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The Tongue and Malocclusion

A Project Submitted to the College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled "**Tongue and Malocclusion**" was prepared by **Abd Al-Rahman Shaker Mahmood** under my Supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor's name: Lecturer Dr. Jinan E. Saloom

Date: /4/2023

Dedication

To the kindest hearts in my life my mother and my father… who give me all the support and care in my life…

To the closest person to me my brother, sister and my friends…

Last but not least to all healthcare workers who fighting against covid -19 with great person risk…

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Introduction

Malocclusions are highly prevalent in childhood and adolescence, being considered a worldwide health problem. It also can be defined as a change in growth that affects the occlusion of the teeth. In schoolchildren, malocclusion can lead to non-aesthetic traits, a poor lingual position, and also changes in speech, which can affect the quality of life **(Alhammadi *et al.*, 2018)**.

Orthodontists agree that the tongue's habitually abnormal movement can cause a variety of malocclusions. It is universally acknowledged that the power of the tongue misshapes the arches and many concerned studies has been devoted to determine whether the tongue is an important factor in malocclusion. Malocclusion could also be caused by abnormal functions, for instance, mouth breathing, tongue thrust, swallowing, and unilateral chewing and also by abnormal postures of oral circumferential muscles like forward tongue thrust, tongue biting, and low tongue at rest. Forces from unintentional and habitual behaviors constantly working on the maxillofacial and alveolar regions can cause the bony structures to generally deform, bringing about jaw deformity and malocclusion **(Lúcio *et al.*, 2013)**.

Growth of the maxilla and mandible is influenced either by genetic and/or environmental factors. It is currently accepted that genes and gene products regulate craniofacial morphogenesis. However, these gene products do not determine growth and specific form, but they rather provide factors that may affect the receptivity and responsiveness of cells to intrinsic and extrinsic stimuli **(Rabelo *et al.*, 2011)**. Therefore, it appears that a range of physiologic, pathologic, and mechanical factors can influence growth. Although it has been shown that a close form and function relationship exists, the degree of interplay is still a matter

of discussion. In order to assess any environmental effects on the development of malocclusion the knowledge of its association with given environmental factors, ie. tongue posture would be useful **(Hitos *et al.*, 2013)**.

Aims of the study

This review aimed to:

To know the tongue concerning its, structure, position, size and functions and To enlighten the tongue thrusting, swallowing and its effect on the development of malocclusion and its management.

Chapter One: Review of Literature

1.1 Tongue structure

The tongue is virtually unique in the body as it is a deformable structure, with no bones, joints or air-filled chambers, which nonetheless, must move about within the oral cavity. The human tongue consists of eight pairs of skeletal muscles—four extrinsic muscles (attached to bony attachment): the genioglossus, styloglossus, hyoglossus, and palatoglossus, and four intrinsic muscles (without any bony support): the transversalis, verticalis, inferior longitudinalis, and superior longitudinalis. **(Figure 1)** Extrinsic muscle fibers originate from external bony attachments and terminate in the tongue, whereas the intrinsic muscles originate and terminate within the tongue mass. Instantaneous whole tongue movements are attributed to former, lingual shape deformation to the latter **(Zaidi *et al.*, 2013)**.

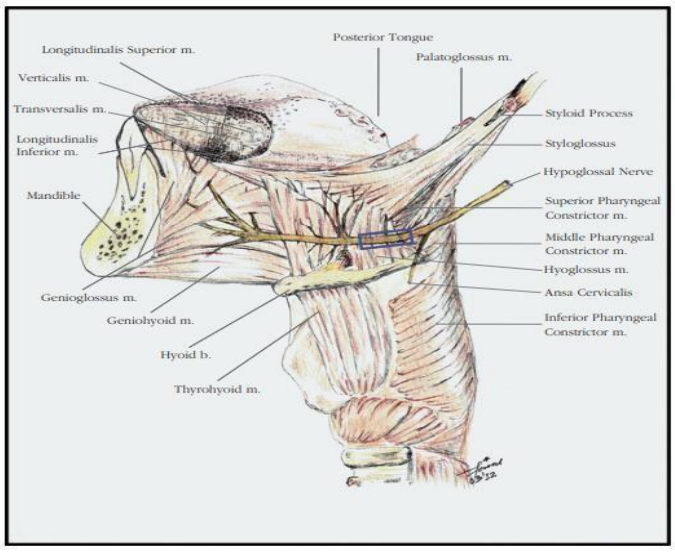

Figure 1: Sketch diagram showing the neuromusculature of the human tongue (Zaidi *et al.*, 2013)

1.2 Functions of Tongue

1.2.1 Mastication

The tongue assistance in mastication is well recognized. Besides controlling, with the assistance of the buccinators the position of the food between the teeth, it also turns the food and mixes it with saliva. On the other hand, it has been evident that the tongue significantly influences masticatory efficiency **(Lin *et al*., 2013)**.

1.2.2 Swallowing

Swallowing patterns have been linked to environmental factors, the tongue position and thrust, mouth breathing and nonnutritive oral habits. The presence of altered swallowing can be attributed to ankloglossia, or tongue tie: a congenital oral anomaly characterized by a short lingual frenum and which negatively affect the growth and development of the stomatognathic system. children with an incorrect swallowing pattern may rarely touch the anterior part of the palate with the tip of the tongue. In addition, lingual muscle action is interrelated with mandibular mobility and position. **(Figure 2)** The role and position of tongue are essential to a physiological swallowing. In children, in deciduous and mixed dentition, atypical or inaccurate lingual postures are consistently associated with facial deformities **(Hitos *et al*., 2013)**.

1.2.3 Speech

Speech disorders or abnormal articulating of one or more sound have a complex multifactorial origin, however the genetic component is the most well documented as a basis of speech disorder. Spoken language formation requires a complex co-ordination of neurological path that regulates the tongue, check, teeth,

lips, alveolus and other vocal apparatus. Hence the spoken language depends on physiological ability to form sound waves that translate through the air are eligible of vibrating the eardrum, the speech apparatus that reproduce these sounds via manipulating air stream including lung, larynx and upper tract including the throat, mouth, palate and nose **(Fisher, 2003)**.

1.2.4 Breathing

While the tongue is at rest, nasal breathing occurs. But a habit or a force is always associated with forced mouth breathing. Physiological breathing plays an active role in harmonious craniofacial development, but when external factors alter its mechanism, its influence on the development of the skull leads to functional and skeletal alterations. Breathing can be classified into 3 types: - nasal; mixed (oro-nasal) and oral. Nasal breathing corresponds to the physiological pattern, while the mixed and oral types are consequences of breathing alterations. Oral breathing is a parafunctional habit whereby air passes exclusively or partially through the mouth instead of the nose, and it is accompanied by skeletal and functional alterations in the orofacial development **(Zicari *et al*., 2009)**.

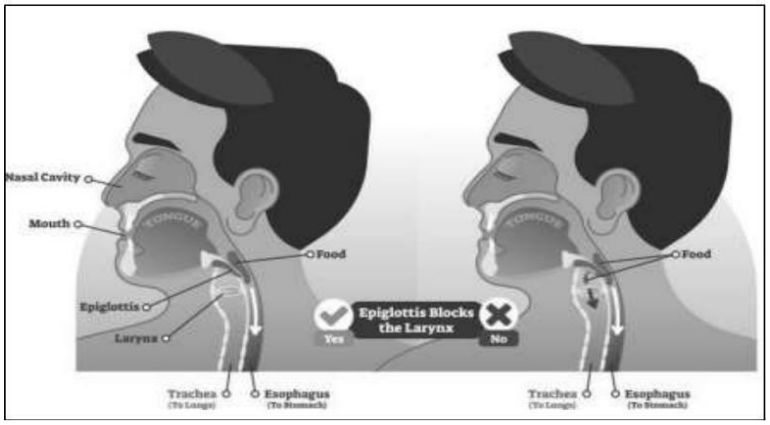

Figure 2: Phases of swallowing (Chakraborty *et al*., 2020)

Therefore, it seems entirely reasonable that an altered respiratory pattern, such as breathing through the mouth rather than the nose, could change the posture of the head, jaw, and tongue **(Proffit, 2019)**. This in turn could alter the equilibrium of pressures on the jaws and teeth and affect both jaw growth and tooth position. To breathe through the mouth, one must lower the mandible and tongue and extend (tip back) the head. If these postural changes were maintained, three effects on growth would be expected: (1) anterior face height would increase, and posterior teeth would super-erupt; (2) unless there was unusual vertical growth of the ramus, the mandible would rotate down and back, opening the bite anteriorly and increasing overjet; and (3) increased pressure from the stretched cheeks might cause a narrower maxillary dental arch **(Kim, 2015)**.

1.3 Tongue position and Malocclusion

Malocclusions are related to altered tongue position and speech distortion, regarding tongue position it was found that schoolchildren that presented anterior open bite and oral–/oral-nasal respiratory are more likely to have altered positions of the tongue **(Wertzner and Fonologia, 2004).**

Primozic *et al.* (2013) showed that Class III subjects have a significantly lower tongue posture as compared to Class I subjects. The lower tongue posture has also been associated with greater values of the parameters (surface area and volume) describing the mandibular alveolar morphology, while the transverse widths of the dental arches appear not to be influenced. Class III patients showed a significantly greater mouth floor surface area and volume as compared to the Class I subjects.

1.4 Tongue size and Malocclusion

The normal size of a tongue is variable and differs with increasing age, with the greatest growth occurring in the first 8 years since birth and attaining full growth at 18 years of age. Macroglossia generally refers to long term painless enlargement of the tongue which protrudes beyond the alveolar ridge or teeth **(Martínez *et al.*, 2016)**. It is an uncommon anatomical abnormality and is usually a sign of an underlying condition and rarely seen alone. It is seen in a wide variety of conditions**(Figure 3)**. Isolated macroglossia is very rare and is inherited as an autosomal dominant trait. Depending on the size of the tongue and other structures in the oral cavity, it can be classified as true macroglossia and relative macroglossia **(Murthy and Laing, 2004)**.

True and relative macroglossia may be further subdivided into congenital and acquired disorders. In true macroglossia, there is an apparent enlargement of the tongue due to an underlying disease or condition, and relevant histopathological findings can be noted. In relative macroglossia, the tongue appears larger than compared to other structures in the oral cavity. Prominent examples include Down syndrome, where tongue appears enlarged due to hypotonia and Pierre Robin syndrome due to micrognathia **(Topouzelis *et al.*, 2011)**.

The diagnosis is usually based on subjective criteria such as tongue shape and protrusion, the presence of speech difficulties and deglutition or respiratory problems. The most important sign of macroglossia is tongue protrusion through the lips. The enlarged tongue appears clinically normal to palpation and the alveolar bone shows a reduction in thickness caused by tongue pressure. Tongue protrusion might cause anterior open bite, proclination of upper and lower incisors

and development of diastemas. Temporomandibular joint disorder and maxillofacial problems can be others clinical findings in patient with macroglossia **(Vritsali *et al*., 2005)**. Clinical consequences of macroglossia are noise during breathing, respiratory disorders, such as obstruction of superior airway, feeding difficulties leading to malnutrition and tongue infections caused by prolonged air exposition.

Tongue protrusion influences skeletal growth and can lead to the development of a skeletal Class III disharmony, increased gonial angle and anterior open bite. Treatment of macroglossia is still unclear, surgical tongue reduction is recommended in order to improve aesthetic appearance, speech and dental problems **(Topouzelis *et al*., 2011)**. Partial glossectomy often determines an improvement of the anterior open bite, although in more severe cases orthodontic treatment and orthognatic surgery might be useful for the correction of the malocclusion **(Spivey and Bradshaw, 2009)**.

Figure 3: 3.5-year-old boy presented with macroglossia (de Guilarte *et al*., 2009)

1.5 Tongue-Thrust Swallowing

Tongue functions during swallowing are of interest to many orthodontics, oral surgeons, neurophysiologists and speech therapist.

Three major problems are usually associated with abnormal forward tongue positioning—anterior open bite, protrusion of the incisors, and lisping**(Figure 4)**. **Proffit (2019)** suggests two major reasons for a relatively high prevalence of anterior tongue positioning in children, related to physiology (maturation) and to anatomy (growth). Infants normally position the tongue forward and downward in the mouth at rest and during swallowing to help establish an airway for respiration. An infant's swallow is characterized by strong lip activity, placement of the tongue tip against the lower lip, and relaxation of the elevator muscles of the mandible. Physiologic transitions in swallowing patterns begin during the first year of life as teeth erupt and continue over the next several years as oral function matures. There is a gradual activation of the elevator muscles of the mandible in swallowing so that a mature swallowing pattern is characterized by relaxation of the lips, placement of the tongue behind the maxillary incisors, and elevation of the mandible until posterior teeth come into contact in occlusion. This is usually observed before a child is 4 or 5 years of age **(Dean, 2016)**.

An abnormal swallowing pattern prolonged into the mixed and permanent dentitions is characterized by protrusion of the tongue between the anterior dentition, lack of molar contact, and excessive circumoral muscle activity.

The adaptation to the more typical adult swallowing pattern appears to be related to an increase in the functional space for tongue activity during adolescent growth changes. The mandible follows skeletal growth patterns that allow space for a downward and backward accommodation of the tongue. Vertical growth of the

dentoalveolar structures of the mandible and maxilla contributes to an increase in oropharyngeal space that allows the tongue to assume a more posterior position as the child proceeds through puberty. Transition toward adult swallowing patterns appears to be affected by a prolonged digit-sucking habit or by a skeletal malocclusion in which anterior open bite **(Fig. 5 and 6)** or incisor protrusion exists between the dental arches (e.g., Class II division 1). In these individuals, continued functional tongue protrusion during deglutition is viewed as an adaptation that maintains the anterior open bite and is not a primary etiological factor in causing the open bite. Studies have shown that there is no "equal balance" of forces on the dentition produced by the tongue vs. the lip musculature during functional activity. The expansive forces of the tongue are significantly greater than and not balanced by the containing forces of the lips. The shape of the dental arches and position of the teeth do not appear to be overwhelmingly influenced by the horizontally directed pressures of the lips and tongue during normal functional activities such as swallowing and speaking **(Pancherz *et al.*, 2014)**.

Figure 4: Anterior open bite resulting from a tongue thrust swallowing pattern (Dean, 2016).

Figure 5: Tongue thrust swallow (Jalaly *et al*., 2009)

Figure 6: Anterior tongue thrust associated with anterior open bite (Burford and Noar, 2003)

Many studies have demonstrated that tongue thrusting, also known as visceral swallowing or infantile swallowing, plays a significant role in the etiology of some orofacial deformities **(Bru¨ckl and Tra¨ger, 1962. and Graber, 1963)**. Tongue thrusting habit pose a special problem and the literature is replete with case reports demonstrating simple cases acquiring unexpected complications due to the presence of persistent tongue thrust. Several reported studies found tongue therapy to be effective in containing the habit and there was no relapse or reverting of the habit noticed **(Narayan *et al*., 2011)**.

A forward tongue posture, where the tongue rests between the incisors, may obstruct incisor eruption and lead to the development of an anterior open bite. This should not be confused with a secondary adaptive tongue thrust, in which the

tongue moves forward during swallowing to contact the lips and form an anterior oral seal secondary to an anterior open bite. A diagnostic feature on the lateral cephalograph suggesting forward tongue posture is the presence of a reverse curve of Spee in the lower arch caused by reduced incisor eruption. Tongue-thrust habits can be observed clinically with forced opening of the lips during swallowing. Orthodontists can easily notice the difference in tongue movements between a mature swallower and a tongue thrust swallower. However, a quantitative and qualitative diagnostic method for differentiating the two swallowing patterns has rarely been reported **(Chien and Paul, 2004)**.

Types of tongue thrust

Singaraju and Chetan (2009) classified the tongue thrust into:

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 behavior developed to achieve an oral seal, it can be grouped as functional

4. Anatomic tongue thrust: Persons having enlarged tongue can have an anterior tongue posture. **[Figure 7]**

Figure 7: Different type of tongue thrust, (a) Anterior tongue thrust, (b) posterior tongue thrust, (c) both anterior/posterior tongue thrust, (d) lateral tongue thrust due to delay in eruption of permanent posterior teeth, (e) unilateral tongue thrust – unilateral posterior open bite **(Singaraju and Chetan, 2009)**

James Braner and Holt classification (Singaraju and Chetan, 2009)

Type 1: Non-deforming tongue thrust

Type 2: 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 3: Deforming lateral tongue thrust

Sub Group 1: Posterior open bite

Sub Group 2: Posterior cross bite

Sub Group 3: Deep overbite

Type 4: 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 cross bite

Moyers classification

According to **(Peng *et al*., 2004)**

Simple tongue thrust: Here the tongue thrusting with teeth are together

Complex tongue thrust: Here teeth are apart

Retained infantile swallow: Persistence of the infantile swallow

1.5.1 Intra oral features

According to **(Burford and Noar, 2003)**

1. Proclined, spaced and sometimes flared upper anterior resulting in increased over jet
2. Retroclined or proclined lower anterior depending upon the type of tongue thrust
3. Presence of an anterior open bite
4. Presence of posterior cross bites
5. The simple tongue thrust is characterized by abnormal tooth contact during the swallowing act. They exhibit good intercuspation of posterior teeth in contrast to complex tongue thrust
6. The tongue is thrust forward during swallowing to help establish an anterior lip.

1.5.2 Extra oral features

1. Usually dolichocephalic face
2. Increased lower anterior facial height
3. Incompetent lips
4. Expression less face as the mandible is stabilized by facial muscles instead of masticatory muscles during deglutition.
5. Speech problems like sibilant distortions and lisping, etc. Abnormal mentalis muscle activity is seen. **(Singaraju and Chetan, 2009)**

1.5.3 Management

The treatment of tongue thrust can be divided into various steps

1.5.3.1 Myofunctional therapy: which include orofacial myofunctional exercises for tongue thrust

Tongue exercises **(Khemka *et al*., 2015)**

1. Tongue spot: The child is asked to locate the spot behind the upper incisors on the palate. Hold the tongue at the postion for 10 seconds and repeat 10 times.

2. Tongue click: Placing the tongue against the roof of the mouth (at the spot) snap it down, to make a clicking or popping noise.

3. Swallowing thin liquid: The child is asked to take some water in the mouth, at the same time holding the tongue at the spot and Hold for 5 seconds and swallow.

4. Tongue-sideways movement exercise: This exercise involves protruding the tongue out and moving it in extreme right and left directions for 10 seconds in each direction and repeated 10 times on each side.

5. Tongue-rolling exercise: In this exercise, the child is required to roll the tongue by folding its edges toward the midline such that it resembles a taco shell. In this rolled position the child has to protrude the tongue out to the maximum extent possible while holding it for 10 seconds and repeated 10 times.

6. Hold of tongue blades and push the tongue: In this exercise, the child is expected to keep two tongue blades or ice cream sticks on the incisal edge of lower anterior teeth with 2–3 cm of the blade extending inside the mouth. Then, the child is required to try and lift the tongue blades against the resistance of the firmly held blades **(Fig. 8 and 9) (Ashith, *et al*., 2015**).

Figure 8: Hold of tongue blades (Oinam *et al*., 2022)

Figure 9: Tongue push exercise (Oinam *et al*., 2022)

7. Tongue retraction: In this exercise, the patient is required to touch the back of his tongue against the palate while holding it in this least of 3 seconds. This exercise is to be repeated 5 times at any given instant **(Oinam *et al*., 2022)**.

Figure 10: Teeth counting exercise (Oinam *et al*., 2022)

1.5.3.2 Removable appliance therapy:

Removable appliances use for tongue thrusting **(Yadav *et al.*, 2018)**

1. Oral screen

Oral screen is a myofunctional appliance. It is a thin sheet of acrylic processed over the occluded, waxed, working casts extending deep into the vestibular sulcus, both labially and buccally, which acts as a screen between the teeth and surrounding musculature **(Lin *et al.* 2013)**.

Modification of oral screen **(Lin *et al*. 2013):**

1. Double oral screen: a smaller lingual screen is attached to the oral screen with 0.9 mm stainless steel wire that runs through the bite in the lateral incisor region. It is useful in cases where there is simultaneous tongue thrusting and mouth breathing
2. Hotz modification – it has a projection of acrylic or wire to keep the tongue away.
3. Modified or rehak oral screen is combined with a nipple like projections which protroudes anteriorly which is to be retained by the lips. The natural sucking movements of the patient are used to enhance the effect of the screen.

2. Hawley Appliance with Tongue Crib

Armamentarium Used: 0.7 mm HSSW is used for the fabrication of adam s clasp, labial bow and a crib. Separating media is applied on the cast and is allowed to dry. It is followed by fabrication of acrylic plate using sprinkle on technique (Fig. 11) **(Pradeep *et al.*, 2022)**.

Figure 11: Hawley'S appliance with tongue crib (Abraham *et al.*, 2013)

1.5.3.3 Fixed appliance therapy:

Some of the fixed appliances used in tongue thrusting are:

1.Tongue crib with quad helix: Appliance Design: To correct the tongue thrusting habit and resolve the transverse, vertical, and functional deficiencies, we used quad helix, made of 0.036 inches stainless steel wire soldered to bands on the first permanent molars (Fig. 12) **(Ashith *et al.*, 2015)**.

Figure 12: Tongue crib with quad helix (Ashith *et al.*, 2015)

2. Modified Nance palatal arch appliance: Nance palatal arch appliances in which acrylic button can be used to place the tongue in the correct position (Fig. 13) **(Almuzian *et al.*, 2015)**.

Figure 13: Nance palatal arch appliances (Almuzian *et al.*, 2015)

3. Modified blue grass appliances

Appliance Design: The components of modified blue grass appliance were molar bands, stainless steel wire, lingual sheath and a hexagonal shaped acrylic roller (Fig. 14) **(Mithun *et al.*, 2020)**.

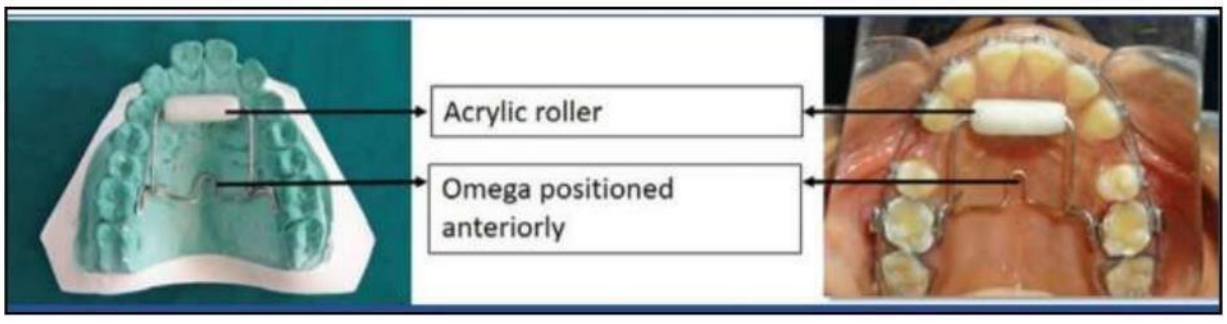

Figure 14: Modified blue glass appliances (Mohammad *et al.*, 2018)

4. Modified lingual arch with tongue crib

The modified lingual arch with tongue crib was soldered onto the molar bands, it was placed inside the patient's mouth and checked for any discomfort and interference (Fig. 15) **(Lin *et al.*, 2013; Raj and Chandra, 2020)**.

Figure 15: Modified Lingual Arch with Tongue Crib (Taslan *et al.*, 2010)

5. **Hybrid Appliance Design**

Hybrid Habit Correcting Appliance (Fig. 16) incorporates a tongue bead, a palatal crib and a U-loop which is attached to the molar bands on eith5. er sides **(Raj and Chandra, 2020)**.

Figure 16: Hybrid Appliance Design (Raj and Chandra, 2020

Chapter two: Discussion

Discussion

The tongue is basically a mass of muscle that is almost completely covered by a mucous membrane. It occupies most of the oral cavity and oropharynx. It is known for its role in taste, but it also assists with mastication (chewing), deglutition (swallowing), articulation (speech), and oral cleaning. Five cranial nerves contribute to the complex innervation of this multifunctional organ **(Adil and Meyers, 2017)**.

Deleterious oral habits are the common problem of pediatricians, which affects the quality of life. Oral habits are repetitive behavior in the oral cavity that result in loss of tooth structure and they include digit sucking, pacifier sucking, lip sucking and biting, nail biting, bruxism, self-injurious habits, mouth breathing and tongue thrusting **(Kumari *et al*., 2017)**.

Tongue thrusting is a condition in which the tongue is observed thrusting between, and the tooth do not close in centric during deglutition. Tongue thrust is an oral habit pattern related to persistence of the infantile swallow pattern during childhood and adolescence and thereby produces protrusion of anterior tooth segment and open bite. Such habits are considered to be normal in children up to the age of 4-5 year. However if these habits persist beyond the eruption of permanent teeth it could lead to various deleterious effect on the teeth. Thus identifying and treating tongue thrusting habit at an early age prevent the development of malocclusion in the future **(Shah *et al*., 2022)**.

Posterior crossbite is associated with altered tongue position and speech distortion. Anterior open bites and oral/oronasal breathing mode are also

associated with altered tongue position, but do not interfere in speech distortion. Deep bite appears as a protection factor for speech distortion and altered tongue position. This reinforces the importance of a multi-professional approach for treating children who have different types of malocclusions **(Assaf *et al*., 2021)**.

Chapter three: Conclusions and Suggestions

Conclusions

- Abnormal tongue behavior usually associated with dental and alveolar changes of maxilla and mandible.
- Tongue exercises, removable and fixed orthodontic appliance therapy can help children to properly swallow thus preventing major orthodontic problems, abnormal speech pattern and abnormal facial development.
- Tongue posture is significantly lower in Class III subjects as compared to Class I subjects and the difference is mainly present in the posterior regions. In all subjects, tongue posture is associated with the ratios of the dental and alveolar characteristics of the maxilla and mandible.

Suggestions

1. Survey study to know the preveleance of the tongue thrusting habit among the patients attending orthodontic clinic.
2. Further review study to include all the types of bad oral habits and their effects on the development of malocclusion.

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