Laser-assisted Soft Tissue Management in Esthetic Dentistry

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Abstract: Soft tissue health and esthetics are important factors in achievement of an attractive smile. The relationship between periodontium and restoration is critical if gingival health and esthetics are the goal. Current use of lasers in esthetic dentistry includes a wide variety of soft tissue procedures. Numerous wavelengths are used, and their specific use depends on different tissue absorption characteristics. When laser surgery is considered, it is important to follow the same principles as in conventional periodontal surgery. The zone of attached gingiva, alveolar crest position, gingival sulcus, epithelial attachment, and periodontal ligament must be taken in consideration. This article discusses use of a CO_2 laser in soft-tissue management of diastema closure and gingival hyperpigmentation. We will demonstrate how CO_2 laser can be used to manage the soft tissues in association with the restoration to improve esthetics.

Keywords: lasers; esthetic dentistry.

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In creating a beautiful, natural-looking smile, the health and esthetics of the soft tissue as well as the esthetic result of the dental restoration must be taken into consideration. It is important to establish harmony, balance, and continuity of the gingival margins. Gingival height and marginal contour in the maxillary anterior region need to be parallel to the form of the upper lip. Gingival margins of the central incisors should be symmetrical and 0.5 to 1 mm apical to the gingival margins of the lateral incisors, and canines should be at the same level as central incisors.[2] The form of the interdental papillae is of great esthetic concern; papillae should fill gingival embrasures to the contact point in a thin triangular shape. The most apical point of the clinical crowns, the "zenith point" is more esthetically pleasing on the central incisors when it peaks slightly distal to the midline of the tooth. Ideally, the zenith of lateral incisors is mid-facial.

During diastema closure, the zenith points must be repositioned mesially to avoid a mesially tilted appearance. In the case of diastema, the papilla has a blunt appearance; therefore, the preparation design of porcelain veneers will dictate the final outcome in terms of shape and position of papilla. The most important part of preparation design is the interproximal finish line preparation. It should be placed subgingivally starting approximately 1/3 of the way towards the diastema and should extend throughout the entire interproximal area.

In that way, the lab technician will be able to build up the emergence profile, which will gently compress papilla in a coronal direction, ie, more incisally. Moreover, the interdental contact points may need to be moved more apically for a complete closure of the interdental space.

Fig 1a

Fig 1b

Fig 1 Preoperative clinical view (a, b). Observe the diastema between the two incisors and the negative effect on facial appearance.

Fig 1c Interdental diastema and zenith points of teeth 11 and 21 at their originally correct position.

Fig 1d Bone sounding before surgery.

Using the laser, it is possible to perform a gingivectomy.[8] Different laser wavelengths have been used for this gingival surgical procedure, especially for delicate sculpturing of the gingival tissue for cosmetic laminate veneers without bleeding.[7,8-10,12] However, the Er:YAG laser may be used for soft-tissue surgery if no coagulation effect is desired, without closing the wound by sutures.[4] In addition, the parameters used and the correct wavelength selection are of clinical significance. For example, the Er:YAG laser could not ablate the soft tissues efficiently at a low pulse rate and is more effective and safer at a high pulse rate, as has been shown recently.[1]

The decision to perform laser-assisted gingivectomy depends on the amount of soft-tissue reduction needed, and the amount (width) of the keratinized gingiva in association with the location of the alveolar crest. Although most complex cases require interdisciplinary

treatment, in most clinical cases, the optimum esthetic result may be achieved with laser-assisted gingival contouring.

The present clinical report presents two of the main indications in which the laser is of clinical significance, especially in the management of soft tissues.

First Clinical Case Report

A 37-year-old female patient presented with the complaint that she does "not like spaces between her teeth and would like whiter teeth". The medical history was unremarkable. Comprehensive dental examination revealed sound teeth and healthy periodontium. The radiographic examination showed no pathological findings.

The diagnosis was (1) multiple diastemas, (2) excessive gingival display at teeth 11 and 21, (3) uneven, dissimilar gingival margins (Figs 1a and 1b). The treatment objective was to close the diastemas, creating the illusion of physically shifted teeth with an esthetically pleasing width to length ratio (8:10), to establish crisp, triangular papillae, which fill the entire contact area and to create even, symmetrical gingival margins which follow the contour of the patient's upper lip.

The different orthodontic and restorative options were discussed extensively with the patient, but she immediately declined the option of orthodontic treatment due to the length of therapy.

The dental imaging gave us a good idea of the desired result, but the final outcome during lip movement could not be evaluated. A composite mock-up in this case was performed for better visualization and patient communication. Diagnostic models, face bow transfer, centric-relation bite registration together with a model of the mock-up and preoperative photos were sent to the dental laboratory in order to guide laboratory technicians in fabricating an ideal functional diagnostic wax-up and a soft-tissue surgical guide.

The treatment area was anesthetized with 2% lidocaine HCl with 1:100,000 epinephrine (Henry Schein, Melville, NY, USA). Teeth 14, 13, 12, 11, 21, 22, 23, and 24 were prepared for porcelain veneers based on the diagnostic wax up and the preparation guides.

Special considerations were taken for preparations of teeth 11 and 21, since spaces were large and there was an excess display of gingiva (Fig 1c). The intrasulcular bone sounding revealed 4.5 mm from bone crest to the most apical part of the gingival margin, which means that maximum of 1.5 mm can be removed from the gingival margin without violating biological width (Fig 1d). The preliminary finish line was placed at the level of the free gingival margin.

An Ulraspeed CO_2 (DEKA, Fort Lauderdale, FL, USA) laser was used for gingival contouring. First, we shifted the zenith points mesially by approximately 1 mm and then 1.5 apically using the laser. With the CO_2 mechanical perio tip and a 3W power setting at 100 Hz frequency, defocused beam, we were able to incise and scallop the tissue precisely and to make the proper gingival contour (Fig 2a). The surgical guide was used for verifying the desired gingival level. In addition, a small amount of gingival tissue was removed interproximally to make room for the porcelain, which had to be considered by the laboratory technician in order to compress the papillae and better fill the contact area.

A final finish line was placed at the gingival margin level except mesio-interproximally, where we finished the margins subgingivally to create a proper emergence profile, which will be easily cleanable by the patient (Figs 2b and 2c). The final impressions were taken on the same day (Aquasil Ultra, Dentsply/Caulk, Milford, DE, USA) and the provisional restorations (Fig 3) fabricated (Luxatemp Fluorescence, Zenith/ DMG, Engelwood, NJ, USA).

During surgical treatment, the patient experienced no discomfort; no antibiotics or analgesics were prescribed postoperatively. Two and half weeks later, the final porcelain veneer restorations (IPS Empress, Ivoclar Vivadent, Amherst, NY, USA) fabricated by Frontier Dental Lab (El Dorado Hills, CA, USA) were placed and cemented with Appeal (Ivoclar Vivadent, Amherst, NY).

The patient was very happy with the final result and length of time it took to complete this treatment, which would not have been possible without performing a laser-assisted gingivectomy (Fig 4).

Second Clinical Case Report

A 42-year-old female came to our clinic for consultation and, if possible, esthetic treatment of gingival hyperpigmentation. The prosthetic restoration was not sufficient and was scheduled for replacement a couple of weeks later. The patient had a high gummy smile (Fig 5) and pocket depth measurements of 1 to 3 mm. The width of the keratinized gingiva was more than 5 mm bucally. We suggested using the CO_2 laser for soft-tissue vaporization and a power setting of 5 W in a continuous-wave mode with a noncontact defocused beam to remove the hyperpigmented tissues.

Fig 2a Preparation of the tissue using the CO_2 laser with the perio tip.

Fig 2b Occlusal view of interproximal gingival contouring and interproximal subgingival finish line placement.

Fig 2c Buccal view of interproximal gingival contouring and interproximal subgingival finish line placement.

Fig 3a

Fig 3b

Figs 3a and b Clinical result with the provisionalization immediately after surgery.

Fig 4a

Fig 4b

Figs 4a and 4b Final result of the veneer restoration after 1 month, showing the excellent soft tissue healing and the natural esthetic appearance.

Fig 4c Note symmetry of the gingival margins and mesialized zenith points of teeth 11 and 21 that have created the illusion of bodily shifted central incisors.

Fig 5 High gummy smile with gingival hyperpigmentation. The insufficient prosthetic restoration should be removed after laser periodontal treatment.

Fig 6 Significant charring during the CO_2 laser irradiation shows complete epithelial removal.

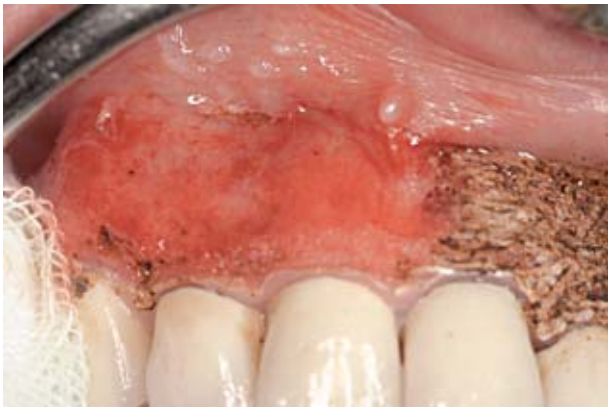

Fig 7 Superficial bleeding after the removal of the charred surface is a sign of complete epithelial removal.

Fig 8 Excellent esthetic result after 3 months without any recurrence. Observe also the new keratinization of the epithelium.

After a topical anesthesia with xylocain spray 2%, we ablated and vaporized the superficial gingival tissue from the first left to the first right maxillary premolar (esthetic area). The superpulsed CO_2 laser (Ultraspeed, DEKA) was able to produce superficial charring (Fig 6), which was removed immediately after the irradiation with wet gauze. Because of the deep tissue vaporization using these power parameters, it was possible to completely remove the epithelium, including the basement membrane, where the melanin is localized. Evidence of complete epithelial removal was the bleeding (Fig 7) which occurred after the use of wet gauze to wipe the charred surface. To produce hemostatis, we immediately applied the CO_2 laser at 2 W in continuous wave mode to the surgical site. No dressing, antibiotics, or analgesics were used after surgery. The patient showed excellent soft-tissue healing without scar tissue formation and no recurrence. The final outcome 3 months after surgery was an esthetic result (Fig 8) and a satisfied patient. The final prosthetic restoration had to be done by the referring dentist.

DISCUSSION

In these clinical reports, we presented clinical applications of the CO_2 laser in the field of esthetic dentistry. As an alternative treatment to the CO_2 ultraspeed laser gingival contouring, a conventional scalpel, electrosurgery, or another laser wavelength could be employed.

Without any doubt, conventional gingivectomy and gingivoplasty are associated with discomfort and sometimes postoperative complications such as bleeding. The electrosurgical knife is related to bacteremia[3] and tissue necrosis due to tissue overheating. An additional shrinkage of the gingival margin is very often associated with this tissue necrosis, which is of clinical importance because it is imperative to avoid gingival recessions in the anterior areas.

Similarly, soft-tissue removal with other laser types (such as Er:YAG or Er,Cr:YSGG) is relatively slow and inefficient with suboptimal coagulation, or tissue vaporization is poorly controlled, especially in the intrasulcular areas, eg, when Nd:YAG or diode lasers are used. For these reasons, the preferred laser for indications such as those presented here is an ultraspeed CO_2 laser, which allows efficient incision, vaporization, and coagulation of the surgical site. This laser causes less bleeding, minimizes postoperative complications, and significantly reduces the chair time. Additional reports in different countries[5,6,10] also presented this clinical application as an effective tool for daily practice in esthetic dentistry.

CONCLUSIONS

The way soft tissue is handled around dental restorations is extremely important for the final esthetic outcome. Soft-tissue laser-assisted gingivectomy and gingivoplasty is a very helpful way to quickly achieve predictable esthetic results and create a natural, pleasing gingival appearance. The use of the CO_2 laser makes it possible to reduce papilla height with less risk.

The surgery is associated with less discomfort, excellent healing, and a predictable final result. The exact measurement of the probing pocket depth during treatment has to be considered in order to avoid problems arising from the violation of the biological width and recurrence.

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