

Anterior Open Bite: Causes, Diagnosis and Management

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ABSTRACT

Background: Open bite is a malocclusion that occurs in the vertical plane, characterised by lack of vertical overlap between maxillary and mandibular dentition¹⁻³. Anterior open bite has multiple aetiologies, broadly classified as skeletal or dental in origin. The anterior open bite, in particular, the skeletal type is called as “stigmata of malocclusion”⁵. Accurate differentiation is essential in determining treatment plan: dental open bites may be corrected spontaneously in growing patients and is generally amenable to orthodontic treatment, whereas skeletal cases frequently worsen with growth and require combined orthodontic and surgical treatment. Incidence of post-treatment relapse is high and poses a challenge to treat successfully.

Keywords: Anterior open bite, Aetiology, Diagnosis, Orthodontic treatment.

INTRODUCTION

Anterior open bite (AOB) is present when there is no incisor contact and no vertical overlap of the lower incisors by the uppers⁴. AOB may be defined as a negative overbite between the incisal edges of maxillary and mandibular anterior teeth, with the posterior teeth in occlusion⁵. AOBs are aesthetically unattractive particularly during speech when the tongue is pressed between teeth and lips. Severity varies from edge-to-edge relationship to a severe handicapping open bite.



Fig 1: Anterior Open Bite (AOB).

Incidence: AOB varies according to age and ethnic group. It is more common in Africans and Afro-Caribbeans (5-10%)^{7,8}. In UK, the reported incidence in children is 2-4%⁶, in age groups of nine to early teens. This reduction is accounted for by normal occlusal development, neural maturation of the child favouring the cessation of oral habits, decrease in size of the adenoids and the establishment of a normal adult swallowing pattern.

Aetiology^{9,10,11,17}: The aetiology of AOB is multifactorial and can occur due to variety of hereditary and non-hereditary factors. Resultant malocclusion is an interaction between these factors. Following are some of the factors responsible for AOB:

1. **Heredity with genetic disposition** – Inherited factors such as increased tongue size, and abnormal skeletal size and growth pattern of the maxilla and mandible can also be responsible for open bite malocclusion.

2. **Habits** –

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- **Digit sucking habit:** incidence of digit sucking is around 30% at 1 year of age, 12% at 9 years and 2% at 12 years. Most persistent are females¹². Influence made by digit sucking depends on age, intensity, frequency, duration of the habit. The malocclusion resolves once the child give up the habit. AOB caused by digit sucking is often asymmetrical being greater on 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 proclined whereas the effect on lower incisors is more variable. Children who suck digit for 6 hours or more each day, particularly those who sleep with digit between teeth all night can develop a significant malocclusion¹³. Persisting habit have a minor effect on skeletal pattern causing tilting of the maxillary plane in an anticlockwise direction¹² and anterior displacement of maxilla¹⁴.
- **Abnormal Tongue Function:** A tongue thrust on swallowing is often noted in patients with an AOB. Two types are observed – primary(endogenous) & secondary(adaptive). Nearly all tongue thrusting falls into the second type where the tongue is thrust forward on swallowing as an adaptive response to presence of AOB to prevent food/liquid/saliva escaping from the front of the mouth¹⁵. Proffit¹⁶ suggested resting position of tongue has much greater influence on tooth position than any tongue thrust, as the duration of the activity would be too short to have a significant effect.

Endogenous tongue thrust is often associated with excessive circumoral contraction on swallowing. Treatment for AOB with this type should not be carried out, as relapse will almost certainly occur¹⁷. Tongue thrusting may develop as a complication of digit sucking habit or may occur as a compensatory mechanism for existing open bite⁵.

1. Skeletal factors:

- AOB shows an undergrowth in the anterior segment with excessive growth in the posterior alveolar portion.
- Increased anterior and decreased posterior facial height. The posterior face height(Sella-

Gonion) and Anterior face height(Nasion-Menton) are measured on lateral cephalogram with teeth in habitual occlusion to estimate growth directions according to recommendations of JARBAK(1972).

$$\text{JARABAK RATIO} = \left[\frac{\text{POSTERIOR FACE HEIGHT}}{\text{ANTERIOR FACE HEIGHT}} \right] * 100$$

- Vertical growth pattern or backward rotation or clockwise rotation of the lower jaw.
- Anticlockwise rotation of the maxillary base.
- Divergent jaw bases.
- Short ramus with long or short body and Increased gonial angle (articulare-gonion-menton).

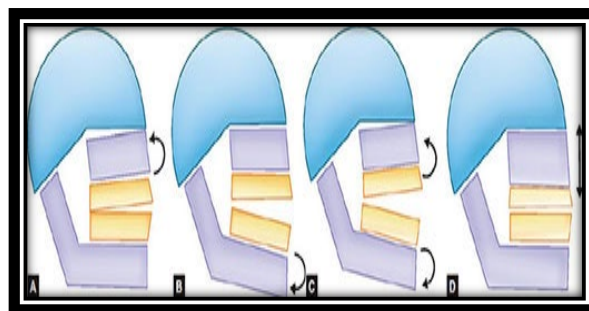


Fig 2: Skeletal factors creating AOB

2. **Neurological Disturbances:** neurological disturbances that affect the oral or facial musculature may give rise to AOB. Gershtater¹⁸ reports an incidence of 32.3% in patients with learning disabilities.
3. **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 mandible, excessive eruption of the posterior teeth, narrowing of the maxillary arch and AOB that worsens with growth¹³.
4. **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.

5. **Pathological 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 Forte fractures of the maxilla.

Classification:

1. Skeletal Anterior Open Bite:- Apertognathia
2. Dental Anterior Open Bite: - May be Unilateral or Bilateral

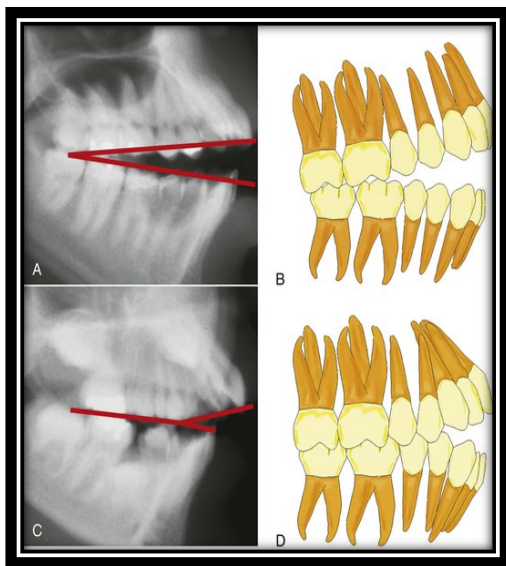


Fig 3: Skeletal AOB (A&B); Dental AOB (C&D)

Features of Skeletal AOB:

1. Long and narrow face with a marked convex profile. If underlying skeletal base is Class III then profile may be concave.
2. Short upper lip may be present with excessive maxillary incisor exposure.
3. Increased lower anterior facial height and decreased upper anterior facial height.
4. Steep mandibular plane angle is present. Clockwise or backwards rotation of mandible is seen. FMA angle is more than 30 degrees. Increased gonial angle & marked antegonial notch.
5. Small mandibular body and ramus.

6. Divergent jaw bases as well as horizontal cephalometric planes.
7. There is upward rotation of maxillary jaw base.

Features of Dental AOB:

1. Proclined upper anterior teeth.
2. Failure of upper and lower anteriors to overlap.
3. Presence of a narrow maxillary arch due to a lowered tongue posture due to habit.
4. Spacing may be present between upper and lower anteriors

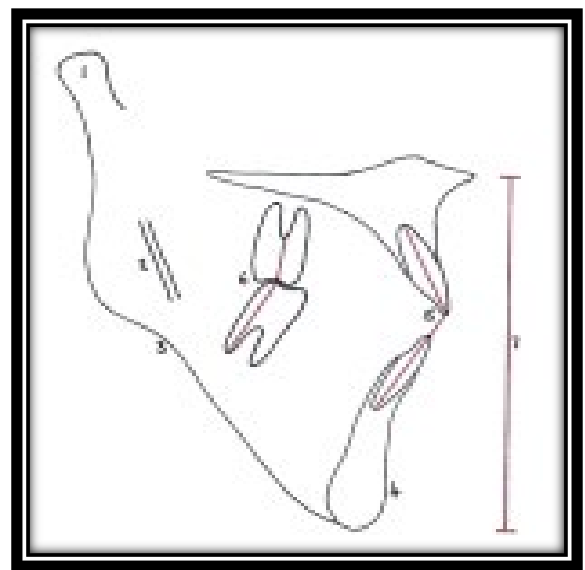


Fig 4: Bjork's features illustrating a posterior mandibular growth rotation. 1: Backward inclination of condylar head; 2: straight mandibular canal; 3: antegonial notch; 4: receding chin; 5: reduced interincisal angle; 6: reduced intermolar angle; 7: increased lower anterior face height.

Other features: Speech defects can be found with lisping of voice. There may be associated upper respiratory infections. Lispings associated with anterior openbite and spacings is called interdental stigmatism.

Diagnosis: It should include a thorough case history pointing to critical examination towards presence of any etiological factors like habits, hereditary content. Cephalometric analysis will differentiate a dental AOB from a skeletal component.

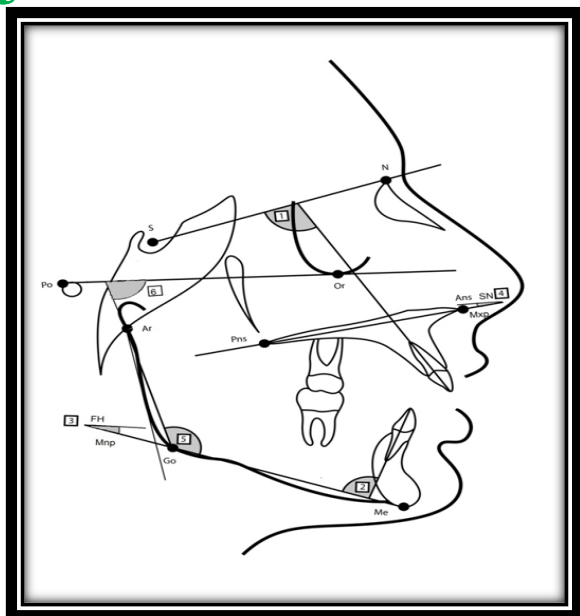


Fig 5: Cephalometric analysis as diagnostic modality for AOB

Indications for treatment¹⁹: Patients with an AOB greater than 4mm fall into the “need” for treatment category (Index of Orthodontic Treatment Need: 4). An AOB less than 4mm would be borderline or be considered no to be in need of treatment unless some other aspect of malocclusion took precedence.

Treatment of AOB:

Treatment depends on the age of the patient, his/her concerns and expectations, and the aetiology of malocclusion. Mizrahi²⁰ described four modalities of treatment: -

1. Myofunctional therapy
2. Orthodontic mechanotherapy (using fixed and removable appliances)
3. Surgical therapy
4. Combination of two or more of the above

Prevention of habits^{21,22,23}:

AOB have been diagnosed as a result of habits such as thumb sucking or tongue thrusting, requiring their interception using passive habit breaking appliances. The habit breaking appliance can be either fixed or removable type of crib. The palatal crib may be an excellent treatment option, since it prevents thumb sucking and avoids tongue thrusting. Presence of abnormal nasopharyngeal pathology should be ruled out after referring the patient to an otolaryngist.



Fig 6: Palatal crib- a habit breaking appliance.

Myofunctional Therapy:

1. Posterior Bite blocks:

Passive posterior bite blocks are functional appliances that are used to open the bite 3-4mm beyond rest position. In patients that are in growing stage, this posterior bite block inhibits the increase in height of the bucco dento-alveolar processes, thus preventing downward and backward rotation²⁴ of the mandible and allowing differential eruption to occur as the labial segment can erupt unhindered, hence closing AOB. Modifications include spring loading the bite blocks and use of repelling magnets embedded in the acrylic of the biteblocks²⁵. Highpull headgear to bite blocks may increase their efficiency. Where the AOB is associated with a Class II skeletal pattern, a Twin Block appliance with highpull headgear can be used to correct the anteroposterior discrepancy whilst controlling vertical dimensions.



Fig 7: Twin block appliance with tongue guard

2. Functional Regulator Appliance (FR-4):

The appliance is effective where the open bite is at least partly due to faulty postural activity of the orofacial musculature. The FR-4 works by allowing vertical eruption of the upper and lower incisors and retraction of the maxillary incisors, and some authors have reported a change in mandibular rotation from a downward and backward direction to upwards and forwards²⁶.

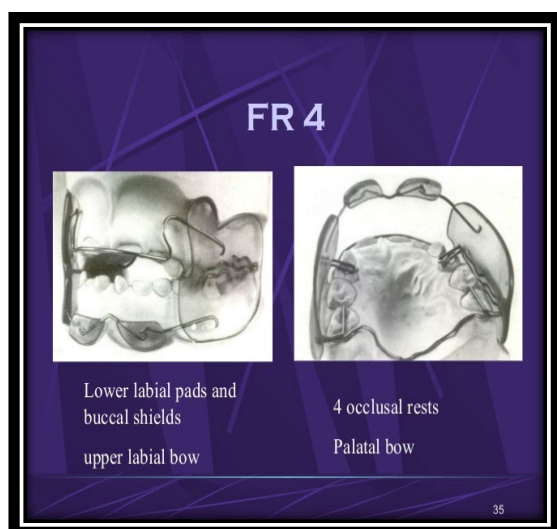


Fig 8: Frankel's Functional Regulator 4 for AOB treatment

Fixed Appliances: Anterior open bites can be closed using fixed appliances and vertical intermaxillary elastics to extrude the anterior teeth. This may be combined with a transpalatal arch (TPA) and highpull headgear to limit vertical development of the maxillary molar teeth. The TPA functions to prevent buccal rolling of the first molars, which could cause the bite to be propped open on their palatal cusps. Use of anterior elastics may be successful in patients in whom a digit-sucking habit has artificially inhibited eruption, but is unlikely to work if the aetiology is primarily skeletal. Class II or Class III elastics should not be used as they cause molar extrusion. Where anterior open bites are associated with proclined incisors, such as some bimaxillary proclination cases and Class II/I malocclusions, retraction of the incisors results in an extrusive movement, as the crown is rotated around the centre of rotation of the tooth²⁷. This reduces/eliminates the open bite. Stability depends on the tongue adapting to a new functional position after treatment. Kim²⁸ reported on the use

of a multiloop edgewise archwire together with heavy anterior elastics to achieve molar intrusion and simultaneous incisor extrusion to close anterior open bites. The posterior teeth are distally uprighted using this technique. Although this method has proved successful, excellent compliance with elastic wear is essential and long-term stability has yet to be determined.



Fig 9: Box elastics for AOB correction.



Fig 10: Kim's method - Multiloop Edgewise Archwire.

Extra-Oral Traction:

1. **Vertical Pull Chincup:** Vertical pull chincup therapy has been used to limit excessive vertical growth. Pearson²⁹ reported on 20 growing patients with backward rotational tendencies treated by the extraction of four first premolars, chincup therapy and fixed appliances. He showed that chincup therapy was effective in reducing the angle between the maxillary and mandibular planes and at closing all anterior open bites. Mandibular autorotation was attributed to reduction in the 'wedging' effect by premolar extraction, retardation of eruption of posterior teeth and redirection of

condylar growth. However, chincup therapy generally has poor compliance rates and there is some concern that it may cause condylar damage.

2. **Highpull Headgear:** - Highpull headgear applied to the maxillary molar teeth and worn for 14 hours per day has been used to inhibit eruption of the posterior teeth and hence limit vertical growth. Headgear can be applied directly to the upper molar bands of a fixed appliance or used in conjunction with a functional appliance or an upper removable appliance such as a maxillary intrusion splint. This form of treatment is based on the assumption that overdevelopment of the posterior maxilla is responsible for the deformity³⁰.



Fig 11: High pull headgear(left) & Vertical pull chincup(right)

Orthognathic Surgery: A combination of fixed-appliance orthodontics and orthognathic surgery may be required to treat skeletal open bites³¹. 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 required³².

Relapse of AOB has been attributed to the following factors:

1. unfavourable growth (a posterior mandibular growth rotation).
2. soft-tissue factors such as an unfavourable tongue posture.
3. resumption of a digit-sucking habit.

4. inappropriate orthodontic tooth movement, such as extrusion of incisors where their eruption had not been previously impeded
5. surgery that has increased the posterior face height – as would occur if the AOB is closed using a mandibular procedure only³³.

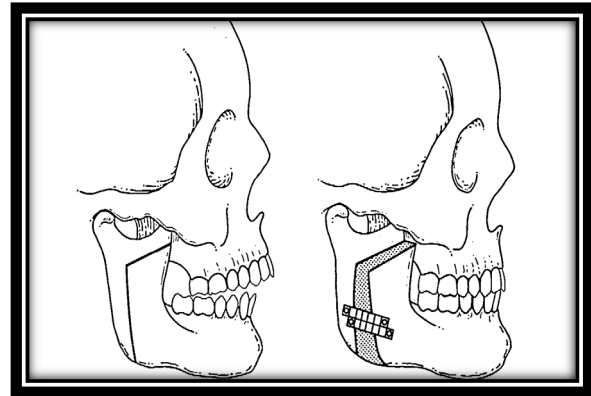


Fig 12: Surgical correction of AOB with bilateral mandibular rotation. [Reitzik et al. Am. J.Orthod. Dentofac. Orthop. January 1990]

Retention: has been directed towards intrusion, or at least prevention of eruption, of maxillary posterior teeth³², 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 issue³⁴.

CONCLUSION

Anterior open bite has multiple aetiologies and accurate diagnosis is the key to determining the best management strategy for the individual patient. Many open bites will resolve spontaneously before the age of 12 due to ceasing of digit habits and maturation in the swallowing pattern. Older patients with 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 problems³⁵.

Any associated digit habit should be ceased before active orthodontic treatment is commenced. Treatment options include attempting to redirect growth using myofunctional appliances, use of conventional fixed appliances with highpull headgear and/or vertical anterior elastics, and a

joint orthodontic/surgical approach for skeletal open bites. Long-term retention is recommended.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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