SJIF Impact Factor: 6.711

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

ISSN: 2457-0400
Volume: 8.
Issue: 10
Page N. 130-134
Year: 2024

Original Article www.wjahr.com

COMPARATIVE EVALUATION OF SURGICAL TREATMENT OF ANKYLOGLOSSIA USING DIODE LASER AND SCALPEL IN PATIENTS UNDERGOING ORTHODONTIC THERAPY

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Article Received date: 19 August 2024 **Article Revised date:** 09 September 2024 **Article Accepted date:** 29 September 2024

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ABSTRACT
An aberrant frenum can negatively impact gingival health when it is attached too close to the gingival margin, either by interfering with plaque control or due to muscle pull. Such a condition often necessitates a frenectomy, which can be performed using a scalpel, electrocautery, or soft tissue lasers. This study aimed to compare to and evaluate the benefits of conventional and laser assisted frenectomy in patients undergoing orthodontic therapy. **Materials and Methods:** Twenty patients aged 16 to 30 years were randomly divided into two groups

- **Group A (n = 10):** Subjects treated with the conventional scalpel technique.
- **Group B (n = 10):** Subjects treated with the diode laser technique.

The study evaluated various parameters, including pain, inflammation, swelling, speech difficulty, and wound healing at intervals of baseline, 1 week, 1 month and 3 months. **Results:** The study found that patients treated with the diode laser experienced significantly less postoperative pain ($P < 0.0001$) and required fewer analgesics ($P < 0.001$) compared to those treated with the scalpel. Wound healing after 7 days and 1 month showed a statistically significant difference, with better outcomes observed in Group B (diode laser). However, by the end of 3 months, there was no significant difference in wound healing between the two groups.

KEYWORDS: Aberrant frenum, electrocautery, diode laser, frenectomy.

INTRODUCTION

Ankyloglossia which is commonly known as tongue tie, is a condition where the tongue's movement is restricted due to a short lingual frenulum. Ankyloglossia can be observed in neonates, children, or adults. The prevalence of ankyloglossia is well established in newborn and is seen in approximately 4%–5% in the newborn population with a 3:1 male to female preponderance.[1]

When the frenulum is too short, it tethers the tongue, limiting its mobility. A short frenulum can also contribute to the development of anomalies which include decrease in the size of the upper respiratory tract; the formation of an open bite; periodontal diseases due to destruction of the supporting structures of the periodontium on the lingual side of the incisors, leading to progression of recession. Defective lingual frenulum can also contribute to increased plaque formation, which negatively affects oral hygiene.

Ankyloglossia can significantly affect essential functions such as chewing, swallowing, speech, and the alignment of teeth which could further lead to malocclusion. Speech impairments, including articulation disorders, are common in children with tongue-tie. Conditions such as interdental lisping, rhotacism, and multiple dyslalias, along with speech delays, are often linked to anatomical defects and limited tongue mobility. Adults can

experience similar speech disorders. Rhotacism, particularly the misarticulation of the /R/ sound, is prevalent worldwide and is often caused by a shortened frenulum. In adults, it is easier to diagnose misarticulation related to the frenulum, which may also be associated with abnormal biting, chewing, and swallowing patterns.[1] In some patients, a short and hypertrophied lingual frenulum can lead to a diastema between the mandibular central incisors. In old age, a highly attached frenulum of the tongue in an edentulous jaw can interfere with the prosthesis.[2]

Table 1: Classification of Ankylosis according to Kotlow LA 1999.

Class I	Mild ankyloglossia 12 to 16 mm of the free tongue
Class II	Moderate ankyloglossia 8 to 11 mm of the free tongue
Class III	Severe ankyloglossia 3 to 7 mm of the free tongue
Class IV	Complete ankyloglossia less than 3 mm of the free tongue

Table 2: Classification of Ankylosis according to Corryllos.

Type I	Thin and elastic frenulum; attaches the tip of the tongue to the alveolar ridge, and the tongue forms a heart shape
Type II	Thin and elastic frenulum; 2–4 mm behind the tongue tip, attaches by the alveolar ridge
Type III	Thick, fibrous and non-elastic frenulum; attaches mid-tongue to the floor of the mouth
Type IV	The frenulum is not seen, but felt, with a fibrous or submucosal thick and shiny attachment from the base of the tongue to the floor of the mouth

Treatment of ankyloglossia includes, frenotomy (dissecting the frenulum) or a frenectomy (excising the frenulum). In some cases, the frenulum attachment site is repositioned apically or laterally to the gingival margin through a procedure called frenuloplasty. Frenectomy can be done using a laser, scalpel, or surgical scissors. This procedure is often carried out in children and infants when it is immediately identified. In adults, correction of the lingual frenulum might be required during certain stages of orthodontic treatment, placing dental implants or in response to periodontal diseases.

The aim of this study was to compare and evaluate the benefits of conventional and laser assisted frenectomy in patients undergoing orthodontic therapy.

MATERIALS AND METHODS

The study was conducted in Department of Periodontology, Sharavathi Dental College and Hospital where twenty patients within age group of 16 to 30 years, systemically healthy with high lingual frenum attachment and speech difficulty, undergoing orthodontic therapy were selected. After performing phase 1 periodontal therapy patients were randomized into two groups, Group A and Group B, using coin flip method.

Group A: Comprised of 10 patients selected for conventional scalpel technique Group B: Comprised of 10 patients selected for diode Laser technique.

All the procedures were carried out by single operator after obtaining patient consent and following parameters have been assessed; Surgical time duration was recorded for all cases. Group A underwent conventional scalpel surgery followed by suturing while Group B had laser surgery. Bleeding during surgical procedure was scored as 1- no bleeding, 2-Slight, 3- Moderate, 4-Severe.Pain was assessed using the Visual Analog Scale (VAS), scoring criteria of 0 to 10 from 0 ("no pain") to 10 ("worst pain imaginable"). Post operative pain score was recorded during the procedure, 3 hours after surgery, and on the 1st and 7th postoperative days. Additionally, patients reported their discomfort during eating and speaking on the 1st and 7th days post-surgery using the VAS.

Patients were also asked to complete questionnaires to rate their pain during the surgery, 3 hours afterward, and their discomfort during chewing and speaking on the 1st and 7th days post-surgery. Photographs were taken during these assessments to compare healing during follow-up. Data collection and assessments were performed by the same examiner, who was unaware of the surgical method used for each patient.

Treatment protocol

Patients were explained about the treatment procedure and informed consent was obtained. Thorough scaling and polishing were done one week prior to the surgical procedure and patients were instructed to maintain good oral hygiene.

For the conventional classical technique using scalpel the area was anesthetized with 2% lignocaine with 1:80,000 adrenaline. During the procedure, the tip of the tongue should be fixed and restricted from any movement. A hemostat was first inserted to the base of the lingual frenum at the depth of the vestibule and clamped in place. Two incisions were then made using #15 blade, one at the top and one at the bottom of the hemostat, effectively removing the intervening frenum. The hemostat was then used to release the muscle fibers adhered to underlying periosteum to allow for a tension-free closure of the wound. The wound edges were

approximated together 4-0 silk interrupted sutures to promote healing by primary intention, thereby reducing scar tissue formation. The area was covered with a periodontal dressing. Patients were recalled on the 7th day for suture removal. Swelling and pain were reported during the 1st postoperative week, which subsided due to the administration of an anesthetic drug. The patient was recommended to perform tongue exercises after a week. Complete healing was noted within a month after the surgery.

Laser assisted lingual frenectomy was performed after the area was anesthetized with 2% lignocaine with 1:80,000 adrenaline. A soft tissue diode laser of wavelength of 980 nm, power of 1.5 W and energy using laser tip in continuous mode was used to severe the fibrous attachment moving in a paintbrush like stroke from the base to the apex of the frenum to excise it. Any remaining fibers on the periosteum were carefully removed by gently sweeping the laser tip. The ablated tissue remnants were then cleaned with gauze soaked in saline.

Patients were recalled on the 7th day for post operative evaluation for swelling and pain.

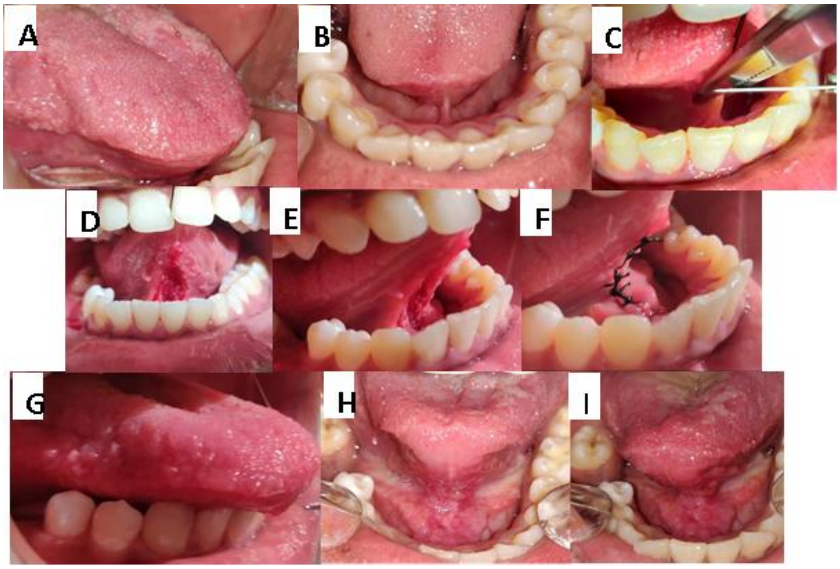

Figure 1: A,B: Preoperative photograph showing high lingual frenum attachment; C,D,E: Frenectomy using scalpel; F: Interrupted silk sutures; G,H: postoperative healing after one month; I: postoperative healing after 3 months.

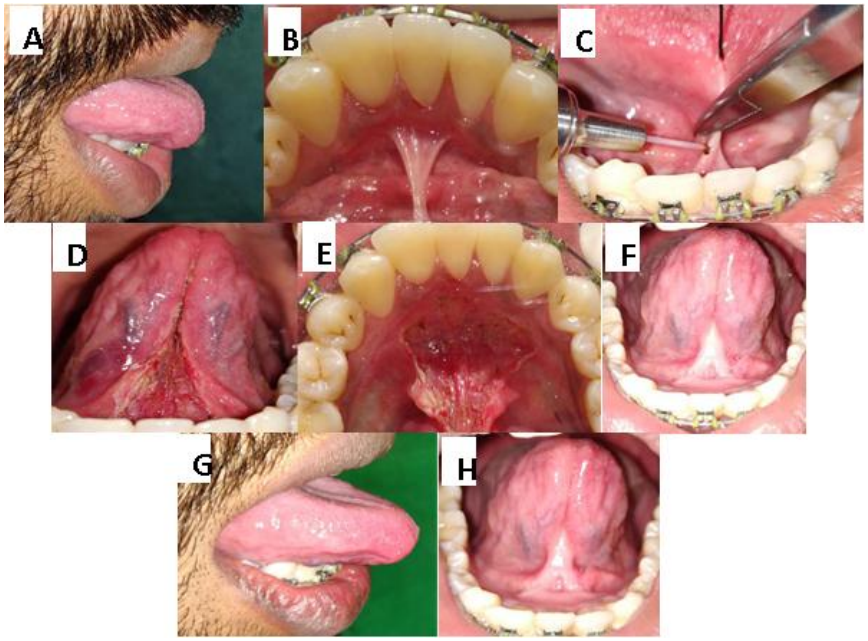

Figure 2: A,B: Preoperative photograph showing high lingual frenum attachment; C,D,E: Frenectomy using diode laser; F,G: Postoperative healing after one month; H: Post operative healing after three months.

STATISTICAL ANALYSIS

A statistical analysis was performed using a Statistical Package for Social Sciences (SPSS) software version 23. Nonparametric tests were chosen for continuous variables because the data were not distributed normally. Comparisons between groups were applied using the Mann–Whitney U-test. Results were represented as mean ± standard deviation and median (minimum-maximum). $P < 0.05$ was considered significant.

RESULTS

Comparison of VAS score, intraoperative bleeding, healing outcome, and number of analgesics have been assessed for the groups.

Table 3: Mean scores of pain perception after conventional and laser technique.

	Group	Number of patients	Mean ± SD	Statistical significance
VAS on day 1	A – Scalpel	10	4.275±1.14	P=0.0027*
	B – Laser	10	2.05±1.035	
VAS on day 7	A – Scalpel	10	2.15±1.83	P=0.0014*
	B – Laser	10	0.355±1.83	
Number of Analgesic used	A – Scalpel	10	4.12±0.7	P=0.0014*
	B – Laser	10	1.87±0.83	

Table 4: Mean score of bleeding during surgery.

	Group	Number Of Patients	Mean ± SD	Statistical significance
Bleeding during surgery	A – Scalpel B – Laser	10 10	2.57 ± 0.53 0.24 ± 0.35	P=0.0002*

Table 5: Mean scores of wound healing after conventional and laser technique.

	GROUP	NUMBER OF PATIENTS	Mean ± SD	Statistical significance
After 7 days	A – Scalpel B – Laser	10 10	1.4± 0.82 2 ± 0.82	P=0.0002*

DISCUSSION

After the surgical treatment there was increase in functional improvement of the tongue in both the groups. In the present study group B showed better treatment results of postoperative pain, bleeding and edema compared to group A.

The severity of pain after a frenectomy largely depends on the depth of the incision.[4] Studies have reported that conventional frenectomies often result in postoperative pain and discomfort, and the use of sutures can increase the risk of complications. Suturing the floor of the mouth can sometimes obstruct Wharton's duct, leading to swelling in the area and potentially damaging the lingual nerve, which may result in numbness at the tip of the tongue. Postoperative complications, such as bleeding, formation of a ranula or hematoma, and prolonged healing and discomfort, can occur, though these are generally infrequent with careful surgical technique. However, if the frenulum is not fully excised or if rehabilitation is insufficient, there is a risk of fibrosis and recurrent ankyloglossia, which can hinder clinical improvement.

In contrast, soft tissue lasers offer a viable alternative, as they eliminate the need for sutures, reduce surgical time, and result in less postoperative pain and discomfort, leading to higher patient acceptance.[5] Diode laser operates using solid semiconductor crystals, typically composed of a combination of materials like aluminum (with a wavelength of 800 nm) or indium (900 nm), along with gallium and arsenic, and has a penetration depth of 1 mm. This type of laser is designed for use on soft tissues because laser radiation at these wavelengths is poorly absorbed by hard tissues.

David et al (2015) reported that at low-energy levels, diode laser radiation can stimulate the proliferation of fibroblasts, promoting tissue healing and regeneration.[6] **Garrocho et al (2019)** stated that diode laser radiation is well absorbed by hemoglobin and melanin, but it is poorly absorbed by water; therefore, it has a significant ability to seal capillaries by denaturing the protein and stimulating the production of coagulation factor VII.[7]

Compared to conventional frenectomy methods, using a diode laser for correcting the lingual frenulum offers several advantages: it shortens the duration of the operation, eliminates intraoperative bleeding, and provides a bactericidal effect that benefits patients at high risk for postoperative infections. Additionally, it promotes better tissue regeneration and results in less postoperative pain. Some studies suggest that diode lasers with wavelengths of 450 nm and 980 nm are particularly effective at vaporizing tissue while minimizing thermal damage to surrounding areas.[8,9]

Oganyan et al (2023) reviewed and recommended parameters for lingual frenectomy which include a wavelength of 810-980 nm, a fiber diameter of 320-400

microns, power of 1.8- 3.0W and energy of 272J; the surgery should be carried out in the continuous mode.[10]

The high temperature generated by the laser during surgery effectively decontaminates the wound surface, reducing the risk of infection and often eliminating the need for antibiotic therapy. Additionally, the laser cauterizes nerve endings, which decreases postoperative pain reducing the patient's need for analgesics.

CONCLUSION

Laser frenectomy of the tongue is a simple and safe surgical procedure that is less traumatic compared to traditional scalpel surgery. The use of laser technology offers several advantages, including a bloodless surgical field, no need for sutures, minimal swelling, and moderate postoperative pain. These benefits make the high-intensity diode laser a reliable alternative for soft tissue surgeries.

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