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Diode laser versus conventional technique for frenectomy- A randomised controlled clinical trial

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Abstract
Aim: Diode lasers are most commonly used for oral soft tissue surgeries. The aim of this randomised controlled clinical trial was to evaluate the use of diode laser for frenectomy on clinical and healing outcomes.
Materials and Method: Twenty patients aged between 18 to 45 years were selected requiring frenectomy of maxillary labial frenum were randomly assigned to either test group or control group. For test group soft tissue diode laser was used for frenum removal and for control group conventional scalpel technique was used. Clinical and healing outcomes were measured using for pain (visual analogue scale), discomfort during speech, bleeding severity, swelling, redness and wound healing. Recall visits were done at 1, 7 and 30 days.
Results: The clinical and healing outcomes were statistically significant for diode laser group. There was less pain, discomfort during speech and increased healing on the test sideat 1 and7 days recall visit. Bleeding and redness immediately after surgery was less on the test side than on the control side.
Conclusion: The use of soft tissue diode laser could be an alternative to conventional scalpel technique for maxillary labial frenectomy as it causes less pain, less bleeding and improved healing of tissues.

Keywords: Diode laser; frenectomy; healing; maxillary frenum; oral soft tissue; surgery

Introduction
The frenum is a mucous membrane fold that attaches the lip and the cheek to the alveolar mucosa, the gingiva and the underlying periosteum [1]. Frenum problem most often occurs on the labial surface between the maxillary and mandibular incisors and in canine and premolar areas and less often on the lingual surface of mandible [2].
The size and location of the frenum may lead to compromise in esthetic and function. The frenum attaching to the gingival interdental papilla or penetrating deep into the palatine papilla are considered pathological. The frenum when attached too close to the gingival margin or interdental papilla it may jeopardize gingival health by causing a muscle pull which may lead to opening of the gingival sulcus and subsequently plaque accumulation [2, 3]. The high frenal attachment may also interfere in plaque control due to inability to place the toothbrush properly. The high frenal pull may also cause recession and malalignment of teeth [2, 3]. The maxillary frenum between the maxillary central incisors causes midline diastema leading compromise in aesthetics. Aesthetics concerns in patients have led to increasing importance in seeking dental treatment for the purpose of achieving perfect smile.
The management of aberrant frenum is known as frenectomy [3]. Frenectomy is complete removal of the frenum, including its attachment of the underlying bone [4]. There are several techniques for removal of frenum which includes the traditional scalpel, electro surgery and lasers. The conventional scalpel technique causes more pain and discomfort and leaves alarge rhomboidal wound in the lower part [5]. Electro cautery delays the process of healing as the wound edges are not approximated by sutures and healing takes place by secondary intention [3].
Laser are available today with wide range of characteristics for use in the field of dentistry. Diode lasers have the advantages of being compact, affordable, ease of operation, simple set up, and versatile [6]. The active medium of the diode laser is a solid-state semiconductor made of aluminium, gallium and arsenide which produces laser wavelength in the near infrared spectral region between 808 nm and 980nm. The diode wavelength are absorbed in haemoglobin and melanin and have little absorption in dental hard tissue [7, 8].

The radiations in diode laser can be either continuous or pulsed and utilizes an optical flexible fibre ranging from 200 to 600µm to deliver the treatment beam to the target area [7, 8].
Several case reports have shown the advantages of diode lasers on frenectomy of maxillary labial frenum [6-11] but only one study [11] according to our knowledge have compared the clinical and healing outcomes to traditional scalpel technique. Therefore, the aim of our randomised controlled clinical trial was to compare diode laser and surgical scalpel technique for maxillary labial frenectomy.

Materials and method
This study was conducted in Department of Periodontology, Patna Dental College and Hospital. The study was conducted after obtaining approval from institutional ethics committee board. Informed consent was obtained from every patient before enrolling in the study.

Study groups
Twenty patients were selected for this study aged between 18-45who required frenectomy due to high maxillary frenum attachment. The patients were then randomly divided into two groups with 10 patients in each group by coin toss method. For test group, 980 nm diode laser and for control group conventional scalpel technique was used. All the subjects were systemically healthy, did not use any antibiotics, and had good oral hygiene at the time of surgery. Surgical procedures were performed after proper clinical and haematological examination. Initial phase I therapy was performed before surgery for all the patients.

Surgical Procedure
For laser technique, topical spray (Nummit spray, lidocaine USP 15% w/w) was used to obtain surface anaesthesia. A 400 um fibre tip was used with 980 nm wavelength, power setting of 1.5 W in contact mode and the tip was moved with a paint brush technique from the base to the apex of the frenum. Neither surgical suture nor wound dressing was used after surgery (figure 1-3).
For the conventional scalpel technique, local anaesthesia (2% lignocaine with 1:80000 adrenaline) was given. The frenum was engaged with hemostat which was inserted into the depth of vestibule and a diamond shaped incision using a No. 15 blade was placed on the upper and under surface of hemostat. The whole band of tissues together with its alveolar attachment was excised and fibrous attachments were dissected to the underlying periosteum. The wound edges were sutured with interrupted sutures using non resorbable 3-0 black silk suture (Ethicon, Johnson & Johnson limited, USA) (figure 4-7). The surgical site was covered with periodontal pack (Coe-pak). The pack and sutures were removed after one week post-operatively.
Post-operative instruction was given to the patient and instructed to use analgesics in case of pain only. All the patients were recalled at 1, seven and 30days after surgery to assess healing.

Outcome measurement
To assess pain experienced after each surgical procedure and speech complication, visual analog scale was used (VAS). Each patient was asked to make a vertical mark between the two end-points on a 100mm VAS scale for pain and discomfort during speech at one, seven- and 30-days post operatively. The left end-point was designated as no pain and the right end point was designated as worst pain imaginable, and the score was between 0 and 100 [12].
The severity of bleeding was recorded by the operator by scoring the amount of bleeding during the procedure for each patient and a score between 0 (no bleeding) and 3 (severe bleeding) was given [13]. Severity of redness was marked on a five-point scale; from pale red (1) to deep red (5) [12]. Inflammation of the tissues were recorded as present or absent.
Seven and 30 days post-operatively, each patient was recalled determining the wound healing. For each patient, the healing was scored as 1: complete epithelialization, 2: incomplete epithelialization, 3: ulcer, and 4: tissue defect or necrosis [12].
A single periodontist examined clinically and recorded the data who was unaware of which procedure was applied to the jaws.

Statistical Analysis
Computer software (SPSS Version 15, SPSS, Chicago, IL, USA) was used to conduct the statistical analysis. Student t test was used for intragroup comparison assessing VAS scores of pain and discomfort. For binary and categorial data chi square test was used. Statistical significance was considered when p value was less than 0.05.

Result
The study characteristics of the participants are described under table 1. A total of 20 patients participated for this study of which 12 were male with age range of 25.12 ± 2.15 and 8 were females with an age range of 27.41 ± 1.81.
The mean and standard deviation for VAS score for pain, speech discomfort and wound healing 1, 7 and 30 days is summarized under table 2. The analysis showed that VAS score for pain and speech discomfort was significantly less for test group than control group at one-(p=0.00;0.00) and seven-days-(p=0.00;0.96) post-operative and no difference was seen 30 days after surgery (p= 0.84; 0.49). Similarly improved wound healing was present on test side on both one day (p= 0.02) and seven days after surgery (p=0.00).
Intraoperative bleeding and redness immediately after surgery is summarized in Table 3. The redness and bleedingwere more for the scalpel group and the difference was statistically significant (0.00).

Table 1: Study Characteristics of population

Gender	Number	Age
Male	12	25.12 ± 2.15
Female	8	27.41 ± 1.81

Table 2: Comparison of pain, speech discomfort at 1, 7, 30 days post-operatively between test and control group.

Outcomes	Groups	One day post-surgery (mean±SD)	One week post-surgery (mean±SD)	One month post-surgery (mean±SD)
Pain	Test	11.6±2.98	4.54± 0.26	0.61±0.11
	Control	22.0 ± 6.23	10.89±0.15	0.51±0.10
	P value	0.00*	0.00*	0.84
Speech discomfort	Test	8.71± 2.70	3.44±1.14	0.84 ± 0.21
	Control	17.60 ± 4.23	4.59± 1.74	1.20± 0.65
	P value	0.00*	0.96	0.49
Wound healing	Test	2.2 ± 0.05	1.2 ±0.35	1.1 ± 0.49
	Control	3.9 ± 0.47	2.4 ± 0.47	1.2 ± 0.21
	P value	0.02*	0.00*	0.36

Table 3: Comparison of severity of bleeding and tissue redness immediately after surgery between test and control group.

Outcomes	Groups	Immediatelypost surgery (mean±SD)
Severity of bleeding	Test	0.58 ± 1.21
	Control	2.14 ±1.77
	P value	0.00*
Redness	Test	1.24 ±0.36
	control	3.3 ± 1.41
	P value	0.00*

Fig 1: Papillary type high frenal attachment between maxillary central incisors.

Fig 2: Immediate post operative after use of diode laser.

Fig 3: Healing after 7 days

Fig 4: High frenal attachment between incisors.

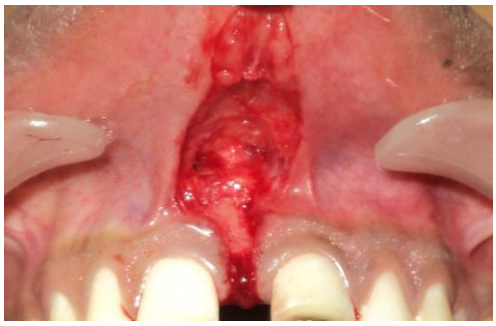

Fig 5: Wound after removal of frenum by conventional scalpel technique.

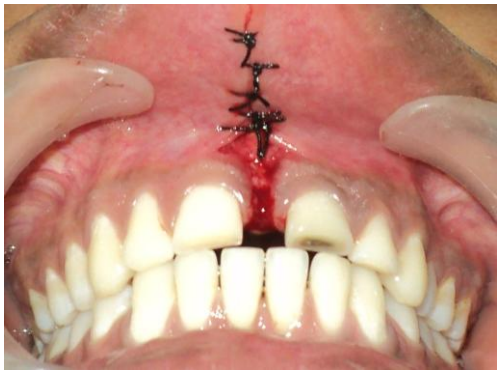

Fig 6: Sutures placed.

Fig 7: Healing after 7 days.

Discussion

The results of our randomised clinical trial showed that diode laser is beneficial in achieving better clinical and healing outcomes compared to conventional scalpel technique. Among the various lasers used in dentistry diode lasers are more frequently used. The oraltissue is composed of > 90% water; therefore, a diode laser is easy and effective for use in intraoral soft tissue surgery, especially frenectomy because of its affinity towards water. The result showed that diode laser resulted in improved wound healing, less pain and discomfort, less bleeding, redness and inflammation and increased patient satisfaction. Additional advantages of diode lasers include; decreases the need for anaesthesia; provides a bloodless field for surgery; more precise and visible cut; controls haemostasis and the surgical operations are generally sutureless. Also, the laser instantly disinfects the surgical wound as well.

The pain was significantly less for diode laser in our study. The reason for less or no post-operative pain is due to the sealing of the sensory nerve endings with the heat of the laser beam [11]. Lasers also bring about sealing of lymphatics and fibrin clot is formed which protects it from external trauma [13]. Sutures can also cause post-operative discomfort due to accumulation of plaque and calculus. Diode laser frenectomy showed improved and faster wound healing than conventional scalpel technique. The classical scalpel technique leaves a longitudinal surgical incision and scarring, which may lead to periodontal problem and unesthetic appearance [13]. Laser induced wounds because of definite and clean wound, generally heal with secondary intention and no scar formation compared to scalpel incisions. This is may be due to the minimal degree of wound contraction following laser irradiation which occurs through induction and formation of smaller number of myofibroblasts and collagen [7].

Romanos and Nentwig [6] used diode laser in a variety of oral soft tissue surgeries and their results showed that there was less swelling, bleeding, pain and scar tissue formation. Similar findings were seen by Uraz *et al*. [11] Derikvand *et al*. [8] and Azma *et al*. [9]

The drawback diode lasers are that they are expensive, special equipment required, requires additional skills for operation and limited use. Another disadvantage of diode laser is that during operation while performing the incision some fumes were released from vaporization of epithelium with a burning smell, which can provoke stress and hurt in the patient, and for relief of this complication, it is necessary to operate with a powerful air evacuator.

The use of diode laser could be asafer alternative to conventional scalpel technique, as it promotes healing, reduces pain and discomfort for the patient.

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