

Orthodontic treatment of anterior open bite

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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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Table 1. Prevalence of anterior open bite in various groups.

Country	Sample	Age	Dentition	Prevalence reported	Study
Hong Kong	201 dental students	Mean age, 20 years	Permanent	1.5%	Tang 1994 ¹⁰
USA	White, black, and Mexican Americans	12–17 years		3.5%	Proffit <i>et al.</i> 1998 ¹¹
UK				2–4% in children, 4% in adults	O'Brien 1993 ¹²
Malaysia	347 high school children including Malays, Chinese, and Indians	15–19 years		6% in Chinese and 1.3% in Malays	Woon <i>et al.</i> 1989 ¹³
Colombia	4724 children	5–17 years	Deciduous	9%	Thilander <i>et al.</i> 2001 ¹⁴
			Early mixed	11%	
			Late mixed	6.2%	
			Permanent	8.7%	
				4.2% of adolescents have open bite > 3 mm	

mixed dentition. There are reports that digit sucking can lead to tilting of the maxillary plane in a counterclockwise direction¹⁵ or to anterior displacement of the maxilla¹⁶.

Provided that the non-nutritive sucking habit is stopped, most cases of open bite improve spontaneously during the transition from mixed to permanent dentition^{17,18}. 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 ended¹⁷.

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 angle¹⁸. 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

hypothesis¹⁹, 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-cut²⁰.

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 overbite²¹. 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 incisors²².

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.

Interceptive treatment

Vertical growth of the jaws continues throughout puberty. It is thus important to identify the

problem of anterior open bite at an early stage because interceptive treatment might help in avoiding complicated therapy in the future.

Anterior open bite can be superimposed with discrepancies in anteroposterior and transverse dimensions. Consequently, orthodontists use various treatment modalities to address these three-dimensional problems. Orthodontic appliances aim to impede dental eruption and thereby control vertical development; reduce or redirect vertical skeletal growth with intraoral or extraoral forces; or extrude anterior teeth.

Vertical holding appliance

The vertical holding appliance (VHA) is a modified transpalatal arch that has an acrylic pad. The VHA uses tongue pressure to reduce the vertical dentoalveolar development of maxillary permanent first molars²³. Some researchers have concluded that the VHA is useful in restricting and helping reduce the percentage of lower anterior facial height in growing patients²⁴.

High-pull headgear

Some researchers have studied the effects that different directions of pull by extraoral forces have on the teeth and the palatal and occlusal planes^{25–27}. Their results suggest that high-pull headgear reduces the vertical eruption of upper molars. Such a change in the dentoalveolus minimizes clockwise rotation and, in some cases, results in counterclockwise rotation of the mandible.

Caldwell *et al.* showed that the use of acrylic splints combined with high-pull headgear among patients with Class II division 1 malocclusion and maxillary dentoalveolar protrusion resulted in a superior and distal displacement of the maxilla, reduction in the SNA angle, clockwise rotation of the palatal plane, and relative intrusion of the upper molars²⁸. Furthermore, in a group of eight patients with mixed dentition, Ngan *et al.* demonstrated that the application of a headgear activator yielded favourable results as treatment for open bite complicated with skeletal Class II and a vertical growth pattern²⁹.

Vertical chin cup

The vertical chin cup, together with fixed appliances, has been used to manage anterior open bite in growing patients. In an investigation of 4-bicuspid extraction followed by application of a vertical-pull chin cup for an average of 9 months and then fixed appliance therapy, the mandibular plane angle decreased by an average of 4° and all open bites closed³⁰.

Posterior bite blocks

Posterior bite blocks impede posterior teeth eruption and their design has been continuously modified. They can be made of wire or plastic to fit between the maxillary and mandibular teeth, or they can be spring-loaded or fitted with magnets. The blocks are usually set at a slightly elevated position vertically, so that, in theory, the stretched muscles place an intrusive force on the posterior teeth, which in turn helps control eruption and permits an upward and forward autorotation of the mandible³¹. Both animal model and human studies have shown that posterior bite blocks modify the vertical skeletal pattern effectively³².

Spring-loaded bite block

The spring-loaded bite block has helical springs that are placed both lingually and buccally between the first premolar region and the last molar region. The ends of the springs are embedded occlusally in the molar regions of the acrylic part of the device. The upper and lower acrylic occlusal blocks are connected by palatal and lingual wires, which are activated to a force of 450 g bilaterally. Patients are instructed to use the appliance for an average of 16 h daily³³.

Active vertical corrector

The active vertical corrector, designed by Dellinger, has a bite block that has embedded in it eight opposing field (four per arch) cobalt-samarium magnets³⁴. Acrylic shields prevent lateral jaw deviations and the corrector can be used together with a vertical chin cup. In his study with three patients, correction of open

bites was achieved by the intrusion of the posterior teeth in both arches by reciprocal forces; this resulted in a reduction in anterior facial height, which allowed the mandible to rotate in upward and forward directions after 4–7 months of treatment.

Fränkel IV regulator

The Fränkel IV regulator was introduced and evaluated by Fränkel and Fränkel among 30 patients with a hyperdivergent skeletal pattern, a large interlabial distance, and postural weakness of the orofacial muscles; the control group comprised 11 patients with untreated open bite³⁵. Fränkel and Fränkel believed that changes of the vertical components may have resulted from lip-seal training, with the function regulator acting as an exercise device and leading to postural balance between the forward and backward rotating muscles³⁵.

Camouflage treatment of anterior open bite

Some mild cases of open bite can be corrected by fixed appliances that cause dental movements while the skeletal profile and characteristics are kept unchanged. Treatment may involve extractions, use of elastics, or application of mini-implants or miniplates.

Extractions

Extraction of the first premolars has been accepted by many clinicians in the management of skeletal open bite due to the draw-bridge effect of reducing the inclination of both upper and lower incisors to increase overbite. Alternatively, molars can be extracted, to supposedly remove the wedge that opened the bite^{36,37}. Some researchers, however, have shown that extraction therapy does not improve the lower facial height or proportion of patients with open bite, who usually have supra-eruption of the lower molars^{38,39}. Pearson reported that a significant increase in the lower posterior facial height can occur during extraction therapy of moderately steep cases⁴⁰. Similar findings were also reported by Nahoum, who suggested that although molar extractions may close the anterior open bite,

the physiological rest position of the mandible would not change, thus leaving total facial height unaltered⁴¹.

Use of elastics

Fixed appliance treatment with the use of vertical elastics is a common method of correcting open bites. One of these techniques is the multiloop edgewise archwire (MEAW) technique, which involves the use of multiloop gable-bend archwires and vertical elastics in the canine regions. The goals include correcting the inclination of the occlusal plane, aligning the maxillary incisors relative to the lip line, and making the axial inclinations of the posterior teeth upright. The MEAW technique only minimally affects the skeletal pattern. Treatment changes occur mainly by a dentoalveolar compensation mechanism that causes retraction and extrusion of the anterior teeth and an upright movement of the posterior teeth. Thus, the upper and lower occlusal planes move towards each other³³. Extrusion of the anterior teeth, as achieved by the MEAW appliance, has limited usefulness for patients who have adequate or excessive dentoalveolar height before treatment.

Mini-implants and miniplates

The use of surgical bone plates in a skeletal anchorage unit was first described in 1985³⁹. Later, titanium miniplates at the mandibular corpus area were used as anchorage during the intrusion of the mandibular posterior dentoalveolar segment in the correction of anterior open bite⁴². In two case reports, the lower molars were intruded by about 3–5 mm, with the open bite significantly improved. The titanium miniplate, named the Skeletal Anchorage System, is temporarily implanted in the maxilla and/or mandible as an immobile intraoral anchor, particularly to achieve considerable intrusion of the molars in the case of anterior open bite. Such an effect can also be obtained by minimum extrusion of the lower incisors and counterclockwise rotation of the occlusal plane⁴².

Recently, miniscrews and microscrews have been applied to provide absolute anchorage⁴³.

In addition, Park *et al.* demonstrated that maxillary microscrews provide anchorage for intruding posterior teeth and retracting anterior teeth, whereas mandibular microscrews provide an intrusion force distal to the mandibular first molars to prevent mesial tipping of the posterior teeth during space closure⁴⁴.

Stability of open bite correction

Retention of closed anterior open bite is a major problem. One reason is that vertical growth and eruption of posterior teeth may continue until the late teenage years or early twenties, with vertical growth of the maxilla being the last stage of maturation¹. Studies of long-term outcomes following orthodontic treatment for open bite, and following surgically treated cases⁴⁵, indicated that the relapse rate is about 40%. Clinicians attempt to retain the corrected open bite for growing patients by applying a vertical chin cup or high-pull headgear to the upper molars in conjunction with a standard removable retainer. An orthodontic appliance with bite blocks between the posterior teeth, such as an open bite activator or a bionator, can also be used.

Conclusions

Although there have been many reported cases and studies of successfully treated open bite with different nonsurgical treatment modalities, there has been no evidence-based evaluation to determine the better options. Only a few papers have addressed the long-term results and, owing to different methods of measurement in overbite and the small samples studied, concrete information on the relapse rate and predictors of relapse is still not available.

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