

Case Report

## Applications of 445nm soft tissue diode laser in soft tissue dental surgeries: A case series

Aehad Ul Haque, Nand Lal, Pavitra Rastogi, Shalini Kaushal, Manisha Verma

Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, India

### ABSTRACT

**Background:** Through the recent years various types of lasers have found use in dentistry. Among them diode lasers have gained a special place in the arena of soft tissue surgery. **Purpose:** To substantiate the applicability of low wavelength Diode Laser in soft tissue dental surgeries. **Cases:** Five different cases in which soft tissue dental surgery was indicated, were included: (1) A 21-year-old female patient who underwent frenectomy; (2) A 24-year-old female patient who underwent excision of gingival polyp; (3) A 30-year-old patient who underwent Gingivectomy; (4) A 32-year-old female patient who underwent surgical crown lengthening and (5) A 28-year-old male patient who underwent operculectomy. **Case Management:** Each of these patients was successfully treated using low wavelength 445nm Soft Tissue Diode Laser. **Conclusion:** All the patients experienced normal post-operative healing without any complications. The overall outcome in each case was favourable. The use of low wavelength diode lasers is strongly suggested for soft tissue dental surgeries, owing to their ease of use, versatility, minimal thermal damage and good post-operative healing.

Keywords: Diode Laser; Dentistry; Soft Tissue Surgery

Correspondence: Aehad Ul Haque, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, 226003, Lucknow, India. Email: aehad.haque@gmail.com

### INTRODUCTION

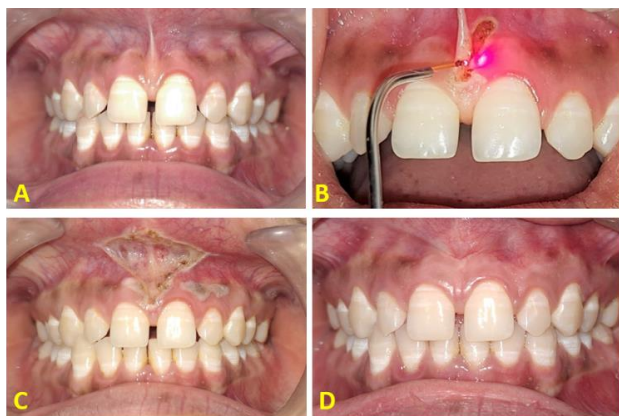
Ever since the introduction of Ruby Laser by Maiman in 1960, several types of lasers, ranging from neodymium-doped yttrium aluminium garnet (Nd:YAG) and erbium to carbon dioxide and diode, have been used in dentistry with varying wavelengths.<sup>1</sup> Among all the laser types, diode lasers have been used most frequently in dentistry.<sup>2</sup> The diode laser contains a solid state semiconductor made of gallium, aluminium and arsenide, which produces laser wavelengths between 808 and 980 nm, that is near infrared spectrum.<sup>3</sup> Most Diode lasers deliver laser beam to the working field through a flexible optical fiber, in a continuous or pulsed mode.

An *ex vivo* study performed on rats, has demonstrated that the best-absorbed wavelengths by different soft tissues are those around 400/500 nm (blue and green) and 1500 nm (middle infra-red), which are not often used in dentistry.<sup>4</sup> The lower wavelength diode lasers such as 445-450nm show a high level of absorption in melanin and haemoglobin based on the absorption constant.<sup>5</sup> Thus, they possess the ability to precisely incise and ablate the oral soft tissues with minimal thermal damage.<sup>6</sup> These properties of diode lasers also help in providing

a relatively bloodless field and excellent postsurgical healing even in the absence of sutures.<sup>7</sup> With an aim of further substantiating the clinical applicability of diode lasers in dentistry, we are reporting five cases successfully treated with 445nm diode laser under different clinical circumstances.

### CASE 1

A 21-year-old female patient was referred to the department for frenectomy. Oral examination of the patient revealed that her maxillary labial frenum had a papillary (high) attachment (Figure 1A). Maxillary labial frenectomy was performed using diode laser under local anaesthesia. The laser tip was used in a sweeping motion gradually cutting the frenum from its lower attachment at the interdental papilla between the maxillary central incisors, towards the superior attachment reaching the maxillary labial vestibule (Figure 1B). No surgical sutures or wound dressing were given (Figure 1C). Good and uneventful initial healing could be noted by the 7<sup>th</sup> day of performing the procedure, followed by complete healing in about 15 days (Figure 1D).

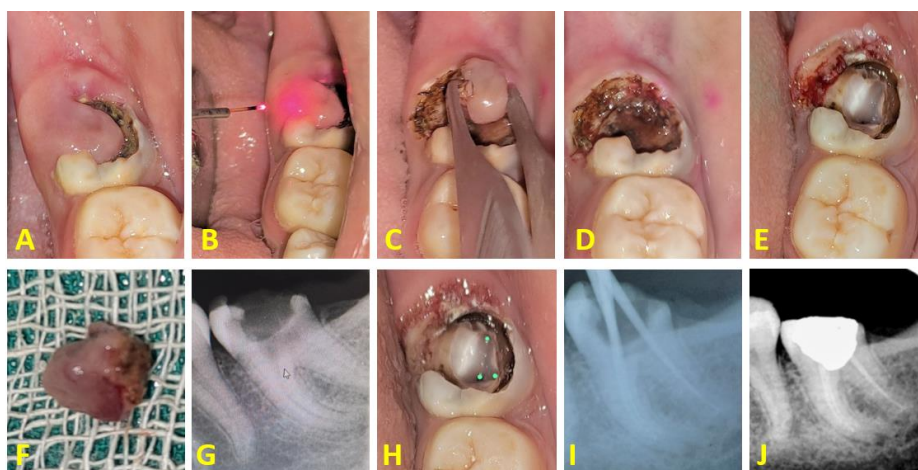


**Figure 1.** (A) Pre-operative Clinical Picture; (B) Frenectomy by Soft Tissue Diode Laser; (C) Immediately After Treatment; (D) 15 Days Follow Up.

**CASE 2**

A 24-year-old female patient presented to the department with a complaint of hypersensitivity to cold food items in lower left back region of jaw. Upon oral examination it was found that the left mandibular third molar of the patient had deep caries, which was superimposed by a gingival polyp (Figure 2A). The tooth was not tender on percussion.

After thorough clinical and radiographic evaluation, Laser-assisted excision of the gingival polyp was performed under local anaesthesia (Figure 2B). Since negligible bleeding occurred during the excision of gingival polyp, Root Canal Treatment of the involved tooth was initiated in the same sitting (Figure 2E) and completed within a week (Figure 2J). Excellent soft tissue healing was observed at the surgical site within 7 days.



**Figure 2.** (A) Gingival Polyp; (B) Excision by Laser; (C) Polyp Removed; (D) Underlying Carious Lesion; (E) Access Opening Done; (F) Excised Tissue; (G) Pre-operative Radiograph; (H) Root Canal Orifices Located; (I) Biomechanical Preparation Done; (J) Obturation Done.



**Figure 3.** (A) Pre-operative Radiograph; (B) Gingival Hyperplasia (palatal view); (C) Facial View; (D) Excision by Laser; (E) Immediate Post-operative Picture (Palatal View); (F) Immediate Post-operative Picture (Facial View); (G) Excised Tissue; (H) 30 Days Follow-Up; (I) 30 Days Follow-Up (Facial View); (J) Histopathologic View of the excised tissue (Haematoxylin and Eosin).



**CASE 3**

A female patient, 30 years of age reported to the department with a chief complaint of a swelling in her gums, in the upper front tooth region, for 1 year. The intraoral examination revealed a localised gingival enlargement in respect to the interdental papilla between the left maxillary lateral incisor and canine (Figure 3B-C). The enlargement was light pink in colour, firm in consistency, had a smooth surface and was non tender on palpation, although it showed slight bleeding on probing. There were no associated infra-bony pockets. Medical history of the patient did not reveal any significant findings, as the patient was systemically healthy and neither was she pregnant, nor was she using any dentifrices or medications which could potentially cause gingival hyperplasia. Also, there was no history of trauma or parafunctional habits like mouth breathing. Radiographic evaluation showed no significant findings in the alveolar bone or teeth of the region (Figure 3A). An initial diagnosis of localized reactive gingival hyperplasia was made and the differential diagnosis included fibrous epulis, pyogenic granuloma and peripheral giant cell granuloma.

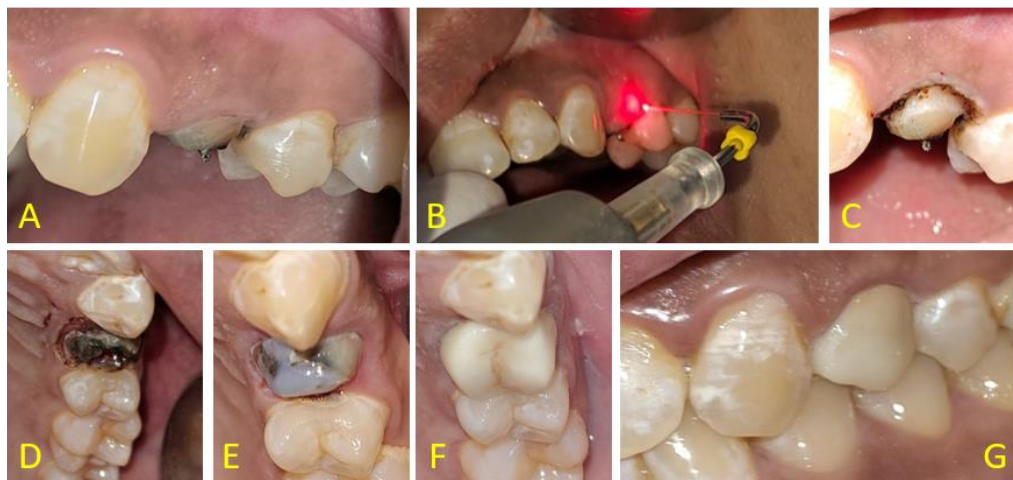
The patient first underwent scaling and root planing followed by gingival curettage of the region. There was reduction in bleeding on probing and redness of the

gingival overgrowth, but no significant reduction was observed in size of the overgrowth. After one month, the overgrowth was excised using diode laser (Figure 3D). Histopathological evaluation of the excised tissue was performed and a final diagnosis of Inflammatory Fibroepithelial Gingival Hyperplasia was reached upon. Healing of the surgical site was monitored at weekly intervals for up to 30 days, and it was found to be quick and excellent (Figure 3H-I).

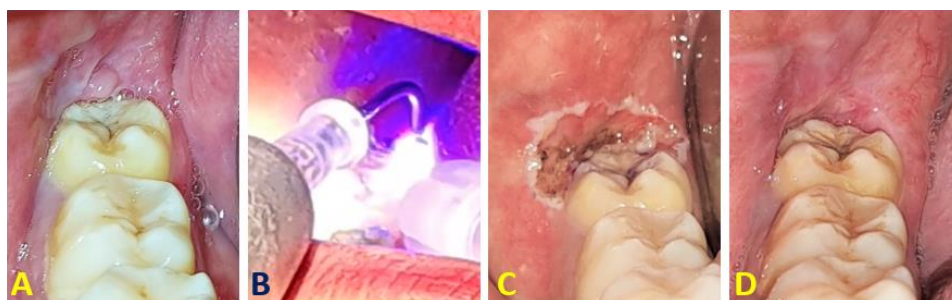
**CASE 4**

A 32 years old female patient reported to the department with a chief complaint of food lodgement in upper left back tooth region for 1 month. Dental history of the patient revealed that she had received a fixed dental prosthesis (FDP) in respect to left maxillary first premolar 6 months back, which got dislodged 1 month ago. Clinical examination of the patient revealed that her left maxillary first premolar had indeed been prepared for an FDP, but the tooth lacked sufficient clinical crown height to ensure proper retention of the same (Figure 4A).

After proper clinical and radiographic evaluation, surgical crown lengthening by means of laser excision of



**Figure 4.** (A) Pre-operative picture; (B) Crown lengthening Done by Laser; (C) Immediate Post-operative View (Buccal Aspect); (D) Immediate Post-operative View (Palatal Aspect); (E) Core Build-up by Composite Resin followed by Tooth Preparation; (F) Final Prosthesis given; (G) Final Prosthesis (Buccal View).



**Figure 5.** (A) Clinical Picture prior to Surgery; (B) Operculectomy by Laser; (C) Immediately After the Procedure; (D) 20 Days Follow-Up.

the surrounding gingiva was performed (Figure 4B). The surgical site exhibited excellent healing. On the 15<sup>th</sup> day after crown lengthening procedure, the tooth was restored using composite resin and prepared to receive an all-ceramic FDP (Figure 4E). The FDP was inserted 3 days later (Figure 4F-G). The patient reported no discomfort throughout the treatment.

## CASE 5

A 28 years old male patient reported to the department with a complaint of pain and swelling in lower right back region of jaw. Clinical examination of the patient revealed an acutely inflamed pericoronal flap (operculum) associated with right mandibular 3<sup>rd</sup> Molar (Figure 5A). In order to treat the acute phase, scaling and root planing followed by gingival curettage were performed under local anaesthesia. The patient was prescribed with anti-inflammatory drugs (Aceclofenac 100mg + Serratiopeptidase 15mg + Paracetamol 325mg), to be taken twice daily for three days. The patient was kept on a follow-up of one month, with weekly visits.

Once the inflammation subsided, Operculectomy of the pericoronal flap was performed under local anaesthesia, using diode laser (Figure 5B). The surgical site showed complete healing within 20 days of the laser surgery (Figure 5D). Thereafter the patient was kept on a 6 months follow-up and the patient was able to maintain oral hygiene of the region, without any recurrence of inflammation.

## CASES MANAGEMENT

Each case was managed by means of Soft Tissue Laser Surgery using 445nm wavelength diode laser, at a power of 2.0W. The laser beam was directed to the surgical by means of a 320-micron fiber optic tip. The laser was used in a continuous wave mode.

Each of the above patients was prescribed with analgesics (Aceclofenac 100mg + Paracetamol 325mg) to be taken if needed (*si opus sit*). Four of the the five patients reported that they took the prescribed analgesic on the first day after laser surgery, following which they did not find a need to take the same. The patient who underwent operculectomy (Case 5) reported taking the analgesic for 3 days following laser surgery due to ensuing pain and discomfort.

## DISCUSSION

Through this paper we present five distinct soft tissue dental surgeries, which were successfully carried out using a 445 nm diode laser. These procedures could have alternatively been performed using a scalpel or electrosurgery, but we used diode laser surgery owing to its advantages such as,

discernible, and precise incisions;<sup>8</sup> minimal post-operative pain and discomfort due to heat induced sensory nerve ending sealing,<sup>9</sup> reduced haemorrhage which improves visibility of surgical site;<sup>2</sup> less anaesthesia and minimal risk of infection due to the laser's anti-bacterial effect.<sup>10</sup>

In case 4, the patient presented with a tooth having short clinical crown, as the clinical crown height was less than 2mm.<sup>11</sup> Crown lengthening was planned for restoring this tooth, but in order to determine the modality and amount of crown lengthening to be performed, bone sounding was done pre-operatively by means of transgingival probing under local anaesthesia.

Bone sounding revealed that the tooth had 2mm of biologic width and a probing sulcus depth of 2mm. Thus, it was concluded that the clinical crown height for this tooth could safely be increased by 1mm using laser assisted excision of gingival tissue around the tooth, without any bone reduction. During tooth preparation, an equigingival margin was given. Alternatively, a subgingival margin could have been used, but it was deferred because sub-gingival margins can potentially jeopardize the periodontal health of teeth.<sup>12</sup>

The applicability of different modes (continuous or pulsed) and parameters of laser beam, such as power and wavelength, can further be investigated in different oral soft tissue biotypes. An ex-vitro study has shown that lower wavelength diode lasers like 445nm exhibit a better cutting efficiency when compared to lasers of the infrared zone such as 970nm.<sup>6</sup> The thermal effect of 445nm diode laser was studied by Palaia et al in animal soft tissue samples, in an ex-vivo study, which revealed that the thermal damage caused by the laser was less than 1mm of tissue.<sup>13</sup> All the five patients reported pain and discomfort during the first 24 hours following the laser surgery, a similar finding has also been observed in a study which investigated pain following the use of diode laser for management of gingival hyperpigmentation.<sup>14</sup> These findings must be validated by carrying out comparative clinical studies with an appropriate sample size, in order to compare the efficacy of Laser Surgery with other modalities of soft-tissue dental surgery, such as Cryosurgery and Electrosurgery.

## CONCLUSION

Low wavelength diode lasers when used for soft tissue dental surgery, can reduce the operational time, provide remarkable post-operative healing and ensure excellent patient comfort. Lasers can thus be considered an alternative or adjunct to conventional scalpel surgery in the field of dentistry.

## ETHICAL CONSIDERATIONS

Each procedure was preceded by the obtainment of informed consent from the patient.

## CONFLICT OF INTEREST

The authors declare that they have no known competing interests or personal relationships that could influence the work reported in this paper.

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