Laser-Assisted Gingival Tissue Procedures in Esthetic Dentistry

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Soft tissue lasers are increasing in popularity among clinicians in part due to their potential value in preprosthetic gingival procedures. The ability of soft tissue lasers to control moisture and facilitate hemostasis appears particularly promising for clinicians excising gingival tissues, performing esthetic crown lengthening, and using resective techniques for gingival troughing—and these applications will grow as practitioners become more familiar with such technologies. This presentation highlights the use of the 810 nm diode laser for perio-restorative procedures in the anterior maxilla.

Though soft tissue lasers have not been widely accepted by the dental community, they offer the potential to enhance preprosthetic gingival procedures while exhibiting decreased biologic side effects. An evaluation of their clinical benefits is necessary to ascertain the advantages of their application in restorative dentistry procedures.

Laser-Assisted Gingivectomy/ Gingivoplasty

The removal of gingival tissue for restorative purposes is usually performed in order for a clinician to gain access and deliver treatment to areas located below the gingival margin. Depending on the particular clinical scenario, one or more surfaces may be involved around a single tooth or multiple teeth. Additionally, situations may present where gingival excision is required for the purposes of facilitating moisture control throughout the restorative procedure, even though

Figure 1. Diode lasers provide unsurpassed operator control, allowing for precise tracing of a pre-established incision design.

the area to be treated is located supragingivally (eg, in cases where gingival inflammation is present, posing a risk of bleeding in conjunction with the attendant increase in crevicular fluid flow).

Alternatives for gingival tissue removal include the use of a scalpel, electrosurgery, and/or lasers.[1,2] The traditional surgical approach utilizing a scalpel blade exhibits the disadvantage of eliciting bleeding, which is a concern particularly if restorative dentistry is to be performed subsequently. Alternatively, electrosurgery has been utilized effectively to excise gingival tissue, while simultaneously providing adequate hemostasis,[1] and is therefore preferred by many restorative dentists. Heat generation with this technique, however, occurs to a degree where irreversible damage to the alveolar crest may result,[1,3] leading to recession and exposure of restorative margins, which negatively affects the esthetic zone. Lasers offer the potential of increased operator control and minimal collateral tissue damage. Diode lasers, specifically, operate at a wavelength that is easily absorbed by the gingival tissues,[4] while posing little risk of damaging the tooth structure. Despite this, caution should still be exercised to avoid thermal injury resulting from excessive heat generation.

Esthetic Crown Lengthening

Despite the clinical naiveté expressed by many surgeons, esthetic crown lengthening is a technically demanding endeavor that requires gingival incisions exhibiting a higher degree of precision than that achieved with a scalpel blade, regardless of the operator's skill level. The fine tip of the diode laser offers superb control and can be easily manipulated to precisely create the gingival margin contours required to successfully perform esthetic crown lengthening procedures (Figure 1). Prior to any such treatment, the area should be probed and bone sounding (i.e., biologic width) should be performed. The amount of attached gingiva, the location of the crest of bone, and how much crown lengthening is needed will determine if a full flap and osseous recontouring is the appropriate method of treatment versus a gingivectomy with a scalpel or a dental laser.

Additionally, since esthetic demands are the driving force behind treatment,[5] a provisional restoration must be frequently placed during the same appointment. Laser incisions are completed while achieving excellent hemostasis so that inadequate moisture control is not a factor interfering with the fabrication of the temporary and adjunctive restorative procedures.

The 810 nm soft tissue diode laser (i.e., Odyssey®, Ivoclar Vivadent, Amherst, NY) offers unprecedented control of the tissue sculpting procedure. Fine revisions of the incision line are achieved with ease with a degree of coagulation, resulting in excellent hemostasis and a clean surgical field.[6] The diode laser exhibits little or no affinity for the dental hard tissues, metal alloys, or porcelain and,

Figure 2. Gingival excision is achieved in layers with excellent hemostasis and a clean surgical field.

therefore, may be utilized in close proximity to the root surface or existing restorations or implants.[4] This can be accomplished with little or no effect on the cementum layer, without concerns of conducting an electrical current through the tooth structure or an existing metallic restoration, and without the potential occurrence of thermal injury to the pulp (Figure 2).

From a technical perspective, the diode laser may be used with the fiber tip either in contact to cut or in close proximity to treat the target area. The unit under evaluation includes an aiming light to facilitate guidance of the laser beam during non-contact use. Placement of the tip directly in contact with the surgical site for cutting, however, enhances tactile feedback while providing the operator with a sense of familiarity relative to other dental cutting or drilling procedures. Power settings are adjustable, and the laser beam may be delivered in a constant or pulsed mode.[7]

The gingivectomy technique with a diode laser is slightly different than electrosurgery. Since the energy is concentrated at the tip of the fiber and tissue penetration is shallow, the laser beam must be oriented along the incision plane while the ablation is advanced through the layers (Figure 2). In the author's experience, this results in soft tissue removal that is somewhat slower than what is possible with electrosurgery, although operative control is significantly increased. Alternatively, the laser beam may be applied in a constant mode to provide faster cutting, but this could lead to increased thermal transfer to the adjacent tissues. Temperatures higher than 200°C will result in carbonization and formation of a charred layer, which absorbs heat and may interfere with adequate energy transfer from the laser. Removal of the carbonized residue from the tooth structure may be cumbersome, and could become an esthetic concern when translucent all-ceramic restorations will be placed subsequently. The operator must adjust his or her technique and laser settings to achieve an acceptable balance between optimum cutting efficiency and the reduction of charred layer formation.

In addition, depending on the degree of gingival tissue excised and the periodontal biotype, an external bevel gingivectomy may be required to develop natural contours from the new gingival margin location. This surgical beveling was traditionally performed with a scalpel, knife, surgical nippers, or a round diamond, resulting in a large, bleeding surface wound that would contribute to the patient's postoperative discomfort. In contrast, preparing the external bevel gingivectomy with a diode laser produces a bloodless environment as well as a clean surgical field that lends itself to the successful completion of the restorative procedure at hand (Figure 3).[6]

Figure 3. The diode laser may be utilized to perform a bloodless external bevel gingivectomy, facilitating the immediate placement of provisional restorations.

Figure 4. Postoperative appearance two weeks following laser-assisted esthetic crown lengthening with immediate provisionalization.

The degree of coagulation and hemostasis achieved with the diode laser results in a dry operating field that facilitates the immediate fabrication of a provisional restoration, avoiding the exposure of subgingival root surfaces and open embrasure spaces. This is a distinct advantage in the management of the esthetically aware patient. Laser surgery is well tolerated by the tissues, and the short-term healing response compares favorably to scalpel incisions and electrosurgery (Figure 4).[6]

Figure 5. Preoperative view of abutment(s) prior to definitive impressions. Please note inflamed tissues and presence of bleeding.

Pre-Impression Gingival Troughing

Impression procedures are the key factor in the fabrication of indirect restorations.[8] The intraoral structures must be replicated in vivo and precisely duplicated in the laboratory environment. Exposure of subgingival finish lines in conjunction with adequate moisture control are prerequisites for the achievement of accurate impressions.[1,8] A double-cord retraction technique has been advocated to mechanically displace the sulcus, providing access to the finish line so that it may be adequately captured by the impression material.[8] Although capable of yielding excellent results, the double retraction cord technique is considered cumbersome by many clinicians. An alternative method utilizes electrosurgery to resect the gingival wall of the sulcus, therefore creating a trough along the finish line where the impression material will be subsequently syringed.[1] One problem with electrosurgery, however, is the fact that lateral heat generation will cause necrosis of the alveolar crest. Recession has been a consistent side effect of this technique, which is detrimental within the esthetic zone. Additionally, hemostasis is not always effective with plasmatic extravasation occurring as a result of soft tissue trauma (Figure 5).

Diode lasers offer clinicians the potential of utilizing a resective technique for gingival troughing, which simplifies the impression procedure while providing adequate hemostasis and allowing improved control of heat transfer to the adjacent tissues (Figure 6).[6] Provided that necrosis of the alveolar crest is avoided, healing following gingival excision with a diode laser should lead to the regeneration of the dentogingival complex to preoperative or near preoperative gingival margin levels. Therefore, thermal energy generation and transfer must be controlled by using the laser beam

Figure 6. Gingival troughing with the diode laser exposes finish lines while providing excellent hemostasis. Heat transfer to the alveolar crest must be carefully monitored.

Figure 7. Access to preparation margins coupled with adequate moisture control results in consistently successful impression taking.

> **Lasers offer the potential of increased operator control and minimal collateral tissue damage.**

in a pulsed mode whenever possible, as well as implementing the use of cooling methods such as running an air current or incorporating a water spray throughout the procedure.

The quality and duration of hemostasis achieved facilitate the completion of multiple accurate impressions (Figure 7). This is becoming of particular importance given the increasing popularity of zirconia frameworks, which cannot be soldered to compensate for impression inaccuracies as is the case with metal-ceramic techniques.

Conclusion

Diode laser units are characterized by their compact dimensions and relatively low cost. Their use in pre-prosthetic soft tissue management offers a number of potential advantages. Gingival excision and esthetic crown lengthening procedures can be performed with unprecedented levels of precision while achieving excellent hemostasis. Though diode lasers demonstrate great effectiveness when utilized for gingival troughing prior to taking definitive impressions, questions still remain regarding heat generation and transfer to the adjacent tissues. Assuming that a protocol can be developed to consistently apply this technique without eliciting alveolar crest necrosis, diode lasers would be a welcomed addition to the restorative dentist's armamentarium, in terms of clinical effectiveness, practicality, and cost efficiency.

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