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Management Of Ankyloglossia In Pediatric Patients Using Diode Laser: A Case Series

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Abstract: Aim and background: Ankyloglossia also known as tongue-tie is an uncommon congenital oral condition that can lead to challenges in breastfeeding, speech articulation, and oral hygiene maintenance, including difficulty cleaning the teeth. Ankyloglossia is marked by an unusually short and thick lingual frenulum attached to the genioglossus muscle or by the fusion of the tongue's underside to the floor of the mouth, restricting the mobility of the tongue tip. Lingual frenectomy is considered the most effective treatment to alleviate the issues related to ankyloglossia. This case series focuses on various degrees of ankyloglossia, the clinical signs associated with it and its management using laser treatment across different age groups of pediatric patients and reports three cases in which diode laser was utilized for lingual frenectomy. The diode laser has proven to be an outstanding choice for these procedures, offering superior bleeding control, enhanced precision, reduced discomfort and faster healing time.

Case description: Pediatric patient with limited tongue mobility complained of speech difficulties, including challenges in articulating certain sounds, reduced efficacy in mechanically cleaning the oral cavity due to restricted tongue movement, as well as potential gingival recession or malocclusion. Therefore, surgical intervention for ankyloglossia was considered based on the patient's history of speech, mechanical, and social challenges. This report presents a case series with a 1-year follow-up of three lingual frenectomy procedures conducted using a diode laser. In Case 1, Class IV ankyloglossia was observed; in Case 2, Class II ankyloglossia; and in Case 3, Class III ankyloglossia according to Kotlow was noted. The lingual frenectomy was performed under local anaesthesia utilizing a diode laser. Healing progress was evaluated at 1 week, 1 month, 3 months, and 1-year post-procedure followed by post operative speech therapy.

Conclusion: The anatomical structure and positioning of the lingual tissue make it prone to various intraoperative and postoperative complications, despite the relatively simple nature of the lingual frenectomy procedure. Hence using laser to manage ankyloglossia in pediatric patients is efficient and safe alternative treatment considering the need to limit the operating time in uncooperative pediatric patient.

Clinical significance: Concerning the anatomy of the lingual frenulum, no significant morphological alterations occur over time in its thickness or its attachment to the tongue and the floor of the mouth. Therefore, in the absence of substantial evidence regarding the optimal timing and approach for surgical intervention, procedures such as lingual frenotomy or frenectomy for functional impairments should be evaluated on an individual basis. Pediatric ankyloglossia, which may result in breastfeeding challenges and disruptions in orofacial and oro-functional development, is typically identifiable early in life. Timely diagnosis can help avert early cessation of breastfeeding and mitigate potential complications later on

Keywords: Ankyloglossia, Diode Laser, Frenectomy

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Introduction

The lingual frenum is a mucosal fold that connects the underside of the tongue to the floor of the oral cavity. When this frenum is abnormally short or contains muscle fibres, leading to a thickened and fibrotic structure, it can result in a condition known as ankyloglossia, or "tongue-tie." The term "ankyloglossia" is derived from the Greek words ankylos meaning "crooked" and glossa meaning "tongue." This condition was first described in the medical literature in the 1960s, when Wallace characterized tongue-tie as a disorder in which the tongue's tip cannot extend beyond the lower incisors due to a shortened frenulum lingua, which may also contain fibrous or scar tissue.[1]

Ankyloglossia is often associated with difficulties in breastfeeding and can be addressed through a surgical procedure known as frenectomy, which entails the complete excision of the frenulum and its attachment [2]. In neonatal populations, the prevalence of the condition is estimated to be between 4.4% and 4.8%, with a male-to-female ratio of approximately 3:1. In clinical practice, the term "ankyloglossia" has been applied to a range of conditions, including instances where the tongue is abnormally adherent to the floor of the mouth or when tongue mobility is restricted due to a thickened, shortened lingual frenulum.[3]

Subsequently, Kotlow categorized ankyloglossia based on the extent of the free tongue into the following classifications:[2]
Class I: Mild, characterized by 12 to 16 mm of free tongue
Class II: Moderate, with 8 to 11 mm of free tongue
Class III: Severe, exhibiting 3 to 7 mm of free tongue
Class IV: Complete, with less than 3 mm of free tongue.

Orofacial activities, including sucking, mastication, swallowing, speech, phonation, and articulation, are primarily facilitated by the movements of the tongue. These motions can be disrupted by the positioning of the lingual frenulum. Frenectomy is a standard surgical procedure aimed at releasing the lingual frenulum, traditionally performed using a scalpel or electrocautery, and more recently utilizing soft or hard tissue lasers.
Several common complications are associated with ankyloglossia (tongue-tie), including:
Breastfeeding: Infants with tongue-tie may struggle to latch onto the mother's breast properly, complicating feeding and potentially impairing the emotional bonding process between mother and child.[5,6,7,8,9]

Speech Development: Speech articulation is predominantly perceptual, with significant variability in assessment results across individuals and professionals from diverse medical disciplines.[10] The articulation challenges observed in individuals with ankyloglossia are particularly noticeable with consonants and sounds such as /s/, /z/, /t/, /d/, /l/, /sh/, /ch/, /th/, and /dg/, with the production of the "r" sound being notably difficult. Since parents may not always accurately report speech difficulties, it is recommended that an evaluation be conducted by a speech-language pathologist with expertise in assessing lingual restrictions (despite the lack of a standardized consensus on assessment methods) before proceeding with a recommendation for frenotomy.[11,12]
Dental Health: Inadequate tongue movement can hinder the removal of food debris, increasing the risk of dental caries.
Periodontal Health: Conditions such as gingivitis and halitosis may arise due to limited tongue mobility.

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Feeding and Digestion: Children with restricted tongue movement may exhibit messy eating habits as they are unable to properly manipulate food, leading to issues such as cracked lips due to an inability to adequately moisten them.

The aim of this paper is to present three case report of pediatric ankyloglossia in patients of varying ages, outlining the diagnostic criteria and the rationale for treatment decisions, which culminated in the performance of a lingual frenotomy using a diode laser.

Case description:

Case 1

A 9-year-old female patient presented to the Department of Pedodontics with her primary concern of difficulty in tongue mobility along with malaligned anterior teeth, and speech. Due to restricted tongue movement, the patient also expressed difficulty in maintaining proper oral hygiene. Her ocular, nasal and pharyngeal examination along with the overall physical assessment, was normal. Upon clinical intraoral examination, a shortened lingual frenum and limited tongue mobility were observed. The patient was diagnosed with Class IV ankyloglossia based on Kotlow's classification. he assessment of ankyloglossia was conducted using the classification and grading system proposed by Kotlow. A digital vernier calliper, capable of precise measurements to the nearest 0.01 mm, was employed for this purpose. The distance between the tip of the tongue and the attachment site of the lingual frenum was recorded in millimetres which was 2 mm in this case. Since the tongue is a highly mobile structure, a dental instrument is positioned at the base of the tongue, where the frenum attaches, to provide stabilization She exhibited restricted tongue protrusion, with a midline indentation of the tongue during extension, which gave the appearance of a heart-shaped tongue. There was no evidence of gingival recession around the lingual mandibular incisors, and she presented with an anterior crossbite concerning the right maxillary central incisor. Additionally, she experienced speech difficulties, such as challenges in rolling the "r" sound and articulating certain consonants like "t" and "n".According to Kotlow's classification it was diagnosed as Class IV

Case 2

A 5-year-old male patient presented to the Department of Pedodontics with a primary complaint of pain in the lower right and left back region of the jaw and restricted tongue mobility. The patient also exhibited speech difficulties and displayed signs of apprehension. Upon obtaining the natal history, the parents reported initial feeding difficulties during the first 6 months of life, as the child was unable to fully protrude the tongue. By the age of one, when speech development began, the child struggled to pronounce sounds such as 's', 'r', and 't'. Additionally, the patient experienced challenges with chewing, swallowing, and activities like licking ice cream. The distance between the tongue tip and the attachment site of the lingual frenum was measured at 5 mm using a digital calliper. Intraoral examination revealed a thick inferior lingual frenum attached 11 mm from the tongue tip, which limited tongue movements including protrusion, lateral motion, and the ability to touch the palate with the tongue. A V-shaped notch was observed at the tongue tip during protrusion, and the tongue curved downward when extended, contributing to a deviated swallowing pattern. Based on Kotlow's classification system, the ankyloglossia was identified as Class II.

Case 3

A 12-year-old male patient reported to the Department of Pedodontics complained of difficulty in complete protrusion of tongue

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and movement of the tongue. On intraoral examination a thick inferior lingual frenum attached 5mm from the tip of the tongue using calliper as done in the previous cases. Restricted tongue motions including protrusion, lateral movements and inability to touch the palate with the tongue tip was observed. Inadequate oral hygiene maintenance on the lingual surface of the mandibular anterior were observed due to ankyloglossia. Based on Kotlow's classification system, the ankyloglossia was identified as Class III

After discussing general dental care and treatment protocols, it was recommended to address the lingual frenum, which could be excised using either traditional scalpel methods with suturing or a laser. The parents opted for the laser procedure. Lingual frenectomy was performed in all cases using Biolase soft tissue diode laser. Necessary blood investigations and Informed consent was obtained for the same.

Surgical Procedure

A lingual frenectomy was performed utilizing a diode laser (Biolase Epic™; USA). A 0.2% lignocaine solution was administered via injection into the frenum and the tip of the tongue. A suture was placed through the dorsal surface of the tongue to assist with manipulation during the procedure. The Biolase diode laser, delivering a maximum optical power of 1.5 W, with a 400 µm fibre optic tip in pulse mode, was employed. The tongue was stabilized with the suture, and tissue excision was carried out with the diode laser in contact mode. The laser tip was moved from the apex to the base of the frenum using a brushing technique, progressively excising the tissue. Simultaneously, wet gauze was used to gently mop the area, preventing excessive thermal injury to the excised tissue. After excision, a diamond-shaped wound was observed, and tongue protrusion was assessed by having the patient touch the tongue tip to the palatal surface of the incisors. Haemorrhage was minimal and sutures were not placed. Post-operative analgesics were prescribed, and the patient was followed up for 12 months.

The patients with speech articulation were referred to speech therapist for further aid.

Discussion:

The term 'laser' is an acronym for Light Amplification by Stimulated Emission of Radiation and generally refers to any device used to amplify light, producing a highly concentrated, coherent light wave.[13]. Diode lasers emit light with wavelengths ranging from 655 to 980 nm. The emitted laser light is monochromatic, coherent, and collimated, enabling the delivery of a focused energy pulse to a specific target area. Diode lasers operate in either continuous wave or pulsed modes, with the ability to be applied in direct contact or at a distance from the tissue. Pulsed operation allows for tissue cooling between bursts, reducing the risk of collateral thermal damage.[14] Laser energy excises tissue more effectively than a scalpel, facilitating complete vaporization and coagulation of blood vessels. The hemostatic effect occurs when laser energy interacts with soft tissues, leading to capillary sealing via protein denaturation and activation of clotting factor VIII.[15] The enhanced hemostasis and absence of postoperative swelling have been attributed to the augmented activation of platelets by the laser and the sealing of lymphatic vessels.[16] As a result of superior hemostasis, the surgical field remains clear, improving visibility of the operative site, which may not require sutures. Histological analysis of laser-induced wounds has shown a significantly reduced number of myofibroblasts.[16]This reduction leads to diminished wound contraction and scarring, ultimately enhancing the healing process. Additionally, laser-mediated wound

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sterilization lowers the necessity for postoperative care and antibiotic use.[18]
Lasers have emerged as a viable treatment alternative for various oral surgical lesions due to their distinct advantages over traditional scalpel techniques:[19]

- Soft tissue incision is highly efficient, with minimal bleeding, ensuring a clear surgical field;
- The use of sutures or oral packing is unnecessary, as lasers effectively weld the tissue;
- There is no postoperative infection, and the requirement for analgesics or antibiotics is eliminated due to the bactericidal properties of lasers;
- Wound contraction and scarring are reduced or completely absent, leading to enhanced wound healing owing to the lower presence of myofibroblasts;
- While the initial phase of healing may be slower due to a higher number of inflammatory cells, overall recovery is expedited, with complete ultrastructural healing typically occurring within 21 days.

There is considerable variation in opinions regarding the clinical significance of ankyloglossia. Ankyloglossia, commonly known as tongue-tie, can impact various functions including speech, feeding, oral hygiene, and social interactions. It leads to blanching of the soft tissue during tongue retraction and exerts pressure on the mandibular anterior teeth. Furthermore, it interferes with effective tooth brushing, thereby increasing the risk of plaque buildup, the onset of gingival inflammation, and potential gingival recession.[21,22,23.24.25.26]
Children diagnosed with ankyloglossia are often subjected to a range of therapeutic interventions, with the chosen approach being contingent on the severity of the functional consequences of the condition:

• When functional impairments are minimal or absent, surgical intervention is generally avoided, and speech therapy is recommended.
• In cases where functional limitations are related to speech or orthodontic concerns, surgical correction is typically performed at the earliest opportunity.
• If localized gingival recession is present on the lingual aspect of the mandibular incisors and is associated with ankyloglossia, addressing plaque-induced gingival inflammation may reduce the recession without the need for surgery. However, if the recession persists despite optimal oral hygiene, surgical treatment may be necessary.
• In instances where other complications are identified, the decision to proceed with surgical intervention is made on a case-by-case basis. • For cases of severe ankyloglossia, immediate surgical intervention is generally advised.
Currently, various surgical techniques are available to correct an abnormal frenulum, including frenotomy and frenectomy. In the cases discussed in this article, we opted for frenectomy, a decision that was made following a thorough preoperative assessment of each individual case.[23,25]
Deterrence and patient education are critical components in the diagnosis and management of ankyloglossia. The condition should be identified when there is restricted tongue movement attributable to an abnormality of the lingual frenulum. Not all cases of tongue-tie necessitate surgical intervention. In cases where a neonate exhibits breastfeeding difficulties, differential diagnoses should be considered to rule out other potential causes. Poor latch or positioning during breastfeeding is the most common factor contributing to feeding challenges. First-time mothers and other individuals experiencing breastfeeding issues should be encouraged to consult with a lactation specialist to receive appropriate support and guidance. It is essential that patients are thoroughly educated on the

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potential risks and complications associated with frenotomy, as the procedure may not always address the underlying breastfeeding difficulties.

The management of ankyloglossia involves a multidisciplinary approach, encompassing various medical and dental specialties. It may be encountered by primary care providers, pediatricians, otolaryngologists, nurse practitioners, lactation consultants, speech-language pathologists, and dental professionals.

The treatment of ankyloglossia is a subject of ongoing debate, which can lead to confusion for parents seeking differing perspectives. The optimal course of action for any healthcare professional addressing this condition is to assess the potential benefits for the patient. In cases where the condition does not cause significant issues during the neonatal stage, observation remains the most appropriate management strategy. Once other potential causes of feeding difficulties have been ruled out, frenotomy may be considered as a potential treatment. It is essential that this procedure be performed by a trained and qualified healthcare provider.

When patients present with speech or articulation difficulties, the clinical decision-making process becomes more intricate, and referral to a speech-language pathologist for further evaluation and therapy is recommended. In most cases, patients benefit from a period of observation. However, frenotomy is generally regarded as a low-risk procedure that can be conducted in an outpatient setting without the need for anesthesia. It has the potential to alleviate breastfeeding difficulties and provide relief to mothers who are often experiencing frustration.

Conclusion: Early identification and intervention of ankyloglossia are crucial for proper functional oral development in pediatric patients. Additionally, lingual frenulectomy using laser surgery offers a more effective and comfortable treatment option for both the pediatric patient and the dental professional, when compared to conventional scalpel or blade techniques.

Clinical significance: Frenectomy enables the prevention of premature breastfeeding cessation and reduces the likelihood of future complications. AAPD recognizes that causes other than ankyloglossia are more common for breastfeeding difficulties and that, while frenulectomy for an infant with ankyloglossia can lead to an improvement in breastfeeding, not all infants with ankyloglossia require surgical intervention. Due to the broad differential diagnosis, a team-based approach including consultation with other specialists like otolaryngologists, paediatrician, speech therapist can aid in treatment planning[20]

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Figures and figure legends:

Case 1

Figure 1: Heart shaped Tongue

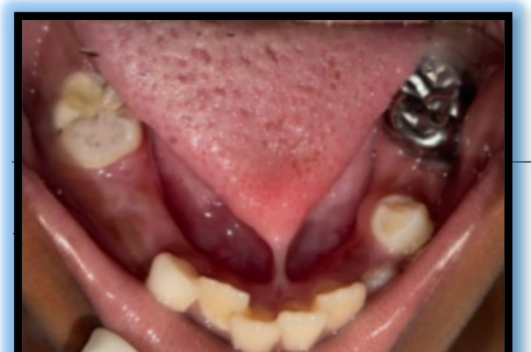


Figure 2 and 3: Measurement of lingual Frenulum using vernier calliper





Figure 4: Grade IV ankyloglossia



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Figure 5: Frenectomy done using laser



Figure 6: Follow up

Figure 7: Grade II ankyloglossia



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Figure 8: Follow up



Figure 9: Grade III ankyloglossia



Figure 10: Frenectomy done using laser

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