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ETIOLOGY AND PATHOGENESIS OF ANTERIOR OPEN BITE: A REVIEW

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ABSTRACT

***Objective*: To review the etiology and pathogenesis of anterior open bite malocclusion.**
***Data source*: Review of literature was affected through Pubmed, Google scholar and Science direct. References identified from articles found from the primary search were also reviewed.**
***Study selection*: Published data on etiology and pathogenesis of anterior open bite over the last five decades (1960-2009) were utilised.**
***Data extraction*: Full articles, abstracts and relevant book chapters were read and analysed to determine the relevant material for this article.**
***Data analysis*: All relevant articles were reviewed in full and necessary information eextracted as necessary.**
***Conclusion*: A clear understanding of the etiology and pathogenesis of anterior open bite is essential in the diagnosis, prevention and management of this malocclusion.**

INTRODUCTION

Dental malocclusion may be congenital or develop as the child grows. Malocclusion requiring treatment was diagnosed in more than half (52.3%) of 12 year olds surveyed in South Africa (1). Severe and handicapping malocclusion requiring specialised treatment was diagnosed in 31 %. The country does not have sufficient numbers of appropriately trained personnel that is, orthodontists to meet this need (2). Early diagnosis coupled with interceptive procedures can significantly reduce the proportion of children with severe malocclusion. Clinicians should therefore strive to have sound knowledge on malocclusions.

Anterior open bite (AOB) malocclusion which is defined as lack of contact between upper and lower incisors is common among the country's African population (3-5). Children with this condition suffer from among others psychosocial and functional problems. This article reviews the etiology and pathogenesis of AOB.

ETIOLOGY

As with most orthodontic problems, etiology of AOB is complex, multifactorial and largely unknown (3, 4, 6-10). AOB has skeletal and dental components and often the two occur together in the same individual (6). These are reviewed jointly. Some of the causative factors include habits, hereditary factors, aberrant skeletal development. airway obstruction, stage of development, iatrogenic factors, neurological disturbances, muscular dystrophy, disproportionately large tongue, temporal mandibular joint derangements and pathological factors.

With regards to habits, it is well established that non-nutritive sucking of items such as digits, pacifiers or toys is common among children. Studies have shown that prolonged non-nutritive sucking habit is associated with anterior open bite malocclusion (11-14). Another common habit is tongue thrust swallow, where the tongue tip is placed in a forward position between the incisors during swallowing, has been suggested as an etiological factor for this malocclusion (15-18). However it has been argued that tongue thrusting could be the result and not the cause of AOB (15, 19). Other habits such as lip sucking and lip biting (20-22), nail biting (22) and mouth breathing (15, 23) have been attributed as a possible etiological factors for AOB.

Hereditary factors have also been blamed for this malocclusion. Grabber *et al* (7) stated that some types of malocclusion such as long face open bite problems have an inherited component. Cases of AOB have been shown to be more common among blacks than whites or Hispanics in USA(24). Aberrant skeletal development is another factor that is well

documented as contributing to this malocclusion. For example excess vertical growth has been blamed for the development of AOB (4, 15, 17, 25, 26). Cozza *et al*. observed an association between hyper divergent face and AOB(12).

Regarding the airways, several authors have indicated that airway obstruction could lead to AOB(8, 15, 26, 27). However, Trask *et al*. found no relationship between airway obstruction and AOB (28). Another factor associated with AOB is the stage of development. Children in transitional dentition stage where the rate of eruption of anterior teeth has slowed down may develop transitional or pseudo open bite (10, 17). For patients with dentitions that is already developed and are undergoing orthodontic treatment. Poor mechanics during fixed appliance treatment may also cause AOB(10, 29).

Neurological disturbances that affect the oral or facial musculature may also give rise to AOB(4, 10, 29). A high incidence of AOB has been demonstrated in mentally retarded and emotionally disturbed children (18). Conditions like cerebral palsy that are associated with brain damage can lead to low muscular tonicity and resultant AOB. Abnormalities in muscular tonicity are also found in muscular dystrophy. This condition refers to a group of progressive genetically determined primary myopathies(30). The decrease in tonic muscle activity that occurs in muscular dystrophy and various muscle weakness syndromes have been attributed to the development of AOB(15, 29, 31).AOB may also develop in individuals with disproportionately large tongue (4, 32). The condition may be found in both congenital malformation such as cretinism, Down's syndrome. Beckwith-Wiedemann syndrome or in acquired conditions as in acromegaly (33).

Temporal mandibular joint (TMJ) derangement has also been associated with this malocclusion. It has been speculated that posterior rotation of the mandible due to condylar resorption may result in AOB(34). Riolo *et al*.(35) found a positive correlation between AOB and TM] dysfunction. Other pathologies associated with AOB include cleft lip and palate as well as trauma in condylar fractures or Le Fort fractures(29).

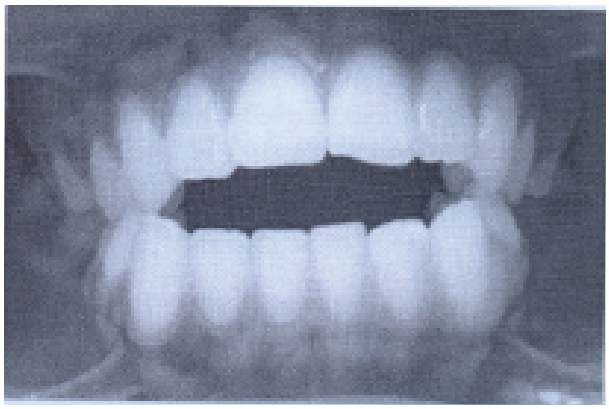
PATHOGENESIS

The pathogenesis of most habits could be explained by equilibrium theory. that states that light forces of long enough duration are capable of moving teethe(15). These forces can be grouped into intrinsic (coming from the tongue and lips), extrinsic forces (coming from the thumb, fingers, pacifiers and others) and occlusal forces(19).

When a thumb/finger is placed between the anterior teeth in digit sucking habit. The mandible must be lowered to accommodate it. The interposed digit directly impedes incisor eruption. Furthermore, the separation of the jaws alters the vertical equilibrium on the posterior teeth, resulting in more eruption of the posterior teeth. Because of the geometry of the jaws, over-eruption of the posterior teeth results in opening of the bite anteriorly. The AOB arises by a combination of interference with normal eruption of incisors and excessive eruption of posterior teethe(15).

How much the teeth are displaced depends on duration, frequency and intensity of the sucking habit (36). However the duration (number of hours per day of sucking) correlates better with the resultant malocclusion than the intensity (magnitude pressure) of sucking(15). Children who digit suck for six hours or more each day, particularly those who sleep with the digit between the teeth all night, can develop significant malocclusion(29). A classical presentation of AOB is shown in figure 1.

Figure 1
An example of anterior open bite



Regarding the tongue habits, the vertical position of a tooth is known to be determined by the equilibrium between forces that produce eruption and those that oppose it(19). Although forces from mastication are the ones that primarily oppose eruption, lighter more sustained forces from the soft tissue such as the tongue interposed between the teeth are equally important.

Forward positioning of the tongue or a disproportionately large tongue and its resultant posture is believed to mechanically interfere with anterior teeth eruption thus causing and maintaining AOB(4, 15). The pressure from the tongue on the incisors if not equally countered by forces from the lips may cause outward displacement of those teeth (37) thus accentuating AOB malocclusion.

Tongue tip protrusion during swallowing (tongue thrusting), is often associated with AOB. Both Proffit and Fields(15) and Proffit(19) consider tongue thrust swallow as a result of displaced incisors and not the cause. They argue that tongue thrust swallowing has a too short a duration to have an impact on tooth

position. Supporting this argument, Ngan and Fields (8) indicated that given the physiology of tooth movement, it is unlikely that tongue thrust, but rather resting tongue posture plays a role in the etiology of AOB.

In the airway obstruction cases, it is known that excessive amounts of adenoid tissue may obstruct the nasopharyngeal cavity and prevent proper naso-respiratory function. This may force an individual to breath through the mouth. During mouth breathing, the mandible and the tongue are lowered, and the head is extended(15). If these postural changes are to be maintained, the vertical equilibrium will be disrupted causing over eruption of the posterior teeth. Additionally this posture causes the downward and backward rotation of the mandible. The effect of the over eruption of posterior teeth or downward and backward rotation of the mandible is to open the bitc anteriorly. In case of grossly enlarged palatine tonsils the oro-pharynx may become mechanically blocked. If this happens, the tongue may be forced to move forward and lie between the anterior teeth thus preventing their eruption or displace them during eruption causing AOB(4).

Anterior open bite malocclusion arising from abnormal skeletal growth pattern have comprehensively been dealt with in the literature (25, 38-42). From this literature one can conclude that any growth pattern that yields negative rotation of the maxilla or a positive rotation of the mandible or a combination of the two would result in AOB.

Neurological disturbances and muscular dystrophies that lead to decrease in tonic muscle activity may allow the mandible to drop downward away from the rest of the facial skeleton. This subsequently disturbs the equilibrium of the posterior teeth resulting in AOB(15). It is also reasonable to argue that reduction of tongue muscle tone may lead to anterior positioning of the tongue, hence interfering with the eruption of incisors resulting in AOB. Incomplete eruption of incisors during early stage of individual's development (mixed dentition stage) has been associated with high prevalence of AOB malocclusion (9).

Anterior open bite cases may be associated with pathological conditions like trauma. AOB is uncommon in maxillofacial patients who present with Le forte 1 and condylar neck fractures. In both cases the direction of displacement of the bony fragments leads to malocclusion. Bilateral condylar fractures may be followed by displacement of theramus superiorly by the masticatory muscles. This subsequently result in premature contact of the posterior teeth and AOB deformity(43). Similarly, Le Fort fractures that leads to posterior and inferior displacement of the maxilla, may also cause premature contact of the posterior teeth and AOB malocclusion(44).

In conclusion it is clear that several factors are associated with the etiology of AOB and that cases related to habits (especially the digit and tongue habits) are the most common. The pathogenesis of most habits could be explained by the equilibrium theory.

A clear understanding of the etiology and pathogenesis of AOB is essential in the diagnosis, prevention and management of this malocclusion. Common AOB cases that are associated with simple etiologic factors such as digit sucking or simple tongue thrust should easily be managed by the dentist. However, those associated with complex etiologies like aberrant skeletal development, neurological disturbances (cerebral palsy), disproportionately large tongue (Down's syndrome) and others should be rightfully diagnosed and referred for specialised orthodontic care.

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