Surgical Lengthening of the Clinical Tooth Crown by Using Semiconductor Diode Laser: A Case Series

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Abstract: Surgical crown lengthening procedures are performed to aid in the retention of prostheses by allowing proper tooth preparation, impression procedures and placement of restorative margins. A healthy periodontium is a key to a successful prosthesis. It is necessary to prepare periodontal tissues properly before restorative treatment to ensure good form, function, and esthetics of the masticatory apparatus, as well as patient comfort. There are different surgical techniques used for crown lengthening, eg, gingivectomy, apically displaced flap, crown lengthening with ostectomy, and lasers. The success of such procedures depends on the biological width.

The present case series describes surgical crown lengthening procedures by using semiconductor diode laser, as the diode laser technique is easier, is well accepted by patients, and provideds predictable postoperative results.

Keywords: diode laser, crown lengthening, biological width, gingivectomy, gingivoplasty.

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Robicsek[1] pioneered the gingivectomy procedure. Where gingivectomy involves the excision of the soft tissue wall of a pathological periodontal pocket, gingivoplasty is a reshaping of the gingiva to create physiological gingival contours. Gingivectomy and gingivoplasty can be done conventionally using a scalpel, rotary coarse diamond burs, a periodontal knife, electrodes, chemosurgery, or laser.

Laser stands for Light Amplification by Stimulated Emission of Radiation, and is the new technique for soft tissue surgery.[2] Lasers have been used in dentistry since the beginning of the 1980s. Semiconductor diode laser has been used for gingivectomy, frenectomy, incisional and excisional biopsy, soft tissue tuberosity reduction, operculum removal, coagulation of graft donor site, and exposure of soft tissue covering osseointegrated implants.

The present case series describes three case reports of gingivectomy and gingivoplasty using semiconductor diode lasers, which is a simple, effective method that produces good results with patient satisfaction.

CASE DESCRIPTIONS

Three patients were treated who had gummy and esthetically unpleasant smiles, due to uneven gingival

Fig 1a Case 1. Preoperative view.

Fig 1b Case 1. Gingival contouring by diode laser.

Fig 1c Case 1. 2-week postoperative view.

Fig 1d Case 1. Tooth preparation.

Fig 1e Case 1. Definitive restoration.

margins in the maxillary anterior region. They had no systemic diseases associated with healing disturbances, pathological gingival enlargement (eg, drug associated, inflammatory or idiopathic etc). The surgical procedure and follow-up was explained in detail to the patients and consent forms were signed.

Case 1

A 24-year-old male patient visited the Department of Prosthodontics, Rural Dental College, Loni for the replacement of existing crown restorations. Clinical examination revealed ceramic crowns on teeth 11 and 12 in place for 2 years, short clinical height of teeth 11 and 12, and uneven gingival margins on these teeth comparison with teeth 21 and 22 (Fig 1a). Sulcus depth measured using a pocket marker was more than 2 mm, and patient was apprehensive of the scalpel, so gingivectomy using semiconductor diode laser was planned.

To improve the oral hygiene, oral prophylaxis was done and oral hygiene instructions were given. Gingivectomy was planned from mesial of the maxillary central incisor to distal of the maxillary lateral incisor at the level of the maxillary left central and lateral incisors by measuring crown height.

A semiconductor diode surgical laser unit (ezlase, wavelength 800 to 940 nm, Biolase Technologies; Irvine, CA, USA) bearing a 400-micron-diameter disposable tip with contact method and power set at 4 W in continuous pulse mode was used for gingivectomy and gingivoplasty of the maxillary right central and lateral incisors. The semiconductor diode laser was used in continuous mode, and was operated in a contact method using a flexible fiber optic delivery system. As there is no need for anesthesia, only topical lignocaine spray was used. Laser ablation started from the base of bleeding points created by the pocket marker. Ablation was performed using light brushing strokes and the tip was kept in continuous motion.[3] Remnants of the ablated tissue were removed using sterile gauze dampened with saline (Fig 1b). Gingivoplasty was done in the interdental papilla and marginal gingiva to create a normal physiological contour by changing the tip angulations. This procedure was repeated until the desired level of marginal tissue removal was achieved. A smaller laser tip, 300 micron in diameter, was used at the gingival margin interdental papilla in order to achieve better control.[4]

Fig 2a Case 2. Preoperative view.

Fig 2b Case 2. Gingivectomy and gingivoplasty by diode laser.

Fig 2c Case 2. 2-week postoperative view.

Fig 2d Case 2. Tooth preparation.

Fig 2e Case 2. Definitive restoration.

Laser Safety

Safety glasses were worn by the operator, patient and assistant. Highly reflective instruments or instruments with mirrored surface were avoided as there could be reflection of the laser beam.[5]

Case 2

A 28-year-old female patient reported to Department of Prosthodontics with the chief complaint of missing maxillary anterior teeth and gummy smile. On examination, crown height was inadequate for abutment teeth and excessive gingival growth was seen in the edentulous area (Fig 2a). Gingivectomy and gingivoplasty using laser was planned. After phase I thearpy, gingivectomy and gingivoplasty was done by using the semiconductor diode laser in continuous mode, contact method (Fig 2b). Gingival troughing was done in the region of missing teeth to achieve emergence profile.

Case 3

A 26-year-old male patient was referred to the Department of Prosthodontics for replacement of old restorations. On examination, teeth 11 and 12 had been restored with porcelain-fused-to-metal crowns. Also, the gingival margins were esthetically unpleasant (Fig 3a). The decision was made to lengthen the crowns using laser, followed by all-ceramic restorations (Fig 3b).

After surgery, postoperative instructions were given and patients were recalled after 1, 2, and 3 weeks for follow-up; and definitive restorations were subsequently performed (Figs 1c, 1d, 1e; Figs 2c, 2d, 2e; Figs 3c, 3d).

Clinical Evaluation

Clinical parameters such as bleeding, wound healing, gingival color, pain, and difficulty of procedure were evaluated immediately and at 1, 2, and 3 weeks postoperatively. A list of clinical observations and patient responses prepared by Ishii et al[6] and Kawashima et al[7] was used for evaluation.

Fig 3a Case 3. Preoperative view.

Fig 3b Case 3. Crown lengthening by diode laser.

Fig 3c Case 3. 2 weeks postoperative view.

Fig 3d Case 3. Definitive restoration.

There was no bleeding either immediately postoperatively or in the follow-up period. Wound healing was slightly delayed and the procedure was very easy to perform. Patients reported no pain during surgery or follow-up.

DISCUSSION

There are various situations in which surgical crown lengthening is required, such as restoration of subgingival caries or fracture, inadequate clinical crown length, and unequal or unesthetic gingival heights. If a sulcus depth greater than 2 mm is found, especially on the facial aspect of the tooth, gingivectomy can be performed to lengthen the clinical crown.[8]

In all the three patients, there was no postoperative pain, swelling or bleeding from the operated area. Excellent postoperative results were obtained after 2 weeks, as there is delayed healing in laser. Six weeks postoperatively, definitive restorations were placed and the results were esthetically pleasant.

Surgical treatment is faster and more favorable for indirect restorations when higher clinical tooth crown is necessary.[9] Scalpel surgery causes unpleasant bleeding during and after the operation, and it is necessary to cover the exposed lamina propria with periodontal pack for 7 to 10 days. The diode laser causes minimal damage to the periosteum and bone under the gingiva being treated, and it has the unique property of being able to remove a thin layer of epithelium cleanly. Although healing of laser wounds is slower than healing of scalpel wounds, laser wounds are sterile and less likely to become inflamed.[10] Blood vessels in the surrounding tissue up to a diameter of 0.5 mm are sealed by the laser; the primary advantage is hemostasis and a relatively dry field.

The semiconductor diode laser is emitted in continuous-wave or gated-pulsed modes, and is usually operated in contact mode using a flexible fiber optic delivery system. Laser light at 800 to 980 nm is poorly absorbed in water, but highly absorbed in hemoglobin and other pigments.[11] Since the diode laser basically does not interact with dental hard tissues, this laser is an excellent soft tissue surgical laser, indicated for cutting and coagulating gingiva and oral mucosa, and for soft tissue curettage or sulcular debridement. The diode laser exhibits thermal effects because of its "hot tip" caused by heat accumulation at the end of the fiber, and produces a relatively thick coagulation layer on the treated surface. The usage is quite similar to electrocauterization. Tissue penetration of a diode laser is less than that of the Nd:YAG laser, while the

rate of heat generation is higher. The advantages of diode lasers are the smaller size of the units as well as the lower financial costs. Diode laser does not produce any deleterious effect on the root surface. Thus, it is generally considered that diode laser surgery can be performed safely in close proximity to dental hard tissue.

In an in vitro and in vivo study, Moritz et al[5] showed a bactericidal effect of diode laser. They found that an extraordinarily high reduction of bacteria could be achieved. It creates locally sterile conditions, which results in a reduction of bacteremia concomitant to operation. It is also postulated that low output power laser mediates an analgesic effect related to depressed nerve transmission in dentinal hypersensitivity.

Bragger et al[12] showed how periodontal tissues change after surgical clinical tooth crown lengthening. Six weeks postoperatively, attachment level and probing depth did not change, and the level of marginal gingiva established during operation almost precisely corresponds to the level of marginal gingiva after healing. According to their study, final restoration should be performed not earlier than 6 weeks after the operation, and because of possible retraction, it is recommended to wait longer in esthetical areas.

The usual mechanisms of diode laser that lead to ablation or decomposition of biological materials are photochemical, thermal or plasma mediated. Thermal ablation means that the energy delivered by the laser interacts with the irradiated material by an absorption process yielding a temperature rise there. As the temperature increases at the surgical site, the soft tissues are subjected to warming (37°C to 60°C), protein denaturization, coagulation (> 60°C), welding (70°C to 900°C), vaporization (100°C to 150°C), vaporization and carbonization (> 200°C).[2] The rapid rise in intracellular temperature and pressure leads to cellular rupture, as well as release of vapor and cellular debris, termed the laser plume.

The chief advantages of laser use are: (1) a relatively bloodless surgical and postsurgical course; (2) the ability to coagulate, vaporize, or cut tissues; (3) sterilization of the wound site; (4) minimal swelling and scarring; (5) little mechanical trauma; (6) reduction of surgical time; (7) high patient acceptance; (8) reduced postoperative pain, possibly due to the protein coagulum that is formed on the wound surface, thereby acting as a biologic dressing and sealing the ends of the sensory nerves.

CONCLUSION

There are a number of alternative modalities that will correct the esthetic problems. The decisive factor is what works best for the individual patient. From this case series, it can be concluded that the application of the diode laser appears to be a safe and effective alternative procedure for the treatment of altered gingival contour.

"It is said the greatest discovery in dentistry in the past 100 years is the local anesthesia which takes away the pain. The second greatest discovery in dentistry is the laser which takes away the needle and the drill." – Dr. Philip Ting, DDS, MDS.[13]

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