side of the image into focus and, therefore, can only be used to evaluate the morphological characteristics and orthodontic tooth movement in posterior dentoalveolar segments separately on each side.²¹

Orthodontic treatments of growing patients with open-bite malocclusion have been conducted with one or more of the following appliances: (1) an edgewise appliance,^{2,12–14,22,23} (2) vertical elastics,^{1,13,14,23,24} (3) high-pull head-

Multiloop Edgewise Arch-wire Technique for Skeletal Class III Openbite: A Case Report

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ABSTRACT

Skeletal Class III with openbite is one of the most difficult malocclusion to treat orthodontically. Generally, the morphological characteristics of this malocclusion are poor antero-posterior growth of the maxilla or excessive growth of the mandible with high angle. An 18-year-old male had Class III malocclusion with retrognathic maxilla and normal mandible with high angle. All third molars except on fourth quadrant were extracted to eliminate the posterior crowding. Multiloop Edgewise Arch-wire (MEAW) technique was used to upright the mesially inclined buccal teeth and to correct occlusal plane. In nine month time, anterior cross bite and open bite were corrected; normal overjet, overbite and Class I canine relation were achieved.

Keywords: Class III malocclusion, Multiloop Edgewise Arch-wire, openbite

INTRODUCTION

Skeletal Class III open bite is usually characterized by a high mandibular plane angle, obtuse gonial angle, overdeveloped mandible or underdeveloped maxilla, excessive vertical dimension of the upper molar, flattening of the occlusal plane, labial tipping of the maxillary anterior teeth, lingual tipping of the mandibular anterior teeth and a small cranial base angle. It may displace glenoid fossa anteriorly to cause a forward positioning of the mandible. These factors generally contribute to the development of skeletal malocclusion as well as facial deformities, and are believed to originate from genetic and/or environmental factors.¹

The posterior discrepancy is an important etiological factor in the development of a skeletal Class III malocclusion because it affects occlusal plane. The occlusal plane is the most important component affecting the lower face vertically. The vertical position of posterior teeth in Class III malocclusion is not stable during growth and development.^{2,3} Continuous molar eruption occurs not only during growth of the facial structure but also during the post pubertal growth period.^{4,5}

When the supra-eruption of molars occurs, several unfavorable changes take place. If the patient's growth potential is low the mandible may rotate backward. Consequently, an anterior open bite may be created.

However, if the patient has sufficient growth potential, vertical growth of condyle is stimulated, then the mandible rotates forward creating a skeletal Class III malocclusion.⁶

Genetics may not be the sole reason this type of Class III malocclusion develops; rather the continued eruption of second and third molar in a limited space may be the major contributing factor. A developing Class III malocclusion may be considered an effect of the posterior discrepancy or posterior crowding which is related to the insufficient eruption space caused by the insufficient anterior-posterior diameter due to an increased vertical growth of the maxilla.⁷

Here, we used MEAW technique developed by Kim⁸ to reconstruct the occlusal plane and correct the Class III malocclusion. This system typically includes the following changes:

1. The Posterior teeth were intruded and uprighted so that the occlusal plane could be reconstructed and the mandible repositioned posteriorly
2. Repositioning the mandible might prevent overgrowth of the condyle
3. The maxilla could be protracted downward and forward.

To eliminate the posterior discrepancy, the upper and lower third molars should be extracted prior to the onset of treatment.

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Treatment results and long-term stability of anterior open bite malocclusion

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Structured Abstract

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ORIGINAL ARTICLE



Stability of anterior open-bite extraction and nonextraction treatment in the permanent dentition

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Introduction: Although stability of anterior open-bite extraction and nonextraction treatment has been investigated, results suggesting that extraction treatment is more stable have not been confronted. Therefore, the purpose of this cephalometric study was to compare the long-term stability of anterior open-bite extraction and nonextraction treatment in the permanent dentition. **Methods:** Group 1 consisted of 21 patients treated without extractions, and group 2 included 31 patients treated with extractions who had orthodontic treatment with fixed appliances. Cephalometric headplates were obtained at pretreatment, posttreatment, and postretention. The groups were compared at these 3 times and during the treatment and posttreatment periods with independent *t* tests. The number of patients with a clinically significant relapse of the open bite was compared between the groups with chi-square tests. **Results:** During treatment, the maxillary incisors had greater retraction amounts, and the mandibular incisors had greater retraction and lingual tipping, and less extrusion in the extraction group. In the posttreatment period, the extraction group demonstrated statistically greater stability of the overbite. However, there was no statistically significant difference in the percentages of patients with clinically significant relapse of the open bite between the groups. **Conclusion:** Open-bite extraction treatment has greater stability of the overbite than open-bite nonextraction treatment. (Am J Orthod Dentofacial Orthop 2006;129:768-74)

Stability of open-bite malocclusion correction in the permanent dentition is the major concern in the orthodontic treatment of this problem.¹⁻⁸

Several authors investigated the stability of open-bite malocclusion correction without differentiating between extraction and nonextraction treatment approaches.^{1,2,9} More recently, we conducted 2 studies that separately investigated the stability of nonextraction¹⁰ and extraction¹¹ treatment, and the results pointed toward greater stability of extraction treatment. However, these results have not been directly confronted to elucidate whether the stability of extraction treatment is significantly greater than that of the nonextraction approach. Therefore, our objective was to test the following null hypothesis: stability of anterior open-bite treatment in

the permanent dentition with and without extractions is similar in the long term.

MATERIAL AND METHODS

The sample comprised 2 patient groups of both sexes from the orthodontic department at Bauru Dental School, University of São Paulo. Group 1 consisted of 21 subjects (16 female, 5 male) with Class I malocclusions and a mean age of 12.4 years (range, 10.8-16.3 years) at pretreatment (T1) treated without extractions. Thirteen patients underwent maxillary expansion with either hyrax or Haas appliances to correct posterior crossbites or to provide space in the maxillary arch. The mean treatment time was 2.4 years (range, 1.1-4.1 years) between T1 and posttreatment (T2). The mean posttreatment period for this group was 5.22 years (range, 3.08-9.33 years). Group 2 consisted of 31 patients (23 female, 8 male) with a mean age of 13.22 years at T1 treated with extractions. The mean treatment time was 2.46 years (range, 1.0-4.25 years) between T1 and T2. The mean posttreatment period for this group was 8.35 years (range, 5.25-23.67 years). Sixteen patients had Angle Class I malocclusions, and 15 had Class II malocclusions. Twenty-four were treated with 4 first premolar extractions, 2 were treated with 4 second premolar extractions, 1 was treated with

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Original Article**Evaluating the Stability of Open Bite Treatments and Its Predictive Factors in the Retention Phase during Permanent Dentition**Parisa Salehi ^a, Hamid Reza Pakshir ^a, Seyed Ali Reza Hoseini ^b^a Orthodontic Research Center, Dept. of Orthodontics, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran.^b Post graduate Specialist in Orthodontics, Member of Orthodontic Research Center, Dept. of Orthodontics, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran.**KEY WORDS**Open bite;
Relapse;
Stability;
Retention**ABSTRACT****Statement of the Problem:** Orthodontists often find challenges in treating the anterior open bite and maintaining the results.**Purpose:** This retrospective study was aimed to evaluate the stability of corrected open bite in the retention phase during permanent dentition.**Materials and Method:** A total number of 37 patients, including 20 males and 17 females, with the mean age of 18±2.1 years at the beginning of the treatment were studied after correction of the anterior open bite. Overbites of the patients were measured from their lateral cephalograms before (T₁), at the end (T₂) and at least 3 years after the end of the treatment in the presence of their fixed retainers (T₃). The mean overbite changes and the number of patients with open bite, due to treatment relapse, at T₃ were calculated. The relationship between the pre-treatment factors and the treatment relapse was assessed at T₁ and T₂. Also the effects of treatment methods, extraction and adjunctive use of removable appliances on the post-treatment relapse were evaluated.**Results:** The mean overbite change during the post-treatment period was -0.46±0.7 mm and six patients (16.2%) had relapse in the follow-up recall. Cephalometric Jaraback index showed statistically significant, but weak correlation with overbite changes after the treatment ($p=0.035$; $r=-0.353$). No significant difference was found between the extraction and non-extraction groups ($p=0.117$) the use and the type of the removable appliances ($p=0.801$).**Conclusion:** Fixed retainers alone are insufficient for stabilizing the results of corrected open bite. The change of overbite in the retention phase could not be predicted from cephalometric measurements. Extraction and use of adjunctive removable appliance did not have any effect on the treatment relapse.**Corresponding Author:** Hoseini SA., Dept. of Orthodontics, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran. Email: alirezahoseini3196@gmail.com Tel: +98-71-36263193-4Received January 2014;
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Introduction

Orthodontists often find challenges in treating the anterior open bite and maintaining the results. Race and age are the two variables which can affect the occurrence of anterior open bite. [1] For instance, the prevalence of open bite is more in African Americans than in Caucasians or Hispanics. [1] The prevalence of open bite in

different Iranian populations and various age categories has been reported to be from 1.6% [2] to 7.8%. [3] Prevalence of open bite has been shown to be 3.8% among the students aged 9-11 in downtown Shiraz in 2000. [4]

Open bite is a multifactorial, i.e. it cannot be induced by only a single factor. [5] The underlying influ-

Stability of anterior open bite correction of adults treated with lingual appliances

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SUMMARY The aim of this study was to evaluate retrospectively the stability of treatment outcomes of adult anterior open bite (AOpB) cases, treated non-surgically, using a conservative approach with lingual orthodontics (LO). Thirty-nine adult AOpB patients consecutively treated by one operator (SG), with Ormco™ Generation 7 LO brackets and a conservative treatment protocol, with or without extractions, were evaluated clinically before treatment, at the end of active orthodontic treatment, and after a follow-up period, divided into a short-term group (ST): 1–2 years post-treatment, and a long-term group (LT): more than 2 years and up to 11 years post-treatment. All patients had a positive overbite at the end of active treatment (T2). Stability of the open bite correction was seen in 87.2 per cent of the patients (T3). Relapse to a negative overbite was seen in one patient (2.5 per cent). Post-treatment improvement of the overbite was demonstrated, with no difference between the ST and the LT groups. Stability of the transverse molar relations was significantly correlated with stability of AOpB correction. The LO appliance with the presented treatment protocol is a viable procedure for AOpB correction in adult patients, who are not suitable for surgical procedures, to improve or to enhance facial aesthetics. Post-treatment improvement of the overbite was observed in patients treated with this treatment approach in this study.

Introduction

The anterior open bite (AOpB) malocclusion can be a severe malocclusion, involving dental, skeletal, facial, functional, and aesthetic discrepancies (Proffit and Fields, 2000). It may derive from undereruption of anterior teeth, overeruption of the posterior teeth, excessive vertical development of the maxilla, or deficiency in mandibular ramus height. AOpB is associated with constricted upper arch and posterior x-bite, and involves functional abnormalities such as tongue interposition, lisping, and involuntary spluttering when speaking. Each type of AOpB has its specific aesthetic features, dental characteristics, and cephalometric findings (Straub, 1960; Brauer and Holt, 1965; Turvey *et al.*, 1988; Denison *et al.*, 1989; Miguel *et al.*, 1995; Lo and Shapiro, 1998; Justus, 2001; Reyneke *et al.*, 2007).

Several theories have been proposed for the aetiology of AOpB, including heredity, unfavourable growth, tongue posture, sucking habits, and obstruction of nasal breathing (Solow and Kreiborg, 1977; Proffit *et al.*, 1983; Nanda, 1988; Brenchley, 1991; Vig, 1998).

The treatment of AOpB depends on the type of AOpB, the severity of the case, and the age of the patient. For adult patients the main treatment approach for severe AOpB is often surgical. Stability was reported in about 75–85 per cent of the cases treated with different surgical procedures (Bailey *et al.*, 2004; Ding *et al.*, 2007; Espeland *et al.*, 2008;

Stansbury *et al.*, 2010; Teittinen *et al.*, 2012). Despite the relative stability of surgically corrected AOpB, orthodontic camouflage or conventional orthodontic treatment is usually preferred by the patients due to reduced risks. However, the non-surgical approach is considered to be less consistent and predictable. Long-term stability of surgical and non-surgical therapies for AOpB malocclusion was studied in a meta-analysis (Greenlee *et al.*, 2011) and indicated moderate stability of both the surgical (82 per cent) and non-surgical (75 per cent) treatments of AOpB, measured by positive overbite (OB) at 12 or more months after the treatment interventions.

The long-term skeletal and dental stability of open bite correction is reported as moderate regardless of the treatment modality, surgical or non-surgical (Lopez-Gavito *et al.*, 1985). It was suggested that stability might be complicated because of the influence of the musculature, thus control of tongue habits and muscular training is a major factor in achieving stability after open bite correction. This subject was addressed by Fränkel and Fränkel (1983), who suggested that correction of open bite in children resulted from lip-seal training and improving the postural position of the muscles. It was supported by Huang *et al.* (1990), who showed that crib therapy over a period of several years was helpful in achieving stability of the orthodontic correction of the open-bite malocclusion. When using tongue spur, they observed no indentations of the spur on the tongue, indicating the



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Long-term stability of anterior open bite closure corrected by surgical-orthodontic treatment

Teittinen, Marjut ; Tuovinen, Veikko ; Tammela, Leena ; Schätzle, Marc ; Peltomäki, Timo

Abstract: In adults, superior repositioning of posterior maxilla with or without mandibular surgery has become the treatment method of choice to close anterior open bite. Study aim was to examine the long-term stability of anterior open bite closure by superior repositioning of maxilla or by combining maxillary impaction with mandibular surgery. The sample comprised 24 patients who underwent anterior open bite closure by superior repositioning of maxilla (maxillary group, n = 12, mean age 29.3 years) or by maxillary impaction and mandibular osteotomy (bimaxillary group, n = 12, mean age 30.8 years). Lateral cephalograms were studied prior to surgery (T1), the first post-operative day (T2) and in the long term (T3, maxillary group mean 3.5 years; bimaxillary group mean 2.0 years). Paired and two-sample t-tests were used to assess differences within and between the groups. The vertical incisal bite relations were -2.6 and -2.2 mm at T1; 1.23 and 0.98 mm at T2; and 1.85 and 0.73 mm at T3 in the maxillary and bimaxillary groups. At T3, all subjects had positive overbite in the maxillary group, but open bite recurred in three subjects with bimaxillary surgery. For both groups, the maxilla relapsed vertically. Significant changes in sagittal and vertical positions of the mandible occurred in both groups. In the bimaxillary group, the changes were larger and statistically significant. In general, the maxilla seems to relapse moderately vertically and the mandible both vertically and sagittally, particularly when both jaws were operated on. Overbite seems to be more stable when only the maxilla has been operated on.

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Three-year stability of open-bite correction by 1-piece maxillary osteotomy

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Introduction: The purpose of this retrospective cephalometric study was to evaluate the long-term vertical stability of anterior open-bite correction by 1-piece Le Fort I osteotomy and rigid fixation. **Methods:** The sample comprised 40 consecutively treated patients from the files of the Department of Orthodontics, University of Oslo, Norway. All subjects had received a 1-piece Le Fort I osteotomy as the only surgical procedure from 1990 through 1998 and were followed for 3 years according to a protocol for data collection. Lateral cephalograms were obtained before surgery and at 5 occasions after surgery. **Results:** The mean open bite before surgery was 2.6 mm; at the 3-year follow-up, 35 patients had a positive overbite, and the remaining 5 patients had an open bite between 0.2 and 0.9 mm. Impaction of the posterior maxilla ≥ 2 mm relapsed on average by 31%, and inferior repositioning of the anterior maxilla ≥ 2 mm relapsed by 62%. Maxillary vertical skeletal changes during the postsurgery period were compensated for by orthodontic dentoalveolar adaptation. Most of the skeletal relapse occurred during the first 6 months after surgery and always in the direction opposite to the surgical movement. The relative contribution of mandibular and maxillary changes in anterior open-bite closure was approximately 3:1. **Conclusions:** Surgical correction of anterior open bite was generally stable over a 3-year period, and skeletal relapse was counteracted by dentoalveolar compensation. (*Am J Orthod Dentofacial Orthop* 2008;134:60-6)

Treatment of anterior open bite is a great challenge in clinical orthodontics. Relapse has been reported in 25% to 38% of conventionally treated patients.¹⁻³ Attempts to control maxillary development and prevent eruption of the posterior teeth during growth are often frustrated by late adolescent growth changes.⁴ Once growth has ceased, mechanics aimed at posterior molar intrusion can be attempted, but significant intrusion is rarely achieved.⁵ In nongrowing patients, 2 options remain for this type of malocclusion: extrusion of anterior teeth or orthognathic surgery.^{4,6} A combined orthodontic and surgical approach has now been established as a standard method to correct open bite and ensure facial harmony and functional occlusion.⁷

Surgical management of anterior open bite can be achieved with various surgical techniques,⁸ but most commonly maxillary Le Fort I impaction either alone or in conjunction with mandibular osteotomy is used to eliminate open bites. Early reports on the stability of these procedures showed varying results.⁹⁻¹¹ These

studies took place before the introduction of rigid internal fixation, which has been shown to result in excellent stability.^{12,13} Proffit et al,¹⁴ in considering a hierarchy of stability for orthognathic surgery procedures, proposed maxillary impaction as the most stable procedure and maintained that the type of fixation (rigid internal or wire) in maxillary impactions did not influence stability. Bimaxillary procedures to correct anterior open bite appear to be less stable than maxillary procedures alone.^{7,13}

Even if surgery-assisted orthodontics is a valid procedure to correct open-bite malocclusions in nongrowing patients, current evidence to establish clinical protocols is insufficient. Conflicting reports might be related to the lack of homogeneity of the studied samples and inconsistent treatment protocols. The purpose of this study was to evaluate the long-term stability of anterior open-bite correction with 1-piece Le Fort I osteotomy and rigid fixation. The objectives were to examine the amount, direction, and timescale of vertical change at selected skeletal and dental cephalometric landmarks. An additional objective was to analyze the relative contributions of the dental and skeletal changes to the overall result.

MATERIAL AND METHODS

The sample comprised 40 consecutive patients (16 male, 24 female) who had 1-piece Le Fort I osteotomy as the only surgical procedure to correct an open bite.

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Skeletal and dento-alveolar stability after surgical-orthodontic treatment of anterior open bite: a retrospective study

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SUMMARY The aim of this investigation was to assess skeletal and dento-alveolar stability after surgical-orthodontic correction of skeletal anterior open bite treated by maxillary intrusion (group A) versus extrusion (group B). The cephalometric records of 49 adult anterior open bite patients (group A: $n = 38$, group B: $n = 11$), treated by the same maxillofacial surgeon, were examined at different timepoints, i.e. at the start of the orthodontic treatment (T1), before surgery (T2), immediately after surgery (T3), early post-operatively (± 20 weeks, T4) and one year post-operatively (T5). A bimaxillary operation was performed in 31 of the patients in group A and in six in group B. Rigid internal fixation was standard. If maxillary expansion was necessary, surgically assisted rapid palatal expansion (SRPE) was performed at least 9 months before the Le Fort I osteotomy. Forty-five patients received combined surgical and orthodontic treatment.

The surgical open bite reduction (A, mean 3.9 mm; B, mean 7.7 mm) and the increase of overbite (A, mean 2.4 mm; B, mean 2.7 mm), remained stable one year post-operatively. SNA (T2–T3), showed a high tendency for relapse. The clockwise rotation of the palatal plane (1.7 degrees; T2–T3), relapsed completely within the first post-operative year. Anterior facial height reduction (A, mean -5.5 mm; B, mean -0.8 mm) occurred at the time of surgery.

It can be concluded that open bite patients, treated by posterior Le Fort I impaction as well as with anterior extrusion, with or without an additional bilateral sagittal split osteotomy (BSSO), one year post-surgery, exhibit relatively good clinical dental and skeletal stability.

Introduction

The results of combined orthodontic and surgical treatment of skeletal open bites in adults are known to be rather unpredictable (Denison *et al.*, 1989). Variable rates and amounts of relapse have been reported after surgery (Forsell *et al.*, 1992). Relapse has a skeletal and a dento-alveolar component, and its aetiology is considered to be multifactorial. Among other factors, the type of osteotomy is claimed to play an important role in post-treatment stability (Brammer *et al.*, 1980; Hiranaka and Kelly, 1987). The surgical

treatment of preference has changed over the years from mandibular osteotomies, including segmental osteotomies, to maxillary procedures (Epker and Fish, 1977). Surgical procedures involving a Le Fort I osteotomy render more stable and predictable results than those obtained with only mandibular ramus osteotomies (Schmidt and Sailer, 1991). Some studies have shown that bimaxillary osteotomies result in less mandibular, but more maxillary relapse than in each of the separate osteotomies (Hiranaka and Kelly, 1987). Others have, however, reported a comparable relapse tendency for both procedures

Long-term stability of anterior open-bite closure with bilateral sagittal split osteotomy

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Introduction: Maxillary impaction and bimaxillary osteotomies are used to treat anterior open-bite malocclusions but can have adverse soft-tissue effects. Correcting an anterior open bite with a single mandibular procedure avoids these undesirable soft-tissue effects, but the stability of this procedure is unknown. The purpose of this study was to assess the long-term stability of anterior open-bite correction with bilateral sagittal split osteotomy and rigid internal fixation. **Methods:** Orthognathic surgical records of 1 oral surgeon were searched for all patients treated for anterior open bite with bilateral sagittal split osteotomy and surgical closing rotation of the mandible with rigid internal fixation. Cephalometric films from initial consultation, presurgery, postsurgery, orthodontic appliance removal, and a mean of 4.5 years after orthodontic appliance removal were collected, traced, and measured. **Results:** Thirty-one patients fit the inclusion criteria for this study and had an initial mean open bite of -2.6 mm (SD, 1.1 mm). The patients experienced an average mandibular closing rotation of 3.7° (SD, 2.4°) with surgery. By orthodontic appliance removal, the mandible rotated open 1.1° , and incisor overlap was 1.4 mm (SD, 1.0 mm). Approximately 4.5 years after orthodontic appliance removal, the mean incisor overlap was maintained at 1.0 mm (SD, 1.0 mm), yet the mandible rotated open an additional 1.1° . Only 3 patients relapsed to no incisor overlap in the long term, and only 3 patients experienced relapse greater than 1 mm in the long term. **Conclusions:** Approximately 90% of the treated patients had a positive incisor overlap 4.5 years after orthodontic appliance removal. Despite a 60% loss of mandibular surgical closing rotation, only 10% of the patients relapsed to no incisor overlap in the long term. Bilateral sagittal split osteotomy and surgical closing rotation of the mandible by using rigid internal fixation should be considered a stable alternative in the treatment of mild-to-moderate anterior open-bite malocclusions. (*Am J Orthod Dentofacial Orthop* 2012;142:792-800)

Anterior open bite is a term used to describe instances when the maxillary and mandibular incisors fail to overlap or contact with each other, resulting in significant esthetic and functional difficulties. When open bites have skeletal components, as in many nongrowing patients, they are often associated with greater vertical facial relationships and are not self-

correcting.¹⁻³ The correction of such a vertical discrepancy can be difficult and often necessitates surgery.

Historically, a bilateral sagittal split osteotomy with closing rotation of the mandible using intermaxillary wire fixation was used to treat patients with anterior open bite and had a significant rate of relapse.⁴⁻⁶ Factors that contributed to relapse included improper condylar seating, unstable fixation, magnitude of advancement, pterygoid muscle and connective or soft-tissue pull, and postoperative muscle strength and length changes.⁷⁻¹⁰

The focus then shifted to maxillary impaction surgery for the correction of anterior open bite. However, the adverse soft-tissue effects of this surgery made this option less desirable for some patients. These effects include increased alar cartilage width, an upturned nose with increased nares exposure, flattening of the upper lip, thinning of the vermilion, an obtuse nasolabial angle, and excessive gingival display.¹¹⁻¹³ The use of dual jaw surgery has attempted to ameliorate these soft-tissue effects, yet patients can still suffer from undesirable esthetic results.¹⁴

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Orthodontic treatment of anterior open-bite malocclusion: Stability 10 years postretention

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Introduction: The postretention stability of open-bite treatment is a controversial topic in orthodontics. **Methods:** In this study, the lateral cephalometric radiographs of 64 patients treated with orthodontics alone were evaluated to determine the amount of postretention change. The mean postretention interval was 14 years. The sample was divided into 3 groups based on the amounts of pretreatment overbite: (1) the contact group (n = 24), incisal overlap and incisal contact; (2) the overlap group (n = 25), incisal overlap and no incisal contact; and (3) the open-bite group (n = 15), no incisal overlap. The headfilms were digitized, and the values were analyzed. **Results:** The 3 groups reacted differently. During the postretention period, mean overbite deepened in all groups, with the contact group deepening significantly more than the open-bite group. Overjet increased significantly more in the open-bite group than in the contact group. Pretreatment overjet correlated mildly with postretention overjet relapse in the open-bite group. **Conclusions:** All 64 subjects had positive incisal overlap at the postretention recall. (Am J Orthod Dentofacial Orthop 2010;137:302.e1-302.e8)

Anterior open-bite therapy has long been considered a challenge to orthodontists. The prevalence of anterior open bite ranges from 1.5% to 11% among various age and ethnic groups,¹ and it has been shown that approximately 17% of orthodontic patients have open bite.² The successful treatment of open bite with well-maintained results is difficult; the combination of anteroposterior discrepancy with skeletal open bite requires the highest degree of diagnostic and clinical skill.³

Today, orthodontists have many treatment options. High-pull headgear,⁴⁻⁸ chin cups,⁸ various types of bite blocks,^{9,10} functional appliances,¹¹ extractions, multi-loop edgewise archwires,¹² mini-implants,¹³⁻¹⁵ and orthognathic surgery¹⁶⁻¹⁹ are some examples of the treatment modalities for treating anterior open bite. However, the prognosis with those treatment modalities has been shown to be inconclusive.^{2,12,16,19-28}

When considering the patient's investment of time, discomfort, and money, the issue of stability becomes even more important.

Relapse of open bite can occur because of tongue size or posture,²⁹ digit-sucking habits,^{30,31} respiratory problems,^{32,33} condylar resorption,³⁴ and unfavorable growth patterns.³⁵ However, no known characteristics are clear predictors of relapse.^{25-28,36}

Despite this controversy, relatively few studies have investigated the stability of open-bite treatment. Some studies were based on the results of short posttreatment periods,^{12,23} and some used different methods to measure vertical relationships.^{2,24} In addition, many previous studies^{2,22,24} neglected to separate the anteroposterior component from the vertical problem, as suggested by Sassouni,³⁷ who compared subjects with open-bite characteristics with those with deep-bite. In light of these problems, we examined open-bite subjects treated with conventional orthodontics after at least 9.5 years postretention. The purposes of the study included (1) assessment of the long-term stability of anterior open bite treated orthodontically, (2) investigation of any significant cephalometric changes during the postretention period, (3) contrast and comparison of postretention cephalometric changes in patients with various categories of vertical incisal overlap, and (4) search for significant correlations between pretreatment cephalometric values and postretention changes.

MATERIAL AND METHODS

All subjects from the postretention files at the University of Washington in Seattle were selected if they

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