



Surgical Techniques for the Treatment of Tongue Tie in Children: A Comparative Study

Atishkumar B. Gujrathi^{1*}, Vijayalaxmi Ambulgekar¹ and Ashwini Handal¹

¹Department of ENT, Dr. S. C. Government Medical College, Nanded (431601), Maharashtra, India.

Authors' contributions

This work was carried out in collaboration between all authors. Author ABG designed the study, wrote the protocol and wrote the first draft of the manuscript. Author VA managed the literature searches and guide the principle author in structuring the article and author AH managed in collecting and analyzing the data. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Ankyloglossia is another name for tongue tie which in mild form is characterized by mucous membrane bands to complete ankyloglossia whereby the tongue is tethered to the floor of the mouth. It can affect feeding, speech, and oral hygiene [3] as well as have mechanical/social effects. Ankyloglossia can also prevent the tongue from contacting the anterior palate.

Materials and Methods: The study aimed to find out best possible surgical modality of frenectomy by comparing scalpel, electro-cautery and CO₂ laser in the treatment of tongue tie. This is a prospective randomized double blind clinical trial conducted in the department of ENT, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra. All patients were categorized in to three groups randomly as group A, group B and group C. Each group contains 18 patients and among group A, B and C, frenectomy was done by conventional scalpel technique, by bipolar cautery and CO₂ laser respectively. Then patients were assessed on post-operation day 1 for symptomatology and inflammatory signs, on post-operation day 7 for wound healing and any

*Corresponding author: E-mail: dr_atish2012@yahoo.co.in;

complications and also after 1 month post-operation for scar and contracture of wound.

Results: In our study, about 61% of population is of male and female were remaining 39% (ratio 1.6:1) which is matching with the previous studies. Amongst all patients most common age group is between 1-4 years of age group. Most of the patients were in Kotlow's class III having severe ankyloglossia (3-7 mm) followed by class I having Mild ankyloglossia (12-16 mm).

Conclusion: Laser and electro-cautery treatment used for frenectomy operations provides better patient perception in terms of postoperative pain and function than that obtained by the scalpel technique.

Keywords: Ankyloglossia; laser; electro-cautery; scalpel.

1. INTRODUCTION

Tongue-tie is a congenital anomaly of oral cavity which decreases the mobility of the tongue tip [1] and is caused by an unusually short, thick lingual frenulum, which is a membrane connecting the underside of the tongue to the floor of the mouth. Ankyloglossia is a other name for tongue tie and which varies in degree of severity from mild cases characterized by mucous membrane bands to complete ankyloglossia whereby the tongue is tethered to the floor of the mouth. Ankyloglossia can also prevent the tongue from contacting the anterior palate. This may affect an infantile swallowing and hamper the progression to an adult-like swallowing which can result in an open bite deformity [2]. It can affect feeding, speech, and oral hygiene [3] as well as have mechanical/social effects [4]. Its prevalence is around 4.4% to 4.8% in newborns, with a male to female ratio of 3:1.0. [5-7] in many individuals, ankyloglossia is asymptomatic and may resolve spontaneously, if not resolved then the affected individuals may learn to compensate adequately for their decreased lingual mobility.

The purpose of this study is to assess the superiority of bipolar cautery and CO₂ laser versus conventional scalpel technique for frenectomy.

2. METHODS AND MATERIALS

2.1 Trial Design

This is a prospective randomized double blind clinical trial conducted in the department of ENT, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra, India. After taking approval from local ethical committee, study was conducted from March 2013 to March 2015.

2.2 Participants

The study population comprised of all children reporting to the outpatient department and satisfying the following inclusion criteria.

- Confirmation of ankyloglossia;
- Aged between 1 to 12 years;
- Informed consent from parents or legal guardians to participate in the study.

Using simple random sampling strategy, patients were allocated equally into three groups A, B and C. For each group with 18 patients, a distinct intervention was scheduled; group A, B and C, frenectomy was done by conventional scalpel technique, by bipolar cautery and CO₂ laser respectively. Then patients were assessed on post op day 1 for symptomatology and inflammatory signs, on post op day 7 for wound healing and any complications and also after 1 month post-op for scar and contracture of wound.

2.3 Sample Size

No formal sample size calculation was done for this study, it was anticipated that equal allocation will be done based on the patients numbers presenting at the site.

2.4 Randomization Sampling of Subjects

Detailed history and oral examinations were undertaken on all eligible participants. Following these procedures, participants were categorized into four classes according to the Kotlow's classification. According to Kotlow, ankyloglossia can be of four types depending on clinically available free tongue (protrusion of tongue) [8].

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

Participants were allocated to any of the three treatment groups on the basis of chance. Simple random sampling technique was used to achieve 1:1:1 allocation. Kotlow's classification was used as strata, it was expected that perfect randomization would result in equal distribution according to this strata. Computer generated numbers were used for selecting participants. Using simple random sampling strategy, 18 patients were allocated equally into three groups A, B and C., and subjected frenectomy using conventional scalpel technique, by bipolar cautery and CO₂ laser respectively.

2.5 Allocation of Intervention

Before administration of interventions, all patients were given local anesthesia with sedation; in case of uncooperative patients general anesthesia was preferred. Patients were allocated to any of the three arms of treatment. Once allocated the surgery was undertaken as described below:

- a. frenectomy using scalpel,
- b. frenectomy using bipolar electro-cautery or
- c. frenectomy using CO₂ laser

(a) Frenectomy using scalpel: Frenectomies are performed with scalpel using blade no. 15. The procedure was carried under local anesthesia with 2% lignocaine hydrochloride. First a hemostat is inserted at the depth of the vestibule and clamped into position followed by giving two incisions at the superior and inferior aspect of the hemostat. By this way the intervening frenum is removed. Muscle fibers are then removed with the help of hemostat, and wound edges approximated with 4-0 vicryl suture. Analgesics and antibiotics were prescribed for about 7 days post-op (Fig. 1).

(b) Frenectomy using bipolar electro-cautery: Tongue is held by stay suture and using bipolar electrode the frenum is cut in middle up to the depth of the vestibule (Fig. 2).

(c) Frenectomy using CO₂ laser: When performing lingual frenectomy using CO₂ laser, the tongue is raised to gain access and frenectomy performed using CO₂ laser in a constant motion. Irrigation with saline irrigation was given and there was no need for sutures (Fig. 3).



Fig. 1. Showing tongue tie release and suturing



Fig. 2. Tongue tie release after electro-cautery



Fig. 3. Tongue tie release after application of CO₂ laser

2.6 Blinding

This is a double blind study as patients and clinician both were not aware of the treatment to receive or undertake on the day. Patients were given the unique code and clinician was asked to perform intervention randomly on the day without prior knowledge. Only the researcher was aware of research project and process.

2.7 Ascertainment of Outcomes

To evaluate the outcome of interventions, patients were assessed post-operatively on day 1 for symptomatology and inflammatory signs; on day 7 for wound healing and any complications and also after 1 month for scar and contracture of wound. The following signs and symptoms of inflammation and wound healing process are regarded as primary outcomes. These clinical outcomes are clearly discernable, not prone to misclassifications, thus require not criteria. Assessment of these outcomes was done independently by blinded clinicians.

- Operative time: It was calculated from the start of incision to the end of the procedure. The time taken during anesthesia was excluded. Operative time was categorized in three groups as 0-10 minutes, 10-20 minutes and more than 20 minutes.
- Bleeding: Bleeding during the interventions were judged by blood soakage of surgical cotton pad while mopping the wound and was categorized in three groups i.e. bloodless, one cotton pad soak, more than one cotton pad soak.
- Suturing of the wound was done with 4-0 vicryl, every patient by scalpel technique needed suturing, it was not needed at all in CO₂ and electro-cautery; this is probably because of less tissue handling and bloodless field.
- Edema was assessed by clinical examination of presence at the site i.e. at floor of mouth and tongue.
- Pain: The patients were asked to separately rate the pain and discomfort associated with eating and chewing on a 10 cm visual analog scale (VAS) immediate postoperatively, 1st day and 7th day. The patient was asked to make a vertical mark between two endpoints on the pain scale. Related to the pain scale, the left end point was nominated as "no pain," whereas the right end point was nominated as "worst pain imaginable." A single trained operator was engaged in recording the scores.
- Medications prescriptions were judged by asking symptomatology and presence of signs of inflammations.
- Patients were asked to follow up on 30th post operative day to see for wound contracture and scarring. Contracture and scarring were assessed by examining the

patient's tongue movements in all direction and palpation of wound for induration and consistency.

2.8 Data Analysis

All patients were analyzed in this study (intention to treat analysis). All patients were followed-up during the time of trial. Results are summarized and presented as frequencies and percentages. No analytical analysis was undertaken due to small sample size and increased risk of type 1 error.

3. RESULTS

In our study, about 61% of population is of male and female were remaining 39% (ratio 1.6:1) which is matching with the previous studies. Amongst the different age groups; most common age is between 1 years to 4 years of age group and least common is 9 years to 12 years of age group (Table 1).

Kotlow class III i.e. sever ankyloglossia (3-7 mm) is the most common presentation which was about 37 percent (Table 1).

The cardinal signs of inflammation in the form of edema and pain, signs of healing especially slough formation at the operative site, complete healing with slight scarring and complete healing with no complications were the outcome indices in our study.

- Operative time: Amongst all the technique, 100% interventions by CO₂ laser were finished in 0-10 minutes; 61% interventions by electro-cautery in 0-10 minutes and remaining 39% in 10-20 minutes. Hence CO₂ laser and electro-cautery were least time consuming as compare to scalpel technique, this is probably because of bloodless field and no sutures were needed (Table 2).
- Bleeding: In our study, about 94% of interventions by Co₂ laser and electro-cautery were bloodless; remaining 6% of patients need only one cotton pad and there were no need of more than one pad in a single case. As compare to scalpel technique, 67% of cases had more than one cotton pad soakage and remaining 33% had one cotton pad soakage (Table 2).
- Suturing: Suturing of the wound was done with 4-0 vicryl, every patient by scalpel

- technique needed suturing, it was not needed at all in CO₂ and electro-cautery; this is probably because of less tissue handling and bloodless field (Table 2).
- Pain: Among the interventions, by scalpel technique, 50% of the patients showed sever pain i. e. score more than 7, and remaining 50% patients showed mild to moderate pain at day 1st and even at day 7th. By laser technique, 61% of the patients had moderate i.e. score 4-7 and 39% of patients had mild form of pain i.e. score 1-3, probably this could be due to more tissue charring and lateral thermal damage. While by electro-cautery, 67% of patients had no pain at all and remaining 33% of patients had mild form of pain (Table 2).
 - Edema: No edema were seen in CO₂ laser and electro-cautery (100%) while it was present in every case undergoing scalpel technique (100%) which was in range from slight edema at floor mouth lasting for a day to swollen tongue and extension to sublingual and submandibular space lasting for a week (Table 2).
 - Post operative medication: Every patient undergoing scalpel method having pain while speaking and eating and signs of inflammation which were lasted for a day or a week; so 100% of patients require medications in the form of antibiotics, anti-inflammatory drugs by oral route. Also all scalpel technique patients were given sutures, so to avoid secondary infections we had prescribed medications even if the symptoms and signs were last for a day.

While interventions performed by CO₂ laser, all patients were prescribed analgesics for a day only, as they were having mild to moderate amount of pain during immediate post-op. While after electro-cautery, only 33% of patient needs medications in the form of analgesics for a day post-op. The entire patients were given antiseptic gargles immediate post-op and were advised to take soft diet for a few days post-op (Table 2).

- Wound contracture and scarring: About 67% of patients by scalpel technique having contracture and scarring and it was present in only 4% and 1% of patients by electro-cautery and CO₂ laser technique respectively (Table 2).

4. DISCUSSION

Nevertheless, inspite of the various modifications which have been proposed for frenectomy, the widely followed procedure which remains is the conventional scalpel technique. The conventional scalpel technique leaves a longitudinal surgical incision and scarring, which may lead to periodontal problems and an unaesthetic appearance, thereby necessitating other modifications [9].

Among all the approaches for frenectomy which were employed, the electro-cautery and CO₂ laser procedure offered the advantage of minimal time consumption and a bloodless field during the surgical procedure, with no requirement of sutures.

Table 1. Baseline demographic and clinical characteristics of study participants

Variable	Intervention groups			Total
	A	B	C	
Gender				
Male	11	10	12	33 (61%)
Female	07	08	06	21 (39%)
Age group				
1-4	08	08	09	25 (46%)
5-8	06	05	04	15 (28%)
9-12	04	05	05	14 (26%)
Kotlow classification				
I	04	03	06	13 (25%)
II	02	04	05	11 (20%)
III	08	07	05	20 (37%)
IV	04	04	02	10 (18%)

Table 2. Summary of clinical outcomes by treatment groups methods

Variable	Intervention groups		
	A	B	C
1. Operation time			
• 0-10 min	00(0%)	11(61%)	18 (100%)
• 10-20 min	7(39%)	7(39%)	00(0%)
• Above 20 min	11(61%)	00(0%)	00(0%)
2. Bleeding (Volume)			
• Bloodless	00(0%)	17(94%)	17(94%)
• One cotton pad soak	6(33%)	1(6%)	1 (6%)
• More than one cotton pad soak	12(67%)	00(0%)	00(0%)
3. Suturing			
• Yes	18(100%)	00(0%)	00(0%)
• No	00(0%)	18(100%)	18(100%)
4. Pain			
• No (score 0)	00(0%)	12 (67%)	00(0%)
• Mild (1-3)	2(11%)	6 (33%)	7(39%)
• Moderate (3-7)	7(39%)	00	11(61%)
• Severe (more than 7)	9 (50%)	00(0%)	00(0%)
5. Edema			
• None	00(0%)	18 (100%)	18(100%)
• Present	18(100%)	00(0%)	00(0%)
6. Post operative medication (duration)			
• Not needed	00(0%)	12(67%)	00(0%)
• Needed on day 1	00(0%)	6(33%)	18(100%)
• Needed on day 7	18(100%)	00(0%)	00(0%)
7. Wound contracture & scarring			
• Yes	12(67%)	4(22%)	1 (6%)
• No	6(33%)	14(78%)	17(96%)

Though lasers have marked the beginning of their use in soft tissue management, electro-cautery are "far less expensive than the CO₂ lasers" and hence it can be questioned whether "the advantages of the CO₂ laser are significant enough to compensate for the additional cost" [10]. Also when John et al. [11] compared mucosal incisions made by scalpel, CO₂ Laser, electro-cautery, he concluded that, on subjective evaluation of ease of use, constant-voltage electro-surgery scored highest ($p < 0.05$) on a scale of 0 to 4, followed by the CO₂ laser. The speed of incisions and excisions, measured in seconds, was also faster for electro-cautery unit as compared to CO₂ laser. The collateral tissue damage was also less in electro-cautery group as compared to laser. Other advantages of it over lasers are that they require no safety glasses and can remove large amounts of tissue quickly. [10] hence till certain extent, we can justify the use of electro-cautery over the novel technique of laser in routine practice. Also in our study, electro-cautery were best tolerated over CO₂ laser in terms of post-operative pain and it is equally effective in terms of post operative

edema, suture less and bloodless intra-operative field. But considering the operative time, the CO₂ laser is far better than electro-cautery and scalpel technique.

In comparing the handling properties between scalpel, electro-cautery and CO₂ laser, it was observed that scalpel has more advantages of ease of use, low cost, precise incision with well defined margins, no unwanted lateral tissue damage can be used to bone proximity and economic. Disadvantages of scalpel are need of anesthesia, excessive bleeding, inadequate visibility caused by blood in the operative field, need of suturing and need of post operative medication [12].

Advantages of electro-cautery observed are, the electrode cuts on its sides as well as on its tip, angulated electrode meets the clinical need, hemostasis is immediate and consistent, the wound is nearly painless and the tip is self disinfecting. Disadvantages of electro-cautery include unavoidable burning – flesh odor, low tactile sense, does not allow to use near the

implants, bone can be damaged, dangerous in explosive environment, contraindicated in pacemakers [12].

Laser was found advantageous in that no harm to dental hard tissues. Their judicious use does not injure the dental pulp, because of low or no heat production and can be used around dental implant. Laser assisted surgeries are easy to perform with less discomfort, minimal or no bleeding due to sealing of capillaries by protein denaturation and stimulation of clotting factor VII production, shorten healing time with reduced post operative bleeding and edema [13].

Histologically, laser wounds have been found to contain significantly lower number of myofibroblasts, thereby resulting in less wound contracture and scarring, and ultimately improved healing. Laser itself are antimicrobial and remove endotoxins from root surface [14].

Disadvantages of lasers includes eye damage by laser light, so protective glasses are required. Cutting is slower than that with electro-cautery. Working area should be free from combustible gases. During laser use, laser plume requires use of high filtration face masks. In terms of expenditure, the laser is far more costly than electro-cautery and scalpel technique.

Kara [15] compared Nd: YAG laser to conventional scalpel surgery and reported that patients treated with laser reported higher levels of satisfaction, less postsurgical pain and discomfort. Haytac and Ozcelik [16] compared 20 frenectomy procedures performed with CO₂ laser to an equal number performed with conventional scalpel surgery and reported that patients treated with laser experienced less pain after 1st day and 7th day.

In this study, it was observed that patients treated with the CO₂ laser experienced less pain and discomfort than scalpel technique. But electro-cautery is better in terms of post operative pain than CO₂ laser.

When compared with those treated with scalpel. It has also been observed that the reduction in pain and discomfort levels from the 1st to the 7th day is much more significant for the laser group. As patients undergone Laser frenectomy require analgesics only for a day. The increased pain perception associated with the scalpel frenectomy might be attributed to the fact that it is a more intrusive surgical procedure involving

blood loss, wide surgical wound, more tissue handling and suturing. The sutures also contribute to the discomfort postoperatively since they interfere with regular functions such as speech and intake of food.

On the contrary, the decreased pain and discomfort in the laser group might be ascribed to the protein coagulum formed over the wound, which acts like a biological dressing, aids in sealing of the ends of sensory nerves [17]. According to Schuller DE study, lasers cause less bleeding with minimal scarring, less postoperative pain and a minimal number of cases requiring suturing with quicker wound healing [18].

Thus, though the approaches to the problem of not using the traditional scalpel have merits but further improvements can still be made considering the healing aspect. Healing was complete by first post-operative month.

5. CONCLUSION

This study supports the use of CO₂ lasers and electro-cautery in procedures like frenectomy. CO₂ lasers provide better patient perception in terms of reduced operative time, no any inflammatory sign, suture less while electro-cautery provide better patient perception in terms of post operative pain, suture less and cost effective. Taking into consideration the admirable clinical outcome, both electro-cautery and CO₂ laser offers a safe, effective, acceptable and satisfactory alternative for frenectomy operations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Messner AH, Lalakea ML. The effect of ankyloglossia on speech in children. *Otolaryngology-Head and Neck Surgery*. 2002;127(6):539-45.
2. Horton CE, Crawford HH, Adamson JE, Ashbell TS. Tongue-tie. *The Cleft Palate Journal*. 1969;6:8-23.
3. Travis, Lee Edward. *Handbook of speech language pathology and audiology*. New York, New York: Appleton-Century-Crofts Education Division Meredith Corporation; 1971.

4. Lalakea M. Lauren, Messner, Anna H. Ankyloglossia: The adolescent and adult perspective. *Otolaryngology-Head and Neck Surgery*. 2003;128(5):746–52. DOI: 10.1016/s0194-5998(03)00258-4 PMID 12748571
5. Friend GW, Harris EF, Mincer HH, Fong TL, Carruth KR. Oral anomalies in the neonate, by race and gender, in an urban setting. *Pediatr Dent*. 1990;12(3):157–161.
6. Heller J, Gabbay J, O'Hara C, Heller M, Bradley JP. Improved ankyloglossia correction with four-flap Z-frenuloplasty. *Ann Plast Surg*. 2005;54(6):623–628.
7. Messner AH, Lalakea ML, Aby J, Macmahon J, Bair E. Ankyloglossia: Incidence and associated feeding difficulties. *Arch Otolaryngol Head Neck Surg*. 2000;126(1):36–39.
8. Kotlow LA. Ankyloglossia (Tongue tie): A diagnostic and treatment quandary. *Quintessence Int*. 1999;30:259-262.
9. Devishree et al. Frenectomy: A review with the reports of surgical techniques. *J Clin Diagn Res*. 2012;6(9):1587–92.
10. Glenn A et al. The diode laser as an electrosurgery replacement. *C.E. Article Electrosurgery*. 2013;6-13.
11. John Liboon et al. A comparison of mucosal incisions made by scalpel, CO₂ laser, electrocautery and constant-voltage electrocautery. *Otolaryngol Head Neck Surg*. 1997;116(3):379-385.
12. Sachin Funde et al. Comparison between laser, electrocautery and scalpel in the treatment of drug induced gingival overgrowth: A case report. *IJSS Case Reports & Reviews*. 2015;1(10).
13. Vescovi P, Corcione L, Meleti M, Merigo E, Fornaini C, Manfredi M, et al. Nd: YAG laser versus traditional scalpel. A preliminary histological analysis of specimens from the human oral mucosa. *Lasers Med Sci*. 2010;25:685-91.
14. Zeinoun T, Nammour S, Dourov N, Aftimos G, Luomanen M. Myofibroblasts in healing laser excision wounds. *Lasers Surg Med*. 2001;28:74-9.
15. Kara C. Evaluation of patient perceptions of frenectomy: A comparison of Nd: YAG laser and conventional techniques. *Photomed Laser Surg*. 2008;26:147-52.
16. Haytac MC, Ozcelik O. Evaluation of patient perceptions after frenectomy operations: A comparison of carbon dioxide laser and scalpel techniques. *J Periodontol*. 2006;77:1815-9.
17. Fisher SE, Frame JW, Browne RM, Tranter RM. A comparative histological study of wound healing following CO₂ laser and conventional surgical excision of canine buccal mucosa. *Arch Oral Biol*. 1983;28:287-91.
18. Schuller DE. Use of the laser in the oral cavity. *Otolaryngol Clin North Am*. 1990;23:31-42.

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