

Diode Laser Treatment for Gingival Enlargement Associated with Orthodontic Appliances: A Clinical Approach

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Abstract

Background: Fixed orthodontic therapy often predisposes patients to gingivitis and gingival enlargement due to poor oral hygiene. Diode lasers have emerged as an effective and minimally invasive approach for managing gingival enlargement, offering numerous advantages over traditional techniques. **Case Report:** A 15-year-old female patient undergoing orthodontic treatment presented with gingival enlargement associated with poor oral hygiene. The patient was referred from the Department of Orthodontics to the Department of Periodontics at Althawra Specialized Dental Center. Initial management included oral hygiene instructions and the use of 0.12% chlorhexidine mouthwash twice daily for one week, followed by two weeks of maintenance with proper brushing techniques. While there was a noticeable reduction in inflammation, the gingiva remained enlarged, soft, and delicate in texture. **Treatment:** Gingivectomy was performed under local anesthesia using a diode laser (810–980 nm). Healing and patient comfort were assessed at 7 and 14 days postoperatively. Pain and discomfort were evaluated using a verbal rating scale for the first seven days following surgery. **Results:** During the first week, healing was good, with minimal swelling. By the second week, slight swelling was observed in regions around teeth 16 and 26, but overall healing was deemed excellent. The diode laser provided a clean incision, superior hemostasis, a dry surgical field, and eliminated the need for sutures. Its use was associated with reduced postoperative infections, minimal edema, and greater patient comfort. **Conclusion:** Diode lasers are a safe, efficient, and versatile tool for managing gingival enlargement in orthodontic patients. Their ability to offer precise soft tissue interventions, minimize postoperative discomfort, and reduce complications highlights their potential as a superior alternative to conventional surgical techniques in orthodontic practice.

Keywords: Gingival, Orthodontic, Diode Lasers, Periodontics

Introduction

Malocclusion is the third most common oral health concern worldwide. It is often associated with a range of illnesses, including poor oral hygiene, periodontal disease, TMJ sickness, speech problems, and mouth breathing. Through the establishment of proper teeth alignment and the achievement of harmonious occlusal and jaw connections, orthodontic therapy may usually prevent or treat these disorders. Nevertheless, orthodontic therapy has the risk of adverse consequences in addition to advantages [1]. Fixed orthodontic appliance treatment is frequently linked to pathological alterations in periodontal tissues [2, 3]. In addition to causing functional and aesthetic problems, gingival enlargement has been shown to interfere with orthodontic tooth movement and make it more difficult to maintain good dental hygiene, which in turn damages the periodontium more significantly [4]. Most orthodontists find that maintaining excellent periodontal status is a common and ongoing concern for their patients, and that the increasing number of adults undergoing orthodontic treatment increases the risk of iatrogenic periodontal damage. Numerous international studies examined the effects of fixed orthodontic equipment on patients' gingivitis and loss of periodontal attachment [5]. The management of gingival enlargement is contingent upon the particular cause and underlying pathology. The strategy employed is contingent upon the type of enlargement and is guided by the clinical and pathological manifestations. Before any surgical measures are taken, Phase I treatment should be implemented. Addressing gingival enlargement necessitates an individualized approach that is tailored to the root cause. In cases where dental plaque is the culprit, nonsurgical

treatment focuses on enhancing oral hygiene [6]. To achieve optimal oral health, it is crucial to undergo professional cleaning procedures such as scaling and root planning, which effectively eliminate plaque and calculus. Equally important is patient education, which emphasizes the significance of proper brushing and flossing techniques, the utilization of antimicrobial mouthwashes, and the regularity of dental visits. Additionally, it is essential to address local factors that contribute to plaque formation, such as making necessary adjustments or replacements to problematic restorations and modifying orthodontic appliances to minimize plaque buildup. When nonsurgical methods prove to be ineffective, the appropriate course of action for treating gingival enlargement is surgical intervention. One such surgical procedure is gingivectomy, which entails the removal of excess free gingival tissue, allowing patients to maintain proper oral hygiene [7]. A gingivectomy is the surgical removal of the gingiva with the goals of flattening the tooth roots to promote gingival healing, removing the periodontal pocket walls, and providing access and visibility for the complete removal of calculus. returning the gingiva to its natural form [8]. One can do a gingivectomy with a laser, electrosurgery, or knife [9]. The most common method utilized nowadays is still the traditional gingivectomy, which is done with a scalpel. Its affordability and durability are its advantages, however establishing hemostasis may be challenging [10, 11]. Over the past ten years, lasers have attracted a lot of attention as a non-invasive substitute for periodontal surgery [12]. In 1960, Maiman created lasers, a relatively new modern technology [13]. Scholars have investigated. Both soft and hard tissues are treated using lasers in

dentistry [14]. On the other hand, it was first effectively used in the oral cavity in 1977 and has since been updated and enhanced [15]. Diode lasers are the best surgical lasers for soft tissues because they seldom interact with hard dental tissue [16, 17]. Diode lasers are advantageous for soft tissues because of their better cutting powers, their ability to cut to depths of 2–6 mm, their ability to block lymphatic and small blood vessels, which causes hemostasis, and their ability to minimize edema following surgery [18]. By using localized warmth and the formation of a scab layer, it also disinfects the affected region. Reduced postoperative tissue contraction [19, 20], faster wound healing, and pain reduction all contribute to less scarring [21]. One possible approach for oral soft tissue surgery is to use continuous or pulsed diode lasers with wavelengths between 810 and 980 nm. The photothermal effect of diode lasers is used to eliminate oral mucosal lesions by excision or ablation/evaporation Technique [22].

CASE PRESENTATION

A 15-year-old female patient was referred to the periodontic department while undergoing orthodontic treatment. The patient complained of swelling of the upper and lower jaws. She also complained of gingival bleeding while brushing. There was no other relevant medical, dental or family history. On clinical examination, the marginal and papillary gingiva of the maxillary dental arch showed signs of redness and swelling. In addition, there was significant inflammation of the interdental papillae and marginal gingiva with bleeding on probing. It was evident that the diameter of the collective pseudo-pockets was approximately 4 mm, as shown in Figure (1). The treatment plan performed included initial periodontal treatment and supragingival and subgingival scaling, as shown in Figure (2). Oral hygiene instructions were given and 0.12% chlorhexidine mouthwash was used twice a day for one week. Following a two-weeks period of non-surgical treatment involving scaling and root planing, the patient returned to the clinic, as shown in Figure (3). (PI), (PPD), and

(BOP% less than 10%) were recorded. For the surgical procedure, the site was numbed with local anesthesia using a solution containing 2% lidocaine and 1:80,000 adrenaline, with a total of 2.2 ml administered per cartilage. The CEJ was determined using a periodontal probe, and bleeding points were marked using a pocket depth marker. The fiber tip was initiated by applying either articulating paper or dark chromophore, and the laser was activated to prime the fiber tip. The preparation of the fiber tip was considered complete when it ignited the articulation paper. To enhance thermal interaction with the tissue and expedite lesion removal, fiber priming was utilized to concentrate thermal energy at the fiber tip. The technique utilized QuickLase UK's diode lasers, which emit light in the range of 810-980 nm. The diameter of the fiber tip used in the procedure was measured at 400 μ m.

The power output, ranging from 1.5 to 2W seen figure (4), was adjusted based on the thickness of the gingival tissue. To ensure safety and minimize unwanted reflections, both the surgical team and the patient were advised to wear protective eyewear, and the surgical area was cleared of any reflective objects such as jewelry, watches, and shiny medical equipment. Tissue slices were created using a sweeping brush stroke motion with the fiber, resulting in beveled edges. Throughout the surgical procedure, a member of the surgical team was assigned the task of positioning the suction tip in close proximity to the surgical site in order to eliminate any smoke or odor that may arise from the laser tissue ablation process. Additionally, this individual was responsible for continuously irrigating the area with normal saline to maintain a cool environment. To prevent excessive heat generation and ensure optimal tissue condition, the laser was paused approximately every 30 seconds for a thorough inspection of the gingival tissue. Any tissue debris that accumulated on the operative site and the tip was carefully removed using wet gauze. Notably, the surgical site was left uncovered without the use of a surgical pack, as depicted in figure (5).



FIGURE 1: First Visit



FIGURE 2: Immediate after Scaling and Root Planing

Inform the patient to avoid eating spices and acids during the first week of the operation and to commit to brushing and mouthwashing. should come every week for a period of four weeks for the purpose of examination. To assess any pain or discomfort experienced within the first week after the surgery, patients were provided with a case sheet for evaluation. In the first week after the diode lasers surgery low level of pain and discomfort according to visual scale at 2-4 days after the surgery, no pain and discomfort at the one week, healing was very

good, swelling was mild, as shown figure (6 A). In the second week, tissue colour all tissue pink, healing was excellent, although there was a slight amount of swelling in teeth 16 and 26, overall healing was deemed excellent as shown figure (6 B). As the third and fourth weeks transpired, the healing continued to be excellent, with no signs of swelling, as shown figure (6 C), (6 D). Additionally, throughout the weeks of evaluation, a noticeable decrease in both the Plaque Index (PI) and Bleeding on Probing (BOP) percentages was observed.



FIGURE 3: After Two Weeks from the Non-Surgical Treatment (Scaling and Root Planning)



FIGURE 4: Power Setting in the Diode Lasers (810-980nm)



FIGURE 5: Laser Procedure for Management of the Gingival Enlargement due to Orthodontic Appliance



FIGURE 6: Follow up Evaluation of Healing in the Laser Surgery (A) After One week from the Laser Surgery.



FIGURE 6(B): After Two Weeks from the Laser Surgery.



FIGURE 6(C): After Three Weeks from the Laser Surgery.



FIGURE 6(D): After Four Weeks from the Laser Surgery

Discussion

Orthodontic treatment is one of the factors contributing to gingival overgrowth or enlargement in individuals. Numerous studies have demonstrated that the nickel ions found in orthodontic brackets cause alterations in the gingival tissue or gingival overgrowth in patients receiving orthodontic treatment. One of the several ways that nickel ions interact with gingival tissues in orthodontic bands is by fibroblast proliferation, which causes gingival overgrowth [23]. According to the study, the use of 810 nm wavelength energy is more effective in promoting coagulation in highly vascularized tissue following extensive procedures, as it significantly impacts blood factors. Conversely, the use of 980 nm wavelength energy is more suitable for ablation, as it is highly absorbed by water and results in limited tissue involvement in areas with less vascularized tissue and narrower tissue involvement. The combination of these two

wavelengths enhances both coagulation and ablation while minimizing thermal damage [24]. CO₂ and Nd: YAG lasers are not the most suitable for orthodontic applications due to their large size and high cost, erbium lasers have become widely used in both hard and soft tissue dental practices. However, when it comes to orthodontic specialty practice, the diode laser appears to be the most ideal option. Specifically designed for soft tissue energy, the diode laser can safely remove tissue without any risk to neighboring teeth and ensure proper hemostasis. In contrast, the use of erbium lasers in soft tissue surgery requires careful attention to avoid damaging tooth structure and offers inferior bleeding control [25]. According to the study, the use of 810 nm wavelength energy is more effective in promoting coagulation in highly vascularized tissue following extensive procedures, as it significantly impacts blood factors. Conversely, the use of 980 nm wavelength energy is more suitable for ablation, as it is highly absorbed by water and results in limited tissue involvement in areas

with less vascularized tissue and narrower tissue involvement. The combination of these two wavelengths enhances both coagulation and ablation while minimizing thermal damage [26]. A potential method for performing soft tissue surgery in the oral cavity involves the use of a diode laser that emits wavelengths between 810 and 980 nm, either continuously or in pulses. By harnessing the photothermal effect of the diode laser, lesions on the oral mucosa can be eliminated through excision techniques or ablation/vaporization procedures [23]. In this case, it was observed that there was no bleeding during laser surgery. This lack of bleeding can be attributed to the increase in tissue temperature that occurs after the absorption of laser light by biological tissue. Once the tissue temperature reaches 60°C, coagulation takes place through a process known as photo-coagulation. This process involves the instant denaturation of proteins, enzymes, and other bioactive molecules. As a result, there is a modification in the molecular structures of tissue collagen fibers, causing the irradiated tissue to constrict against the nearby blood vessels. Additionally, the collagen in the blood vessel walls undergoes shrinkage, which aids in improving hemostasis. Furthermore, the laser's impact on erythrocytes leads to enhanced platelet aggregation, further promoting hemostasis. Diode lasers, due to their high absorption by hemoglobin and melanin, allow for precise cutting of soft tissue while ensuring excellent hemostasis. These lasers also have the ability to penetrate deeply, surpassing other types of lasers such as CO₂ lasers. As a result, the use of diode lasers reduces both the operation time and post-operative bleeding, eliminating the need for surgical packs or sutures [27]. Low levels of Postoperative pain and discomfort after the laser surgery utilized a visual analog scale (VAS). This can be attributed to the heat produced by the laser, which inhibits the pain receptors, as well as the

coagulation process that creates a dry and isolated environment, reducing the risk of infection in the wound [28]. The healing process following laser surgery was found to be more rapid. The fundamental concept behind the modulation of cells through laser therapy is that targeted irradiation at a specific wavelength can modify cellular behavior by influencing either the mitochondrial respiratory chain or the calcium channels within the cell membrane. This, in turn, stimulates an enhancement in cell metabolism and promotes cell proliferation. As a result, these effects contribute to an exceptional coagulation ability and trigger unique healing mechanisms that differ significantly from those observed after the use of a scalpel [29]. Diminished PI and BOP% following gingivectomy using diode lasers in this investigation because the bacterial cell wall is altered and the cell membrane is destroyed by the diode laser, which has a strong antibacterial impact. The bacterial targets are exposed to a photo-thermal action by the diode laser. Additionally, it has a photo-disruptive effect on bacteria that are inaccessible to humans. In these cases, cell death may not happen right away; instead, sublethal damage is caused, which inhibits the growth of the bacteria by destroying the integrity of their cell walls and accumulating denatured proteins, which stops the bacteria from growing and leads to cell lysis. Heat can have this impact on bacteria even at extremely low temperatures [30].

Conclusion

According to the obtained result, diode lasers 810-980nm can be used effectively at the selected power setting in the management of gingival enlargement due to orthodontic appliance.

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