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# Comparison of Pain Perception between Scalpel and Laser Technique During and After Frenotomy

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## ABSTRACT

Introduction: Frenotomy is a procedure to incise and relocate the high level frenum attachment, which can be performed by laser or scalpel surgical technique.

Objective: To compare post-operative pain, rescue analgesic drug, and post-operative pain during speaking and chewing after frenotomy surgery using either diode laser or conventional scalpel.

Methods: This was a prospective clinical comparative study done at the Department of Periodontics and Oral Implantology, People's Dental College and Hospital, Sorhakhutte, Kathmandu, Nepal from 2023 August to 2024 March. A total of 28 participants (14 in each group) were included in this research by convenience sampling. Post-operative pain was measured using the Numerical Rating Scale. Other clinical outcomes measured were duration of surgery, number of rescue analgesic drugs consumed, and pain during speaking and chewing in post-operative day-1, day-2, day-3, and day-7. A p-value <0.05 was considered a significant difference for all statistical analysis.

Results: The use of diode laser showed statistically significant reduction of post-operative pain ($p < 0.05$), while there was no statistically significant difference on rescue analgesic drug between the groups ($p > 0.05$). The laser group showed significantly less pain on chewing on post-operative day-3 and day-7 compared to the scalpel group. There was a significant reduction of pain during speaking on post-operative day-2, day-3, and day-7 in the laser group.

Conclusions: Labial frenotomies performed with diode laser offer significantly less pain and discomfort during speech and chewing compared to frenotomy with scalpel.

Keywords: Frenotomy; diode laser; pain; scalpel surgery.

## INTRODUCTION

Frenum is fibrous fold of mucous membrane with underlying periosteal insertion extending from lips and cheeks to alveolar and/or gingival mucosa near central incisors. It helps in modulating labial movement.[1] High frenal attachment that shifts interdental papilla when extended and has reduced zone of attached gingiva are pathogenic. It limits lip movements, creates diastemas, difficulty in plaque control, and prosthetic and speech problems. Surgical excision of frenum prevents all these complications. Frenectomy is the complete removal of frenum, including its attachment to underlying bone, while frenotomy is incision and relocation of frenal attachment.[2] These procedures can be performed either with conventional scalpel or lasers. Conventional methods are reported to induce post-operative pain, swelling, bleeding, and discomfort. However, lasers can be efficient alternative as minimally invasive procedure reducing various ailments of conventional surgery. Studies report benefits of laser with successful clinical outcomes to perform frenectomy.[3] Various lasers with different tissue interaction, wavelength, and frequency: diode, neodymium-doped yttrium aluminum garnet (Nd: YAG), Er:YAG, $CO_2$ are being used widely for soft-tissue surgeries such as in frenectomy, gingivectomy, or gingivoplasty.[4]

Diode lasers for soft tissue surgery have gained popularity over recent years. Diode absorption depth in water, especially in 810–980 nm wavelength is comparatively greater than other lasers and it has affinity for wet tissues.[5] Diode laser irradiation is

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also poorly absorbed by tooth structure in close proximity to enamel. Since oral tissue is composed of >90% water, these diode properties have made it easy, safe, and effective for use in intraoral soft tissue surgeries. Diode lasers are portable, cost-effective, and less technique sensitive.[6]

To authors' knowledge, pain assessment between scalpel and diode laser in frenotomy procedure is very limited. Therefore, this study aimed to compare post-operative pain and rescue analgesic drug between conventional scalpel and diode laser techniques in a frenotomy procedure.

## METHODS

A prospective comparative clinical study of post-operative pain between conventional scalpel and diode laser techniques in a frenotomy procedure was done at Department of Periodontics and Oral Implantology, People's Dental College and Hospital (PDCH), Nepal. Ethical clearance was done by the Institutional review committee (IRC) of PDCH (Ref. 2022 25).

A study by Kara[7] found a statistically significant difference of visual analogue scale (VAS) score in pain between conventional scalpel technique: mean ± standard deviation (SD) = 1.09± 1.02 and laser = 0.15± 0.33 after frenectomy at day-7. Using the mean and SD from both groups, adequate sample size was calculated using OpenEpi.com[8] in this study to detect a clinically significant difference between two independent means of VAS scores. A total of 28 participants (14 in each of the control and intervention groups) were required to detect an effect size of 1.24 as calculated from mean difference and standard difference from both groups, at 90% power, and 5% type I error.

Patients with mandibular anterior frenum extending to the interdental papilla of central incisors with age group between 18–45 years, who fall into American Society of Anaesthesiologist (ASA): class I or II were selected by convenience sampling technique to include in this research.

Those patients with any history of allergy to local anaesthetics and/or opioids, previous experience of painful dental treatment and have gingivitis, periodontitis, pulpitis were excluded from the study. In addition, patients with a history of narcotic or alcohol abuse or any a history of current liver disease such as cirrhosis, acute or chronic hepatitis, cardiac diseases such as recent myocardial infarction, chronic opioid analgesic user, pregnant and lactating mother were also not included in this study.

Before surgery, vitals such as Blood pressure, Pulse rate, and Respiratory rate were examined. Before surgery all patients underwent oral prophylaxis (scaling) and if required root planing. Patients were explained about the surgical procedures and its complications such as pain, swelling, and bleeding. The papillary or papilla penetrating types of frenal attachments were classified according to classification given by Placek et al.[9]

All surgical procedures were performed by a single operator. In the control group (scalpel technique), 2% lignocaine was used for local infiltration around the high frenum attachment and 15 number blade was used to surgically relocate frenum from its base (Figure 1a and 1b). For the laser group, a diode laser (SIROLaser Advance Dental Diode Laser) with 980 nm wavelength, 320µm fiber tip and 3.0 W power was used. Local infiltration will be used to obtain anaesthesia. Fiber tip of the laser was used in contact mode and moved with a paint brush stroke, from the base to the apex of the frenum, thereby excising it (figure 2a and 2b). Sutures were not used in both groups. Care was taken to avoid any contact to the root surface or the alveolar bone. In both techniques, non-eugenol periodontal dressing (COE-PAK) was placed after completion of frenotomy.

After surgery, the patients were advised to be on a soft or liquid diet for one week. Periodontal dressing was removed on the seventh day. The patients were given amoxicillin 500 mg for three times per day for five days and paracetamol 500 mg as a rescue analgesic drug to be taken at six-hour intervals for the control of pain.

Numeric Rating Scale (NRS) was used to rate the pain experienced by each patient. All patients were explained about the NRS to describe the pain as 0 represents no pain and 10 the worst possible pain at the time of consent. The NRS is categorised as 1-3 (mild pain), 4-6 (moderate pain), and 7-10 (severe

pain). Pain assessment was started immediately after the completion of surgery as operation day and then at post-operative day one, two, three, and seven.

Following the surgery, all patients were given a standardised NRS form to record the values of post-operative pain. Pain assessment was categorised as overall pain, during chewing foods, and during speaking. This form had to be returned to the researcher on the seventh day of surgery.

The total duration of operation was recorded from the time of first incision to the final closure of wound. All patients were asked to record the rescue analgesic consumption in a post-operative data collection sheet.

Demographic data including age at the time of operation and sex were recorded. Operative variables included type of frenum attachment and duration of surgery. All the data were registered and recorded in proforma by using NRS.

Independent sample t-tests were used to compare the means of continuous variables between the two intervention groups. Similarly, Chi-square or Fisher's exact tests were used to compare the proportions of categorical variables between the two groups. All data were recorded to an Excel sheet and transferred to SPSS® v. 22.0 software for Windows (IBM Corp., Armonk, NY, USA) for statistical analysis. A p-value of <0.05 is considered as statistical significance.

**Figure 1a,1b: Frenotomy with scalpel.**

**Figure 2a, 2b: Frenotomy with laser.**

## RESULTS

There were a total of 28 patients who underwent frenotomy, with mean age of 31 years (range: 18 to 58 years) and 19 patients (67%) were females.

The mean duration of surgery was 19.2 min in the laser group and 26.7 min in the scalpel group with significant difference (Table 1; p<0.05). The type of frenal attachment showed no significant difference between the groups.

The use of laser in frenotomy did not show significant difference in mean pain score when compared with the scalpel at immediate after surgery, post-operative day one (Table 2; all p value>0.05). However, the use of laser resulted in lower mean pain scores at post-operative day two, three, and seven (Table 2; all p value>0.05). In addition, overall mean pain in seven days of evaluation was statistically significant different between the two groups.

The overall mean total number of analgesic requirement by the laser group of patients did not differ significantly when compared to the scalpel group of patients in frenotomy at all follow up periods (p value >0.05).

The patients who underwent laser surgery had lower mean pain during chewing function on post-operative day three and seven when compared with the scalpel group with statistically significant difference (Table 3; p<0.05). Similarly, after surgery during speaking, laser group patients had statistically significant lower mean pain on post-operative day two and three. While there was no statistical difference on day one and seven when compared to the scalpel group.

**Table 1: Comparison of patient and surgical characteristics between the two groups.**

| Variables | Intervention | | p-value |
|---|---|---|---|
| | Laser (n = 14) | Scalpel (n = 14) | |
| **Age (in years)** | | | |
| Mean ± SD | 29.6 ± 9.3 | 32.6 ± 9.1 | 0.399[1] |
| **Sex** | | | |
| Male | 5 | 4 | 0.686[2] |
| Female | 9 | 10 | |
| **Duration of Surgery (min)** | | | |
| Mean ± SD | 19.2 ± 4.4 | 26.7 ± 6.6 | 0.002[1]* |
| **Type of frenal attachment** | | | |
| Gingival | 5 | 5 | 0.589[2] |
| Papillary | 8 | 9 | |
| Papillary penetrating | 1 | 0 | |

Abbreviations: SD, standard deviation; min, minutes. [1]Independent t-test, [2] Pearson Chi-Square test or Fisher's Exact test; *Significant relationship (p <0.05)

**Table 2: Comparison of mean Numerical Rating Scale scores for pain between the study groups.**

| Variables | Mean ± SD | | p-value |
|---|---|---|---|
| | Laser (n=14) | Scalpel (n=14) | |
| Immediately after surgery | 1.86 ± 0.53 | 2.29 ± 0.72 | 0.087 |
| Post-op Day 1 | 2.14 ± 0.94 | 2.86 ± 1.02 | 0.067 |
| Post-op Day 2 | 1.29 ± 0.72 | 2.29 ± 1.13 | 0.010* |
| Post-op Day 3 | 0.71 ± 0.72 | 1.79 ± 0.89 | 0.002* |
| Post-op Day 7 | 0.29 ± 0.46 | 0.86 ± 0.53 | 0.006* |
| Overall Mean pain | 1.25 ± 0.54 | 2.01 ± 0.73 | 0.005* |
| Total number of analgesics | 2.50 ± 2.10 | 4.64 ± 3.24 | 0.050 |

Abbreviations; SD, standard deviation; independent sample t- test; *Significant relationship (p <0.05)

**Table 3: Comparison of mean Numerical Rating Scale scores for pain between the study groups associated with chewing and speaking.**

| Variables | | Mean ± SD | | p-value |
|---|---|---|---|---|
| | | Laser (n=14) | Scalpel (n=14) | |
| Chewing | Post-op Day 1 | 2.14 ± 0.86 | 2.79 ± 1.05 | 0.089 |
| | Post-op Day 2 | 1.36 ± 0.74 | 2.07 ± 1.20 | 0.071 |
| | Post-op Day 3 | 0.57 ± 0.51 | 1.43 ± 1.15 | 0.018* |
| | Post-op Day 7 | 0.14 ± 0.36 | 0.64 ± 0.74 | 0.033* |
| Speaking | Post-op Day 1 | 1.36 ± 0.74 | 1.93 ± 0.82 | 0.066 |
| | Post-op Day 2 | 0.50 ± 0.65 | 1.21 ± 1.05 | 0.040* |
| | Post-op Day 3 | 0.07 ± 0.26 | 0.57 ± 0.75 | 0.028* |
| | Post-op Day 7 | 0.07 ± 0.26 | 0.29 ± 0.46 | 0.149 |

Abbreviations; SD, standard deviation; independent sample t- test; *Significant relationship (p <0.05)

## DISCUSSION

This study focussed on evaluation of the post-operative pain during and after frenotomy surgery using scalpel and diode laser through NRS and the number of rescue analgesics used to relieve pain. Diode laser is gaining popularity as an effective alternative to conventional scalpel intraoral soft tissue surgery due to its portability, cost effective and easy handling properties. Other benefits of laser assistance in these surgeries include shorter operative time, haemostasis, or less post-operative pain. There are no studies to authors' knowledge which evaluated or compared the post-operative pain perception of patients after frenotomy surgery between diode laser and scalpel.

The result of this study showed significant difference in mean NRS score when compared with the scalpel on post-operative day two, three, and seven, while it showed no significant difference on immediate after surgery and post-operative day one. This can be explained by the mechanism that the laser could seal lymphatic and nerve ending channels, which reduced post-operative swelling and the inflammatory response,[10] thus resulting in lesser pain.

Similarly in various other researches, the laser seemed to cause significantly less post-operative pain on the surgery day[7,11,12] one day,[7,11-13] three days,[12] and seventh day[7,13] in frenectomy procedures.

In contrast, a study by Uraj et al.,[14] showed no significant difference on post-operative pain between diode laser and scalpel group in frenectomy surgery.

Few studies mention that the laser beam ensures the incised tissue remains sterilised during the process. Thus, the risk of post-operative infection is reduced. Pain and swelling after surgery are minimised with laser treatment and fewer wound contractions occur during healing, which means that mucosal scar formation is less. This may be the reason for less pain during the third and seventh post-operative day.

Frenotomy procedure requires immediate haemostasis with pressure pack and haemostatic agents. Diode laser frenotomy overcome this disadvantage as it precisely coagulates, vaporises or cuts tissue.[13] This feature reduced the surgical duration in laser frenotomy as haemostasis occurs immediately, which was apparent in this study (p <0.05; Table 1). There is abundant evidence confirming markedly short surgical duration in laser frenectomy group compared to scalpel group.[15,16]

The overall mean total number of analgesic requirements by the laser group of patients didnot differ significantly when compared to the scalpel group of patients (p value >0.05). Since the pain threshold differs among different individuals, this difference can affect the results of such a comparative study. Similar results were reported in a meta-analysis by Protacio et al. which did not show any significant difference in consumption of rescue analgesics in frenectomy procedure between scalpel and laser group.

The laser group showed significantly less pain on chewing on post-operative days three and seven compared to the scalpel group. There was a significant reduction of pain during speaking on post-operative day two, three, and seven in the laser group. While the study by Protacio et al. showed significant lower mean pain during chewing and speaking on day one and seven in the laser group in frenectomy surgery.

This study has provided additional information in the literature regarding the benefits of the diode laser in frenotomy procedures. The limitation of this research could be information bias which could be due to the lack of blinding to study participants, as they can easily perceive treatment modality of surgical procedure, either scalpel or laser. This might have affected clinical outcome and pain perception. Further research with larger sample sizes and additional clinical evaluation of bleeding and soft tissue wound healing would provide more evidence in such type of surgery.

## CONCLUSIONS

This study suggests that labial frenotomies performed with diode laser offer significantly less pain and discomfort during speech and chewing compared to frenotomy with scalpel. Lasers also offer significant reduction in surgical duration and need for rescue analgesics. Further well-designed studies with larger samples and more standardised methodology are recommended to provide a higher level of evidence on laser benefits.

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