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The Application of Soft Tissue Lasers in Periodontics- A Case Series

Dr. Moitri Ojha

Senior lecturer, Department of Periodontology, SMBT Dental College, Sangamner, Maharashtra, India.

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KEYWORDS

Diode lasers, soft tissue surgery, hemostasis, healing

ABSTRACT:

Introduction:

Laser surgeries have been considered as a substitute for scalpel/conventional soft tissue surgeries due to its versatile property, ease of working, hemostasis and able to decontaminate the area of contact. The growing popularity of soft tissue lasers along with patients' compliance have led researchers to conduct studies and modify the properties of existing lasers.

Case series:

A total of seven cases requiring soft tissue periodontal surgeries were treated using diode laser with a wavelength of 980nm, 1.5W energy output, in a pulsed, contact mode of delivery. The treatments included in this case series were frenectomy, vestibuloplasty, gingivectomy, depigmentation, excision of pulp polyp and Laser assisted pocket disinfection. Following single-session of laser therapy, the patients were recalled for follow-ups to assess the wound healing and condition of the surgical sites.

Results:

All the patients were followed-up after surgery and they displayed favourable surgical outcome (minimal post-operative complications)

Conclusion:

The use of soft tissue diode lasers in periodontal surgeries is a simple surgical tool that consumes less time, offers better patient compliance and hence can be considered as an alternative to conventional surgeries

1. Introduction

Advances in technology and skills have satisfied the fast-growing needs of medical science.[1]The history of therapeutic modalities has been traced long back when cavemen used heated charcoals to achieve hemostasis or shamans performed brain surgeries using cutting or scrapping tools. Also, the oldest documentation of amputation has been recorded to be 31000 years old.[2] Ever since the production of modern-day scalpels, surgeries have become much easier.[3] Nevertheless, there has been a rising interest in developing surgical tools causing bloodless field.[4] Studies began intensively in unravelling the impact of electrocautery, lasers and cryotherapy in surgical field.[5]

The properties of light were explored widely by Newton and he was the first to propose the particle behavior of light.[6] In 1917 Einstein framed the theorem of "stimulated emission of photos" which laid the cornerstone of laser (Light amplification by stimulated emission of radiation). It was not until 1960 when the first laser was launched from a ruby crystal by Theodore Mainman.[7] Within a year or two, Goldman and his colleagues studied the interaction of these photons with biological tissues and popularized the application of lasers in medical field.[8] Lasers have been classified widely according to their use- hard and soft tissue *lasers (Soft tissue laser- Argon and Nd;YAG, Hard tissue laser: Er: YAG),* forms- solids and gas (*solid- Nd:YAG, gas- Argon, helium and cabon dioxide)* and their wavelength. Diodes are soft tissue lasers and have been commonly

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practiced in dentistry. These lasers induce a bactericidal action and sterilize the biological area of contact, promotes hemostasis, are quick and enable to work in bloodless field. Studies have also demonstrated that their use can minimize inflammation in soft tissues as they encourage the production of endorphins (pain relieving mediators) and suppress the pain signals and nerve sensitivity.[9,10]

This article highlights several cases and possible applications of lasers in periodontal surgery.

2. Methods

Case report:1

Frenectomy:

A 22 -year male patient undergoing orthodontic therapy was referred to the Department of Periodontology for the excision of a high frenal attachment. The patient did not reveal any medical history nor any deleterious habits. On intraoral examination, thick frenum was observed w.r.t 11,21. The patient was enlightened about the frenectomy procedure and its implications. After a week of oral prophylaxis, the surgical procedure using soft tissue diode laser was planned.

After administration of local anesthesia (2% lidocaine with 1:1,00,000 adrenaline) and examination of subjective and objective symptoms, the laser tip was activated using special black paper. The activated laser tip was used to excise the frenal attachment using a fine brushing motion leaving a circular raw eroded area. **(Figure: 1 and 2)** Underlying fibers were resected to prevent relapse. The laser unit had a wavelength of 980nm, working at a continuous mode with an output energy of 1.5W. Periodontal pack was placed over the surgical site so as to prevent debris accumulation and the same was removed after a week of surgery. Patient was given post-operative instructions and was prescribed analgesics. He was followed up for one month and wound healing was assessed which was uneventful. Also, the patient did not complain of any post-operative swelling, pain or bleeding although there was a mild sensitivity over the surgical site.

Figure 1: The figure demonstrates high maxillary frenal attachment which is clamped by a hemostat. Laser excision was performed

Figure 2: The figure displays the raw, bloodless surgical wound after laser excision

Case report:2

Vestibulopathy:

An eighty-year-old male patient was referred from the Department of Prosthodontics as the clinicians required a deeper vestibule for denture retention. The patient's medical history was non-contributary. On clinical examination, he was completely edentulous with an inadequate vestibular depth and frenal attachment in the anterior region of maxilla that interfered with denture fit. A laser vestibuloplasty with resection of frenal attachment was planned for the patient. After anesthesia was found to be effective, the procedure was carried out without inducing any bleeding from the surgical site. **(Figure: 3 and 4)** Periodontal dressing was placed at the depth of the incised vestibule. Proper post-operative instructions were given and was recalled for regular follow-ups. The patient did not complain of any post-operative discomfort and the healing was found to be satisfactory.

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Figure 3: The given figure exhibits maxillary edentulous area with shallow vestibule. Therefore, vestibular deepening was planned for proper denture retention

Figure 4: The figure demonstrates post-operative view of laser vestibuloplasty procedure

Case report:3

Gingivectomy:

A 12-year-old male patient was referred to our department by the Department of Orthodontics and Dentofacial orthopedics. On clinical examination it was observed that the patient had gingival overgrowth w.r.t 13 **(Figure: 5).** The patient did not present with any medical conditions or deleterious habits. Oral prophylaxis was advised and gingivectomy was planned for the patient after one month of initial therapy.

On the day of surgery, after administration of local anesthesia, three bleeding points were created w.r.t 13 with the help of Crane-Kaplan pocket marker approximately 3mm apical to gingival margin. A sweeping motion was adopted to excise the gingiva following the bleeding points from mesial to distal end. **(Figure: 6).** The margins were then beveled by scalpel at 45degree angle to root surface. Coe pack was placed and patient was recalled after seven days of surgery. The patient did not have any post-operative complications and wound healing was found to be satisfactory**(Figure: 7).**

Figure 5: The figure presents gingival overgrowth w.r.t 13 tooth

Figure 6: The figure displays excision of gingiva w.r.t 13 tooth which was performed with the combination of scalpel and laser

Figure 7: The figure shows post-operative result of laser gingivectomy procedure after 1 month

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Case report: 4

Depigmentation:

A 25-year-old systemically healthy female patient reported to our department complaining of "darkened gums". On clinical examination her periodontal status was found to be excellent but displayed bilateral pigmentation on maxillary gingiva. (As per the Oral pigmentation index, the score was 2). The gingival biotype was thick which is a good indication to carry out the procedure using lasers or electrocautery. Hence, we planned to carry out depigmentation using soft tissue laser. After administration of bilateral anterior superior nerve block, the ablation of the gingiva was done using horizontal light paint strokes exposing the underlying connective tissue. **(Figure: 8 and 9).** It was confirmed that no nodules or islands of melanin pigmentation persisted. Periodontal dressing was placed over the ablated area and the patient was recalled after 14 days and 1 month of therapy to assess the cosmetic outcome. A complete epithelization of tissues was observed after one month of treatment.

Figure 8: The figure exhibits gingival pigmentation in the maxillary region.

Figure 9: Depigmentation procedure procedure done by diode laser

Case report: 5

Pulp polyp excision:

An eighteen-year-old female patient was referred from the Department of Conservative dentistry and endodontics complaining of pain in her right lower back tooth region. The pain was dull and continuous in nature. Also, she complained of a protruding mass from a right lower tooth that interfered with her mastication. On intra-oral examination, we observed a pale pink, soft, polypoid, pedunculated mass of 1*1*2.5mm on 46. Radiographic evaluation revealed caries involving pulp. Chronic irreversible pulpitis w.r.t 46 was diagnosed. A treatment plan was chalked out that involved excision of this pulp followed by root canal therapy. Following administration of local infiltration w.r.t 46, the mass was excised using diode laser followed by thorough saline irrigation. **(Figure: 10 and 11).** The specimen was sent for histopathological analysis that confirmed chronic hyperplastic pulpitis.

Figure 10: The figure shows excision of pulp polyp being done by laser w.r.t 38 tooth

Figure 11: Post-operative view after excision w.r.t 38 tooth

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Case report: 6

Laser assisted pocket disinfection:

A 31-year-old male patient reported to the Department of Periodontology with the chief complain of food lodgment in the right lower back tooth region. On intra-oral examination, 8mm pockets were observed along with inflammation, bleeding on probing and suppuration w.r.t 45,46 and 47. **(Figure: 12).**

A 7mm pocket depth was noted w.r.t 46 tooth. On radiographic interpretation, OPG demonstrated bone loss w.r.t 45,46 and 47. Pulp vitality test showed normal response w.r.t 45,46,47. Hence, open flap debridement was planned initially w.r.t 45,46 and 47. However, the patient was anxious and did not agree for the surgical intervention. Hence, we chose to perform Laser assisted pocket disinfection w.r.t 45,46 and 47.

After administering adequate local anesthesia (Inferior alveolar nerve block), the fiber tip was activated and inserted into the pocket. The inflamed pocket lining was debrided using this tip in an apico-coronal vertical motion from the margins of gingiva to the depth of the pocket. The charred debrided tissues were removed from the tip with the help of a gauze piece. The area was then thoroughly scaled and root planed followed by saline irrigation to force out any remaining debris. No post-operative dressing was placed. **(Figure: 13).**

The patient was followed up regularly for 6 months. There was a remarkable decrease in the probing pocket depth by 3mm. **(Figure: 14).** Also, the clinical signs of inflammation were significantly reduced.

Figure 12: The figure demonstrates a case of periodontitis with increase pocket depth of 7mm.

Figure 13: Laser assisted pocket disinfection being performed w.r.t 45,46 and 47 teeth

Figure 14: Improvement in clinical parameters after laser assisted pocket disinfection

Case report: 7

Operculectomy:

A 21-year-old male patient presented to our department with the chief complaint of pain and food lodgment in the lower right back tooth region. On intra-oral examination it was observed that 46 tooth was non-carious and partially erupted. Hence, we planned to perform operculectomy for the patient where after adequate administration of local anesthesia, the partially covered operculum was removed by the laser tip in a painting stroke. **(Figure: 15 and 16).** Thorough betadine irrigation was performed and the patient was followed-up for two months. The patient was relieved of his pain and discomfort of food lodgment.

Figure 15: The figure displays operculum covering partially over 48 tooth

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Figure 16: Laser assisted operculectomy performed w.r.t 48 tooth.

Discussion:

Conventional mechanical debridement often fails to achieve proper accessibility and complete decontamination of the infected areas. The emerging field of lasers in periodontics focuses on accomplishing these two concerns. It has been suggested that there are three possible mechanisms by which a laser interacts with the tissues- photothermal, photomechanical and photochemical. Photothermal involves ablation of the tissues where the cells vaporize or coagulates at a high temperature.[11] Photomechanical disruption is the break in the cell continuity due to events like cavitation generation and shock waves production. Photochemical phenomenon includes mechanism where the photons of the lasers are absorbed by the cell components (like cytochrome of mitochondria) to alter and enhance the cellular performances.[12]

We presented a total of seven reports demonstrating the use of diode laser (810-1064nm) in periodontal conditions like high frenal attachment, pigmentation, excision, etc. **Shanmukha et al.** performed a series of cases where excision of pyogenic granuloma, depigmentation and esthetic crown lengthening were performed using diode laser.[13] Similarly, **Nahid et al** accomplished a case series where ankyloglossia, vestibulopathy, frenectomy, pigmentation, gingivectomy and excision was treated using 980nm diode laser.[14] **Marwa et al.** evaluated the healing response of tissue after gingivectomy on low-level laser application using healing score and Visual analogue scale (VAS). The authors concluded that the same could be used as an effective modality to promote quick healing.[15] A clinical trial was conducted by **Amaral et al.** to compare the efficacy of lasers with scalpel in patients with fibrous hyperplasia. He suggested that lasers were less invasive surgical approach though it showed poor healing ability than scalpel.[16]

In spite of its several advantages and vast applications, lasers have certain shortcomings like possibilities of scarring, delayed healing and re-infection which needs to be overcome. Other issues like cost, safety concerns and technical complexities have been questioned

Conclusion:

The recent introduction of Waterlase (that utilizes water) and Periowave (that uses dyes in combination with low level lasers) have broadened the vistas in periodontics. However, there are milestones yet to achieve and drawbacks which have to be overcome. It is anticipated that lasers in dentistry is the next generation tool that would conquer periodontal therapies.

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