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Clinical Efficacy of Diode Laser Frenectomy in Adult Ankyloglossia with Anatomical Variants: A Case Series

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Abstract

Ankyloglossia is a congenital anomaly characterized by a restrictive lingual frenulum that limits tongue mobility and function, with effects that may persist into adulthood when untreated. Although frequently identified during infancy, many cases remain undiagnosed, resulting in long-term functional limitations. Laser-assisted lingual frenectomy has emerged as a minimally invasive alternative to conventional scalpel techniques, offering improved hemostasis, reduced postoperative discomfort, and accelerated healing. This case series describes three adult patients with Kotlow Class I-III ankyloglossia managed using diode laser frenectomy. Clinical evaluation demonstrated predictable improvement in tongue mobility and function with uneventful healing. These findings support the clinical efficacy of diode laser frenectomy in appropriately selected adult patients with anatomically restrictive lingual frenula.

Keywords: Ankyloglossia; Tongue-tie; Adult frenectomy; Diode laser.

Introduction

Ankyloglossia, commonly referred to as tongue-tie, is a congenital oral anomaly characterized by a short, thick, or restrictive lingual frenulum that limits the tongue's physiological range of motion.[1] While often identified during infancy, frenular anatomy undergoes minimal spontaneous elongation with growth; therefore, functional restrictions frequently persist into adolescence and adulthood.[9] Reported prevalence varies widely from 2.5% to 46.3%, reflecting inconsistency in diagnostic criteria and assessment tools.[1,2]

This variability contributes to a significant diagnostic gap, allowing many individuals with functionally relevant ankyloglossia to remain untreated during childhood. Adults with untreated tongue-tie may present with speech articulation difficulties, tongue fatigue, compromised oral hygiene, gingival traction, and altered oral function.[9,13] Long-standing restriction has also been associated with compensatory orofacial muscle activity, malocclusion, and temporomandibular joint disorders.[14,15]

Traditional scalpel frenectomy, although effective, is often associated with intraoperative bleeding, postoperative discomfort, and the need for sutures, which may reduce patient acceptance.[4] Laser-assisted frenectomy has gained popularity due to superior hemostasis, reduced postoperative pain, and faster epithelialization.[3,4] Diode lasers, in particular, are well suited for oral soft-tissue procedures because of their ease of use, controlled tissue interaction, and coagulation properties.[16]

This article presents a descriptive case series of three adult patients with anatomically and functionally significant ankyloglossia managed using diode laser frenectomy, with emphasis on anatomical classification, surgical technique, and functional outcomes.

This descriptive case series includes three adult patients presenting with functional limitations attributed to ankyloglossia. Clinical evaluation included assessment of tongue elevation, protrusion, lateralization, speech articulation and functional impairment.

Free tongue length was measured preoperatively using a periodontal probe from the insertion of the

lingual frenulum at the base of the tongue to the tip of the tongue, in accordance with Kotlow's anatomical classification:[7]

- **Class I (Mild):** 12-16 mm
- **Class II (Moderate):** 8-11 mm
- **Class III (Severe):** 3-7 mm
- **Class IV (Complete):** <3 mm

All procedures were performed using a 980-nm diode laser under local anesthesia. Postoperative instructions included tongue mobility exercises to facilitate functional rehabilitation. Postoperative measurements were recorded at the latest available clinical follow-up for each patient, which varied between 2 weeks and 3 months. Adult-focused reports evaluating diode laser frenectomy across varying anatomical severities of ankyloglossia remain relatively limited in the literature.

CASE SERIES DESCRIPTION

Case 1 - Class I (Mild Ankyloglossia)

A 24-year-old male presented with mild but persistent tongue mobility limitations. Clinical examination revealed restricted elevation toward the palate and reduced fluidity during protrusion. Free tongue length measured within the Class I range (14 mm).

Surgical Intervention:

A diode laser frenectomy was performed using a 980-nm wavelength, 1.5 W continuous mode, and a 400-µm fiber tip. The thin, minimally fibrotic frenulum was released incrementally. Complete epithelialization was observed at the 2-week follow-up, with improved tongue mobility and no complications.

Preoperative and postoperative clinical views are shown in Figure 1.

Case 2 - Class II (Moderate Ankyloglossia)

A 26-year-old female reported difficulty articulating specific speech sounds. Clinical evaluation revealed restricted elevation, lateral movement, and protrusion, with associated gingival traction. Free tongue length measured 10 mm, consistent with Class II ankyloglossia.

Surgical Intervention:

Laser release was performed at 1.5-2 W to address a thicker fibrotic frenulum. Postoperative tongue exercises were prescribed. At 1-month follow-up, the patient demonstrated improved tongue mobility and speech articulation.

Clinical presentation and postoperative outcome are illustrated in Figure 2.

Case 3 - Class III (Severe Ankyloglossia)

A 27-year-old male presented with long-standing functional limitation, bifid tongue appearance, and speech fatigue. Preoperative assessment revealed a thick, inelastic frenulum with free tongue length of 5 mm, consistent with Class III ankyloglossia.

Surgical Intervention:

Diode laser frenectomy was performed at 2 W using controlled ablation of fibrotic connective tissue bands to allow progressive tongue elevation without deep muscular dissection. At 3-month follow-up, the patient demonstrated sustained improvement in tongue elevation, protrusion, contour, and speech intelligibility, with no evidence of relapse.

Preoperative restriction and postoperative tongue mobility are demonstrated in Figure 3.

The preoperative and postoperative tongue mobility measurements across all three cases are summarized in **Table 1**.

Table 1. Pre- and Post-operative Tongue Mobility Assessment

Case	Kotlow Class (Pre-op)	Pre-op Free Tongue Length (mm)	Follow-up Duration	Post-op Free Tongue Length (mm)
Case 1	Class I (Mild)	14 mm	2 weeks	22 mm
Case 2	Class II (Moderate)	10 mm	1 month	21 mm
Case 3	Class III (Severe)	5 mm	3 months	20 mm

DISCUSSION

Clinical Outcomes and Diagnostic Considerations

The clinical outcomes observed in this case series demonstrate the potential for significant functional recovery in adults with untreated ankyloglossia across varying anatomical severities (Kotlow Class I-III). Although ankyloglossia is commonly identified during infancy, wide variability in diagnostic criteria and screening practices contributes to a substantial diagnostic gap, allowing restrictive frenula to persist into adulthood. Reported prevalence in neonates ranges from 2.5% to 46.3%, highlighting inconsistencies in recognition and classification.[1,2] Segal et al. emphasized this variability as a key factor underlying underdiagnosis, while Lalakea and Messner noted that many adults seeking treatment had been overlooked during childhood due to reassurance or limited awareness.[2,9]

Anatomical Considerations and Surgical Technique

From an anatomical perspective, the lingual frenulum is now recognized as a complex, multilayered structure rather than a simple mucosal fold. It may consist of mucosa, fascial connective tissue, and, in more severe cases, involvement of anterior genioglossus muscle fibers.[13] In the present series, diode laser frenectomy was directed toward fibrotic connective tissue restrictions, allowing progressive improvement in tongue elevation, protrusion and lateral mobility without deep

muscular dissection. This approach aligns with current literature suggesting that laser frenectomy is most effective when the restriction is predominantly mucosal or fascial in nature.[17]

While all cases in this series were successfully managed using a 980-nm diode laser, it is important to recognize the limitations of laser-based approaches in comparison with more extensive techniques such as myofrenuloplasty. In the Class III case, a higher power setting (2 W) was required to address a thick, fibrotic frenulum. In contrast, myofrenuloplasty involves blunt dissection along the epimysium to release deeper muscular restrictions that laser energy may not adequately penetrate. Future studies should evaluate whether the thermal action and protective coagulum layer produced by diode lasers provide sufficient long-term functional release in Class IV ankyloglossia, or whether deeper anatomical release techniques offer superior stability in such cases.[6,17]

Clinical Metrics and Public Health Implications

Functional improvement in this series was assessed using objective measurement of free tongue length based on Kotlow's classification, along with clinical evaluation of tongue mobility and speech articulation.[7]

Speech articulation was assessed by asking patients to pronounce syllables containing lingual consonants such as /t/, /d/, /r/, /ch/ and /zh/. In the severe case, preoperative free tongue length measured within the 3-7 mm range. Objective improvements in free tongue length across all three cases **(Table 1)** support the clinical efficacy of diode laser frenectomy in appropriately selected adult patients.

Adult outcome studies suggest that achieving substantial postoperative mobility, often exceeding 20 mm, may be beneficial to compensate for scar contraction during secondary intention healing.[8,12] Improvement in tongue mobility was observed across all cases at their respective follow-up intervals, supporting the clinical utility of diode laser frenectomy in appropriately selected adult patients.

The broader clinical relevance of these findings relates to the treatment gap created by limited awareness and apprehension regarding conventional surgical approaches. Traditional scalpel frenectomy is often associated with intraoperative bleeding, postoperative discomfort and the need for sutures, which may deter adult patients. Diode laser frenectomy addresses these barriers by offering superior hemostasis, reduced postoperative pain and faster wound epithelialization.[4,16]

Role of Postoperative Rehabilitation

Postoperative rehabilitation played a critical role in optimizing outcomes in this series. All patients were prescribed tongue mobility exercises to facilitate neuromuscular re-education and minimize postoperative restriction due to scarring. The importance of adjunctive myofunctional therapy has been emphasized by Marchesan et al., who noted that surgical release alone may be insufficient to achieve optimal functional adaptation.[12] The improvements in speech fluency and tongue coordination observed in the moderate and severe cases further support the necessity of an integrated rehabilitative approach.

Limitations

The primary limitation of this case series is the small sample size (n = 3), which limits generalizability and precludes broad conclusions regarding population-level impact. Additionally, while clinical improvement was evident, future investigations should incorporate standardized speech assessment tools and extended follow-up periods exceeding 12 months to evaluate long-term stability and the risk of reattachment. An additional limitation was the non-uniform postoperative follow-up intervals among cases, which restricted direct temporal comparison of healing and long-term functional stability.

CONCLUSION

Diode laser frenectomy represents an effective and minimally invasive option for improving tongue mobility and function in adults with anatomically restrictive ankyloglossia when appropriately selected based on severity. Objective assessment and postoperative functional rehabilitation are critical for optimal outcomes.

FIGURES

Figure 1. Case 1 - Preoperative and postoperative clinical images

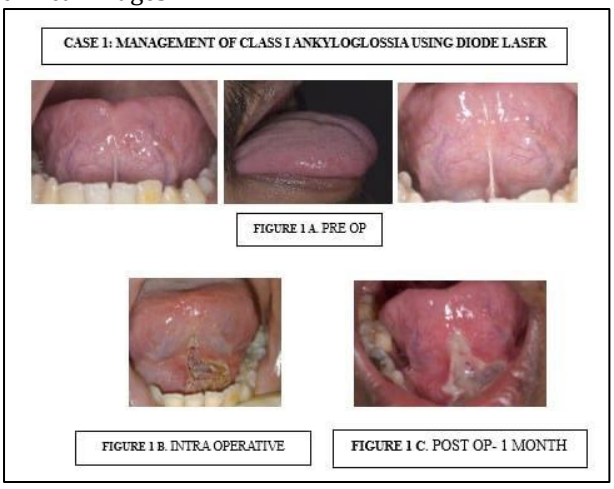


Figure 2. Case 2 - Preoperative and postoperative clinical images

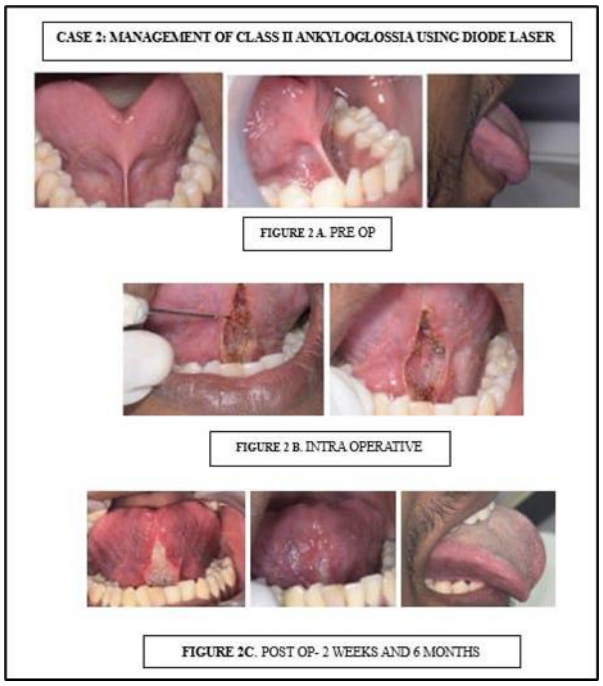
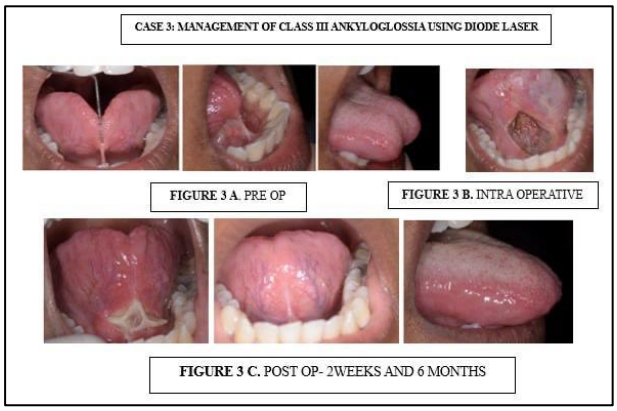


Figure 3. Case 3 - Preoperative and postoperative clinical images



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