

The Effect of (Tongue-Tie: Ankyloglossia) on Dentition and Occlusion: A Review

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REVIEW

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Abstract

This review discusses definitions, complications, etiologies, diagnoses, and management of ankyloglossia. Ankyloglossia is defined as a developmental anomaly of the tongue, which occurs when the lingual frenulum attachment is too tight to the tongue. Several protocols exist for the diagnosis of this condition, including that proposed by Hazelbaker, who assessed tongue movements (seven different movements) and five appearance characteristics (Hazelbaker Assessment Tool for Lingual Frenulum Function), as well as Kotlow's classification method, which categorizes the severity of ankyloglossia through the attachment of the lingual frenulum to the tongue. In addition, scenarios suggested for case management are related to the severity of the condition, which begin with a "wait and see" approach as a first-line treatment for management and subsequent surgical intervention scenarios.

Keywords: Ankyloglossia, Breastfeeding, Frenotomy, Tongue tie

1. Introduction

Ankyloglossia, also called tongue-tie, is a condition that results in impairment of the movement of the tongue due to its tight attachment to the floor of the mouth by the frenulum, causing disorders such as breastfeeding problems, poor speech articulation, malocclusion, etc. Unfortunately, no true definition, parameters, or diagnostic classifications are accepted by healthcare professionals to categorize this condition, and its treatment and/or management is controversial. This review will examine the symptomatology, diagnosis, complications, and management of this condition.

2. Definition

No standard definition has been put forth to describe tongue-tie, but the International Affiliation of Ankyloglossia Professionals termed ankyloglossia as

a condition in which "the lingual frenulum is the tissue remnant that exists in the midline between the floor of the mouth and the ventral surface of the mouth". When the attachment of this tissue is too tight, resulting in restriction in tongue movement, it will be called "symptomatic ankyloglossia" [1].

A group of otolaryngologists with experience in management and treatment of the tongue-tie condition agreed on a definition for ankyloglossia which states "ankyloglossia is a condition of limited tongue movement caused by a restrictive lingual frenulum" [2]. In addition, this panel of experts revealed that professionals were using the terms of "anterior and posterior ankyloglossia" in recent years [2].

Anterior ankyloglossia is a term used to describe the classic tongue-tie condition when the attachment of lingual frenulum is at or close to the tip of the tongue, resulting in impairment of tongue mobility [1]. On the other hand, posterior ankyloglossia is also a subject of controversy regarding diagnosis [2]. A

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panel of specialists termed it “a condition of restricted tongue movement caused by attachment of the lingual frenulum to the posterior aspect of the ventral surface of the tongue”. Others have described posterior ankyloglossia as submucosal tethering of the tongue [2].

3. Etiology of ankyloglossia

The exact cause behind ankyloglossia is equivocal. Some healthcare professionals relate this condition to an association with X-linked cleft palate syndrome. In addition, ankyloglossia has also been observed with rare syndromes, including Kindler, Opitz, and Van Der Woude [3, 4]. Despite these rare conditions, tongue-tie has been noted in patients with no congenital diseases and appears as a congenital anomaly in 0.1% to 4.8% of the population [5, 6]. There is evidence which indicates that ankyloglossia could be a consequence of environmental and/or genetic effects [6]. Molecular research and data analyses illustrate that the mutation that occurs on the TBX22 gene may be the cause of cleft palate, which is associated with ankyloglossia [7, 8]. It can be connected to a hereditary condition known as epidermolysis bullosa, specifically the recessive dystrophic type. The mechanism behind this condition is related to the nature of the disease, which causes blistering of the soft tissue, resulting in tissue separation and scarring, and as an outcome, the movement of the tongue could be restrictive and reduced as a result of the developed adhesions [9]. Some authors report a relationship between this condition and newborn infants from mothers who consumed cocaine during the pregnancy period [10].

4. Problems associated with ankyloglossia

4.1. Breastfeeding and oral ingestion

For infants, this significant issue may be the most prevalent. The importance of this complication is related to its effect on both the mother and infant. Firstly, the infant cannot get sufficient nutrition, whereas the mother may suffer from nipple trauma from ineffective nursing. For a neonate with restrictions in tongue movement, the child will have difficulties in gaining an adequate seal on the breast when nursing, and in order to keep the nipple inside their mouth, they will habit to use their gum pads. Subsequently, the milk flow into the mouth is inadequate, causing dissatisfaction and frustration for the nursing child, which may trigger biting of the nipple and resultant nipple trauma. In addition, authors have noted that the rate of weight gain in children with nursing difficulties is below the normal range,

and in severe cases, the neonate will fail to thrive. Concerning complications for the mother, nursing challenges may cause nipple trauma and severe breast pain while the child is feeding; inadequate drainage of milk, breast infections, and/or clogged milk ducts may occur [11–14].

4.2. Speaking difficulties

Controversies endure about whether ankyloglossia affects the speech and pronunciation of patients or not. Although some studies have demonstrated that it does not cause a delay in speech, ankyloglossia may affect speech intelligibility and pronunciation. The pronunciation of many sounds may be affected, including “th”, “s”, “d”, and “t” sounds, because the restriction of the tongue tip results in an inability of the tongue to reach the palatal gingiva of the upper incisors [15].

4.3. Problems associated with occlusion

In discussion of further issues noted with the tongue tie condition, orthodontists noticed that infants with ankyloglossia may develop an open bite. In a previously published study, ankyloglossia caused maxillary protrusion and consequently, an open bite [16]. The sequence of mechanics that causes this disorder begins when the tongue is raised to touch the palate to create an adequate seal. In patients with ankyloglossia, due to restricted tongue mobility, the tongue will not reach the most favorable position to create an optimal seal, which thrusts the tongue forward when swallowing. This applies force that pushes the upper anterior teeth up and out, hence maxillary protrusion and an open bite [12, 15, 17].

In more severe cases, in which the tongue is positioned much lower than normal, CL III malocclusion results, primarily from the difference in the growth proportions of the jaws. In this condition, the maxilla was not stimulated to grow because of the absence of force application from the tongue [16]. In some cases, malocclusion also may cause bruxism (teeth grinding), especially during sleep. Malocclusion is associated with interference of the tongue frenulum with the neutral position of the tongue facing the palate. This condition also can make the tongue fall backward when the body is relaxed during sleep and cause airway obstruction, leading to breathing disorders such as obstructive sleep apnea. When the tongue interferes with breathing during sleep, teeth grinding is an attempt to restore proper breathing by changing the position of the tongue [34]. The most recent studies about the relationship between malocclusion and ankyloglossia showed a controversial opinion, (Table 1) demonstrated some new studies

Table 1. Effects of ankyloglossia on dentition and occlusion.

Recent Studies	Conclusion
Deregibus A et al. 2021 [18]	The authors recommended that dental care providers should examine the tongue as an important aspect within the comprehensive examination of the malocclusion.
Calvo-Henríquez et al. 2023 [19]	This multicenter study supported the relation between class III malocclusion and short lingual frenum.
Frezza A et al. 2023 [20]	The authors concluded that the early detection and treatment of ankyloglossia to provide adequate mobility for the lingual frenum may prevent dental crowding and other complications in future.
Dydyk, A et al. 2023 [21]	The authors concluded that ankyloglossia can influence occlusion.
Deshkar M et al. 2024 [22]	The authors concluded that malocclusion may be associated with some tongue- related disorders. So, careful examination of tongue position and movement in rest and function is required.
Sawai A C et al. 2024 [23]	The authors demonstrated in their case report that the correction of tongue tie can help in the correction of lower teeth discrepancy and other associated complications.
Póvoa-Santos L. et al. 2024 [24]	The authors concluded in their systematic review that there is no strong evidence existing between ankyloglossia and occlusal or maxillofacial discrepancies.
Kwon TW et al. 2024 [25]	The author concluded that severe cases of ankyloglossia showed impact on occlusion. Also, this may not give clinical implications.

Table 2. Normal range of tongue motion [6, 11].

• Tip of the tongue should protrude outside the mouth without clefting. • Tip of the tongue should be able to sweep the lips easily without straining. • When the tongue is retracted, it should not blanch the tissue lingual to the anterior teeth • The lingual frenulum should not create a diastema between the mandibular central incisors • The lingual frenulum should not prevent the infant from attaching to the maternal nipple while nursing • Children should not exhibit speech difficulties

about the effects of ankyloglossia on occlusion and maxillofacial structures.

4.4. Other problems associated with oral hygiene

Ankyloglossia may obstruct the cleaning of the gingiva and teeth (particularly, the anterior teeth), as it is difficult to wipe the debris and plaque from the tooth surface leading to poor oral hygiene. In addition, gingival recession and irregular teeth arrangement, especially in the lower incisors which may result due to the presence of a short frenulum. In edentulous patients, tongue-tie interferes with the fit of the lower denture causing denture displacement when the tongue moves [2, 7].

4.5. Social concerns among children with ankyloglossia

Children with ankyloglossia may suffer from mockery because of difficulties in eating, licking their lips, drooling, or playing musical instruments, which could affect their self-confidence and cause psychological problems [2, 7].

5. Diagnosis

Ankyloglossia is an abnormal developmental condition associated with the lingual frenulum, which presents as a short, thick tissue attached distally to the floor of the mouth or close to (or onto) the alve-

olar ridge or extending from the tongue tip [11, 27] It is considered a common condition that is clinically observed in neonates; it may be symptomatic or may spontaneously resolve. However, babies may suffer from difficulties in breastfeeding, speech, swallowing, and other complications [27, 28]. Clinical assessment of this condition should begin with educational knowledge, including the normal range of tongue motor limitations, which are listed in (Table 2). After recognizing the normal characteristics of tongue movement, clinicians establish criteria to diagnose ankyloglossia. Hazelbaker composed diagnostic criteria including seven tongue movements and five characteristics for tongue appearance (Table 3). Furthermore, Kotlow assessed the “free tongue” length by measuring the distance from the point that indicated the attachment of the frenulum to the tongue and the tip of the tongue. According to these criteria, he classified ankyloglossia as mild, moderate, severe, or complete (Table 4) [7, 27].

In 1968, Fletcher and Meldrum determined the relative “free tongue” length, which is correlated to speaking difficulties [6, 15]. In 1985, Williams and Waldron introduced different criteria, which emphasize an evaluation of the function of the tongue. According to these criteria, the patient is asked to place their tongue tip on the maxillary alveolar ridge and to open his/her mouth as wide as possible. While maintaining this situation, the dentist measures the distance between the lower and upper incisors and appraises the tongue function [15]. In addition,

Table 3. Hazelbaker's criteria regarding appearance and function of the tongue in cases with ankyloglossia [17].

Functional Movement	Characteristic Appearance
-Lateralization 2: complete 1: body of the tongue but not the tip 0: none	-Appearance of Tongue when Lifted: 2: round or square 1: slight cleft in lip 0: heart shape
-Lift of Tongue 2: tip to mid mouth 1: only edges to mid mouth 0: tip stays at the alveolar ridge or arises to the mid mouth only with jaw closure	-Elasticity of Frenulum 2: very elastic 1: moderate elasticity 0: little or no elasticity
-Extension of Tongue 2: tip over lower lip 1: tip over lower gum only 0: neither or above or anterior or mid tongue humps	-Length of Lingual Frenulum when Tongue Lifted 2: more than 1 cm or embedded in the tongue 1: 1 cm 0: less than 1 cm
-Spread of Anterior Tongue 2: complete 1: moderate or partial 0: little or non	-Attachment of Lingual Frenulum to the Tongue 2: posterior to tip 1: at tip 0: notched tip
-Cupping 2: entire edge, firm cup 1: side edge only, moderate cup 0: poor or no cup	-Attachment of Lingual Frenulum to Inferior Alveolar Ridge 2: attached to floor of mouth or well below the ridge 1: attached just below the ridge 0: attached at ridge
-Peristalsis 2: complete, anterior to posterior (originates from tip) 1: partial; originates posterior to tip 0: non or reverse peristalsis	
-Snap Back 2: non 1: periodic 0: frequent or with each suck	

Table 4. Kotlow's classification of ankyloglossia. [7, 27].

Distance between Tongue Tip and Frenulum Attachment	Kotlow's Classification
Clinically accepted	>16 mm
CL I Mild ankyloglossia	12-16 mm
CL II Moderate ankyloglossia	8-11 mm
CL III Severe ankyloglossia	3-7 mm
CL IV Complete ankyloglossia	<3 mm

to evaluate any possible speaking difficulties, the patient is asked to make specific sounds [15]. Similarly, Messner and Lalakea assessed the function of the tongue in association with speaking impairment. They utilized the criteria of Williams and Waldron, as well as measured the tongue length from the tongue tip to the mandibular incisors when the tongue is protruded forward [26].

6. Management of ankyloglossia

Due to the confusion and controversy surrounding the diagnosis of ankyloglossia, as well as the

emergence of many diagnostic procedures and criteria, the management and/or treatment of ankyloglossia is classified into many separate clinical scenarios or sometimes collected into one specific protocol organized by case selection, severity, and progression.

The first scenario is a "wait and see" approach, which may begin with regular dental visits. Moreover, if there are difficulties in breastfeeding, educational counseling for the mother may be beneficial [6]. In addition, the dentist may provide instructions and advice on how to maintain good oral hygiene and to prevent plaque formation. However, the results of this scenario are dependent on the severity of the ankyloglossia condition, as Marmet et al. observed that this type of protocol produced negative results, with 10 of 13 infants still presented with breastfeeding difficulties after 12 weeks of education for the mother [11]. If there are any speech disorders, they can be handled with a speech therapist, particularly when there is difficulty in articulating "t", "d", "th", and "s" sounds [6].

The second scenario is surgical intervention, which is the recommended course of action as a highly effective ankyloglossia treatment method. Improvement in breastfeeding was experienced on the same day of surgery or within the first five days of surgery [29]. Surgical intervention also has a notable positive effect on speech articulation and oral hygiene in children. Enhancement of infant weight was also noted after surgery due to the maintenance of a favorable seal between the infant's lips and the mother's nipple, subsequently providing sufficient milk flow and optimal nutrition for the infants [30].

The frenotomy procedure is usually indicated in patients suffering from breastfeeding problems and when the conservative approaches to management are ineffective. However, it is contraindicated in many conditions such as neuromuscular disorders, retrognathia, and hypotonia, as this procedure can cause aggravation in glossoptosis (incorrect placement or displacement of the tongue), airway obstructions, and swallowing difficulties [34]. Frenotomy is performed by making an incision in the fascia-like tissue in a single motion parallel and close to the tongue. The patient is restrained in place by a papoose board or by swaddling, and an assistant holds the head of the patient for additional support [35].

7. Lasers in ankyloglossia management

Currently, lasers are utilized extensively for this condition due to their safety, avoidance of the need for suturing, less bleeding, and ease of use. Several types of lasers exist for the frenotomy dental procedure, such as:

- "Erbium:yttrium-aluminum-garnet laser (Er:YAG laser)",
- "Erbium, chromium:yttrium-scandium-gallium-garnet laser (Er,Cr:YSGG laser)"
- diode laser.
- CO₂ laser.

The continuous wave is the recommended form of diode laser "1.5-3 W, 810/940/980 nm". The laser tip must be placed close to the tissue or in direct contact. [6].

In addition to lasers and conventional surgical techniques, electrosurgery may be an option, although it could cause more pain to the patient than the other approaches, as sutures (4/0 polyglycolic acid) are needed for the wound. Usually, the pain can be controlled with analgesics like paracetamol (acetaminophen). In cases in which the frenulum is thick and vascular, the frenectomy (Z-plasty) is preferred by the surgeon to avoid bleeding from the wound, tongue reattachment, and scarring [31].

7.1. Post-surgery tongue exercises

After surgery to release the frenulum, the infants will be able to move their tongues more freely, but this may not happen spontaneously. Exercises should be performed to help the patient to adjust and/or relearn their new, normal tongue movements, strengthen their tongue muscle and to improve their feeding technique [36]. In addition, these exercises may prevent scar development and the need for a second frenotomy. These exercises should be performed two to three times per day for a few weeks or until the feeding process is improved.

Although the stretching exercises may be difficult for both parents and infants, it is believed that the frequency of the exercises decreases the chances of reattachment. The ultimate goal is to have a soft frenulum that extends from the middle of the soft tissue of the floor of the mouth to the middle of the ventral surface of the tongue.

The exercises can be classified as "inside and outside" and performed subsequently from inside to outside, approximately 10 times each or five times on each side (as applicable) [32].

7.2. Inside exercises [32]

- **Out and Ins:** Point the tongue straight out of the mouth, then retract it to the back of the mouth. Repeat 10 times.
- **Pointy Fat:** With a wide-open mouth, curl the tongue upward as if to make an "l" sound, then pull the tongue flat and back as if to make a "k" sound. Repeat 10 times.
- **Suction:** Suction the tongue to the roof of the mouth as if to make a "cluck" sound but do not release the tongue. Hold the suction for 10 seconds while the jaw is dropped, then release the suction to produce the "cluck" sound.
- **Cheek Poke:** While the lips are pressed together, push the tongue against the inner left cheek, hold for 10 seconds, then repeat on the other side. Repeat 5 times on each side.
- **Teeth Count:** While placing the tongue on the lower back right molar, move the tongue forward slowly and count each tooth along the opposite lower side of the mouth. Then begin on the upper left and repeat. Repeat 5 times on each side.
- **Paint the Palate:** Place the tongue tip just behind the upper teeth with the mouth open as wide as possible and slide the tongue backward while scraping the palate.

7.3. Outside exercises [32]

- **Wag:** With the mouth wide open, practice moving the tongue ONLY (the jaw should remain immobile) slowly (and controlled) from the left outside corner of the lips to the right outside corner of lips. Repeat 10 times.
- **Lick Around:** Practice licking substances (ice cream, marshmallow fluff, pudding, etc.) from the upper lip circling around from right to left and continuing over the lower lip to return to the beginning point. Repeat five times in each direction.
- **Lick Ups:** Practice licking an ice cream cone (or removing a ball of ice cream/peanut butter/Nutella from the round part of a spoon) using the tongue tip in an upward motion. Avoid involving the head in this movement.

8. Conclusion

Ankyloglossia is a developmental anomaly that involves the tight attachment of the lingual frenulum to the ventral surface of the tongue due to many etiological factors. Ankyloglossia can cause many disorders in infants, such as breastfeeding issues, difficulty in speech articulation, and other problems associated with occlusion and oral hygiene. The diagnosis of this condition is considered controversial, as many diagnostic criteria have emerged to evaluate the presence and severity of the condition. Management of this condition may vary in association with the severity of each case, including mild cases which are treated with a “wait and see” approach, with education for both the child and parents. In more severe cases, surgery is indicated through two procedures, frenectomy and frenotomy. Post-surgery, it is very important to perform defined exercises for a specific period at a precise frequency to prevent reattachment of the lingual frenulum.

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Conflict of interest

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