IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A review on tongue and speech charecteristics in anterior open bite patients.

Dr.K. Senthil Kumar, P.Aiswarya, N.Aprose, Dr. Mohamed Afradh, Dr.Laavanya

Professor, Student, Student, Reader, Reader

Thai Moogambigai Dental College And Hospital,

Introduction

Anterior open bite (AOB) is one of the most challenging orthodontic problems to correct because it results from the loss of contact between the anterior maxillary and mandibular teeth. It can happen to anyone, regardless of skeletal structure. Because it impacts face aesthetics and communication skills, this type of malocclusion may have a detrimental impact on patients' quality of life [1,2,3]. Although its etiology is multifaceted, it has been linked to interactions between several factors such as genetics, environment, lifestyle choices, changed function, posture changes, neuromuscular inadequacies, and airway obstruction [2,4].

Anterior open bites (AOB) are a kind of dentofacial discord (DFD) that affects esthetics, speech, and food incision; permanent repair needs orthodontics, skeletal stability, and/or orthognathic surgery.[5-8] Because of their multiple genesis and proclivity to relapse, AOB malocclusions are among the most difficult to cure.[8,9] AOB affects 3.5% of children aged 8 to 17 years old; 17% of non-growing individuals undergo surgical orthodontics to address AOB.[10-12]

The tongue is involved in a number of oropharyngeal activities, including respiration, speech, chewing, and deglutition. [13] This muscular organ not only defends the airway from spills and sustains tonic muscle contraction to keep the airway patent, but it also exerts large sustained and instant stresses on teeth and their supporting structures.[14] Because the tongue is located deep within the oral cavity and is inaccessible to many tools, determining its anatomy and function can be difficult. [15] Although it is well known that tooth alignment and inter-labial closure (pressure) play significant parts in functional articulation and speech production [16,17,18], their links to the type and degree of malocclusions are debatable, with few studies addressing this problem [19].

Methods of measuring dental arch

Upper/Lower intermolar width	Straight line measured between the centre point of the mesial fossa of the right molar and the mesial fossa of the left molar. The measurement was not performed when one or both of the molars were absent
Upper/Lower Intercanine distance	Straight line between cusp tips of right and left canines or the middle of the facet resulting from attrition. The measurement was not performed when one or both of the canines were absent
Upper/Lower Length	Straight distance from interdental papilla tip between central incisors to a tangent through mesial surfaces of the second molars
Upper/lower intercanine distance	Straight line between cusp tips of right and left canines or the middle of the facet resulting from attrition. The measurement was not performed when one or both of the canines were absent
Upper/lower perimeter	Sum of four segments: from distal surface of primary second molars or mesial surface of first permanent molar on one side (passing over the contact points) to mesial deciduous or permanent canine on both sides. The other segments were measured from mesial deciduous or permanent canine to a point between two central points on both sides
Upper/lower total length	Straight distance from interdental papilla tip between central incisors to a tangent through mesial surfaces of the second molars
Upper/Lower Interpremolar width	Straight line measured between buccal cusp of the right first premolar and the buccal cusp of the left first premolar. The measurement was not performed when one or both of the molars were absent
Upper anterior length	Distance form interpremolar or deciduous intermolar papilla to the contralateral side
Upper posterior length	Distance form intermolar papilla to the contralateral side

[1]

Tongue motion pattern

Tongue motions are essential throughout the feeding process. Suckling, simple tongue protrusion, sucking, chomping, tongue tip elevation, and lateral tongue movements are the six usual patterns shown in sequence of primitive to more mature patterns.[20]

The presentation of tongue thickness over time in patients with AOB indicates higher dynamic changes in the mid-tongue dorsal surfaces during swallowing in both the sagittal and coronal views. For the majority of patients with normal occlusion, the sequence of motion is flatter in both the posterior as well as anterior areas.[13]

Tongue thickness, motion range and velocity

The tongue has become thicker and bunched. The movement is an outward extension of the lips' boundary. The movement is strong, and it is accompanied by an extraordinary increase in muscular tone. This can happen as part of a total body extension pattern or with head and neck hyperextension. The tongue thrust may make inserting a utensil into the mouth difficult or may cause food to be ejected during feeding. The tongue may shove into the cup or protrude in a very tight, bunched form beneath the cup while drinking.

The average thickness of the middle section of the tongue at rest is virtually the same in both sagittal and coronal views for patients with AOBs and normal occlusion. Swallowing has a wider motion range than chewing. AOBs have a tendency to have a broader range of motion and a higher velocity when swallowing than others.

Tongue motion and its correlation with skeletal pattern

Tongue habits and aberrant tongue movement have been linked to AOB, however the cause-effect relationship between the tongue and AOB is still debated [21,22]. It is also uncertain whether there are distinctions between ethnic groups. AOBs, on the other hand, had a wider range and velocity of motion, as well as a bigger area of constant movement of tongue segments, particularly during swallowing. The AOBs may have poorer regional coordination or fine motor control of functional tongue motion.

Studies have also discovered that tongue thickness and motion while eating and swallowing were, to some extent, related to skeletal traits. Mandible size, for example, may influence changes in tongue thickness during eating because tongue thickness was positively linked with mandibular body length, mandibular length, and mandibular mid-width in both sagittal and coronal perspectives. Because an increased gonial angle was strongly connected to a greater tongue thickness in sagittal view, the tongue thickness and peak velocity during swallowing may be related to the inclination of the mandible.

The motion velocity during chewing was associated with various mandibular traits, including its mid-width internal ramal tilt. These findings also show that tongue thickness at rest and during eating, as well as chewing motion range, are mostly related to mandibular dimensions, but swallowing motion is more dependent on facial height, particularly in coronal view.

The tongue exerts short- and long-term stresses on the surrounding dentition, these forces may result in the formation of an AOB [22,23]. A number of publications [21-26] have found a link between the development of AOB and a tongue thrust swallowing habit. Another theory for the difference in functional tongue movements is that the tongue may have been altered to accommodate dental and craniofacial traits, which in turn may have modulated the neuromuscular system to accommodate functional requirements, such as tongue thrusting. [27,28]

Lip pressure, lip muscle activity, and speech function

Due to morphological irregularities, malocclusion can result in poor speech function, and AOB is one malocclusion that has been linked to articulatory speech difficulties. [29,30,31,32]

AOB individuals have some anatomic anomalies that may alter the interaction of the tongue with the lips, teeth, palate, rugae, and oropharynx, impairing articulation. AOB is associated with speech disorder, and the link between AOB and improper swallowing/sigmatisms has been found to be as high as 75% [28,29,33,34].

Lips play an important role in speech function as well. AOB patients frequently have increased vertical height, proclination of incisors, and incompetent lips, making it difficult for them to shut their lips and acquire proper bilabial consonant patterns. As a result, AOB patients are more likely to have decreased lip pressure, which may result in phonation changes. Furthermore, a lack of lip pressure on the anterior teeth allows for a larger vestibular tilt, worsening AOB. However, some argue that the link between AOB and functional speech impairments is unclear [35]. Lopez-Perez et al. discovered no link between speech impairments and AOB in Mexican Down syndrome children [36].

There is little information available about AOB's real-time lip pressure and articulation state. Even while reduced inter-labial pressures were not found during lip closure in this investigation, the lip muscle (OO) did demonstrate considerably lower activity, indicating a lack of lip function. Many studies articulation assessment supports the premise that AOB is more likely to have disrupted articulation.

AOB and articulatory deficiencies do not directly correlate. Some EMG results also revealed more isolated effort and a longer duration of lip and jaw-opening muscle activation in AOBs during sound production. These characteristics suggest that AOBs may be able to compensate for occlusal abnormalities and achieve acceptable pronunciation by exerting more effort on articulatory components such as the lip and jaw-opening muscles.

It has been shown that the more severe or disabling the malocclusion, the more likely it is that a speech sound error will develop [37]. As a result, more participants with varying degrees of AOB are required for future research into the effects of AOB on articulation and speech function.

Orthognathic surgery and speech

The role of orthognathic surgery in the repair of malocclusion is complex, owing to corrections in both tooth position and jaw position. Higley [38] made one of the first comments, presenting two case reports of patients who had undergone mandibular surgery; one patient's general intelligibility of speech improved, while the second just replaced an anterior stigmatism for a lateral one. Goodstein [39] discovered no difference in speech in five patients who had their mandibular length reduced. Speech problems may actually worsen following surgery due to the jaw being moved.[40]

Dalston and Vig[41] discovered no postoperative speech changes in 40 female orthognathic patients in a larger investigation. Ruscello[42] stated in a significant review that surgical change of the morphology of the mouth cavity does affect the articulators and improves previously disordered speech.

Yamaguchi[43] discovered that majority of the 15 adult Japanese patients who had surgery to repair a mandibular prognathism exhibited clear improvement in a filmed speech analysis. There was no statistical analysis of the data, and there is an urgent need for concentrated scientific inquiry in this area. The evidence is currently ambiguous, and no guarantees of improvement can be made to patients undergoing orthodontic or orthognathic treatment of a malocclusion.

Conclusions

Many of the traditionally linked relationships between occlusal characteristics and speech disorders lack scientific support. The research issue is laden with peril. Speech is a human-only activity, and animal experiments have almost no place in the study of speech generation.

Some sounds appear to be more sensitive to changes in oral anatomy than others. This could be related to the difficulties of individual sound generation, as the sounds obtained last are the most frequently reported as distorted.

The ability to adapt and compensate appears to play a significant role. Bloomer summarized this well:

Normal structure + normal function = normal speech

Abnormal structure + adaptive

function = normal speech

Abnormal structure + no adaptive

function = abnormal speech

Normal structure + abnormal

function = abnormal speech

As a result, the advise is to carefully examine speech when inspecting and evaluating a patient. During normal speech, recognition of often misarticulated sounds should be possible, and any probable relationship to malocclusion should be made. There is no convincing evidence that orthodontic therapy will improve articulation difficulties, so collaboration with a speech therapist is crucial.

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