



Open Bite Malocclusion – A Review Article

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Abstract

Open bite is a malocclusion that happens in the vertical plane, categorized by absence of vertical overlap among the maxillary and mandibular dentition. The anterior open bite predominantly skeletal open bites are called as “stigmata of malocclusion”. Open bites are easy to identify but difficult to treat and retain. The correction of open bite remains a tough task to the clinicians; careful diagnosis also appropriate involvement with proper treatment modalities and appliance choice has a crucial role in the treatment outcomes and long-term stability. Fiasco of tongue posture variation remain the main cause for degeneration of open bite. Prolonged retention with fixed or removable retainer is desirable and necessary in most cases of open bite treatment. The purpose of this article is to develop a better understanding about open bite malocclusion which will help the clinicians to manage the patients with open bite in a better way.

Keywords: Open bite, Aetiology, Management.

Introduction

In 1842 Caravelli invented the term “open bite” as a separate classification of malocclusion. Some writers have resolute that open bite or an inclination towards open bite, happens when overbite is smaller than normal. One school assumed that open bite is considered by end-on incisal relationship, whereas the other school of thought is that no incisal contact be present in

open bite (Pithon, 2013; Cabrera Mde *et al.*, 2010; Shapiro, 2002; Cozza *et al.*, 2005). Open bite was defined by Subtelny and Sakuda, as open vertical dimension among the incisal boundaries of the maxillary and mandibular anterior teeth, although deficiency in vertical dental contact can arise among the anterior or the buccal segment (Subtelny and Sakuda, 1964). The analysis and behaviour of management determine the successful retention of treated open bite malocclusion. Many etiological features are concerned as sources of open bite like heredity, unfavourable growth pattern, digit-sucking habits, tongue abnormal function, orofacial functional matrices and their communications with the skeletal components, imbalance among jaw posture, occlusal and eruptive forces and head position. A complete understanding of its etiologic and growth process remains essential in management of open bite.

Classification of Open Bite

Open bite is classified:

- ❖ **On the concept of area involved as**
 - Anterior open bite
 - Posterior open bite
- ❖ **On the premise of etiological features as**
 - Skeletal open bite
 - Dental open bite
- ❖ **On the premise of molar association as**
 - Class I open bite
 - Class II open bite
 - Class III open bite
- ❖ **On the premise of clinical evaluation as**
 - Simple (occurs among the incisors)
 - Complex (extends from premolar or primary molar from one side to the other)
 - Compound / infantile open bite (completely open with molars)
 - Iatrogenic open bite (significance of orthodontic or surgical therapy)

Anterior Open Bite



Anterior open bite (AOB) could be defined as absence of incisal contact among front teeth when the mandible is brought into full closure (Figure 1).

Figure 1. Anterior open bite

Thus in anterior openbite there's no vertical overlap among the upper and lower anteriors. Anterior open bites are esthetically unpleasant predominantly during speech when the tongue is pressed between the teeth and lips. The anterior openbites mainly skeletal open bites are called as “stigmata of malocclusion” (Prasad *et al.*, 2009).

Classification of Anterior Open Bite

Anterior open bite is broadly divided into two categories:

- Skeletal anterior open bite
- Dental anterior open bite



- Open bites that develops because of excessive vertical growth are termed as ‘skeletal open bite’ (Chang Young and Cheol Moon Seong, 1999) (Figure 2).

Figure 2. Skeletal anterior openbite



- The underdevelopment anteriorly of the maxillary and mandibular alveolar processes is termed as ‘dental open bite’ (Meyer-Marcotty *et al.*, 2007) (Figure 3).

Figure 3. Dental anterior openbite

Features of Skeletal Anterior Open Bite

The skeletal AOB is termed as apertognathia (Mizrahi, 1978).

- Increased lower anterior facial height
- Decreased upper anterior facial height
- Patient may have short upper lip with extreme maxillary incisor exposure.
- Patient with long narrow face
- Increased anterior and reduced posterior facial height
- A steep mandibular plane angle
- Small mandibular body and ramus
- Divergent cephalometric planes
- Steep anterior cranial base

- A downward back-and-forth rotation of the mandible
- An upward tilting of the maxillary skeletal base
- Upright maxillary incisors

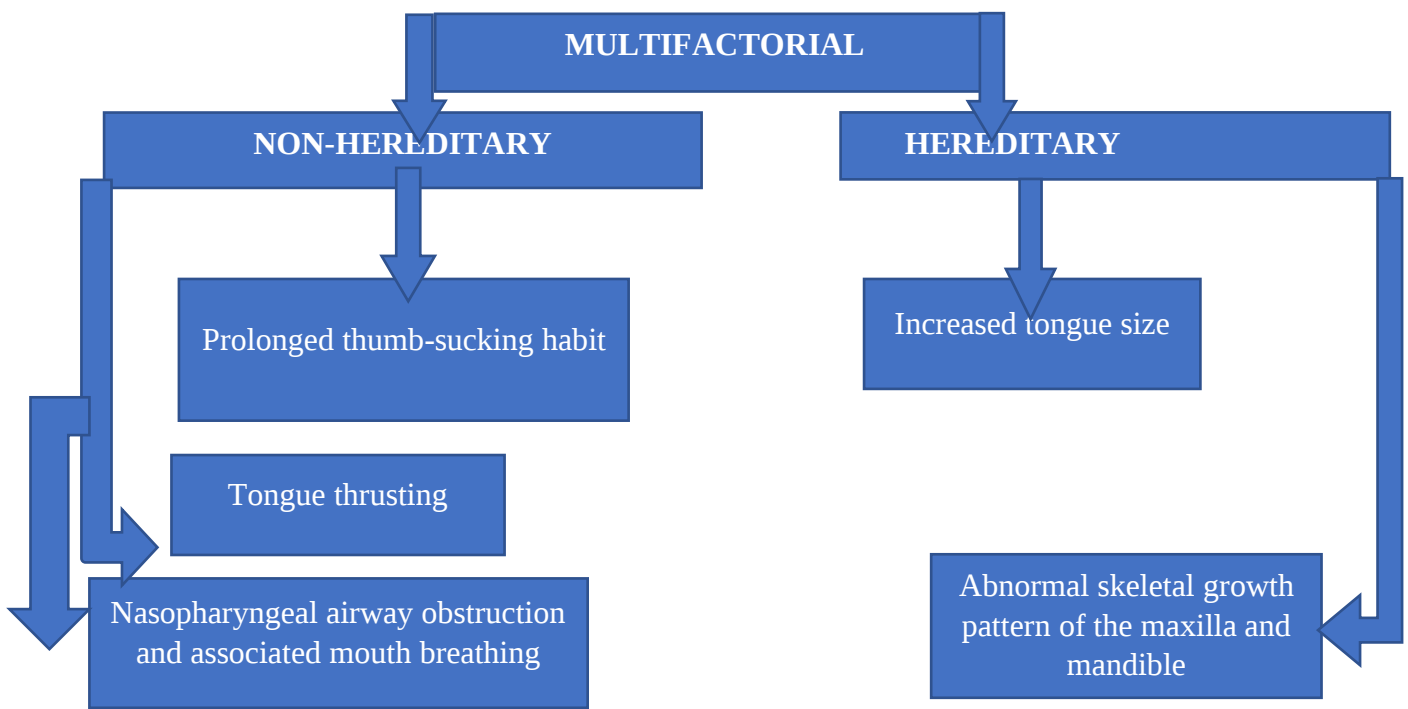
Features of Dental Anterior Open Bite

- Proclination of maxillary anterior teeth
- Absence of overlap between the upper and lower anterior teeth
- Narrow maxillary arch (lowered tongue posture)
- Spacing is seen between the upper and lower anterior teeth.
- In occlusion, the opposing molars and premolars are in contact, the canines may or may not be in contact, the lateral and central incisors shows frank open bite. So, the mouth has appearance of a ‘fish mouth’ (Figure 4)
- Alveolar height of mandible is decreased (Mizrahi, 1978).



Figure 4. Fish mouth appearance

Etiology of Anterior Open Bite (Wajid et al., 2018)



❖ Thumb-Sucking Habits

Prolonged thumb sucking habit may cause of open bite. The posture of thumb positioning, the intensity, frequency of sucking all have an influence on the nature and severity of the open bite. It may leads to restriction of development of the jaw by the thumb or finger (Larsson, 1987) (Figure 5).

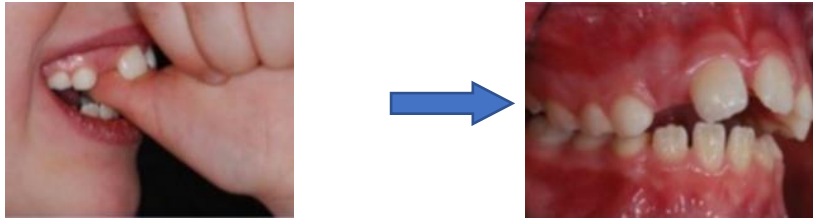


Figure 5. Patient with thumb sucking habit leads to narrow upper jaw due to muscle contraction

❖ Tongue Thrusting Habits

The abnormal swallowing / tongue thrusting habit causes protrusion of the tongue against or among the anterior dentition and excessive circum-oral activity during deglutition. It is a characteristic behaviour for kids under the age of 6 years. This denotes a delay or failure in transition of changing infantile swallow to adult swallowing (Subtelny, 1965). Tongue thrust habit related to mouth breathing and anterior open bite has functional adaptation of malocclusion and can cause speech problems like lisping.

❖ Mouth Breathing

Nasopharyngeal airway obstruction is also related to mouth breathing. Mouth breathing can be caused by physiologic otherwise anatomic conditions, it can be transitional when exercise induced or because of a nasal obstruction and true mouth breathing once the habit continues after the obstruction is removed. Mouth breathing habit due to airway obstruction leads to postural changes such as lip incompetence, lowered tongue position and lower third of the facial height is increased which leads to development of open bite.

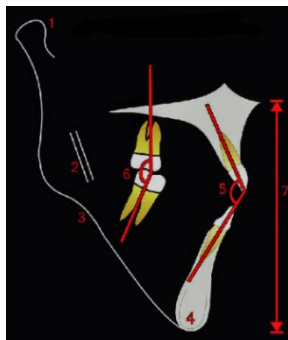
❖ Muscular Dystrophy

The reduction in stimulation of muscle movement that occurs in muscular dystrophy permits the mandible to rotate downwards more than the remainder of the facial skeleton, resulting in enlarged anterior facial height, a posterior development revolving the mandible, excessive eruption of the posterior teeth, narrowing of the maxillary arch and AOB that worsens with growth.

❖ Iatrogenic Open Bite

Poor process during fixed-appliance treatment might cause extrusion of the molar teeth otherwise droopy palatal cusps, which open the bite. Failing to stop overeruption of second molars when using bite planes or functional appliance might also give rise to an AOB.

❖ Skeletal Growth Abnormalities



Open bite can be caused by inherited factors like increased tongue size, and abnormal skeletal growth pattern of maxilla and mandible. Subject with open bite had shorter rami and greater total facial height with clockwise revolution of the mandible (figure 6).

Figure 6. Bjork's features demonstrating a posterior mandibular growth rotation

1. BACKWARD INCLINATION OF CONDYLAR HEAD
2. STRAIGHT MANDIBULAR CANAL
3. ANTEGONIAL NOTCH
4. RECEDING CHIN
5. REDUCED INTERINCISAL ANGLE
6. REDUCED INTERMOLAR ANGLE
7. INCREASED LOWER ANTERIOR FACE HEIGHT (Bjork, 1969).

❖ Pathologic Open Bite

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

Diagnosis

The diagnosis should include a comprehensive case report indicating to critical examination to the circumstance of some etiologic features like habits. Genetic content if it is present must be noted. The cephalometric study will distinguish the dental from a skeletal component (Prasad *et al.*, 2009).

1. Anterior open bite with increased facial proportions

Mainly skeletal problem and patient with increased facial proportions often requires orthognathic surgery to close the open bite.

2. Anterior open bite with history of digit sucking and normal facial proportions

Mainly dental problem so patient has favourable prognosis for treatment by orthodontic means alone provided digit sucking habit is stopped.

Management of Anterior Open Bite

Patients concern for treatment of anterior open bite is mainly for aesthetic purpose, however functional problems with speech, like lisp, difficulty incising food are also present. Although closure of an AOB may help with eating, there's little evidence to show that it helps with speech, and definitely this might not be promised to the patient.

The Index of Orthodontic Treatment Need (IOTN) is typically employed within the hospital services and might in future be utilized in the overall Dental Services, to determine the needs of patients for orthodontic treatment. Only patients with an AOB greater than 4mm fall into the necessity treatment category (IOTN 4). An AOB less than 4mm would be borderline or considered to not need treatment unless another aspect of the malocclusion took precedence.

Methods of Treatment

It depends on patient's age, his/ her anxieties, beliefs, in addition to the pathogenesis of the malocclusion.

Mizrahi, (1978) explained 4 treatment modalities, they are

- Habit correction
- Myofunctional therapy
- Orthodontic mechano-therapy appliances (utilizing fixed or removable appliances)
- Surgical treatment
- Combination of two or more of those mentioned above.

It is important to decide which form of treatment is suitable for every individual case.

Dealing with Sucking Habits

In the deciduous dentition, unless there's sign of trauma, the AOB is generally because of a habit like digit sucking. No interference is indicated aside from encouraging the kid to prevent the habit during changeover from mixed to permanent dentition (Bowden, 1966). However, normalization of overbite can take place between 3 and 5 years.

A kid who continues to be sucking his/her thumb as the maxillary permanent incisors erupt (7.5-9 years) should be actively discouraged from doing so. Initially this could be taken as an advice, possibly in conjunction with an aide memoire like a plaster on the associated finger, a

glove or foul-tasting cosmetics. Alternatively, a little tangible reward can be offered on an everyday for not engaging within the habit. A deterrent appliance is often used, which is either a removable or fixed appliance which prevents sucking of the digit, and must be retained in situ for a minimum of 6 months after sucking has apparently ceased, to make sure the habit has truly stopped (figure 7).

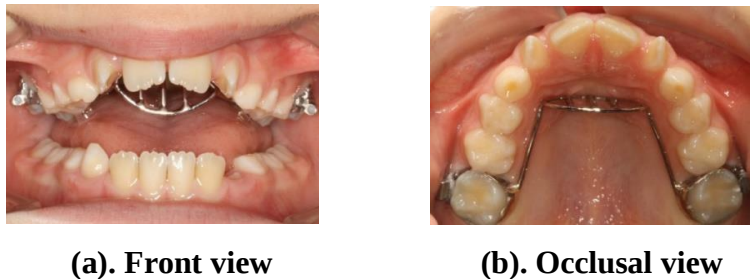


Figure 7. Fixed thumb dissuader

The fixed variety is more assured of success. Sometimes a quad helix appliance is employed, which not only discourages the habit, but has the extra advantage of having the ability to expand the upper arch. This might be necessary in avid thumb suckers, as excessive cheek pressure produced during sucking causes constriction of the upper arch.

These methods are likely to provide good spontaneous resolution of the AOB during 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 also the AOB is also continued by the soft tissue pattern and/or failure of further alveolar development anteriorly. This can be supported by Larsson, (1987) who reported that, when the sucking habit is prolonged beyond the pubertal growth spurt, the open bite won't usually correct spontaneously.

Myofunctional Appliances

Posterior Bite Blocks

Passive posterior bite blocks are functional appliances that are fabricated 3-4mm more than the rest position. In growing patients this prevents the rise in height of the buccal dento-alveolar processes, thus preventing a downward and backward rotation of the mandible (Iskan and Sarisoy, 1997). It also allows differential eruption to occur because the labial segments can erupt unhindered, hence closing the AOB. Modifications have included spring loading the bite blocks and use of repelling magnets embedded within the acrylic of the bite blocks (Noar and Hunt, 1996). High pull headgear to the bite blocks might increase their efficiency (figure 8).



Figure 8. A patient with a class 2 division 1 malocclusion and AOB tendency, being treated with a Twin Block myofunctional appliance with EOT tubes for high pull headgear

Functional Regulator Appliance (FR-4)

These are thought to be effective where the open bite is a minimum and partly due to faulty postural activity of the orofacial musculature. The FR-4 works by allowing vertical eruption of upper and lower incisors and retraction of the maxillary incisors. A few authors have reported a change in mandibular rotation from a downward and backward path to upwards and forwards (Erbay *et al.*, 1995).

Fixed Appliances

Anterior open bites are closed using fixed appliances and vertical intermaxillary elastics are used to extrude the anterior teeth. This might be combined with a transpalatal arch (TPA) and highpull headgear to limit vertical development of the maxillary molar teeth. The TPA functions to stop buccal rolling of the primary molars, which could cause the bite to be propped open on their palatal cusps. Use of anterior elastics is also effective in patients in whom a digit-sucking habit has artificially inhibited eruption but is unlikely to function if the aetiology is primarily skeletal. During this situation the incisors have frequently erupted further than normal as a part of natural compensation, and further extrusion would be aesthetically inappropriate and highly liable to relapse. Distal movement of the teeth using headgear is contraindicated, as this can tend to worsen any AOB. Similarly, Class II or Class III elastics mustn't be used as they cause molar extrusion.

Where anterior open bites are related to proclined incisors, like some bimaxillary proclination cases and Class I/II malocclusions, retraction of the incisors leads to an extrusive movement, because the crown is revolved around the centre of rotation of the tooth (Sarver and Weissman, 1995). This reduces/eliminates the open bite. Stability varies on the tongue adapting to a new functional position after treatment.

Molar extractions are performed in a trial to cut back the magnitude of the open bite by forward mandibular rotation. However, Nahoum, (1977) suggested that, although this could close the anterior open bite, the physiological rest position of the mandible wouldn't change, thus leaving total face height unaltered. Mizrahi, (1978) suggested limiting extraction to the posterior region of the arch where crowding was present. Richardson and Richardson, (1993) reported that the extraction of 4 second permanent molars caused a rise within the overbite compared with a bearing group; a small distal movement of the dentition, with retroclination of incisors and increase within the interincisal angle was also seen.

Kim (1987) suggested that on the utilization of a multiloop edgewise arch wire along with heavy anterior elastics to attain molar intrusion and simultaneous incisor extrusion to close anterior open bites. The posterior teeth are distally uprighed using this system. Although this method has been proved successful, excellent compliance with elastics wear is important and long-term stability has yet to be determined.

Extra-Oral Traction

Vertical Pull Chin Cup

Vertical pull chin cup therapy has been applied to limit excessive vertical growth. Pearson (1978) reported that on 20 growing patients with backward rotational tendencies treated by the extraction of 4 first premolars, chin cup therapy and fixed appliances. Chin cup therapy was effective in reducing the angle between the maxillary and mandibular planes and at closing all



anterior open bite (figure 9). Mandibular autorotation was attributed to reduction within the 'wedging' effect by premolar extraction, retardation of eruption of posterior teeth and redirection of condylar growth. However, chin cup therapy generally has poor compliance rates and there's some concern that it should cause condylar damage.

Figure 9. Vertical Pull Chin Cup

Highpull Headgear

High pull headgear (figure 10) applied to the maxillary molar teeth and worn for 14 hours per day has been utilized to inhibit eruption of the posterior teeth and hence limit vertical growth. Headgear will be applied directly on to the upper molar bands of a fixed appliances or used in conjunction with a functional appliance or an upper removable appliance like maxillary intrusion splint. This form of treatment based on the assumption that over-development of the posterior maxilla is responsible for the deformity (Epker and Fish, 1977).



Figure 10. High Pull Headgear

Orthognathic Surgery

A combination of fixed appliance orthodontics and orthognathic surgery is also required to treat skeletal open bites. Treatment shouldn't be commenced until growth has ceased, as further growth is extremely likely to be unfavourable. Presurgical orthodontics is aimed towards individual arch alignment and arch co-ordination. An apparent step within the occlusal plane mustn't be levelled but maintained using segmental mechanics. Surgery is either segmental or involve the full jaw. Frequently bimaxillary surgery is required.

1. **Maxillary surgical procedures:** Indicated for maxillary excess and anterior open bite. Osteotomy with superior impaction of posterior maxilla is often performed.
 - Total maxillary osteotomy (figure 11).

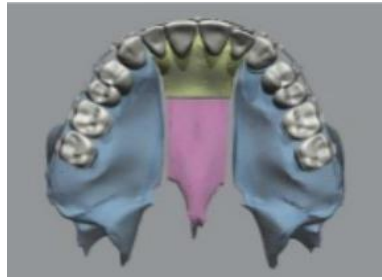


Figure 11. Lefort I osteotomy Lefort II osteotomy Lefort III osteotomy

- Segmental alveolar maxillary osteotomy (figure 12).



(a). Segmental osteotomy between maxillary premolar and canine



(b). Segmental osteotomy between maxillary laterals and canines



(c). segmental osteotomy between maxillary incisors

Figure 12. Anterior segmental osteotomy

2. **Bilateral sagittal splint osteotomy (BSSO):** Indicated for AOB patient with maxillary operation to reduce the posterior facial height also for mandibular set back (less than 7-8mm) (figure 13).

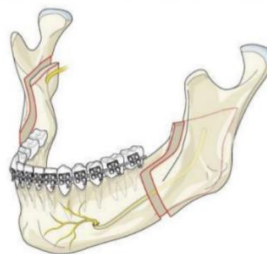


Figure 13. Bilateral sagittal splint osteotomy

Stability

Prediction of the response to treatment and the stability of the outcome is generally unreliable. Relapse rates after treatment of AOB are high. Generally, the more the skeletal elements contribute to the aetiology of the malocclusion the poorer the prognosis for orthodontic treatment alone (Mizrahi, 1978).

Relapse of AOB has been attributed to:

- Unfavourable growth (a posterior mandibular growth rotation)
- Soft-tissue factors like an unfavourable tongue posture

- Resumption of digit sucking habit
- Inappropriate orthodontic tooth movement, like extrusion of incisors where there eruption had not been previously impeded
- Surgery that has increased the posterior face height – as would occur if the AOB is closed by means of a mandibular procedure only (Lopez-Gavito *et al.*, 1985).

Retention that has been directed towards intrusion, or a minimum of prevention of eruption, of maxillary posterior teeth, (Lawry *et al.*, 1990) using either headgear attached to an upper removable retainer or a retainer with passive posterior bite blocks. However, this could ideally be continued until the patient ceases growing, although compliance is obviously an issue.

Posterior Open Bite

POB occurs when the patient bites only the front teeth comes into contact and posterior teeth aren't occluded (figure 14).



Figure 14. Posterior open bite

Causes of Posterior Open Bite

1. **Mechanical interference with eruption**, whether before or after the tooth emerges from the alveolar bone.
 - Resulting from the ankylosis of the tooth to the alveolar bone (trauma)
Example: trauma, supernumerary teeth, and non-resorbing deciduous roots.
 - After the tooth emerges from the alveolar bone, pressure from the soft tissues (cheek, finger, tongue) may also be an obstacle to eruption.
2. **Failure of the eruptive mechanism of the tooth** so that the anticipated amount of eruption doesn't occur. A condition during which non-ankylosed, usually posterior, teeth fail to erupt, either completely or partially due to a failure of the eruption mechanism. The teeth most involved are the deciduous and permanent molars, although premolars and canines may be affected.

A posterior open bite, caused by a primary failure of eruption, won't react to the orthodontic treatment, a segmental alveolar osteotomy that provides the only possible treatment modality.

Management of Posterior Open Bite

The primary aim of the treatment should be to get rid of the cause. Initial treatment includes activator or bionator with flanges to stop lateral tongue thrust. Once the habit is intercepted, the posteriors may be forcefully extruded (Prasad et al., 2009). Fixed appliance might also be accustomed to close lateral open bite by doing intermaxillary elastic traction. In case of posterior open bite due to infra-occlusion of ankylosed teeth, that it might be best treated with crowns on posteriors and return them to normal occlusal level. Posterior open bite is hard to treat if tongue reflex gets fixed. A permanent mode of retention is required after correction.

Conclusion

Open bite malocclusion may be hard to treat in orthodontic practice. Treatment modalities includes functional appliances in growing children and surgeries in adults. Removal of etiology is the main objective. Minor cases will be treated by fixed orthodontics together with some habit breaking appliances. Relapse rates are maximum in this type of malocclusion. Operational efficiency of the stomatological system is undermined in such cases. Extra caution should be exercised when diagnosing and planning treatment for such cases as any error in identifying the etiology may cause a poor treatment outcome.

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