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Anterior Open Bite: Review and Management

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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.*

I. Introduction

In the standard textbook Contemporary Orthodontics, 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.[1]The severity varies, from an almost edge-to-edge relationship to a severe handicapping open bite.

Open bites can be classified as either a skeletal open bite or a dental open bite. A skeletal open bite is usually characterized by vertical maxillary excess, excessive eruption of posterior teeth, downward rotation of the mandible, and normal or excessive eruption of anterior teeth. A dental open bite is characterized by normal facial proportions with or without a history of parafunctional habits. A dental open bite has a better prognosis than a skeletal open bite. [2,3]

The causes of AOB can be subdivided into a number of areas[4-7]:

Tongue Thrusting

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

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 sucking can lead to tilting of the maxillary plane in a counterclockwise direction or to anterior displacement of the maxilla. Provided that the non-nutritive sucking habit is stopped, most cases of open bite improve spontaneously during the transition from mixed to permanent dentition. For patients who have a psychological

dependence on the sucking habit, however, habit control with a tongue crib and any other measures involving habit awareness, the time-out educational (mainly parenting) technique, contract of reward, positive reinforcement, and sensory attenuation (procedures designed to interrupt sensory feedback, such as the use of orthodontic appliances, chemical aversion, and hand wraps of adhesive bandages) should begin as early as possible. The tongue crib has been shown to be effective in stopping thumb sucking in 9 of 10 patients, and it needs to be left in place for 3–6 months after the habit has ended.

Airway obstruction

The 'Adenoid face' consists of a narrow face, protruding teeth, and lips separated at rest, and has often been attributed to chronic mouth breathing. Studies have shown that when the nose is completely blocked, there is usually an immediate change of about 5° in the craniovertebral angle. The jaws move apart as much as the elevation of the maxilla because the head tips back by the depression of the mandible. This was described by Solow and Kreiborg as the soft tissue stretching hypothesis, which posits that an extension of the craniocervical posture leads to a passive stretching of the soft tissue layer comprising skin, muscles, and fascia that covers the head and neck. Stretching of this convex soft tissue layer creates a dorsally directed force, which impedes the forward-directed component of the normal growth of the face. However, the relationship between mouth breathing, altered posture, and the development of malocclusion is not clear-cut. Chronic respiratory obstruction and enlarged pharyngeal adenoids and tonsils may also contribute to mouth breathing. Children with allergies tend to have an increased anterior facial height, accompanied by an increased overjet and decreased overbite. Studies of Swedish children showed that, on average, children who had undergone adenoidectomy had a significantly longer anterior facial height than control children. Children in the adenoidectomy group also tended to display maxillary constriction and more upright incisors. Although prolonged mouth breathing may be a contributory factor for malocclusion, it is not necessarily the main aetiological factor. Therefore, adenoidectomy or tonsillectomy is not recommended in the prevention of malocclusion and should be done for medical purposes only[8-12].

Neurological Disturbances

Neurological disturbances that affect the oral or facial musculature may give rise to AOB. Gershater reported an incidence of 32.3% in patients with learning disabilities.[13]

Muscular Dystrophy

The decrease in tonic muscle activity that occurs in muscular dystrophy allows the mandible to rotate downwards away from the rest of the facial skeleton, resulting in increased anterior facial height, a posterior growth rotation of the mandible, excessive eruption of the posterior teeth, narrowing of the maxillary arch and AOB that worsens with growth

Iatrogenic Open Bite

Poor mechanics during fixed-appliance treatment may cause extrusion of the molar teeth or 'hanging' palatal cusps, which open the bite. Failing to prevent overeruption of second molars when biteplanes or functional appliances are used may also give rise to an AOB.

Pathological Open Bite

Localized AOB may be associated with cleft lip and palate, acromegaly or trauma to the facial skeleton, such as condylar fractures or Le Fort fractures of the maxilla

Cephalometric Diagnosis Of Anterior Open Bite

There are many studies proposing the cephalometric diagnosis of AOB. Cangialosi suggested that patients with AOB had increased posterior-to-anterior facial height and upper-to-lower facial height ratios. In addition, the Sella-Nasion (SN)-to-mandibular plane, the gonial and the maxillary-mandibular plane angles were all increased in the open bite group. The classical study emphasized the great variation that can occur in the dental and skeletal morphology in patients with open bites. Dung and Smith also defined some measurements for diagnosis of an open bite tendency, which included SN-to-mandibular plane angle of 40° or less, a posterior-to-anterior facial height ratio of 0.58 or less, and an upper-to-lower facial height ratio of 0.7 or less. The cephalometric analysis of open bite proposed by Kim 8 ('Kim's Analysis') includes two factors: the overbite depth indicator used for an appraisal of the vertical component, and the anteroposterior dysplasia indicator for the horizontal component. These factors are used to determine the open bite tendency and Class II or III skeletal pattern tendencies, respectively.[15]

Depending on the age of the patient and severity of the open bite, four treatment modalities are usually employed:

1. Advice about cessation of early problems or parafunctional habits
2. Interceptive treatment
3. Camouflage treatment using orthodontics only
4. A combined orthodontic and surgical approach

Dealing with Sucking Habits

In the deciduous dentition, unless there is evidence of trauma, the AOB is most probably due to a habit such as dummy or digit sucking. No intervention is indicated apart from encouraging the child to stop the habit. As the patient gets older (and providing the habit stops) a significant proportion of cases improve spontaneously usually during the changeover from the mixed to the permanent dentition. However, normalization of the overbite can take between 3 and 5 years. A child who is still sucking his/her thumb as the upper permanent incisors erupt (7.5–9 years) should be actively discouraged from doing so. Initially this should take the form of advice, possibly in conjunction with an aide memoire such as a plaster on the associated finger, a glove or foul tasting nail polish. Alternatively, a small tangible reward can be offered on a daily basis for not engaging in the habit. If this is ineffective but the child wants to stop the habit, a deterrent appliance can be used. The appliance is either a removable or a fixed appliance which prevents sucking of the digit, and must be retained in place for a minimum of 6 months after sucking has apparently ceased, to ensure the habit has truly stopped (Figure 8). The fixed variety is more assured of success. Sometimes a quad helix appliance is used, which not only discourages the habit, but has the additional advantage of being able to expand the upper arch. This may be necessary in avid thumbsuckers, as excessive cheek pressure produced during sucking causes constriction of the upper arch. These methods are likely to produce good spontaneous resolution of the AOB in a pre-teen patient, but in an older patient the proclined upper labial segment is held forwards by mesial movement of the buccal segments, and the AOB may be maintained by the soft tissue pattern and/or failure of further alveolar development anteriorly.[16] However, it is essential that any digit habit is stopped first, otherwise not only will the treatment be unsuccessful, but there is also a risk of root resorption of the upper incisors due to the competing forces to which they will be subjected. A protocol for management of sucking habits is shown in Table 1. Use of a tongue guard has been advocated as a means of treating an AOB in a patient with a tongue thrust. this frequently allows spontaneous correction of the AOB, providing it is not skeletal in nature. Stability depends on the thrust being adaptive rather than endogenous. Proffit and Mason suggest limiting use of tongue guards to patients who have reached puberty, as up to 80% of children who have a tongue thrust and AOB at 8 years show improvement without therapy by age 12. [17-19]

II. Management Of Anterior Open Bite

Prevention of Habits

In a study by Larsson the majority of children who sucked dummies stopped using them by the age of 6 years and showed no tendency to suck digits, whereas the group that sucked digits continued with the habit in significant numbers, resulting in malocclusions in the permanent dentition. Hence dummy sucking has been advocated in preference to digit sucking. 'Orthodontic' dummies are now available; these flatten on use, thus preventing undesirable effects on the deciduous occlusion. The child, however, does not always accept such dummies.[19,20]

Table 1: Management protocol for digit-sucking habits. (Courtesy: Daniel Burford and Joe H. Noar. Dent Update 2003; 30: 235-241)

Primary dentitio
- No treatment indicated.
- If dummy-related advise use of 'orthodontic dummy'.
- Reassure parents that AOB should resolve when habit stops.

Early mixed dentition
- Advise patient to give up habit.
- Use simple aides memoire or daily rewards.

Late mixed dentition
- Consider deterrent appliance if advice has not worked.
- May need orthodontic expansion of upper arch.

Permanent dentition
- Spontaneous resolution of AOB unlikely.
- Refer for specialist opinion.

Appliance therapy [21-34]

Appliance therapy usually has one of several goals: to impede dental eruption and thereby control vertical development, to reduce or redirect vertical skeletal growth with intraoral or extraoral forces, or to extrude anterior teeth. Bite blocks often are used as a component of orthodontic appliances to intrude or control eruption of the posterior teeth. Bite blocks made of wire or plastic fit between the maxillary and mandibular teeth at a slightly increased vertical dimension. The stretched muscles theoretically place an intrusive force on the posterior teeth, which in turn helps control eruption. With limited eruption, skeletal growth is directed more anteriorly and less vertically. Dellinger describes the use of the Active Vertical CorrectorTM (AVC), which is a removable or fixed appliance that intrudes the posterior teeth in both the maxilla and mandible by reciprocal forces. This appliance reportedly corrects open bites by actually reducing anterior facial height.

Haydar and Enacar used a Frankel TM appliance (FR4) to correct open bites, and showed that it did decrease the open bite significantly, but produced mainly a dentoalveolar rather than skeletal result. Aragao's function regulator was shown to normalize open bite. Magnets also have been incorporated into bite blocks to exert an intrusive force on the molars with a result of decreasing the open bite. Kuster and Ingervall compared the use of spring-loaded bite blocks with bite blocks with repelling magnets. Their results showed an average improvement in open bite of 1.3 mm in the spring-loaded group and 3.0 mm in the magnet group. There was a tendency toward relapse, but they felt this might be counteracted by a long phase of active retention. Iscan compared spring-loaded bite blocks with passive bite blocks and found no significant difference between the two. Continuous force appears from clinical reports to be able to intrude posterior teeth. This control is required until vertical growth is completed. Maintaining correction is the most difficult task. In correcting skeletal open bite problems, intraoral appliances, such as activators, bionators,

Frankel TM regulators (most with the inclusion of posterior bite blocks), have been used to control vertical maxillary growth of the mixed dentition. Weinbach and Smith showed that a bionator can be used to treat open bite problems, especially if accompanied by a class II molar relationship. Another appliance approach uses extraoral devices to impede the vertical skeletal and dental growth pattern, such as a high-pull headgear. The biggest problem with the headgear is that it is almost impossible to obtain a pure vertical force. Wieslander suggests that for the headgear to obtain a skeletal effect, it must be worn 12-14 hr/day with a force of 10-16 oz (400-450 g) per side. Schudy advocated a high-pull headgear along with a mandibular splint covering the second molars and anterior vertical elastics to treat open bites Pearson suggests controlling the vertical force by using intrusive forces on the mandibular posterior by light mandibular headgears, which he states can be helpful in reducing lower molar height increases and gaining control of the occlusal plane angle. When patients have increased vertical development and a class II malocclusion, the potential exists to use headgear in combination with a functional appliance incorporating posterior bite blocks.

Ngan demonstrated that open bite complicated by a class II vertical growth pattern can be treated during the mixed dentition with favorable results by using a combination of an activator and high-pull headgear.Dermaut studied the effect of headgear activator of Van Beek and found that the use of combined activator and headgear controlled the increase in lower anterior face height. This combined approach of functional appliance and headgear provides some skeletal and dental control. Another appliance aimed at controlling the vertical growth that may cause an open bite is the chin cup. Pearson reported that the use of a vertical-pull chin cup could result in a decrease in mandibular plane angle and an increase in posterior facial height compared with the growth of untreated individuals with a resultant decrease in open bite tendencies. However the chin cup generally has poor compliance rates. Straight wire appliances and leveling the arches may spontaneously correct mild open bites. This has some efficacy if the upper arch has a curve of Spee and the lower does not. Injudicious leveling of the lower arch usually opens the bite and is contraindicated. Some open bites can be treated by stepping the arch wires to close the bite combined with use of vertical elastics. Viazis published a case report using rectangular NiTi wires and elastics to close an anterior open bite. Care must be taken not to erupt the teeth extensively when the patient has increased facial height. Excessive and unesthetic dentoalveolar height can result from this approach if smiling reveals extensive gingival display.

Orthognathic Surgery

A combination of fixed-appliance orthodontics and orthognathic surgery may be required to treat skeletal open bites. Treatment should not be commenced until growth has ceased, as further growth is very likely to be unfavourable. Presurgical orthodontics is aimed at individual arch alignment and arch co-ordination. An obvious step in the occlusal plane should not be levelled but maintained using segmental mechanics. Surgery may be segmental or involve the whole jaw. Frequently bimaxillary surgery is required.[35]

Stability [14,36,37]

Prediction of the response to treatment and the stability of the outcome is generally unreliable. Relapse rates after treatment of AOB are high. As a rule, the more the skeletal elements contribute to the aetiology of the malocclusion the poorer the prognosis for orthodontic treatment alone. Lopez- Gavito et al. reported that,

following orthodontic treatment, more than onethird of patients demonstrated a return of their AOB, and neither the extent of the pretreatment open bite or mandibular plane angle nor any other singlecparameter of dentofacial form was a reliable predictor of post-treatment stability. Relapse of AOB has been attributed to:

- Unfavourable growth (a posterior mandibular growth rotation)
- soft-tissue factors such as an unfavourable tongue posture
- Resumption of a digit-sucking habit;
- Inappropriate orthodontic tooth movement, such as extrusion of incisors where their eruption had not been previously impeded
- Surgery that has increased the posterior face height – as would occur if the aob is closed using a mandibular procedure only.

Retention has been directed towards intrusion, or at least prevention of eruption, of maxillary posterior teeth, using either headgear attached to an upper removable retainer or a retainer with passive posterior biteblocks. However, this should ideally be continued until the patient ceases growing, although compliance is obviously an issue.

III. Conclusion

The problem of open bite is multifactorial. Diagnosis should be viewed in the context of the skeletal structure and the dental structure. Anterior open bite accompanied by a normal lower face height can be treated successfully using appliance therapy if the etiology can be identified as a habit or obvious environmental influence. The influence of tongue, lip and airway on the development of this malocclusion remains to be substantiated. Reliable and valid otolaryngology consultation should be obtained if nasal airway obstruction is suspected. Open bite problems of skeletal nature require orthopedic intervention. Severe skeletal open bite in nongrowing patients usually requires treatment with orthodontic-surgical procedures. The treatment of open bite remains a challenge to the clinician, and careful diagnosis and timely intervention will improve the success of treating this malocclusion.

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