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Management of open bite in adults

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surgery

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿ يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ رَهْبَاتٍ ﴾

[سورة المجادلة: ١١]



Certification of the supervisor

I certify that this project entitled "**Treatment of open bite in adults** " was prepared by the fifth-year student **Hiba Adel Fraq** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor degree in Dentistry.

Supervisor's name : **Hiba M. Hussein**
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Date:

Dedication

This project is dedicated to my parents who have always given me all the support ,

*To my **mother** , thank you for your love and prayers*

*To my **father** , thank you for trusting me and supporting me.*

*Sister **Dr.Huda** thank you for teach me a lot and help me in dentistry*

*Sister **Ph. Anfal** thank you for your kindness and love*

*And **brothers**, thank you for always being there for me*

To soul of my grandparents

Thanks to myself for hold out in the face of all these difficulties

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المحمد لله الذي ما تم جهده ولا ختم سعيه الا بفضلهم ،
وما تحظى العبد من عقبات وصعوبات الا بتوفيقه ومعونته فلك المحامد كلها

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List of abbreviations

Abbreviation	Deceptive
OB	Open bite
AOB	Anterior open bite
POB	Posterior open bite
Tads	Temporary anchorage devices

Introduction

The occlusion means the contact of teeth in opposing dental arches when the jaws are closed (static occlusal relationships) and during various jaw movements (dynamic occlusal relationships) and the occlusion of teeth is the key to oral function (Nelson, 2010; Vashisth *et al.*, 2012) .

Anterior open bite 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 (Lentine-Olivera *et al.*, 2014).

The etiology of anterior open bite (AOB) is multifactorial, including unfavorable growth patterns, digit-sucking habits, enlarged lymphatic tissue, heredity and oral functional matrices (Xin *et al.*, 2015)

Several treatment options are presented, aiming to inhibit the mechanical factors that maintain the anterior open bite and/or limit the excessive vertical growth of facial skeletal components, the removal of harmful habits is a complex therapy with psychological, emotional and family involvement (Cozza *et al.*, 2007; Cassis *et al.*, 2010; Bianchi *et al.*, 2017).

Posterior open bite is one of the most severe malocclusions that can impair patients masticatory functions, yet it is also a condition that is poorly understood and not well studied, it is described as a lack of posterior occlusal contact (Huang *et al.*, 2020) .

AIMS OF THE STUDY

The aims of this study is to shed light on the open bite malocclusion, its possible etiology, complications and the treatment options in adult orthodontics patients

Chapter one

Review of Literatures

1.1 Definitions:

1.1.1 Over bite (OB) (Oliver, 2001; Gill, 2008; Hamdan *et al.*, 2019) : is the vertical overlap of the mandibular incisors by the maxillary incisors, measured perpendicular to the occlusal plane, with the posterior teeth in occlusion, the normal OB Measures 2–4 mm.

There are three features that are analyzed in the classification of an overbite:

- Degree of overlap: edge to edge, reduced, average, increased
- Complete or incomplete: whether there is contact between the lower teeth the opposing teeth/tissue (hard palate) or not.
- Whether contact is traumatic or atraumatic

An average overbite is when the upper anterior teeth cover a third of the lower teeth. Covering less than this is described as ‘reduced’ and more than this is an ‘increased’ overbite. No overlap or contact is considered an ‘anterior open bite’.

1.1.2 Open bite : Open bite can be defined as the lack of contact of opposing teeth, because of their multifactorial etiologies, dental and skeletal open bites are among the most difficult malocclusions to treat to a successful and stable result (Dung and Smith,1988; Nielsen, 1991; De Castilho *et al.*, 2018).

1.1.3 Anterior open bite (AOB) : Anterior open bite malocclusion is defined as the absence of contact between the maxillary and mandibular incisor edges consequently presenting a negative overbite (Fig 1) (Nielsen, 1991; Ngan and Fields, 1997).

Generally, it deteriorates the facial aspect, impairs mastication and speech, subjecting the patient to uncomfortable situations (Janson *et al.*, 2013).



Fig 1 Anterior open bite (Littlewood and Mitchell, 2019)

1.1.4 Posterior open bite (POB) : Posterior Open Bite Can be defined as failure of contact between the posterior teeth when the teeth occlude in centric occlusion. Posterior open bite is rarely observed, especially in adults. In some patients, lateral open bite is due to a disturbance of the eruption mechanism itself so that non-ankylosed teeth cease to erupt. Few lateral, open bite cases are reported in the literature and in the majority involved ankylosed teeth or primary failure of eruption, Other possible causes are tongue interposition, and skeletal discrepancies (Fig 2) (De Castro and Marise, *et al.*, 2010; Wajid *et al.*, 2018; Michelaki *et al.*, 2019).



Fig 2 Posterior open bite due to the presence of a lateral tongue thrust habit (Gurkeerat *et al.*, 2015)

1.2 Etiology of open bite malocclusion

In common with other types of malocclusion, both inherited and environmental factors are implicated in the etiology of anterior open bite, these factors include skeletal pattern, soft tissues, habits, and localized failure of development. In many cases the etiology is multifactorial, and in practice it can be difficult to determine the relative roles of these influences as the presenting malocclusion is similar. However, a thorough history and examination, perhaps with a period of observation, may be helpful (**Mitchell *et al.*, 2013**).

1.2.1 Genetic factors

Patients with normal growth pattern have balanced characteristics between these extreme growth patterns. Consequent to these characteristics, patients with vertical growth pattern are also more susceptible to the environmental influences predisposing to open bite, and consequently present this malocclusion most frequently (**Dung and Smith, 1988; Nanda, 1988, 1990**).

Patients can be classified into three groups according to their growth pattern: horizontal, normal, or vertical growth pattern (Fig 3) patients with horizontal growth pattern usually present low mandibular plane and gonial angles, decreased lower anterior face height, deep overbite, increased free-way space, decreased molar and incisor dentoalveolar heights, and greater biting forces than patients with vertical growth pattern (**Dung And Smith, 1988; Nanda, 1988, 1990; Janson and Valarelli, 2013**).

According to **Kumar (2007)**, inherited open bite is due to inherited growth pattern or abnormally large sized tongue:

- Genetically determined or skeletal open bite
- There is normal eruption of anterior teeth along with the downward backward rotation of the mandible with excessive eruption of posterior teeth

- Short ramus
- Increased gonial angle
- Narrow maxillary arch is possible
- Long face pattern or skeletal open bite with vertical growth pattern.

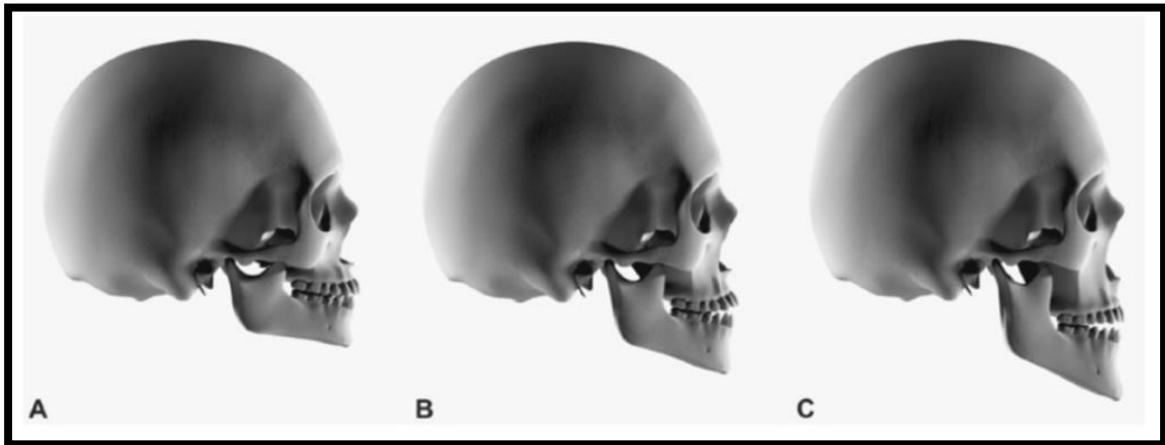


Fig 3 (A), (B), and (C) show horizontal, balanced, and vertical growth patterns. vertical growth pattern is more likely to present anterior open bite (**Janson and Valarelli, 2013**)

1.2.2 Environmental factors

Anterior open bite can be considered as functional consequent to its functional etiologic factors. The most important functional factors are deleterious oral habits, and oral breathing, some other factors may contribute in the environmental etiology such as traumatism and pathologies (**Janson and Valarelli, 2013**)

The greater the influence of environmental factors in the etiology of a malocclusion, the better the orthodontic treatment prognosis, as long as the causative factor is eliminated. When there is a strong genetic etiologic factor, most likely the best approach would consist of orthodontic-surgical approach because environmental open bites are more amenable to an orthodontic approach (**Gurkeerat et al., 2015**) .

1.2.2.1 Deleterious habits

This is denominated the buccinator mechanism. Thus, the teeth are in a balanced position receiving opposing forces arising internally by the tongue and externally by the lips and cheeks (Fig 4) the solution of this muscular balance for some abnormal function of the oral muscles has a negative impact on the teeth position and occlusion, non nutritive sucking habits, such as pacifier and thumb-sucking, atypical tongue thrust, and anterior tongue posture, all considered deleterious oral habits, can break this muscular balance, oral structures, basal bones, teeth, and intra and extra oral musculature, reflecting in a correct function of the stomatognathic system (**Janson and Valarelli, 2013**)

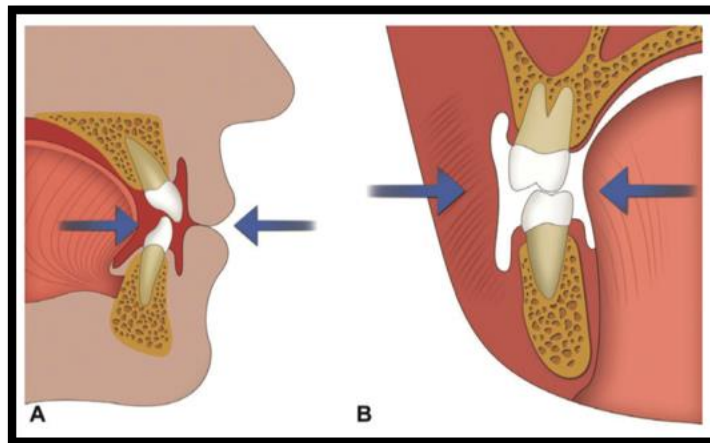


Fig 4 balanced forces between the tongue, lip ,and cheeks on the teeth and bone structures (**Janson and Valarelli, 2013**)

A. Pacifier and thumb-sucking

Humans start sucking fingers, tongue, and lips during fetal life, in the maternal womb (Fig 5) At birth, the infant has a well-developed function of sucking to receive the nutrients essential for life, It is during suction developed in breastfeeding that the children not only get the nutrients that need to meet the physiological demands, as well as feelings of security, warmth, and acceptance necessary for their welfare and for their proper emotional development, At this stage, suction is a mean of communication of the infant with the environment,

the early well-developed oral perception provides a sense of comfort, safety, and emotional satisfaction during sucking, when breastfeeding is not possible, the use of bottles with orthodontic nipples that resemble the anatomy of a woman's breasts is recommended, because they allow better contact of the tongue with the palate, as necessary for normal swallowing (Fig 6), when a child is bottle-fed, his physiological demand is met, but the natural need to suck is not supplied in the few minutes spent in the mother's lap, Thus, the child can begin the compensating thumb or pacifier sucking (**Janson and Valarelli, 2013**)

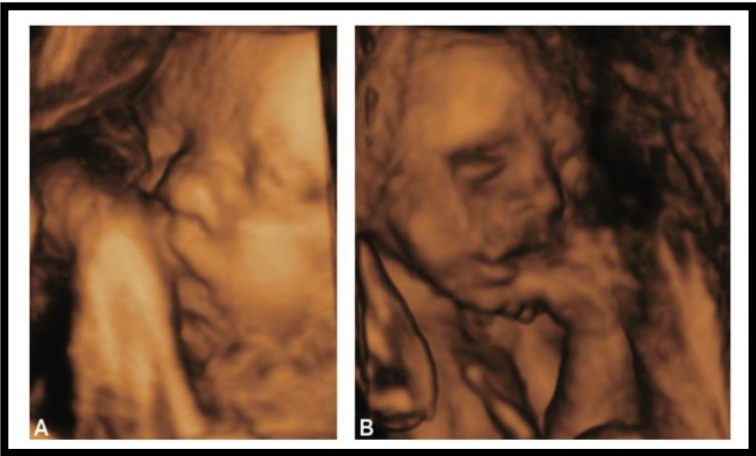


Fig 5 prenatal thumb-sucking seen in a ultra sonographic examination (**Janson and Valarelli, 2013**)



Fig 6 Breastfeeding provides the natural need to suck to the child (**Janson and Valarelli, 2013**)

However, persistence of the habit until the mixed dentition represents a deviation from normality, because these habits are potent etiologic malocclusion factors, particularly for anterior open bite (**Bishara et al., 2006**).

Pacifier or thumb-sucking act as mechanical obstacles, preventing eruption of the anterior teeth and establishing an open bite (Fig 7) (**Proffit et al., 2007**).



Fig 7 Pacifier and thumb-sucking are strong etiologic factors for open-bite malocclusion (**Janson and Valarelli, 2013**)

Anterior open-bite malocclusion due to pacifier use is characteristically restricted to the anterior teeth and circular (Fig 8) anterior open bite consequent to thumb-sucking is characterized by labial inclination of spaced maxillary incisors and lingual inclination of the mandibular incisors (Fig 9) Anterior open bite may be associated to maxillary constriction and uni-or bilateral posterior cross bite, because, during sucking, the tongue is lowered, without contact with the maxillary posterior teeth (**Janson and Valarelli, 2013**)



Fig 8 Anterior open bite caused by the use of pacifier is characterized by being restricted to the anterior region of the dental arches and circular (**Janson and Valarelli, 2013**)

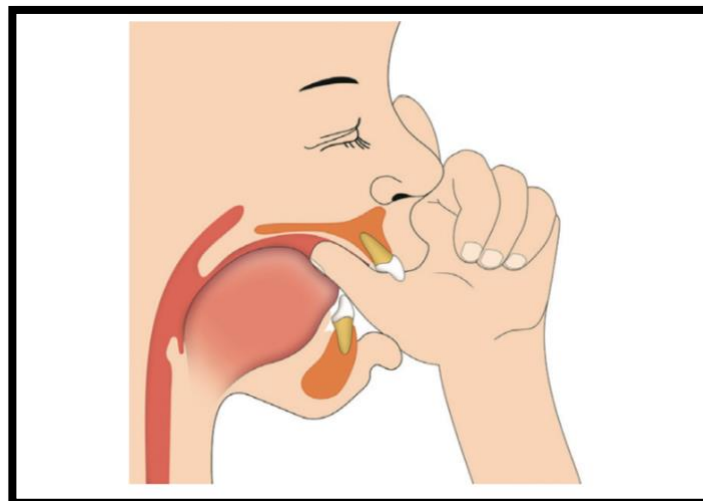


Fig 9 Thumb-sucking characteristically causes labial inclination of the maxillary incisors and lingual inclination of the mandibular incisors (**Janson and Valarelli, 2013**)

B. Anterior tongue posture and tongue thrust

Atypical tongue posture and atypical tongue thrust is present in 100% of cases with anterior open bite (**Fujiki *et al.*, 2004**).

The tongue is considered to have a secondary role in the etiology of anterior open bite because it can maintain or aggravate the existing open bite when placed between the anterior teeth this abnormal tongue placement may occur at rest, during speech, and swallowing (**Fig 10**) (**Proffit *et al.*, 2007**).



Fig10 Anterior tongue posture is also a contributing factor for open bite (Janson and Valarelli, 2013)

1.2.2.2 Mouth breathing (Mitchell *et al.*, 2013)

It has been suggested that the open-mouth posture adopted by individuals who habitually mouth breathe, either due to nasal obstruction or habit, results in overdevelopment of the buccal segment teeth, this leads to an increase in the height of the lower third of the face and consequently a greater incidence of anterior open bite, in support of this it has been shown that patients referred for tonsils ectomy and adenoide ectomy had significantly increased lower facial heights compared with controls, and that post-operatively the disparity between the two groups diminished

However, the differences demonstrated were small, other workers have shown that children referred to ear, nose, and throat clinics exhibit the same range of malocclusions as the normal population, and no relationship has been demonstrated between nasal airway resistance and skeletal pattern in normal individuals.

1.2.2.3 Traumatism

Dental traumatism can cause ankylosis which possibly comes from some kind of injury which causes changes in the periodontal ligament, forming a bone bridge joining the cementum and the lamina dura, ankylosis of any primary tooth may cause, beyond its retention, a delay or even an ectopic eruption of the permanent successor and may cause open-bite malocclusion (fig 11) (mandava and kumar, 2009).

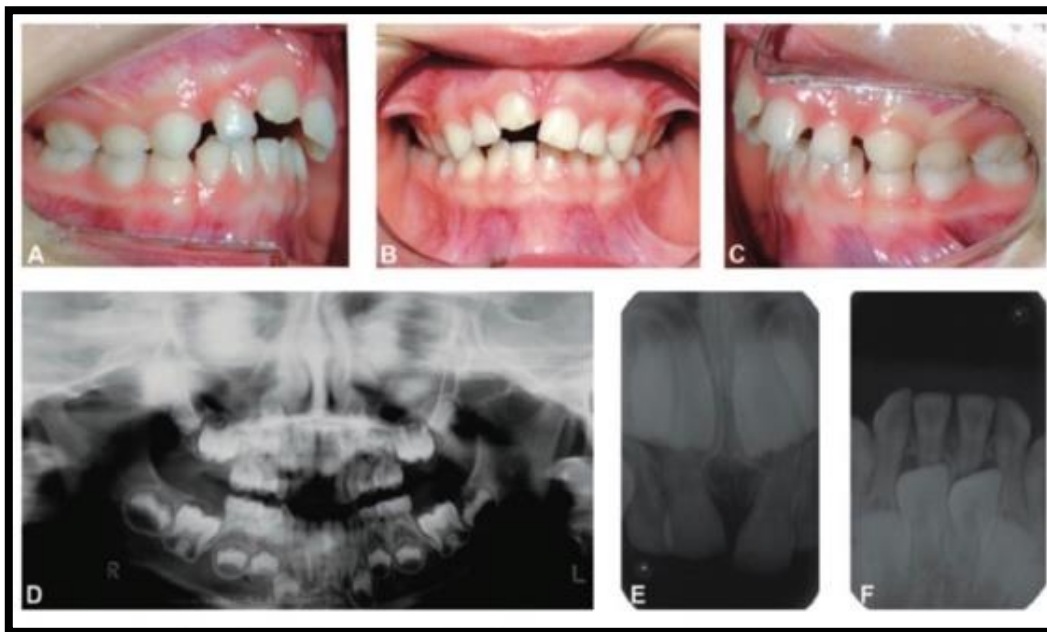


Fig 11 ankylosis of deciduous maxillary incisor due to trauma causing anterior open bite (Janson and Valarelli, 2013)

1.2.3 Eruption disturbances of permanent teeth (Littlewood and Mitchell, 2019)

A POB can also be seen in cases with eruption disturbances, the two main categories of eruption disorder are primary failure of eruption and mechanical failure of eruption, primary failure of eruption is a condition which almost exclusively affects molar teeth and affects all teeth distal to the most mesially affected tooth (Fig.12), although these teeth are not ankylosed they do not respond normally to orthodontic forces and indeed usually become ankylosed if

traction is applied, primary failure of eruption has recently been linked to a specific gene in several familial cases

In contrast, mechanical failure of eruption is associated with radiographical signs of ankylosis and often affects the first permanent molar with the more distal teeth developing and erupting normally, in both types, the affected teeth may erupt and then cease to keep pace with continued vertical development becoming relatively infra-occluded, or may fail to erupt at all, extraction is often the only treatment alternative.

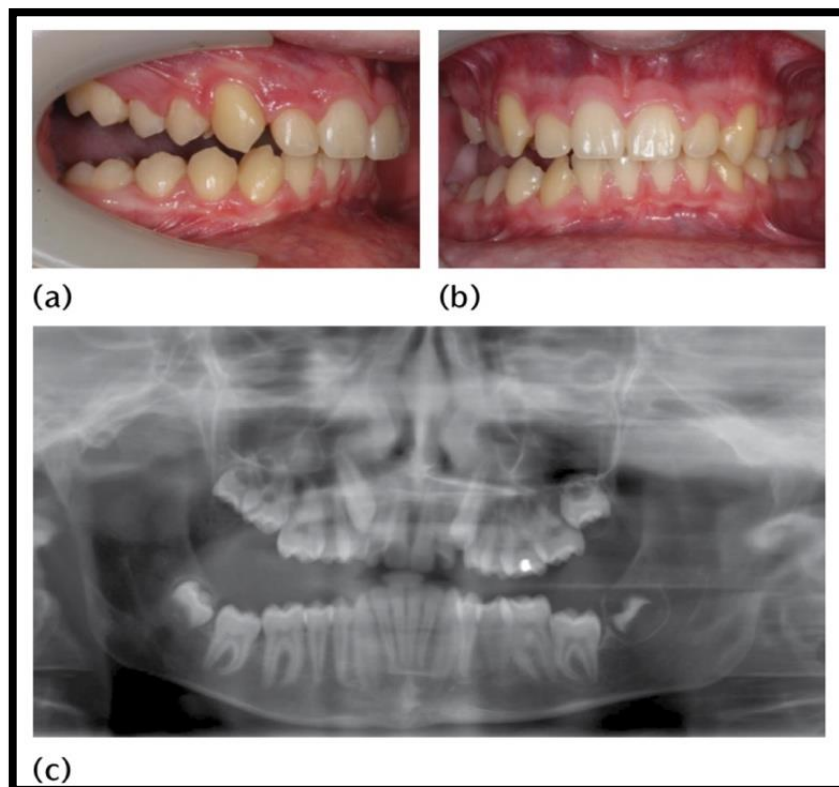


Fig 12 (a–c) Primary failure of eruption of the posterior teeth on the right hand side note that the open bite increases as you progress further back into the mouth (Littlewood and Mitchell, 2019).

1.3 Approaches to the management of anterior open bite

According to **Lentine-Olivera *et al.* (2014)**, there are three possible approaches to management of open bite:

- Acceptance of the anterior open bite
- Orthodontic correction of the anterior open bite
- Surgery

1.3.1 Acceptance of the anterior open bite (Dung and Smith, 1998; Greenlee *et al.*, 2011)

Behavior modification, in this case treatment is aimed at relief of any crowding and alignment of the arches. This approach can be considered in the following situations (particularly if the (AOB) does not present a problem to the patient):

- Mild cases
- Where the soft tissue environment is not favourable, for example where the lips are markedly incompetent and/or an endogenous tongue thrust is suspected
- More marked malocclusions where the patient is not motivated towards surgery.

1.3.2 Orthodontic correction of the anterior open bite (mechanical treatment, such as braces or invisalign)

If growth and the soft tissue environment are favourable, an orthodontic solution to the anterior open bite can be considered, a careful assessment should be carried out (**Dung and Smith, 1998; Lentini-Oliveira *et al.*, 2014**).

In the milder malocclusions the use of high-pull headgear during conventional treatment may suffice. In cases with a more marked anterior open bite associated with a class ii skeletal pattern, a removable appliance or a functional appliance incorporating buccal blocks and high-pull headgear can be used to try to restrain vertical maxillary growth (Fig 13) (Fig 14) (**Kim, 1987; Chate, 1994; Vaden, 1998; Lentine-Oliveira, *et al.*, 2014**).

The introduction of skeletal anchorage devices has also expanded the envelope in terms of the severity of anterior open bite that can be treated non-surgical (Fig 15) (**Lentine-Oliveira *et al.*, 2008; Baek *et al.*, 2010; Lentine-Oliveira *et al.*, 2019**).

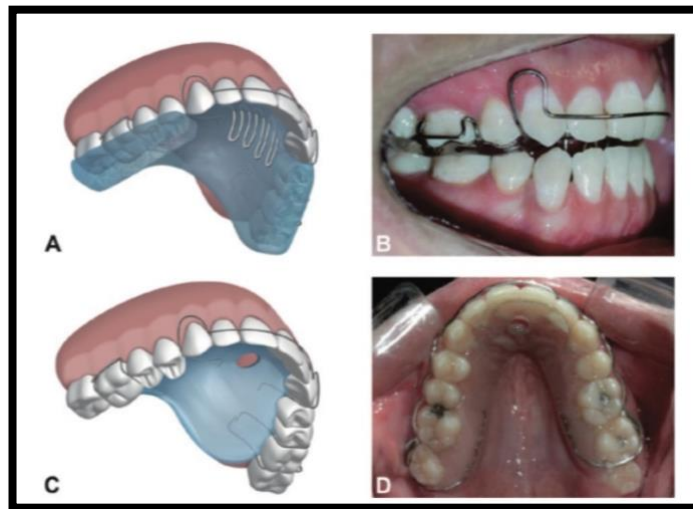


Fig 13 (A) and (B): Retention plate with anterior tongue crib to avoid tongue thrust in the anterior teeth, anterior tongue posture, and a posterior bite block to restrict vertical development of the posterior teeth. (C) and (D): Retention plate with an orifice in the region of incisive papillae to condition correct tongue position (Janson and Valarelli, 2013)

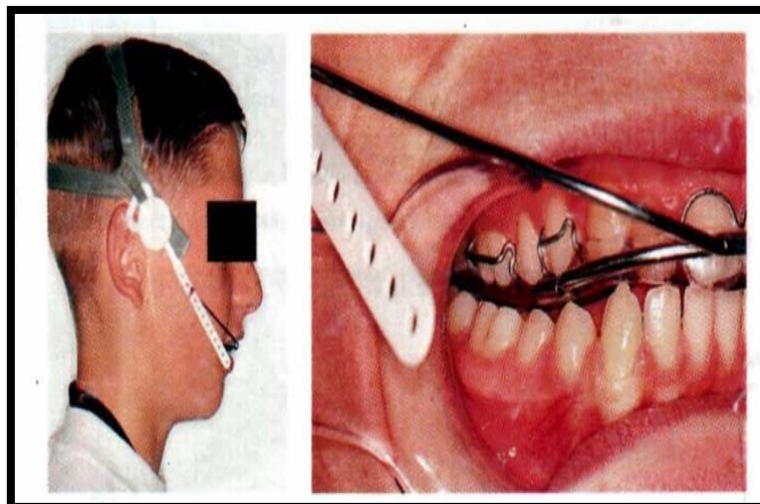


Fig 14 A patient wearing a maxillary intrusion splint and high-pull headgear the face-bow of the headgear slots into tubes embedded in the acrylic of the occlusal capping, which extends to cover all the maxillary teeth (Janson and Valarelli, 2013)

According to Mitchell *et al.* (2013), the methods of intruding the molars:-

- High-pull headgear
- Fixed appliance mechanics
- Buccal capping on a removable/functional appliance
- Repelling magnets
- Temporary anchorage devices (Tads)



Fig 15 patient with an anterior open bite treated using temporary screw anchorage (tads) in the upper arch and fixed appliances: (a-e) pre treatment; (f) posterior intrusion using elastic chain between the tads and the transpalatal arch, the upper rectangular stainless steel archwire is segmented distal to the canines to prevent incisor extrusion during leveling; (g) mid-treatment; (h) a continuous archwire is placed after sufficient posterior intrusion has been achieved; (i) the tads are retained for the duration of active treatment in case additional posterior intrusion is required (Mitchell *et al.*, 2013).

1.3.3 Surgery

This option can be considered once growth has slowed to adult levels for severe problems with a skeletal aetiology and/or where dental compensation will not give an aesthetic or stable result. In some patients an anterior open bite is associated with a ‘gummy’ smile which can be difficult to reduce by orthodontics alone necessitating a surgical approach. Orthognathic surgery is

considered an adjunct procedure to correct dental deformities in adults (Mizrahi, 1978; Orton, 1990; Sant'ana *et al.*, 2013).

1.3.3.1 Combined orthodontic-surgical treatment of skeletal anterior open bite

Contemporary orthognathic surgery is the actual expression of the interaction of orthodontics and or maxillofacial surgery, where both professionals will conduct a complete patient evaluation regarding their requirements and needs to perform a combined treatment planning (Arpornmaeklong *et al.*, 2003).

The interaction between orthodontics and orthognathic surgery expand the treatment possibilities to solve patient complaints and anxieties that could not be treated alone with orthodontics. Manipulation of the apical bases in the three planes of space can provide a better esthetic improvement in the soft tissues than tooth movement within the apical bases, in the orthodontic-surgical treatment, the possibilities and needs of apical base manipulation have to be understood and discussed because in each malocclusion type, different tooth movement will be necessary (Greenlee *et al.*, 2011).

Unlike conventional orthodontic treatment, where the orthodontist is sagittally guided by molar and canine positions and transversely by the cusp to fossa relationship, pre surgical orthodontic preparation is based on the final occlusal and skeletal relationship to be obtained, Therefore understanding of the orthodontic objectives is intimately related to visualizing the final surgical result, In skeletal open bite treatment, orthodontic preparation should provide stable orthodontic tooth positioning, with the smallest dental movement, to provide a situation where the surgery completely corrects the skeletal discrepancies (Espeland *et al.*, 2008; Sant'Ana *et al.*, 2007, 2013).

1.3.3.2 Stages of combined orthodontic-surgical treatment

According to **Arnett And McLaughlin (2004)**, the stages are :

- Treatment planning
- Orthodontic treatment
- Pre surgical impression and revaluation of teeth positioning
- Pre surgical records and definite treatment planning
- Plaster model surgery and construction of an intermediary splint
- Orthognathic surgery
- Bracket rebonding, finishing procedures and appliance removal
- Retention and final records

1.4 Possible benefits of treatment AOB include: (Gill, 2008)

- Improved ability to incise and chew food.
- Improved aesthetics, especially with orthognathic surgery, due to improved incisor display at rest and during smiling, and improved lip competency.
- Improved speech there is no evidence that aob correction improves stigmatism (lisp) although patients may demand treatment on this basis

1.5 Stability of AOB correction: (Gill, 2008)

Relapse of AOB correction can be related to:

- Unfavourable vertical skeletal growth especially if associated with a clockwise (backward) mandibular growth rotation
- A forward tongue posture, macroglossia or a primary endogenous tongue thrust
- Continuation of digit sucking;
- Relapse of inappropriately extruded incisors

1.6 Correction of posterior open bites

The elevation of the etiology remains the main stay of treatment. Since lateral tongue thrust is the most frequently encountered etiologic factor, the use of lateral tongue spikes either fixed or incorporated in a removable appliance, form the first line of treatment (fig 16) vertical elastics used along with fixed orthodontic appliances can be used once the lateral tongue thrust habit has been controlled (fig 17), it has been noted that most of the posterior open bites close spontaneously following the cessation of the tongue thrust habit. Fixed appliances are the most frequently used means for the correction of submerged and impacted teeth (**Gurkeerat *et al.*, 2015**).



Fig 16 Lateral tongue spikes incorporated in an acrylic appliance (**Gurkeerat *et al.*, 2015**)



Fig 17 vertical elastics (**Erdem and Küçükkeleş, 2018**)

Chapter two

Discussion

An anterior open bite is one of the most difficult dental and facial abnormalities to treat in orthodontics, since the etiology is multifactorial, a thorough clinical examination and cephalotomy should be performed while treating the patient with an open bite, the difficulty of this malocclusion depends on a combination of skeletal, alveolar and functional factors and related habits.

Treatment for an open bite depends on the cause, age, and severity of the problem, hence, treatment options may include correction of habits, and use of extraoral devices with or without bite blocks in growing patients, treatment options in non-developing patients include intrusion of the posterior segments with temporary fixation devices, in severe cases, orthognathic surgery (upper jaw, lower jaw or both) is indicated, early and timely treatment of an open bite can avoid the use of fixed devices and surgery

Proper orthodontic treatment of anterior and posterior open bite can be achieved through detailed treatment planning and execution, in severe combined open bite cases, the ideal outcome has a major impact not only on the patient's occlusion but also on the patient's speech, mastication, and oral health quality of life index **(Julia and Augusto, 2015)**

Chapter three

Conclusions and Suggestions

The key is complete habit control to maintain the results, it is well known that open bite etiology is multifactorial dental and skeletal disharmonies are the consequences of these and are more difficult to correct in a non-growing patient and are often associated with dolichofacial pattern, it is important to remember that since the etiology is multifactorial, there is not a single prescription to treat all the patients.

Muscle equilibrium and control of the tongue posture are important factors to achieve long-term stability.

Every habit that causes an imbalance between the teeth and muscles can be considered pernicious for post-treatment stability.

It is necessary to know the real causes that produce and increase these habits since once patients have completed active orthodontic, they tend to slip back into old habits, lingual brackets can help in eliminating the abnormal tongue posture, since muscle function is very difficult to control, some authors recommend not only overcorrecting the initial malocclusion but a long-term retention plan .

Orthodontic treatment can be combined with either skeletal anchorage or orthognathic surgery to achieve acceptable results by increasing overbite and reducing total facial height in patients with severe anterior open bite. However, molar intrusion with skeletal anchorage does not require incisal elongation to increase overbite and reduce lower facial height by counter clock wise rotation of mandible.

For further studies, we suggest conducting more studies on the causes of open bites and the best ways to treat them, maintain the treatment result and reduce relapse.

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