ANTERIOR OPEN BITE: A REVIEW OF ETIOLOGY, DIAGNOSIS, AND MANAGEMENT

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***Abstract*- Open bite has fascinated Orthodontics due to the difficulties regarding its treatment and maintenance of results. This anomaly has distinct characteristics that, in addition to the complexity of multiple etiological factors, have aesthetic and functional consequences.**

This article updates clinicians on the causes, diagnosis 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.

Any increase or decrease in vertical dimension of face results to vertical dysplasia. The increased vertical dimension can lead to open bite.

The treatment approaches are discussed separately for early treatment of growing and non-growing patients. Treatment ranges from correction of etiologic habits to control of hyperdivergent growth and dentoalveolar vertical hyperplasia.

Long-term clinical outcomes are needed to determine treatment effectiveness and clinicians should consider the cost-effectiveness of these early initiated and protracted plans.

***Keywords*- open bite, etiology, diagnosis, management**

INTRODUCTION-

Descriptions of open-bite differ among various authors and investigators. Some orthodontists consider open-bite to be present when there is less than an average overbite, others consider an edge-to-edge relationship to be an open-bite, while still others specify that a definite degree of openness must be present.[1] Overbite" and terms referring to ''openbite" are descriptive the vertical relationship of the upper and lower incisors With the teeth resting together, overbite is present when the leading (incisal) edges of the upper front teeth overlap those of the opposing lower teeth. When that relationship is reversed so the leading edges of the upper teeth lie above those of the lower, an openbite is present. Both the prevalence and severity of vertical overbite were associated with race. About 96 percent of the white children had overbites compared with about 84 percent of the Negro children. In addition, extreme overbites measuring Li mm. or more occurred in significantly more white children (7.6 percent) than Negro children (0.8 percent).[2] Patient with disproportionately long lower face often accompanied by an open bite, this condition has also been labeled "skeletal open bite" however all long lower facial height patient not charectorised with openbite, or not all openbite patient recorded with long face.[3]

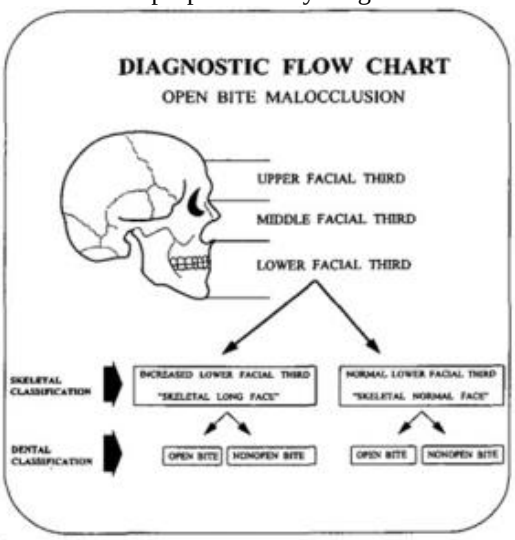

fig 1. This diagnostic flow chart demonstrates the possibilities and relationships between skeletal and dental relationships in open bite malocclusion.

Diagnosis of open bites should be viewed first in the context of skeletal structures. Sassouni classified open bites into skeletal and Dental openbites.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 a dental open bite accompanies the skeletal relationships. Above fig.shows that there are multiple variants of this problem. Patients can be diagnosed (or classified) clinically and/or by cephalometric analysis.[4]

The occlusal trait most often implicated in misarticulations is an anterior open bite. Researchers have consistently noted the relationship between an anterior open bite and sibilant disorders across languages. Many of malocclusion is been associated with misarticulation and anterior openbite is one of them. With regard to vertical occlusal anomalies, incisal open bite was clearly related to consonants that were produced too far anteriorly. Less than one-quarter of the subjects without open bite had this articulatory disorder while half of the subjects who had incisal open bite also had consonants produced too far anteriorly. Risk ratios for producing consonants too far anteriorly were 3.4 times for subjects with open bite and 1.7 times for those with lateral cross-bite compared to individuals without those occlusal anomalies.[5]

PROBLEMS AND PREVALENCE RELATED TO OPEN BITES

The prevalence of skeletal long face malocclusion is unknown, but has been estimated to be 0.6% or 1,350,000 U.S. citizens. [6] The prevalence of dental open bites in U.S. children is approximately 16% in the black population and 4% in the white population,[7]with the prevalence of simple anterior open bites (involving mainly the incisors) decreasing until adolescence.[8]

A total of 416 subjects had complete Anterior open bite after thorough photographic evaluation of the 622 case records in the age range of 20-40 years and among them 181 females and 235 males were noted. In the study, we observed that the prevalence of anterior open bite was 0.5% .It was noted that males had more prevalence (56.5%) than females (43.5%) but not statistically significant. Based on photographic examination the severity of the cases was classified as mild, moderate and severe. The percentage distribution based on severity was mild cases - 96.7% , moderate cases-0.2% severe cases -3.1%. Mild anterior open bite was predominantly seen, and there was no association of open bite severity with Gender P(>.05).[9]

an AOB should have the high risk of relapse of treatment explained and, where there are no other anomalies to be corrected, thought should be given to accepting the malocclusion, particularly if the open bite is small and there are no functional problems. Masticatory and speech is problems have been attributed to open bites. The inability to incise is the chief complaint often voiced by open bite patients. Other patients indicate displeasure with their facial esthetics. Many open bites will resolve by gradually closing without treatment, and transitional open bites, which make up many of the simple open bites, are of little consequence. Complex open bites, those that extend farther distally and those that do not resolve at the end of the mixed dentition years, can be more problematic.[10]

ETIOLOGY

Open bites are generally classified as either skeletal or dental. The dental open bite is generally found in the anterior region within the area of the cuspids and incisors and is associated with normal craniofacial pattern, proclined and undererupted anterior teeth, and thumb or finger sucking habits. The skeletal open bite is often related to excessive vertical growth of the dento-alveolar complex, especially in the posterior molar region. As anterior open bite is often the result of a combination of both factors, it makes classification of open bite as either skeletal or dental difficult. Therefore, it has been suggested that the most clinically useful classification of open bites should be based on etiology.[11]The excessive activity of the tongue, in the act of swallowing or even at rest, can alter the axial inclinations of the incisors and cause the open bite .The compensatory coordination of the tongue movement, the movement of the soft palate and the pharyngeal constrictor muscle activity would still occur during the swallowing .This would be observed quite frequently in patients with some degree of neurologic impairment.[12]

DIGIT SUCKING HABITS

Habits Digit sucking is a common cause of AOB . The incidence of digit sucking is around 30% at 1 year of age, reducing to 12% at 9 years and 2% by 12 years. Most persistent suckers are female[13]The influence made by the digit depends on the age of the patient and the intensity, frequency and duration of the habit. Open bites produced in the primary dentition are of little consequence as they resolve spontaneously once the child gives up the habit. The open bite caused by digit sucking is frequently asymmetrical, being greater on the side where the digit is inserted. The thumb or finger effectively acts as a barrier to the incisors erupting, whilst allowing excessive eruption of the posterior teeth. The upper incisors are invariably proclined whereas the effect on the lower incisors is more variable. Not infrequently there is a crossbite due to narrowing of the upper arch. How much the teeth are displaced correlates better with the number of hours per day of sucking than the magnitude of pressure. Children who digit suck for 6 hours or more each day, particularly those who sleep with a digit between the teeth all night, can develop a significant malocclusion[14] There is some evidence that, as well as dentoalveolar effects, persistent digit sucking can have a minor effect on the skeletal pattern, causing tilting of the maxillary plane in an anti-clockwise direction and anterior displacement of the maxilla[15]

fig 2. *Severe anterior open bite due to avid thumbsucking. Note the asymmetric appearance, the open bite being greater on the side the thumb is sucked.*

fig 3. *Anterior open bite due to aberrant tongue function and posture. Note the characteristic reverse curve of Spee in the lower arch.*

TONGUE THRUST

Another common habit is tongue thrust swallow, where the tongue tip is placed in a forward position between the incisors during swallowing, has been suggested as an etiological factor for this malocclusion. [16] The cause and effect relationship of abnormal tongue function and anterior open bite is not clear. Andersen (1963) considered that tongue thrusting was not a result of bottle feeding or tonsillitis, but was related rather to thumb sucking. Moyers (1963) as well as Subtelny and Sakuda (1964) considered that enlarged tonsils and adenoids did contribute to tongue thrusting. NetT and Kydd (1966) felt that the pressure of the tongue between the teeth alone was not enough to induce an open bite, whereas Proffit and Mason (1975) considered that the resting posture of the tongue was more important in open bite aetiology than the actual swallowing activity. The evidence to date suggests that anterior tongue thrust is more likely to enhance rather than cause open bite (Speidel et al., 1972). True macroglossia is rare, in certain cases tongue size as well as function may be an important factor in the aetiology of anterior open bite (Graber, 1972). Central nervous system disorders following injury, disease or mal-development of the brain contribute to impaired neuromuscular control of the tongue. Gershater in 1972 carried out a survey on children in special schools. He established that there was a higher incidence of open bite malocclusion among mentally retarded and mongoloid children.[17]

Patients with open bite may present: lack of contact between teeth, deficient labial contact, oral breathing, atypical phonation, maxillary arch constriction, inflamed gums (this characteristic may be localized), increase of the lower 1/3 of the face, open mandibular branch, inclined mandibular plan, long clinical crowns, thin and long symphysis, increased occlusal plan, small mandibular body, maxillary retraction, and tendency to become an Angle's Class II (Freitas, et al, 2003; Monguilhott et al., 2003). The cephalometric evaluation shows a divergence of the horizontal planes (sela-nasion, palatal plan and mandibular plan), with a very elevated angle of the mandibular planes. The occlusal elevation reveals arches with reasonable alignment and possible protrusion of the incisors. The shape of the arch is usually satisfactory, with a possible constriction of the upper arch in a "V" shape. The inter-arcades relation in open bite cases may present two distinct patterns: the divergent occlusal pattern (in total open bites) and the upper occlusal plan with an exaggerated Spee curve in the anterior open bites [18]

INDICATIONS FOR TREATMENT

Patients seek treatment mainly on aesthetic grounds. However, there may be functional problems such as difficulty incising food and problems with speech, such as a lisp. Although closure of an AOB may help with eating, there is little evidence to show that it helps with speech[19] and certainly this should not be promised to the patient. The Index of Orthodontic Treatment Need (IOTN) is commonly used in the hospital service, and may in the future be used in the General Dental Services, to determine the needs of patients for orthodontic treatment. Only patients with an AOB greater than 4 mm fall into the 'need' treatment category (IOTN 4). An AOB less than 4 mm would be borderline or be considered not to be in need of treatment, unless some other aspect of the malocclusion took precedence.

DIAGNOSIS

One of the simplest tools to aid in diagnosing the etiology of an anterior open bite is the use of study models that are hand-articulated. If the hand-articulated models fit well in terms of their occlusal relationship, but the patient is unable to get their anterior teeth to touch, you don't have a problem of tooth position within the arch — you have a problem that is related to the position of the mandible relative to the maxilla In these patients, the open bite is typically very linear, meaning the molars have contact, but the open bite becomes progressively larger in a linear fashion as you move from the posterior to the anterior teeth.

fig 4.x Patient is unable to get their anterior teeth to touch.

fig 5 Hand-articulated model.

If the patient has issues with intra-arch tooth position, the hand-articulated models will display an open bite similar to what is seen in the mouth. Typically, the models will show an irregular pattern of eruption. In these patients, it is common to see a well-fitting posterior occlusion with just the anterior teeth -or even some of the anterior teeth not in contact. Later, I'll discuss going further into the diagnosis for each of the typical causes of anterior open bites and the options that exist for treatment.

ETIOLOGY-

Open bites due to a changing relationship between maxilla and mandible

Now I want to discuss the possibilities if the problem is due to the relationship of the mandible to the maxilla.This usually means the hand-articulated models fit well, but the patient can't get their anterior teeth together. This is a common outcome following degenerative joint disease, but can also be an outcome of having a significant shift between the patient's seated condylar position and their habitual occlusion.

In these instances, it is not uncommon for a patient to lose the muscle programming that allowed them to find their intercuspal position. This can occur after an alteration to their posterior occlusion, such as following the restoration or removal of a first or second molar, wearing an occlusal appliance or the initiation of orthodontics.

Diagnosing the etiology of these open bites can be aided by examining the history of the open bite. A key thing to look for would be the timing of the onset of the open bite. It is not uncommon for the onset of an open bite from degenerative joint disease to be progressive and it can occur without symptoms other than the open bite.[20]

fig 6 The open bite may be progressively getting worse, with the rate being dependent upon the rate of the progression of the degenerative process.

Patients presenting with AOB are diagnosed both clinically and cephalometrically and close attention should be paid to the relative positions of the skeletal and dental structures.

fig 7. Severe open bite from second molars forwards.

fig 8. Skeletal features of posterior growth rotation: antegonial notching, recessive chin, reduced inter-incisal angle and increased lower facial height.

A patient with a skeletal open bite may exhibit some, or all, of the following cephalometric features Pronounced antegonial notching; Recessive chin; Reduced inter-incisal angle; Reduced intermolar angle; and Increased lower anterior facial height.

Soft tissues Swallowing requires an effective anterior oral seal. Children with significant lip incompetence can only achieve this by protruding their tongue to a forward position to create this seal. If the tongue is kept forward it will cover the incisors, thus reducing their eruption or, indeed, causing intrusion, leading to a reversed curve of Spee in the lower arch or an increased curve in the upper arch. In this situation, AOB correction may not be stable owing to existing soft tissue/tongue habits, which will not necessarily change, despite a change in the occlusion. It has been shown, however, that 80% of children who have tongue thrust and AOB at 8 years show improvement without therapy, just by normal development, by age 12.[21]

Habits

Digit-sucking may physically impede vertical development of the incisors by the associated finger acting as a physical barrier. Persistence of this habit may cause tilting of the maxillary plane to increase the open bite further.The result of digit-sucking is often an asymmetric open bite with associated posterior crossbite. The latter occurs as a result of increased cheek pressure and lowered tongue position, inducing tooth movement and narrowing of the arch. The incidence of digit-sucking as a cause of AOB decreases as children get older:
30% – 1 year;
12% – 9 years; and , 5% – 12 years.
Children who digit-suck for more than 6 hours per day can often develop a significant malocclusion. Cessation of the sucking may allow an open bite to close naturally, although this could take years. If habits persist after growth has finished, the open bite will often remain. An endogeneous or primary tongue thrust is a rare condition that is difficult to distinguish from an adaptive tongue thrust. The only way of diagnosing this with absolute certainty is when the AOB re-occurs after successful treatment, allowing the provision of an anterior oral seal. If the relapse does occur, then the tongue thrust is generally classified as endogenous rather than adaptive, which is of course a contra-indication to any further orthodontic treatment.There is nothing that can successfully remove the cause of this particular feature of the malocclusion.

Airway obstruction/mouth-breathing

Prolonged mouth-breathing due to increased tonsillar or adenoidal obstruction may be a contributory factor towards malocclusion, but it is not thought to be the main aetiological factor. Adenoidectomy or tonsillectomy should not be recommended to prevent malocclusion and should only be done for specific medical reasons.[22]

Management of Anterior openbite

Anterior open bite is one of the most complex malocclusions to manage. The interaction of skeletal, dental, and soft tissue effects can contribute to develop an anterior open bite. The skeletal open bite requires a more complex approach of treatment to reach function, aesthetics, and stability. The approaches vary depending on the causative factors and the age of patients. Treatment approaches for open bite patients differ when dealing with adults and growing patients. The aim of this descriptive review was to summarize the main existing treatment strategies for anterior open bite, from the noninvasive behavioural shaping to the orthodontic intrusion with skeletal anchorage. [23]

Management in the deciduous dentition

In the deciduous dentition, anterior open bite has been linked to a dento-alveolar involvement in about 95% of cases [24]. when dental open bite is due to thumbsucking, mouth-breathing and atypical swallowing habits, the treatment is mainly “etiological”. The clinician should encourage the patient to the cessation of oro-para-functional habits with positive motivation and reward strategy. Interceptive appliances, when needed, aim to correct the altered tongue posture.[25]

Orofacial myofunctional therapy

Orofacial Myofunctional therapy is composed of a set of exercises that re-educate orofacial muscles in swallowing, speech and resting posture[26] .The aim is to modify function and to stop the non-nutritive sucking habits before the age of 6 years in order to create a favourable environment for the eruption of permanent teeth [27]. Lingual crib and spurs Wire orthodontic appliances placed in a position lingual to the maxillary incisors can prevent the tongue to rest on the anterior teeth and help a child overcome the habits of thumb sucking or tongue thirsting.[28]. Passive devices such as lingual crib and lingual spurs are usually attached to the palatal surface of the upper arch and allow the sucking to stop as they act as a digit-inhibiting tool.

A digit sucking habit should ideally stop before the eruption of the permanent incisors, otherwise it can result in long-term skeletal changes. Tongue posture plays an important role in the disorder of anterior open bite, hence the tongue then returns to its original position resulting in relapse of anterior open bite [29]. This is the reason why the cooperation with other specialists, as well as and otolaryngologist and speech therapist, is crucial to resolve at this stage mouth breathing related to chronic respiratory obstruction and to re-educate the bucco-facial musculature during swallowing and speech [30].

Deterrent appliances

In young patients where the AOB is related to a digit sucking habit the open bite closes naturally after stopping the habit. Passive orthodontic appliances such as the Hayrake appliance can help in stopping thumb-sucking habit and allow spontaneous improvement.

fig 9 **a** An 11-year-old female patient with a digit sucking associated AOB. **b** Patient with fitted Hayrake appliance (deterrent appliance). **c** Occlusal changes 3 months after wearing Hayrake appliance

High-pull headgear

fig.10 Patient wearing high-pull headgear

The use of a high-pull headgear is a common approach for the management of AOB treatment, intruding upper molars that are considered to be extruded and therefore causing the AOB [31]. Some authors also reported some vertical control by minimizing the clockwise rotation or even resulting in a counterclockwise rotation of the mandible [32]. It is often combined with functional and fixed appliance.

Posterior bite blocks

Posterior bite blocks are usually made of acrylic and fit between the maxillary and mandibular teeth. They can be spring loaded or provided with magnets and are usually used in the early treatment of AOB cases. By impeding eruption of the posterior teeth, this allows an upward and forward autorotation of the mandible[33.] Maxillary intrusion splints which cover the whole of the maxillary dentition are also used with high-pull headgear in cases where it is intended to intrude the whole of the maxillary dentition, such as gummy smile cases, which have a degree of vertical maxillary excess. Iscan et al. conducted a study in which they compared the effectiveness of passive posterior bite blocks of two different heights (5 and 10 mm), with an untreated control group of AOB cases. It was revealed that the downward and backward rotation of the mandible continued in the control group increasing lower face height significantly, whereas in the treated groups the mandible rotated upward and forward and produced a positive overbite [34].

Functional appliances

Removable functional appliances combined with high-pull headgear can be used in growing patients where the AOB is associated with a class II malocclusion. This combination helps to correct the anteroposterior discrepancy while controlling the vertical dimension.

In our practice, we usually use a Clark Twinblock as the functional appliance of choice combined with high-pull headgear for the management of AOB with a skeletal II pattern. This removable functional appliance has two bite blocks upper and lower, which work together to posture the lower jaw forward. In Class II AOB cases where the Twinblock is used in combination with high-pull headgear the upper appliance has an expansion screw to widen the arch and always has tubes positioned occlusally between premolars and molars to fit the headgear .

The open bite-bionator is a removable appliance with posterior bite blocks to inhibit the extrusion of the posterior teeth Acrylic portion extends from the lower lingual part into the upper region as a lingual shield; the labial bow is positioned at the height of correct lip closure. Defraia et al. examined 20 patients with a high angle skeletal relationship treated with the bitebionator and compared the MPA to a nontreated control group. The treated group showed a significant smaller palatal planemandibular plane angle (−1.9°) and greater overbite (+1.5 mm). He concludes that early treatment with the open-bite bionator produces an improvement of intermaxillary divergences [35].

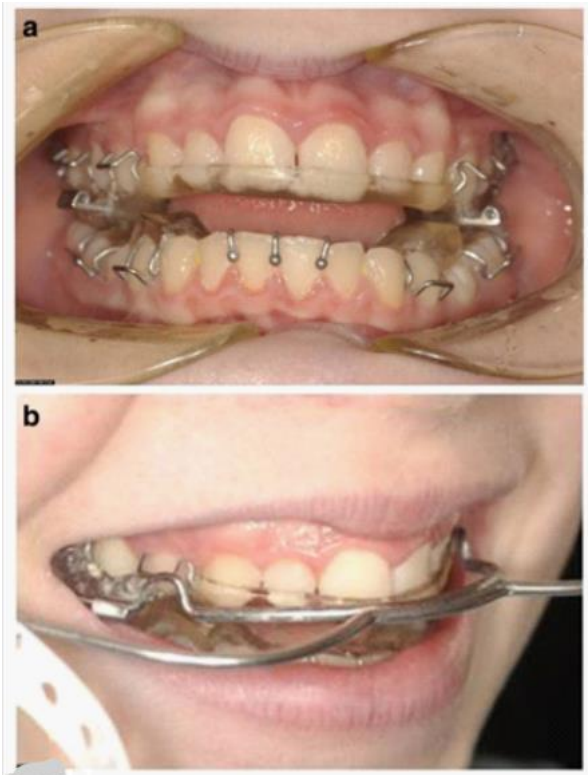

fig 11 **a** Patient with Clark Twinblock with flying tubes to insert a Headgear. **b** Patient wearing Clark Twinblock with high-pull headgear

The Fränkel 4 has been advocated in cases where the open bite occurs partly from faulty postural activity of the orofacial musculature. It is a removable functional appliance which works by allowing vertical eruption of upper and lower incisors and retraction of the upper incisors. Some authors have established that the wear of the Frankel can change the mandibular rotation from downward and backward to upwards and forwards. A randomized clinical trial conducted by Erbay et al. evaluates the effects of Fränkel's function regulator appliance on the treatment of Angle Class I skeletal AOB malocclusion, with results indicating that a spontaneous downward and backward growth direction of the mandible, that were observed in the control group, could be changed to a upward and forward direction by Fränkel 4 therapy.[36]

Vertical chincup

This appliance is occasionally used in growing patients to try to reduce excessive vertical growth by redirecting the condylar growth, but has fallen out of favour in recent years due to poor evidence of its efficacy. In 1978 Pearson treated twenty growing patients with backward rotational tendencies and AOB by extracting four first premolars, wearing a vertical pull chin cup for at least 12 hours a day while waiting for the remaining teeth to erupt. The AOB were all closed and the mandibular plane angles reduced an average 3.9° [37]. Torres et al. investigated the dentoalveolar and soft tissue changes produced by a removable appliance associated with high-pull chin cup therapy in children with an Angle Class I AOB. They compared the outcome of patients treated with a control group and the results showed no significant differences in the level of molar eruption or in lower anterior face height, which suggests that the vertical control expected from the chin cup therapy did not occur [38].

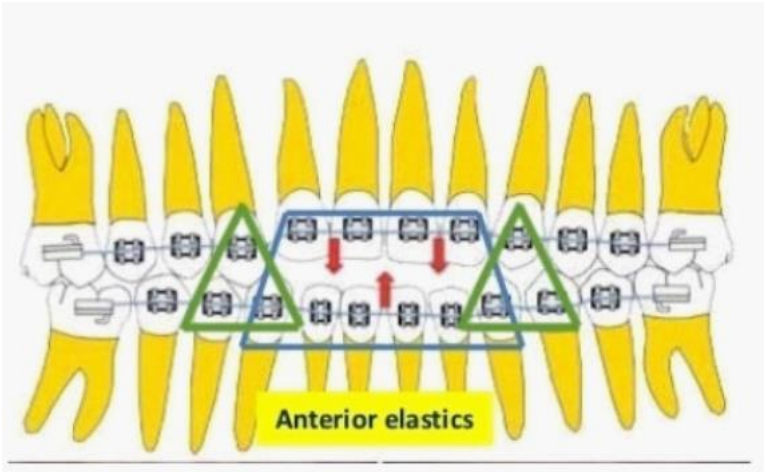

fig12 *Extrusion of anterior teeth through anterior elastics.*

Extrusion of the anterior teeth

The use of curved nickel-titanium arches and anterior elastics can be close the open bite while maintaining the vertical positions of molars [39].

This technique has been not recommended when patients with an anterior open bite exhibit external root resorption of incisors and less facial bony support for these teeth [40]. Simple extrusion of the anterior teeth has been criticized as being unstable, especially considering that the vertical height of the anterior maxilla is already excessive in an open bite case [41] . Extrusion of maxillary anterior teeth might also compromise facial aesthetics, especially in a patient with a gummy smile, also influence the occlusion and determine temporo-mandibular disorders [42].

Intrusion of the posterior teeth

In non-growing patients with the absence of vertical compensation of ramus growth, the intrusion of the posterior teeth can close the open bite without the need for surgical intervention. According to jaw geometry, every 1mm of intrusive vertical movement of the molars would result in about 2 mm of bite closure[43]. Excluding the orthognathic surgery, molar intrusion techniques have been classified into compliance and non-compliance approaches. Highpull headgear, bite blocks,

vertical chin cup have been considered to achieve relative intrusion of molars but require remarkable patient's cooperation. Posterior intrusion by TADs (temporary anchorage devices) ensure a real vertical intrusion without the patient's compliance[44].

True molar Intrusion

The maximum anchorage in molars intrusion can be gained only using TADs, which allow orthodontic movements that were previously thought to be difficult if not impossible[45] .Currently, mini-screws are increasingly used in comparison to other TADs due their low cost and less invasion. Molars intrusion by mini-screws can provide satisfactory occlusal results when facial aesthetics is not compromised and a great comparable stability to other open-bite treatment modalities, as tooth extractions, inter-arch elastics and orthognathic surgery[46].

Mini-screws as temporary anchorage devices

Small titanium screws can provide temporary skeletal anchorage. Mini-screws have a slightly tapered profile, which come in different heights, lengths ranging from 6 to 12mm and diameters from 1.2 to 2mm 46 . Mini screws mostly consist of three components: threaded shaft, cervical area and a head for loading orthodontic forces. The head design differs in a spherical heads and in a slot, indicated for all the most types of skeletal anchorage with the limitation of using rectangular wires[47]. They are biocompatible, do not suffer expansion and are small in order to be placed in any area of the mouth[48]. Self-tapping or self-drilling, mini-screws can be inserted directly through the gingival tissue into bone with a hand driver under local anaesthesia and must with stand orthodontic loads in all planes of the space [49]. Mini-screws system is advantageous keratinized tissue, as regions of D1 to D3 bone based on Mish classification of bone density Skeletal anchorage for molars intrusion in the maxilla can be inserted buccally or palatally [50]. Into the buccal alveolar bone mini screw can be positioned near the mucogingival junction, between roots of the second premolar and the first molar, 5 to 8mm from the alveolar crest[51]. Into the palate mini screw can be inserted in the posterior mid palatal area, where bone density is favourable[52] . In the mandible, the greatest amount of bone is on either side of the first molar, about 11mm from the alveolar crest [53]. Proper angle of insertion is important for cortical anchorage. In the maxillary and mandibular posterior regions, the angle should be 30 to 45 degrees to the occlusal plane[54]. For an efficient intrusion, several authors have recommended loading forces between 100 and 300 grams [55]. Intrusive force, performed by the elastic chains or NiTi coil, should be light and continuous to minimize the risk of root resorption[56]

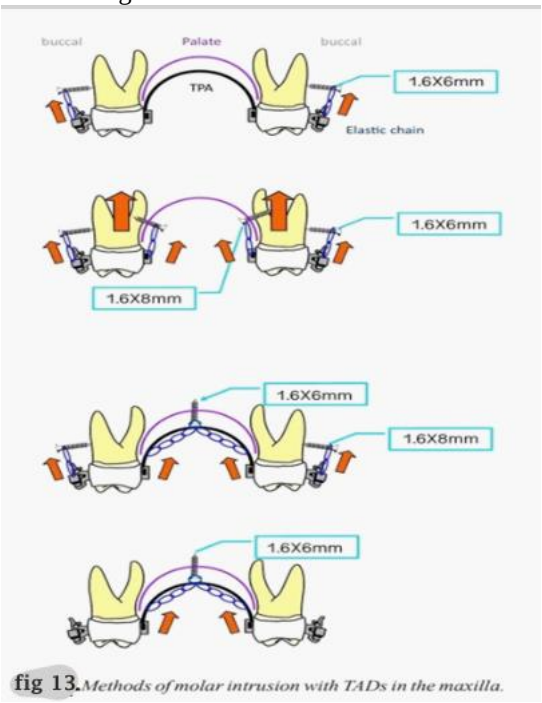

fig 13. *Methods of molar intrusion with TADs in the maxilla.*

Several mechanics for molars intrusion have been proposed First method suggests inserting two mini-screws in the maxilla from the buccal area between the second premolar and the first molar, and the palatal slope on every molar [57]. Intrusion could be performed by one elastomeric chain or nickel titanium coil to pass diagonally across the occlusal table by two small elastomeric chain connected between slot of molar and mini-screw. Intrusive force will exert without tipping of molar crowns. When a single mini-screw is placed in the buccal maxilla each side, a trans-palatal arch must control the over-rotation of molar crowns during intrusion [58]. A rotational moment is created when intrusion force passes buccally to the centre of resistance of the maxillary molars. Trans-palatal arch with crown lingual torque can be bonded on upper molars to control this side effect. Trans-palatal arch should be raised 3 to 5mm away from the palatal mucosa to allow resting tongue pressure to aid with intrusion[59]. In the absence of adequate inter-radicular space, TADs can be placed in the midline palate . With TADs located in the palate, it could be difficult to obtain a vector sum that passes through the centre of resistance. Therefore, monitoring is important. to verify the torque and bucco-palatal position of the molars being intruded by a trans-palatal arch [60]. To enhance anchorage, two mid palatal miniimplants can be connected to each other through a bar. Otherwise, a system composed by one mid palatal and two buccal mini-screws with transpalatal arch could perform intrusive force . In the mandible, one buccal mini-screw per each side of molars combined to lingual arch with lingual crown torque can intrude lower molars, without tipping side effects [61]. Molars intrusion rate is 2.39 mm on average using skeletal anchorage, with better results in the maxilla than mandible [62]. It has been stated that lower molar intrusion, combined with upper intrusion, should be considered in severe open bite cases where maximal closure of the mandibular plane angle is needed, such as lack of incisor showing and lack of overjet in open bite patients [63]. Molars intrusion with skeletal anchorage induces counter-clockwise rotation of the mandible and as a consequence corrects the inter-maxillary relationship with a dramatic improvement in the facial soft tissue convexity in anterior open bite patients [64]. Behaviour shaping strategies aim to eliminate sucking habit and to improve, or at least control, the increased vertical dimension in the deciduous and mixed dentition. In non-growing patients who rejects orthognathic surgery, molar intrusion by TADs has simplified the treatment of skeletal open bite by making it more efficient and aesthetic, without the patient's compliance. Mini-implants have influenced orthodontic treatment plans by providing possible management of complicated discrepancies than those treatable by convectional biomechanics[65]. Intrusion of posterior teeth with TADs was suggested to lead to decreased lower facial height by a counter-clockwise rotation of the mandible. Current evidence suggests the use of aligners as aesthetic alternative to

fixed appliances. The aligner system rapidly evolved and incorporated features able to treat more complex malocclusions. The appliance is purported to have a bite block effect to maintain vertical control . This paper highlighted the open bite treatment [66].

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