(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 5, Issue 1, Page No: 1060-1068
January-February 2022

IJMSCR

Role Of Tongue In The Development Of Malocclusion

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

The tongue that brings healing is a tree of life. Words may heal or break so think twice before using tongue. The normal functioning tongue exercises its greatest influence upon the teeth during deglutition, and even on the position of developing dentition leading to normal occlusion and if abnormality is present then it leads to malocclusion. Therefore, the position, posture and physiology of the tongue plays a critical role in the development of normal occlusion and any deviation from it can lead to pathology. Understanding the physiology, anatomy of the tongue at the earliest is of utmost important to prevent the undesirable sequel and to know the different corrective (orthodontic with or without surgical) treatment modalities to amend the malocclusion caused because of the abnormal tongue.

Keywords: Occlusion, Malocclusion, Tongue, Habits, Developmental Disorders

Introduction

The tongue that brings healing is a tree of life. Words may heal or break so think twice before using tongue. Tongue is located in the floor of mouth. It is a muscular organ with mucous membrane covering.[1] The normal functioning tongue exercises its greatest influence upon the teeth during deglutition, and even on the position of developing dentition leading to normal occlusion and if abnormality is present then it leads to malocclusion. Several studies have reported that the incidence of tongue thrust declines from 97 percent among new-born infants to from 25 to 35 percent at the age of 9 years. After this age, the incidence seems to stabilize.[2,3] Andrews[4] stated that , if there is an imbalance in the activity of the tongue and lips, either of it can influence the position of the developing dentition, and therefore the atypical swallowing habit should be corrected whenever possible. Fishman[5] also demonstrated that form and function have some direct relationship to the abnormal tongue posture and movement relating that position of tongue is related to dento-alveolar morphology. For this, the position of tongue should be evaluated in both the centric occlusion as well as in rest position as maximum time tongue remains in the rest position as abnormalities of both posture or function contributes to development of malocclusion and even speech defects.[6,7] It is known that the tongue's posture, position, size, form and function have significant effect on the developing dentition which if well balanced can lead to normal development of dentition and if any discrepancy is present in above mentioned factors than it may even lead to abnormal development of dentition. The aim of this literature is to know and assess the role of tongue in development of malocclusion as its knowledge may help orthodontist to prevent the malocclusion in later stage of life.

Anomalies of tongue[8]

Hippocrates, Galen and other considered the tongue as the barometer of health, emphasizing its diagnostic

and prognostic importance. Mostly occurs congenitally and those are known as developmental or congenital disorders if the tongue which are described in details below.

Developmental (congenital) disorders

Most of these disorders are related to its shape and size, though structural defects also exist.

1. Aglossia
2. Macroglossia
3. Microglossia
4. Ankyloglossia
5. Fissured tongue
6. Geographic tongue
7. Hairy tongue
8. Median rhomboid glossitis

Normal functions of tongue

The tongue is a mass of muscles covered by a mucous membrane that is important for taste sensation. Beyond its obvious role in eating—manipulating food into a bolus that can be safely passed into the throat with swallowing—it also has a vital contribution to speech and may even affect breathing, especially in sleep.

Function of tongue in development of normal occlusion[9]

The orthodontic profession, in order to advance as a scientific health service, must devote itself to the study of etiology, not only to improve corrective procedures, but also to prevent malocclusion. It is a fact that crowding in the arches plays a part in a great percentage of the malocclusions we see today. Many such irregularities trace their etiology to loss of mesiodistal dimension through early removal of deciduous teeth and similar interferences. Others may be caused by requirement of the arches to accommodate teeth which are too large for the bone structures which under lie them. Pernicious habits, deep overbite, displaced opposing teeth also play their part.

It is easy to see cases in which much crowding of the mandibular permanent incisors existed, as having corrected themselves spontaneously. Eby called attention to the fact that chronologic age does not always concur with physiologic age. Also, Lewis stated that most of the increase in space for the mandibular permanent incisors occurs during the eruption of these teeth. It is generally believed that the space which becomes available after this process is notably small. The studies of Black set forth the fact that in the mandible the average combined width of the deciduous canines and molars ordinarily is greater than that of the permanent canines and premolars by 1.7 mm. However, Broadbent" demonstrated a typical forward migration of the permanent molars upon exfoliation of the second deciduous molars. Nance" found that any space which might be gained for the anterior teeth by the interchange of smaller for larger buccal teeth is eliminated by this migration in most cases.

Orthodontists agree that the tongue in habitually abnormal movement can cause a variety of malocclusions. It has been the general concept that when pernicious habits of the tongue do not exist, that organ has a more or less passive effect upon the denture. The belief has often been expressed that after the arches are formed by innate growth processes, the tongue on the interior, and he lips and cheeks on the exterior provide a balance of forces to maintain given forms of the denture, whether normal or abnormal. Although universal acknowledgment is made of the power of the tongue to misshape the arches, little concerted St. Ltdy has been devoted to determine whether the tongue is an important factor in forming the arches originally tribute to the deformity.

Role of tongue in development of malocclusion[8]

According to habits

Habit which can cause malocclusions due to tongue as etiology is tongue – thrusting habit.

Tongue Thrusting

Tongue thrust is a defined as a condition in which the tongue makes contact with any teeth anterior to the molars during swallowing. Tulley 1969 - stated tongue thrust as the forward movement of the tongue tip between the teeth to meet the lower lip during deglutition and in sounds of speech, so that the tongue becomes interdental. Tongue thrust is an oral habit pattern related to the persistence of an infantile swallow pattern during childhood and adolescence

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and thereby produces an open bite and protrusion of anterior tooth segment.

Types of tongue thrust[9]

1. Physiologic -This comprises of the normal tongue thrust swallow of infancy.

2. Habitual - The tongue thrust swallow is present as a habit even after the correction of the malocclusion.

3. Functional - When the tongue thrust mechanism is an adaptive behaviour developed to achieve an oral seal, it can be grouped as functional.

4. Anatomic - Persons having enlarged tongue can have an anterior tongue posture.

Etiology

Fletcher has proposed the following factors as being the cause for tongue thrusting.

a. Genetic or heredity factor: They are specific anatomic or neuromuscular variations in the oro-facial region that can precipitate tongue thrust. E.g. hypertonic orbicularis oris activity.

b. Learned behaviour (habit): Tongue thrust can be acquired as a habit. The following are some of the predisposing factors that can lead to tongue thrusting;

1. Improper bottle feeding

2. Prolonged thumb sucking

3. Prolonged tonsillar

4. Upper respiratory tract infection

5. Prolonged duration of tenderness of gum or teeth can result in a change in swallowing pattern to avoid pressure on the tender zone.

Classification of tongue thrust

Fig 1- Classification of tongue thrust

Type I	Non deforming tongue thrust
Type II	Deforming anterior tongue thrust Sub group 1: anterior open bite Sub group 2 : associated procumbency of anterior teeth Sub group 3: associated posterior cross bite
Type III	Deforming lateral tongue thrust Sub group 1: posterior open bite Sub group 2 : posterior cross bite Sub group 3: deep overbite
Type IV	Deforming anterior and lateral tongue thrust Sub group 1: Anterior and posterior open bite Sub group 2 : proclination of anterior teeth Sub group 3: posterior crossbite.

Tongue thrust can also be classified as:[9]

1. Simple tongue thrust
2. Complex tongue thrust.
3. Lateral tongue thrust

According to pathologies

Developmental malformations, or defects may be major or minor, single or multiple, depending on their size and site of expression. Their incidence varies from country to country and from author to author.[10] It is referred that more than 20% of congenital defects in man result from simple Mendelian dominant or recessive inheritance and a further10% from extrinsic teratogens, such as viruses, drugs and environmental factors, radiation etc.[11] About10% of defects may be the result of major chromosomal anomalies. Developmental defects can be classified on purely anatomical grounds, such as defects of the face, skull, limbs etc., but where biochemical changes accompany the defects and make a discrete nosological entity, it is often easier to regard them as true biochemical disorders.[11]The most common malformations of the tongue combined with syndromes associated with them, are expandly discussed below. Malformations of the tongue, which are involved in congenital syndromes are classified in

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the following categories, while a small number of them is not classified in any categories. These are:

Aglossia

2. Microglossia

3. Tongue hemiatrophy

4. Tongue hemihypertrophy

5. Macroglossia

6. Long tongue

7. Accessory tongue

8. Ankyloglossia

9. Cleft or bifid tongue

10. Glossitis rhombica mediana

11. Lingual thyroid[12]

Role of swallowing pattern in development of malocclusion

Previous studies report that maxillofacial growth is influenced by genetic and environmental elements and that incorrect breathing, chewing, sucking, and swallowing are promoting factors of malocclusion.[13,14] The clinical presence of anterior open bite, skeletal class II or class III, is often associated with orofacial dysfunctions.[15] Moreover, some studies document the important role of abnormal swallowing in the relapse of the orthodontic treatment.[16,17] Several authors affirm that abnormal deglutition starts as a compensation mechanism derived from a pre-existing malocclusion. Others instead evidence how abnormal swallowing has the tendency to exacerbate malocclusions and to negatively influence the ongoing orthodontic treatment.[18]

According to developmental physiology, a distinction is drawn between infantile, mature, and inconstant swallowing.[19] Infantile or visceral swallowing is characterized by a forward movement of the tongue which promotes a continuous boost against the lingual surfaces of the anterior teeth. This clinical situation is physiological until 4 years, while afterward, it is considered dysfunctional and usually associated with malocclusions. On the other hand, a mature or somatic swallowing pattern is characterized by a cranial movement of the tongue, and the resulting boost is addressed on the incisive papilla. The maturation from a visceral to a somatic deglutition is gradual, and the transitional period is defined as inconstant swallowing.

Swallowing patterns have been linked to environmental factors,[20] tongue position and thrust, mouth breathing, and non-nutritive oral habits. The presence of altered swallowing can also be attributed to ankyloglossia, or tongue-tie: a congenital oral anomaly characterized by an abnormally short lingual frenulum and which negatively affects the growth and development of the stomatognathic system.[21]

Cayley et al. determined that children with an incorrect swallowing pattern may rarely touch the anterior part of the palate with the tip of the tongue.[22] In addition, lingual muscle action is interrelated with mandibular motility and position.[23] Patients with skeletal class III malocclusion have the highest rate of abnormal swallowing, as Fuhrmannand Diedrich in 1994 evaluated by using video-based B-mode ultrasound methods.[24]

Within a dysfunctional swallowing pattern, close attention must be paid to the tongue rest position. Anterior open bite is the predominant type of malocclusion in children aged between 6 and 8 years old.[25] Proffit et al. measured the force levels of the tongue against upper incisors and palate during rest position and normal swallowing. They stated that the tongue resting point was a more important contributing factor than the swallowing position in developing dental arch form.[26] Moreover, the results from the cinematic magnetic resonance imaging analysis described horizontal tongue movement among these individuals and the tendency of placing the tongue between teeth while speaking andswallowing.[27]

When oral dysfunction remains untreated, orofacial myofunctional disorder (OMD) may occur. OMD includes dysfunction of the lips, jaw, tongue, and/or oropharynx that interferes with the normal growth and the development and functions of the other oral structures. The lack of intervention during the critical periods may result in malocclusion and in adequate facial development.[28]

Tests to assess tongue condition

As a general rule, the tongue does not require much testing to assess its health and function. Beyond a visual assessment by a physician or dentist, further

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evaluation may require seeing a specialist. This may be an ear, nose, and throat (ENT) specialist, a neurologist, or even a speech-language pathologist. If indicated, testing may include:

1. Computerized tomography (CT) scan
2. Magnetic resonance imaging (MRI) scan
3. Biopsy
4. Flavour discrimination test

Treatments may depend on the underlying nature of any abnormalities identified. Optimization of the function of the tongue may require surgery, specialized exercises (including myofunctional therapy), or other inventions.

Management of abnormal tongue and habits related to it-

Tongue thrust often self-corrects by 8 or 9years of age by the time the permanent anterior teeth completely erupt. The self-correction occurs because of an improved muscular balance during swallowing as the mature swallow is adopted. However it is seen that orthodontic interception is usually more successful than correction if initiated during the early mixed dentition stage of dental development or between ages 9-11 years. Treatment is generally not recommended when tongue thrust is present without malocclusion or a speech problem. If the tongue thrust is present with malocclusion but no speech problem orthodontic correction of the malocclusion will usually eliminate the tongue thrust. If the tongue thrust is present along with malocclusion and a speech problem, speech-and orthodontic correction are needed.

Management of developmental anomalies of tongue

Management of Aglossia

The term Aglossia implies “the absence of tongue”. It is a rare malformation attributed to the failed embryogenesis of developmental swellings during fourth to eighth intrauterine weeks. Microglossia and Hypoglossia refer to the presence of “a very small or rudimentary tongue”. However, all the three terms have been used in co-occurrence in literature.[29]

Possible treatments of aglossia sequelae have been discussed in literature. Borez et al used a palatal expander for mandibular expansion but the results were unsuccessful. The patient was reported to have lost the ability of phonation and swallowing.[30] It was assumed that palatal expanders are responsible for blocking the elevation of the hypertrophic floor of the mouth, thereby making both swallowing and speech difficult. Surgical treatment to build up the tip of the tongue has been suggested in literature, but later it was maintained that surgical reconstruction of tongue is not required as mastication, swallowing and taste sensations are usually intact, and improvement of speech has no link with surgical intervention. A multidisciplinary approach is needed for adequate function and esthetic rehabilitation of the patient. In early stages, speech therapy should be employed to correct the delayed and slurred speech. Orthodontic, orthopedic and surgical measures are required to correct malocclusion and jaw alignment. Modified palatal expanders often worsen the situation. Distraction Osteogenesis following symphyseal osteotomy has also been suggested. A better alternative for mandibular expansion is the use of rapid prototyping models for making custom made tooth and/ or bone-borne distractors. Distraction vectors are then carefully determined. Prosthetic rehabilitation should be considered with the option of fixed or removable prosthesis. Implant-supported prosthesis may be considered if sufficient bone height and width is present. Otherwise in most cases ridge augmentation with bone grafts may be needed accounting to severe resorption. Difficulties in swallowing and pooling of liquids occurs in the floor of mouth due to the absent tongue. Tongue prosthesis has been advocated in literature in 1972, by Moore. This type of prosthesis provides the patient with a foundation for directing food and thereby assisting in swallowing, as well as speech.[31]

Management of Microglossia

The findings of isolated microglossia can be explained with an understanding of head and neck embryology. Our patient had a defect of the oral tongue, a 1stpharyngeal arch derivative, and a normal pharyngeal tongue, a 3rd & 4th pharyngeal arch derivative.

The mandible is also a 1st arch derivative. Thus, our patient had an isolated 1st arch defect. Hypothetical causes of isolated microglossia vary from vascular anomalies, to syndromes, medications, and tongue thrusting, but none of these theories have been

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substantiated. Microglossia may also be associated with distal limb abnormalities. During the work-up of isolated microglossia, it is important to check for functional thyroid tissue because the thyroid develops at the same time as the tongue during the 4th week gestation. The status of the mandibular condyles must be assessed, as absence of these structures is a contraindication for early Mandibular dysfunction osteogenesis (MDO).When this child was a neonate, we elected for conservative management because the patient had mild airway obstruction and an unknown neuro developmental potential. The evidence for performing MDO for feeding difficulties is also somewhat limited. Lidsky et al made a case for using early MDO to resolve feeding difficulty in children with Pierre Robin Sequence. In a subset analysis of 53 isolated, non-syndromic, Pierre Robin patients, the authors found that 14 of 14 (100%) of early MDO patients did not require a G-tube. Another study by Gursoy et al looked at 10 syndromic infants, treated early with MDO. After 5 years, there was a high relapse rate from inadequate mandibular growth compared to the mid face. They recommended waiting for facial skeletal growth before distracting patients without significant airway compromise.

Management of Macroglossia

Macroglossia is an uncommon condition that can lead to several alterations like dental-muscle-skeletal deformities, orthodontic treatment instability, masticatory, and breathing and phonation problems, characterized by increased size of the tongue, can be caused by congenital malformations or acquired diseases. The most common causes are muscle hypertrophy and congenital vascular malformations, such as lymphangioma and hemangioma.[32] It can be acquired as a result of amyloidosis, myxedema, angioedema, and macromegalia.[33] The tongue can also be normal in size but can seem increased when compared with adjacent structures because of antero posterior mandible or maxillary transverse deficiency or also due to cysts, tumours, and tonsillar hyperplasia that can move up and out the tongue. This last condition is called pseudo macroglossia and must be differentiated from true macroglossia, because its correction is achieved by treating the primary disease.[34]

Accurate diagnosis of true macroglossia is obtained through the signs and symptoms of this alteration, which is of fundamental importance for the correct indication for surgical treatment, in order to restore proper function and provide stability for orthodontic treatment.[35]

The surgical treatment indicated for the true macroglossia is the reductive glossectomy. Several techniques have been proposed in the literature to enable the reduction of the tongue. Peripheral incisions with marginal resection of tissue have as complications hypo-mobility and change in the form of the tongue that becomes globular.[36] Incisions V-shaped positioned in the midline of the tongue are effective in reducing the length but are ineffective in reducing the width of the tongue.[37] Elliptical incision positioned in the midline without reaching the apex of the tongue contributes to reducing the width with little influence on its length.[38] Incisions in the form of keyhole combine characteristics of elliptical and V-shaped incisions and are indicated when the reduction of the width and length of the tongue are desirable and its design can be changed according to the specific needs of each case.

Management of Ankyloglossia

An abnormally tight lingual frenulum often makes the tongue tied down to the floor of the mouth restricting the functions of tongue. Tongue-tie may cause problems which may exist since birth such as breast feeding and swallowing to problems which may persist through lifetime such as dysarthria, mechanical problems, and social issues.[39] An abnormally low position of the tongue may cause mandibular prognathism with maxillary hypo-development due to an exaggerated anterior thrust leading to Class III malocclusion.[40] Whereas, somewhat higher position of tongue in the mouth may lead to tongue thrust causing posterior or anterior open bite. Moreover, excessive forces while retrusion of tongue by patient may cause blanching of tissues, gingival recession, and midline diastema in lower central incisors.

Certainly, children with ankyloglossia are often found to have no speech problems. It is therefore recommended that frenulectomy is only considered as part of the management of speech problems when speech is significantly and noticeably affected and consistent with tongue-tie.[41] The difficulties in articulation are evident for consonants and sounds such as “s, z, t, d, n, l, j, zh, ch, th, dg,” but most

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difficulty is found in production of lingual-alveolar sounds (particularly/l/) and inter dental sounds (voiced and voiceless/th/) because the tongue tip needs to be maximally elevated (up to the alveolar ridge) for the production of/l/ and maximally protruded (up to the lingual surface of the maxillary incisors) for production of /th/. Tongue- tie could be considered a contributing factor if one cannot produce these sounds in the presence of all other speech sounds being produced normally. Therefore, in evaluating the effect of ankyloglossia on speech, it is important to focus on lingual-alveolar sounds.

The muscles of the tongue are as readily trainable as muscles of any other muscle of the body. Hence, the training exercise must be started immediately after surgery.

The following exercises were advised:

(1) stretch the tongue up toward the nose, then down toward the chin and repeat,

(2) open the mouth widely and touch the big front teeth with the tongue with mouth still open, and

(3) close the mouth and poke the tongue into the left and right cheek to make a lump: for 3–5 min bursts, once or twice daily for 3 or 4 weeks postoperatively.[42]

Post-operative exercises following tongue-tie surgery are intended to develop new muscle movements which were restricted before surgery and encourage tongue movements related to cleaning of the oral cavity.

Management of Cleft or bifid tongue

The tongue develops during the fourth week of intra uterine life, originating from a median swelling, the tuberculum impar on the floor of the pharynx and two lateral lingual swellings joining this central structure. These lateral lingual structures grow rapidly to cover the tuberculum impar to form the anterior two-thirds of the tongue. When this process is disturbed, tip of the tongue is divided longitudinally for a certain distance giving rise to cleft tongue/bifid tongue. Treatment includes surgically creating raw wound surface along the bifid border and then suturing them together to heal as a single unit.

Management of Median rhomboid glossitis

Median rhomboid glossitis is a condition characterized by an area of redness and loss of lingual papillae on the central dorsum of the tongue, sometimes including lesions of the tongue and palate. It is seen in patients using inhaled steroids and smokers, and is usually a kind of chronic atrophic oral candidiasis, but hematinic deficiency and diabetes should be excluded. The diagnosis is usually made on the clinical appearance, and tissue biopsy is not usually needed. The histologic picture is one of superficial candidal hyphal infiltration and a polymorphonuclear leukocytic inflammatory infiltrate present in the epithelium. The rete ridges are elongated and hyperplastic (pseudo-epitheliomatous hyperplasia, which may be mistaken for carcinoma).Treatment may involve smoking cessation and prescription of topical or systemic antifungal medication. Usually the mucosal changes resolve with antifungal therapy, but sometimes the lesion is resistant to complete resolution.[43]

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