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Conventional and Current Treatment Approaches for Ankyloglossia

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Abstract

Objectives: Ankyloglossia is an anomaly that results from a short and thick lingual frenulum that causes limited tongue movement. It can cause problems such as difficulty in sucking, abnormal swallowing, speech disorder, malocclusion, gingival recession, especially in infancy. In this research, it was aimed to evaluate the clinical diagnostic criteria of ankyloglossia, functional disorders due to ankyloglossia, clinical treatment approaches of ankyloglossia, and the complications of these approaches that may affect the prognosis based on studies in the literature.

Material and Method: A literature review was conducted to evaluate the studies on ankyloglossia in pediatric dentistry. The articles indexed in PubMed, Google Scholar, SpringerLink, Web of Science, Elsevier ScienceDirect, and Scopus electronic databases were accessed and evaluated using the keywords “ankyloglossia”, “tongue tie”, “lingual frenectomy”, and “pediatric dentistry”.

Results: When the studies in the literature were examined, it was concluded that surgical treatments were planned according to the degree of functional limitations caused by ankyloglossia in children. With the developing technology, the laser is recommended in order to facilitate healing by eliminating the complications of conventional surgical treatment approaches and post-operative discomforts.

Conclusion: Surgical techniques, rehabilitation exercises, and patient cooperation are important for the early correction of functional disorders due to ankyloglossia. With the use of laser in the surgical treatment of ankyloglossia, the need for general/local anesthesia and suturing decreases during the operation, the need for analgesic and/or anti-inflammatory drugs decreases after the operation, and better healing can be achieved by reducing hematoma, inflammation and bleeding. Despite its many advantages, this method has clinical limitations as it requires expensive equipment and trained personnel.

Keywords: *Ankyloglossia, Lingual frenectomy, Tongue tie*

Ankiloglossi için Geleneksel ve Güncel Tedavi Yaklaşımları

ÖZET

Amaç: Ankiloglossi, sınırlı dil hareketine neden olan kısa ve kalın bir lingual frenulumun sonucu gelişen bir anomalidir. Özellikle bebeklik döneminde emme güçlüğü, anormal yutkunma, konuşma bozukluğu, maloklüzyon, diş eti çekilmesi gibi sorunlara yol açabilir. Bu çalışmada ankiloglossinin klinik tanı kriterlerinin, ankiloglossiye bağlı gelişen fonksiyonel bozuklukların, ankiloglossinin klinik tedavi yaklaşımlarının ve bu yaklaşımların prognozu etkileyebilen komplikasyonlarının literatürdeki çalışmalara dayanarak değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntemler: Çocuk diş hekimliği alanında ankiloglossi ile ilgili çalışmaların değerlendirilmesi amacıyla literatür taraması yapılmıştır. PubMed, Google Scholar, SpingerLink, Web of Science, Elsevier ScienceDirect, Scopus elektronik veri tabanlarında indekslenen makalelere “ankyloglossia”, “tongue tie”, “lingual frenectomy” ve “children” anahtar kelimeleri kullanılarak erişim sağlanmış ve değerlendirme yapılmıştır.

Bulgular: Literatürdeki çalışmalar incelendiğinde, ankiloglossinin çocuklarda oluşturduğu fonksiyonel kısıtlılıkların derecesine göre cerrahi tedavilerin planlandığı sonucuna ulaşılmıştır. Gelişen teknoloji ile birlikte konvansiyonel cerrahi tedavi yaklaşımlarının oluşturduğu komplikasyonlar ile post-operatif rahatsızlıkları elimine etmek ve iyileşmeyi kolaylaştırmak amacıyla lazer önerilmektedir.

Sonuç: Ankiloglossiye bağlı gelişen fonksiyonel bozuklukların erken dönemde düzeltilebilmesi için cerrahi teknikler, rehabilitasyon egzersizleri ve hasta kooperasyonu önemlidir. Ankiloglossinin cerrahi tedavisinde lazer kullanımı ile operasyon sırasında genel/lokal anestezi, dikiş ihtiyacı azalır, operasyon sonrası ise analjezik ve/veya antiinflamatuvar ilaç ihtiyacı azalır, hematoma, iltihap, kanama azalarak daha iyi iyileşme sağlanabilir. Birçok avantajına rağmen, bu yöntem pahalı ekipman ve eğitimli personel gerektirdiği için klinik sınırlamaları bulunmaktadır.

Anahtar kelimeler: Ankiloglossi, Dil bağı, Lingual frenektomi

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Introduction

Oral frenulums are anatomical formations located in the oral vestibular region and under the tongue, covered with a mucosal membrane, containing elastic fibers, collagen tissue components, and striated muscle fibers.¹ Newborns have lingual frenulum, defined as tongue tie, and maxillary labial frenulum, defined as lip tie.² Lingual frenulum is seen in 99.5% of healthy infants.³ The frenulum, a triangular fold of tissue, connects the lip, tongue, and buccal muscles to the alveolar bone. It limits the movement of the lips, tongue and cheeks by maintaining the balance between the growing hard and soft tissues during the development of the fetus.^{4,5} In some cases, these structures can cause orthodontic, prosthetic, phonetic or periodontal clinical problems.⁶

Diagnosis of the ankyloglossia

The term “ankyloglossia” was first defined by Wallace in the 1960s as “a condition in which the tip of the tongue cannot protrude beyond the lower incisors as a result of a short lingual frenulum”. An abnormally short and thick lingual frenulum is a congenital anomaly that limits the mobility of the tongue.⁷

Ankyloglossia (tongue tie) is also defined as fibrous adhesion of the tongue to the base of the mouth as a result of short frenulum or genioglossus muscles.^{8,9}

Ankyloglossia, which develops due to the shortness of the lingual frenulum, restricts the movement of the tongue and causes sucking difficulties in infants. It has been reported that the incidence in newborn babies varies between 0.3% and 12%.³

Diagnosis of the ankyloglossia caused by an abnormal lingual frenulum in children can be difficult for dentists.^{8,9} It is generally detected by clinical functional examination in children aged 1-3 years. When tongue mobility decreases, it should be considered that this may be due to a hypertrophic lingual frenulum.^{10,11} The prevalence of ankyloglossia is 0.1% - 10.7%, and it is mostly seen in male.^{12,13} Ankyloglossia is often seen as an isolated finding in children. However, it may be associated with anomalies such as Ehlers-Danlos syndrome, Beckwith-Wiedemann syndrome, X-linked cleft palate.¹⁴⁻¹⁶ In addition, maternal cocaine use has been reported to increase the risk of ankyloglossia.¹⁷ Controversy continues on the diagnostic criteria and treatment of ankyloglossia.

Many research state the diagnostic criteria for ankyloglossia such as free tongue length, tongue mobility, heart-shaped appearance when trying to remove the tongue from the mouth, and the thickness of the tongue fibrous membrane.¹⁸ A diagnosis and treatment protocol should be defined in order to combine the diagnostic criteria of conditions that may reduce tongue mobility, to classify cases of ankyloglossia, to define the severity of the problem, and to reach a solution with common treatment criteria.¹⁹

The following criteria should be met in evaluating the normal range of motion of the tongue:⁹

- The tip of the tongue should be able to protrude out of the mouth without splitting and reach the upper and lower lips without difficulty.
- The tongue should not exert excessive force on the mandibular anterior teeth and should not form a diastema between these teeth.
- The lingual frenulum should allow for normal swallowing.
- Babies should not have a traumatic lesion under the tongue.

- The frenulum should not prevent the mother's nipple and the baby's harmony during breastfeeding.
- There should be no speech disorders associated with limited tongue movements.

The term free tongue is defined as the length from the end of the lingual frenulum attachment to the tongue tip. Since the tongue is a flexible and difficult-to-control muscle in young people, a Boley measuring ruler can be used to measure the distance between the tip of the tongue and the attachment of the frenulum to the tongue.²⁰

Ankyloglossia was classified by Katlow according to free tongue length measurements:⁹

- Normal free tongue range: Free tongue length greater than 16 mm
- Class I: Mild ankyloglossia: Free tongue length 12 - 16 mm
- Class II: Mean ankyloglossia: Free tongue length 8 - 11 mm
- Class III: Severe ankyloglossia: Free tongue length 3 - 7 mm
- Class IV: Complete ankyloglossia: Free tongue length less than 3 mm

- In a study by Ferres et al, an ankyloglossia classification was made based on the degree of limitation of tongue mobility due to hypertrophic tongue frenulum.²¹
- Grade 1: When the patient is asked to lift the tip of his / her tongue towards the palate while her mouth is open, the tongue reaches the highest point it can reach on the palate.
- Grade 2: There is a slight limitation of the tongue caused by the frenulum. When the patient is asked to lift the tongue, the tongue reaches up to three-quarters of the intraoral space, but cannot touch the palate.
- Grade 3: Moderate hypertrophy leads to moderate impairment of tongue motility. When the patient is asked to lift his tongue during the examination, there is a heart-shaped tongue appearance due to the tension caused by the limited tongue mobility.
- Grade 4: There is a frenulum that greatly reduces tongue mobility, the tongue is too close to the base of the mouth, but the base of the tongue and frenulum are still visible. When the patient is asked to lift the tongue, the tongue can reach only one quarter of the intraoral space, tongue movements are reduced, and this can cause bone growth and inhibition of oral functions. Therefore, surgical frenectomy is required.
- Grade 5: The mobility of the tongue is completely limited. The lingual frenulum prevents the tongue movement necessary for optimum orofacial functions. During examination, the base of the tongue or frenulum is not observed due to excessive limitation of tongue movements by the frenulum. This limitation of tongue movements affects the normal development and functions of the structures of the stomatognathic system. Therefore, in this case, surgery is necessary.

Complications and management of the ankyloglossia

Since ankyloglossia will lead to various consequences such as tongue movement limitation, deterioration of mandibular development, accurate diagnosis of ankyloglossia and early intervention when necessary is considered essential. It can cause premature weaning and low weight gain in infants as a result of breastfeeding difficulties. Since ankyloglossia, which is a short lingual frenulum, affects breastfeeding, its

release by frenectomy facilitates breastfeeding.²²⁻²⁴

Frenotomy (cutting the lingual frenulum) is one of the easiest techniques to apply for babies with ankyloglossia, as it is a conservative and quick procedure that can be performed at the baby's first dental examination.^{25,26} Although frenectomy is considered a more invasive and difficult procedure in children with complete excision of the frenulum, it is thought to reduce the recurrence rate because the results are more predictable.^{24,27} There is no definite parameter on the timing of frenectomy for the lingual frenulum in the literature.^{24,10} Some studies suggest early resection of the frenulum when the abnormality of the lingual frenulum begins to make breastfeeding difficult.^{12,28} It is also recommended to perform the operation before abnormal swallowing and speech occur in the child due to frenulum. When the procedure is done in older children, it is thought that children should be referred to a speech therapist to restore normal functions of the tongue.²⁴

Revision of the lingual frenulum may also be considered when abnormalities in tongue function during swallowing cause difficulty

in eating and drinking and tooth alignment.⁹ Ferres et al. evaluated the frenulum as hypertrophic when grade 4 or 5 and as normal frenulum when grade below 3. They reported that frenulums of grade 4 or 5 required surgery because they prevented the movements of the tongue.²¹ Tension in the frenulum may be associated with gingival recession on the lingual of the mandibular incisors or with the diastema between the mandibular central teeth.⁹ Ferres et al recommend a rehabilitation period of 3 to 6 months to maintain control of tongue movements before frenectomy is considered. They also emphasize that problems such as speech, dental malocclusion, and atypical swallowing should be evaluated.²¹ Restriction of tongue mobility during childhood can also cause changes in bone growth by affecting the orofacial structures or oral functions of the child.²⁹

An anatomical balance of the stomatognathic system, which provides the necessary movements for articulation and sound production, is essential for speech to be provided properly. Therefore, when there is a change in the lingual frenulum, the normal relationship of the tongue with other stomatognathic structures is prevented, and lingual

mobility, speech and orofacial functions may be impaired. With changes in the lingual frenulum, the tone of the tongue decreases as the resting position of the tongue is on the base of the mouth instead of the incisive papilla. When tongue mobility and orofacial functions are abnormal, the speech therapist evaluates stomatognathic functions by checking the condition of the frenulum, the mobility-position of the tongue, and the articulatory production of speech. The speech therapist may recommend surgical intervention, if necessary, to eliminate and/or reduce these changes.³⁰

Cuestas et al. reported that changes in the tongue frenulum in preschool and school-age children cause difficulties in pronouncing the sounds produced as a result of the contact of the apex of the tongue with the incisive papilla and/or palate.³¹

Restriction of tongue mobility is thought to be the cause of impaired phonetic sound articulation.³² Speech disorders can be considered pathological if they do not improve in more than 4-5 years during the child's normal developmental period. For this reason, it is thought that the most suitable period for frenectomy

is 4-5 years of age.^{18,33,34} Swallowing disorders are also seen, since ankyloglossia cannot provide the palatal closure necessary for swallowing to occur.^{29,35} In the development process of the stomatognathic system, the tongue is among the adjacent anatomical structures and plays a role in the development of the palate.³⁵ In the case of ankyloglossia, as a result of the tongue position being close to the base of the mouth, maxillary transversal deficiency, crossbite and anterior openbite can be seen. In some patients, a short and hypertrophic lingual frenulum may cause difficulties in orthodontic treatment with removable appliances. Bilateral open bite as a result of tongue position may be related to other factors such as weak muscle tone, macroglossia and masticatory muscles.^{29,35,36} The localization of the frenulum on the gingiva is associated with gingival recession. In the case of ankyloglossia, it is thought that there may be an increase in dental caries due to the inability to remove food residues from the tooth surfaces.³⁷

Conventional and current treatment approaches for ankyloglossia

Conventional frenotomy is a procedure in which the lingual frenulum is released with scissors or scalpel.³⁸ Laser frenectomy is gaining popularity in the current literature.^{39,40} The Z-plasty technique is a modification of the traditional frenectomy approach performed with different flap variations to minimize scar contracture.⁴¹⁻⁴³ Although several reports claim that laser frenectomy and Z-plasty technique give better results, there are also discussions about the advantages it provides over conventional frenectomy.^{41,33,25}

Studies using laser frenectomy and Z plasty technique show functional improvements such as speech articulation and a reduction in complications such as blood loss.^{41,42,44} Mezzapesa et al. reported that surgical treatment with diode laser is the more appropriate treatment method for ankyloglossia because it is safe, noninvasive, has no major complications, and is highly accepted by parents and young patients. It facilitates healing by cutting and coagulating without causing thermal damage to the tissues.⁴⁵ In a study, 1064 nm InGaAsP diode laser was used under local and/or general anesthesia,

and postoperative pain control was achieved with topical anesthesia and acetaminophen after the operation.³⁹ Komori et al. Using a CO2 laser with a wavelength of 10.6 μm , 47% of patients had sutures after resection.⁴⁶ Fiorotti et al. reported that suture is not required after frenotomy with CO2 laser.⁵ Olivi et al. reported that frenectomy can be performed quickly and safely without postoperative symptoms and recurrence with the 2940 nm Erbium:YAG laser (Figure 1).⁴⁷ The same researcher reported that a significant improvement in breastfeeding outcomes was achieved with the application of tongue-tie, lip-tie, buccal-tie surgical release (frenotomy) using diode laser (Figure 2).⁴⁸



Figure 1. Short lingual frenum: **a)** shape of the tongue distorted (cleft); short distance from the tip of the tongue to the attachment of the frenum; **b)** functional reduction of lingual movement: limitation of the tongue to reach the palatal retroincisal spot when the mouth is wide open; **c)** Erbium laser frenectomy at 1,4W, 20pps and 70mJ (selective and minimally invasive incision of the lingual frenum with no bleeding; **d,e)** healing and improved lingual function after 3 weeks.

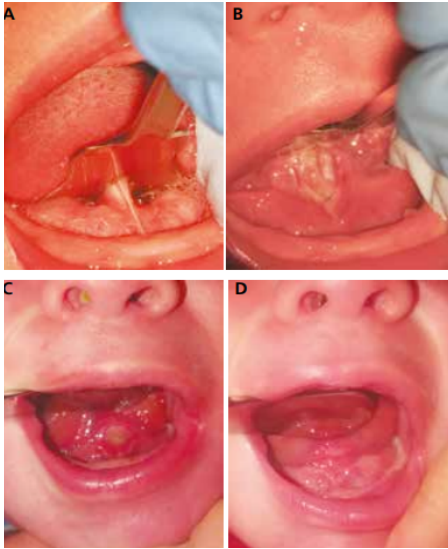


Figure 2. **A)** Pre-surgery intra-operative image showing thick frenum, blanching, restricted movement, and insertion close to the tip of the tongue and mandibular alveolar ridge. **B)** Post surgery intra-operative image showing typical diamond shaped wound, with no bleeding achieved with 1470nm diode laser at 3.5W 50ms on and 50ms off. Note the absence of any signs of charring. **C)** 5 days post-operative image showing advanced second intention healing of the wound, with fibrin layer covering the surgically treated area. **D)** 12 days post-op image shows the healing with complete re-epithelialisation of the wound.

Choi et al. procedures reported by Z-plasty combined with a partial genioglossus myotomy to prevent shortening of the genioglossus muscle.⁴⁹ Ferres-Amat et al. performed a frenotomy with rhombic plasty and myotomy.²¹

One of the differences in conventional frenectomy, laser frenectomy and Z plasty frenectomy approaches is the use of different types of anesthesia. Conventional frenectomy can be performed in infants without general anesthesia. When frenuloplasty was indicated in older children with severe limitation of speech, treatment under general anesthesia was performed. Most Z plasty frenectomy procedures are performed under general anesthesia.

The common approach in laser frenectomy is treatment with topical anesthetic. Since Z plasty frenectomy approach can be applied under general anesthesia in children, it may limit its applications as it creates disadvantages.

Study limitations

Postoperative outcomes have often been reported using subjective measures. Evaluation of results is heterogeneous and few studies have used validated evaluation criteria. It was observed that the patient selection criteria were not specified in the standard way in the studies.

Since the studies in this review were evaluated retrospectively, it can be concluded that further clinical studies are required by evaluating the long-term prognosis in a large

sample group of standard diagnostic criteria and treatment approaches.

Conclusion

Ankyloglossia is a developmental anomaly characterized by an abnormally short, thick lingual frenulum and causes limited tongue movement. It negatively affects nutrition, speech and oral hygiene practices. As the severity of ankyloglossia increases, the growth and development of the stomatognathic system is affected because the tongue is prevented from rising, and maxillary transversal deficiency, anterior open bite, tendency to class III malocclusion and atypical swallowing can be seen. For this reason, the patient's tongue mobility should be improved with surgical techniques, rehabilitation exercises and patient cooperation.

The use of laser in the surgical treatment of ankyloglossia is very comfortable, especially in children. With the use of lasers, the need for less general / local anesthesia and the use of stitches is reduced, the need for less analgesic and / or anti-inflammatory drugs after the operation, better postoperative recovery and reduction of complications such as postoperative bleeding, inflammation, hematoma.

Despite its many advantages, this method requires expensive equipment and trained personnel, which creates clinical limitations.

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