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Original Article

Anterior open bite: Brief introduction and management

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Abstract

Anterior open bite is one of the most challenging malocclusion. Varieties of factors are implicated as being its aetiology, and can be broadly categorized as dentoalveolar or skeletal. It is very important to understand its aetiologies and morphology for proper treatment planning. Open bites of dentoalveolar origin may close spontaneously in the growing patient and generally have good prognosis to orthodontic treatment, whereas skeletal open bites usually require a combination of orthodontics and orthognathic surgery. Various treatment modalities are available, all directed towards intrusion of posterior segment with or without the extrusion of anterior segment of dentition. The post-treatment relapse rate is high regardless of treatment modality.

Key Words: Etiology, management, open bite

Anterior open bite is the discrepancy of vertical relationship of maxilla and mandible. It is present when there is no vertical overlap between upper and lower jaw, and the vertical separation of the incisors is measured to quantify its severity[1].

Figure 1: A 25 year old female with open bite

ETIOLOGY

Anterior open bite has multiple etiologies, but can be broadly described as being dental or skeletal in origin[2,3].

Dentoalveolar Factors

Digit Sucking

Digit sucking is a natural phenomenon in children but if this habit persists beyond the time permanent teeth begin to erupt, it may be the cause of malocclusion. When the thumb or finger is inserted into mouth mandible is positioned downward. The digit creates pressure on incisors blocking their effective eruption while allowing excessive eruption of the posterior teeth. The upper incisors are proclined and the lower incisors are retroclined, and because of cheek pressure maxillary arch is narrowed which might be the cause of posterior crossbite associated with anterior open bite[1,4]. Presence of clean nails and callus on the finger is commonly associated with thumb sucking. Digit sucking not only results in dentoalveolar effects, but also some minor skeletal effects, such as tilting of the maxillary plane in an anti-clockwise directions[5], and according to Larsson as cited by Burford and Noar, anterior displacement of the maxilla[2]. But these effects are transient and disappear as the normal growth pattern resumes with the cessation of habit[1,2].

Tongue Thrust

Tongue thrust is often seen in patients with anterior open bite but whether it is a cause or effect of the open bite is a matter of debate[3]. Thrust of tongue between anterior teeth during swallowing results in intrusion or lack of eruption of these teeth[6]. But the resting posture of tongue rather than swallowing has greater influence on tooth position as the duration of tongue thrust swallow is too short to have an impact on tooth

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position[1]. In anterior open bite anterior seal by tongue is necessary during swallowing, so tongue thrust is the result but not the cause of anterior open bite. However, if there is forward resting posture of tongue, because of macroglossia, treatment of anterior open bite might be unstable and surgical reduction of tongue may be necessary to correct macroglossia[7,8].

Airway Obstruction

Often the term 'Adenoid face', used to describe a condition of narrow face, narrow nose and nasal passage, protruding teeth, anterior open bite, and short and incompetent lips, has been attributed to chronic mouth breathing. When there is complete blockage of nose, about 5° change in the craniovertebral angle occurs immediately[9]. The jaws move apart by the elevation of the maxilla because the head tips back, as well as by the depression of the mandible. The original posture returns as soon as the obstruction is removed. Because total nasal obstruction in human is so rare, it is very difficult to establish the relation between mouth breathing, altered posture and development of malocclusion.

Skeletal Factors

Disharmony in skeletal growth pattern of maxilla and mandible results in open bite[10]. According to Ursi, Almeida and Mordida, as cited by Lenzi, Dutra and Pereira[11], unfavourable vertical growth of jaw bases results in open bite when it is not offset by alveolar increase. Clockwise rotation of the mandible, tipping of the maxilla and diversion of mandibular gonial angle are the causative factor for anterior open bite[8]. Kim[12] reported an inclined occlusal plane and mesial tipping of posterior teeth as a possible cause of an anterior open bite.

According to Bjork[13] cephalometric features related to significantly abnormal growth rotations of open bite are:

1. Overdeveloped lower anterior facial height.
2. More acute interincisal angle caused by the compensating tipping of lower incisors.
3. More acute interpremolar or intermolar angle.
4. Backward inclination of the condylar.head.
5. Straighter mandibular canal.
6. Marked antegonial notch.
7. A receded chin.

Conditions like acromegaly, macroglossia, cleft lip and palate, or trauma to the facial skeleton (condylar fractures or Le Fort fractures of the maxilla), can result into a localized open bite[2]. Poor neuromuscular pattern, particularly in retarded or emotionally disturbed children, also can cause open bite[8]. Muscular dystrophy, some forms of cerebral palsy and various muscle weakness syndromes result in decrease in muscle tonicity allowing mandible to rotate downward away from rest of the facial skeleton, resulting in increased facial height, excessive eruption of posterior teeth and anterior open bite[1].

Iatrogenic open bite may result from poor mechanics during orthodontic treatment[2].

Management:

It is necessary to distinguish open bite of dentoalveolar origin from that of skeletal for the effective treatment. In general, four treatment modalities are used in the treatment of anterior open bite:

(i) Removal of the cause;
(ii) Myofunctional Therapy;
(iii) Camouflage treatment and
(iv) Surgical Correction.

1) Removal of the cause:

During deciduous dentition no intervention is required apart from encouraging the child to stop the habit. But those who continue to suck digit later in life after the eruption of upper permanent central incisors require their interception using passive habit breaking appliances. The habit breaker can be either a removable or a fixed type of crib.

There are many habit breaking appliances to allow normal development of the anterior dentoalveolar region, the palatal crib may be an excellent treatment option, since it prevents thumb or dummy sucking and avoids tongue thrusting[14]. Combination of palatal crib and chin cup therapy, in patients in mixed dentition, has been shown to result a significant extrusion and uprighting of incisors, thereby increasing overbite, and significant growth inhibition of lower anterior facial height as well[14]. Haskell and Mink[15] mentioned. about a fixed habit breaking appliance named bluegrass appliance. They found positive result after inserting the appliance for six months in the early and late mixed dentition children with digit sucking habit.

2) Myofunctional therapy:

Vertical holding appliance

The vertical holding appliance is a fixed functional appliance It is a transpalatal arch with an acrylic pad. It uses functional activity of tongue to create pressure

resulting in intrusion and distal movement of maxillary permanent first molars[16,17].

High-pull headgear

It has been suggested that high-pull headgear reduces the vertical eruption of upper molars[1,18]. Such effect minimizes clockwise rotation and, in some cases, results in counter clockwise rotation of the mandible. However, this type of head gear causes buccal roll out of upper molars causing premature contact between lingual cusp of upper molar and buccal cusp of lower molar, thereby opening the bite, therefore to negate this effect lingual arch is required[18]. Headgear can be applied directly to the upper molar bands[1,19] of a fixed appliance or used in conjunction with a functional appliance[1,20,21] or an upper removable appliance such as a maxillary intrusion splint[19-22].

Vertical pull chin cup

It consists of chin cup and head bonnet connected either by elastic or elastic strap. It creates force in vertical direction and is used in growing patients only. The vertical pull chin cup therapy in growing patients with backward rotational tendencies can retard the vertical eruption of posterior teeth thus resulting closure of anterior open bite[23].

Posterior bite blocks

Posterior bite blocks can be used to impede posterior teeth eruption and thereby achieving the correction of anterior open bite. They can be incorporated in removable appliances, such as activator and bionator, or can be directly cemented on the occlusal surface of posterior teeth. The bite blocks, made of wire or plastic, fit between the maxillary and mandibular teeth, and raise the vertical height 3 to 4mm beyond the rest position. Theoretically, this raising of vertical height creates stretching of muscles, which in turn creates intrusive force on the posterior teeth, thereby helping control eruption and an upward and forward autorotation of the mandible[24]. There are various modifications made in bite blocks. They can be either spring loaded or incorporated with repelling magnets[25].

Frankel IV regulator

The Frankel IV appliance was devised by Frankel and Frankel[26] to treat open bite cases with hyper divergent skeletal pattern, a large interlabial distance, and postural weakness of orofacial muscles. This is the muscle training device, and if selected carefully it can result in open bite correction by allowing vertical eruption of upper and lower incisors and retraction of upper incisors.

3) Camouflage treatment of anterior open bite

Various treatment options are developed for camouflaging the anterior open bite by fixed orthodontics.

Extractions

Schudy[27] suggested non extraction treatment approach for horizontal growth pattern and extraction treatment approach for vertical growth pattern, if bone-tooth relationship demands extraction as attempt to distalization of molars to correct arch length- tooth size discrepancy may further accentuate the open bite. Extraction and protraction of posterior teeth allows anterior rotation of the mandible, thereby closing the bite[23]. Varieties of extraction patterns have been suggested, which include first premolars[23], second premolars[28], first molars[28, 29] or second molars[12]. Aras[28] did a study on extraction treatment. He found no change in mandibular rotation in cases treated with extraction of first premolars. These cases had open bite only in incisor region. Those cases with open bite extending to premolar or molar region were treated with extraction of second premolars or first molars, and in those cases he observed closing rotation of mandible. It is suggested to extract first molars only if these teeth are compromised by extensive decay[12,16] or congenitally malformed[12]. Extraction should be planned based on incisor retraction, area of crowding and condition of tooth rather than desire to change vertical dimension of face[30]. When extraction is planned it is important to control the vertical position of posterior teeth as their vertical occlusal movement during space closure may result in ineffective treatment result[19].

Correction by incisor extrusion

Correction of open bite by extrusion of upper and lower incisor can be implemented in cases with normal skeletal pattern and in high angle cases with deficient incisor display at rest and on smile. Many methods have been suggested for extrusion of incisors.

Extrusion arch is a one-couple force system that applies a single extrusive force to the anterior teeth, and a forward tipping moment along with intrusive force to posterior teeth. To negate undesirable tip forward movement of posterior teeth, a buccal segment from upper first molar to first premolar is added and magnitude of extrusive force is kept low[16].

Vertical elastics from lower incisors to upper incisor

are commonly used in treatment of open bite.

Multiloop edgewise arch wire (MEAW) is the technique developed by Kim[12] which consists of archwires with multiple L loops, and utilizes vertical elastics in the canine regions. The vertical component of loop serves as a breaker between teeth and allows independent movement of the teeth. The horizontal component provides vertical control of each tooth. He suggested using this technique in brackets with 018-inch slots and 016 x .022 - inch archwires. Tip-back bend activation in posterior segment of wire uprights posterior teeth and vertical elastics in anterior segment negate the undesirable intrusive force on anterior teeth, thereby correcting the occlusal plane and closing the bite[12]. Loops incorporation reduces load deflection rate of the wire to one-tenth of 0.016 x 0.022-inch ideal archwire[12, 31]. Treatment changes occur mainly in a dentoalveolar region, and are similar to natural dentoalveolar compensation, along with uprighting of the posterior teeth[32].

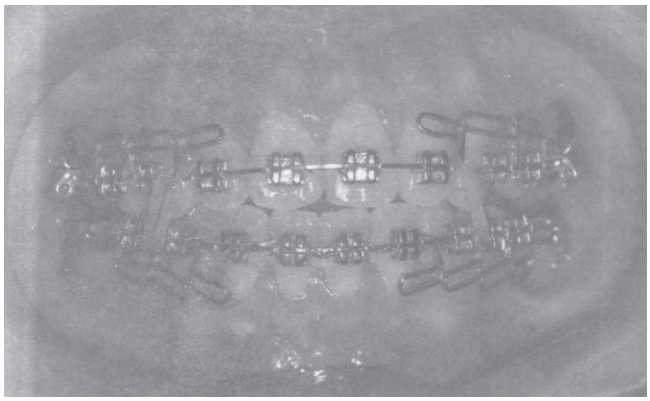

Figure 2: A patient with anterior open bite being treated with MEAW system and elastics.

Clear aligners with elastic

Recently clear aligner is a popular mode of treatment in patients who refuse to wear conventional fixed orthodontic appliance. Successful treatment of anterior open bite with clear aligner by incorporation of elastics has been reported[33].

Skeletal Anchorage System

As quoted by NG, Wong and Hagg[34], the use of surgical bone plates as a skeletal anchorage unit was first described by Jenner and Fitzpatrick. Turley et al.[35], in their animal experiment found titanium endosseous implant as a stationary anchorage system for orthodontic tooth movement. Titanium miniplates were temporarily implanted at the mandibular corpus area as skeletal anchorage and correction of anterior open bite was achieved by successful intrusion of the mandibular posterior teeth with minimal extrusion of anterior teeth[36]. Use of microscrews as skeletal anchorage to control open bite was described by Park et al.[37] in 2004. Intrusion of upper posterior dentoalveolar segment can be achieved by surgically placing an implant on zygomatic buttress. The implant is exposed to oral cavity to which NiTi coil spring is attached from removable appliance with bite blocks to achieve posterior segment intrusion[38].

4) Surgical Correction

Skeletal open bites in adults are best treated by surgical procedures involving the maxilla and mandible. A combination of fixed-appliance orthodontics and orthognathic surgery may be required to treat skeletal open bites. Surgical treatment should be commenced after growth completion as further growth might result in failure of treatment. Surgery is typically indicated in cases with excessive incisor display, severe open bite magnitude whose correction by orthodontic tooth movement is unattainable, and in patients where a pathologic problems (mostly at the temporomandibular joint level) is to be addressed[16]. If surgical treatment is planned, occlusal step should not be leveled during presurgical orthodontics, but should be maintained[2,16]. Attempt to level occlusal plane will result in extrusion of maxillary incisors which is undesirable in open bite cases planned to treat surgically. Segmental mechanics is preferred to level anterior and posterior occlusal plane so that surgeon can later correct occlusal plane[16]. Lefort I impaction[39, 40] is the most common surgery of choice. Mandibular advancement or set back surgery is performed based on occlusal result after maxillary impaction[16].

Stability:

The relapse rate of open bite treatment is high with all the techniques in current use[41]. Burford and Noar quoted Mizrahi[2], "as a rule, the more the skeletal elements contribute to the aetiology of the malocclusion the poorer the prognosis for orthodontic treatment alone". It was documented that following orthodontic treatment, more than 35% of patients demonstrated postretention relapse, and neither the severity of the pretreatment open bite, mandibular plane angle nor any other single parameter of dentofacial form was a reliable predictor of post-treatment stability[42]. Class II open bite cases with sagittal discrepancy and vertical excess have a high risk for relapse[43]. Orthodontic treatment with extraction is more stable than non extraction, as well as one jaw surgery involving maxilla as compared to bimaxillary surgery[44]. In growing patients vertical chin cup or high-

pull headgear is used in conjunction with a removable retainer. A retainer with passive posterior bite blocks can also be used to avoid any future elongation of posterior segments[42]. Upper and lower fixed retainers that include first premolars can also be used[16]. Chewing gum exercise has been suggested to ensure stability of open bite treatment[45]. In case of relapse, intraoral spurs incorporated in maxillary appliance are advised to modify any anterior tongue posture resulting into open bite[46]. Relapse cases of anterior open bite can be best treated with occlusal adjustment if there are satisfactory anteroposterior and transverse relationships[47].

Summary

Aetiology of anterior open bite is multifactorial and it is important to determine the accurate diagnosis for the best management of the patient. Often it is difficult to identify the underlying aetiology as they may be interrelated. Child should be encouraged to cease any associated habit. Interception of habit can be accomplished by different types of appliances. Various treatment modalities are available, and all are directed towards intrusion of posterior segment with or without extrusion of anterior segment. Adults with severe cases are treated with joint orthodontic and surgical approach. Recently clear aligners claim to correct anterior open bite, which might be beneficial for the teenagers and adults who refuse to wear conventional orthodontic braces. Regardless of the treatment option, relapse rate is high so long-term retention is recommended.

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