

Principles of cosmetic dentistry in orthodontics: Part 2. Soft tissue laser technology and cosmetic gingival contouring

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Most orthodontists are familiar with the term “laser” but don’t really know much about them or their applications in orthodontic practice. The most frequent applications of lasers in dentistry include gingivectomy, frenectomy, removal of mucocutaneous lesions, and gingival sculpting associated with implants and mucogingival surgery.¹⁻¹⁰ Rossman and Cobb¹¹ summarized the advantages of lasers in soft tissue surgery: (1) the laser cut is more precise than that of a scalpel, (2) the cut is more visible initially because the laser seals off blood vessels and lymphatics, leaving a clear dry field,¹²⁻¹⁴ (3) the laser sterilizes as it cuts, reducing the risk of blood-borne transmission of disease, (4) minimal postoperative pain and swelling have been reported, (5) less postoperative infection has been reported because the wound is sealed with a biological dressing, (6) less wound contraction occurs during mucosal healing, thus scars do not develop, and (7) less damage occurs to adjacent tissues. These qualities result in a shorter operative time and faster postoperative recuperation.

Our interest in soft tissue lasers came through our increasing application of principles of cosmetic dentistry, which allow us to finish the esthetics of the smile to a much finer degree. These principles were covered in Part 1 of this 3-part series.¹⁵

PRINCIPLES OF SOFT TISSUE LASER TECHNOLOGY

A laser creates a light beam that is monochromatic (it has a very narrow wavelength) and highly collimated through a filamentous tube. The tube or fiber has a cladding layer that collimates the light energy, and it has a protective jacket outside. This means that the

business of the laser occurs at the tip and not the sides of the fiber. Lasers deliver concentrated energy through the fine tip of the optical fiber to tissue, where the energy is absorbed. The degree of absorption will vary with the wavelength of the laser (measured in nanometers), the power or energy output selected by the clinician, and the optical characteristics of the target tissue, including its water content.^{11,16} As the energy is absorbed by the target tissue, the temperature increases at the surgical site, and the soft tissues are instantly subjected to the stages of warming, welding, coagulation, protein denaturation, drying, vaporization, and carbonization.

The laser tip cuts soft tissue through *ablation* of tissue. This means that the cellular temperature is raised rapidly through the absorption of the laser energy by the melanin in the cells, and the cells virtually explode. This characteristic is useful in both cutting and contouring gingival tissues and will be illustrated in this article. Postoperatively, we instruct the patient to use salt water rinses the day of the procedure and the next day to clean the site and to remove any remaining tissue with a wet cotton tip applicator.

THREE BASIC TYPES OF LASERS

Three types of lasers are available for use in dentistry: the CO₂ laser, the erbium laser, and the diode laser.

The CO₂ laser can be somewhat difficult to use in practice. It does not contact the tissue during the cutting phase; thus there is no tactile feedback during the surgical incision. It operates with a wavelength that is invisible to the eye, so the fiber optic delivery system has a helium-neon (He-Ne) laser with a wavelength of 632 nm incorporated as an aiming beam. There is slight delay between when the incision is made and when it can be seen.

The erbium laser has a wavelength of 2790 to 2940 nm, which makes it ideal for absorption by both hydroxyapatite and water. It can also be used to cut soft tissue, but it does not control bleeding.

Private practice.

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The diode laser has a wavelength of 812 to 980 nm, which is in the same range of the absorption coefficient of melanin. The laser energy is absorbed by pigmentation in the soft tissues, and this makes the diode laser an excellent hemostatic agent. Because it is used in contact mode, it also provides tactile feedback during the surgical procedure. The diode laser can often be used without anesthesia to perform very precise anterior soft tissue esthetic surgery or surgery in other areas of the mouth without bleeding or discomfort.

Soft tissue reacts differently to a diode laser than to a scalpel. The laser can deliver energy in either a continuous or a pulsed mode. In the continuous mode, the tissues tend to absorb more energy, resulting in greater heat. The pulsed mode permits intermittent cooling between pulses of energy. Because the amount of heat generated during the procedure translates directly into the amount of collateral damage—and thus postoperative discomfort—it is generally recommended that the laser be used at a lower setting and in the pulse mode for soft tissue procedures.

Our interest in soft tissue lasers began through collaboration with cosmetic dentists who used them routinely for gingival contouring of their restorative patients. After observing several patients treated with this technology and acquiring more knowledge of the principles of cosmetic dentistry (discussed in part 1¹⁵), we became aware of treatment finishing issues that we simply had not seen before. A practical problem that we immediately encountered was that only a small percentage of dentists currently have lasers in their practices, and, when we referred a patient to a periodontist, he or she often would not follow through with the procedure. We thought it appropriate to acquire a diode laser to provide limited services to patients in our office. We selected the diode laser because of its manageable size (Fig 1), lower cost, and ability to cauterize while cutting, and because it generally requires only topical anesthesia. Another major advantage of the diode laser is that the wavelength does not approximate the absorption coefficient of bone or enamel. In other words, it can cut only soft tissue and has no effect on hard tissue.

INDICATIONS FOR SOFT TISSUE LASER TREATMENT

After using the laser in our practice for a few months, we found the list of applications expanding significantly. The first application for lasers in orthodontics is cosmetic gingival contouring; preparing and finishing anterior esthetic orthodontic outcomes make our final results better than ever. This application will be discussed further in this article. The second application is in solving tooth eruption and soft tissue



Fig 1. Diode laser. **A**, Small size lends itself to placement on mobile cart; **B**, instrument is pencil-sized, making it convenient for intraoral use.

problems that impede efficient orthodontic finishing; this application will be addressed in part 3 of this article.¹⁷

Esthetic contouring of the gingival scaffold within the smile framework

Important considerations in finishing our orthodontic patients in terms of smile esthetics now include concepts that are important in cosmetic dentistry—crown heights, tooth proportionality, and gingival shape and contours—therefore, the uses of soft tissue lasers in orthodontic practice broadly fall into the following categories: (1) improving gingival shape and contour, (2) lengthening crowns, (3) idealizing tooth proportionality, and (4) resolving crown/height asymmetries. As mentioned in Part 1,¹⁵ 2 concepts of cosmetic dentistry that are quite important to the final esthetic outcome of orthodontic treatment are *gingival shape* and *gingival contour*. Gingival shape refers to curvature of the gingival margin of the tooth. The

gingival zenith of the maxillary lateral incisors and the mandibular incisors should coincide with their longitudinal axis^{18,19} (Fig 2). Gingival contour, as compared with gingival shape, refers to a more 3-dimensional description of gingival topography. Ideal gingival contour is characterized by sharp interdental papillae and equally tapered gingival margins at the cervical margin of the teeth.

The patient in Figure 3, A, had completed orthodontic treatment and was referred for cosmetic periodontal crown lengthening to increase tooth display. The finished gingival shape was characterized by a narrow gingival apex, and the gingival contours were rounded and unesthetic (Fig 3, B). Figure 3, C, shows the maxillary lateral incisor immediately after recontouring with a diode laser. The precision of the diode laser is demonstrated very well in the refinement of the gingival margins and interdental papilla. Because there is no bleeding, the wound is sealed during the procedure, and because we had tactile feedback with the fiber, the contouring was very precise. An interesting part of the clinician's learning curve is to realize that the laser does not cut like a blade; instead, the tissue is ablated by the laser energy at the fiber tip. The sides of the tip are protected by the collimation cladding, and no energy is imparted through the side of the fiber. The proper technique is not to press the fiber and drag it along the margin to cut, but to simply guide the fiber along the precise route desired and to let the highly directed laser energy do the work. This characteristic is also useful in reshaping the gingival contour. Gingival contour refers to the thickness and shape of the margins of the gingiva to the crown of the tooth. Once a cut is made in a soft tissue gingivectomy, for example, the tip of the fiber is then directed at the rolled margin in a sweeping motion to ablate the margins and bevel them to the desired sharpness. Three weeks after gingival shaping and contouring, the tooth has a much more esthetic appearance (Fig 3, D).

Establishing tooth proportionality before bracket placement

When the dentist is preparing the teeth for laminates, it is not uncommon to reshape and idealize the gingival contour with a soft tissue laser before final preparations are made and impressions are taken. In orthodontic treatment, because we usually cannot make contour adjustments, we tend to overlook gingival shape problems. Often, however, it is useful to reshape the gingival contours before bracket placement. Bracket placement in orthodontics has been directed by the relationship of the bracket slot to the incisal edge. Anterior teeth vary in crown height and incisal edge

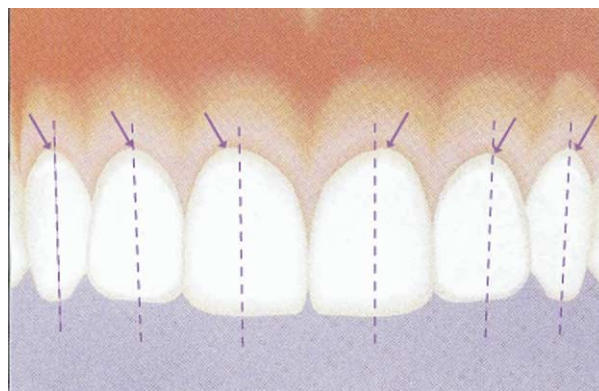


Fig 2. Recommended zenith placement relative to long axis of maxillary anterior teeth. Note that lateral incisor zenith coincides with long axis of tooth, whereas zeniths of central incisors and canines are slightly distal to long axis.

shape. Some investigators recommend reshaping the incisal edges before bracket placement. In smile design, our concepts of set formulas for bracket placement depend on the final incisor placement in the dynamic smile, determined by both the incisal edge and the gingival margin. It is therefore important to be able to visualize the crown in ideal proportion before bracket placement.

The patient in Figure 4 had a disproportionality of the width and height of the maxillary incisors. This disproportion could be due to lack of incisor height (gingival encroachment or delayed or incomplete passive eruption requiring gingival reshaping) or incisors that are morphologically wider than ideal. We decided to improve tooth proportion through laser gingivectomy (Fig 4, B) before bracket placement so that we could maximize our chances of positioning the incisors in their ideal vertical position. Because the soft tissue laser seals the incision as it is made, brackets can be placed immediately after the procedure, and healing of the tissue follows (Fig 4, C).

Crown lengthening

The patient in Figure 5 had a chief complaint of crowded maxillary canines. At rest, her maxillary incisors were 4 mm below the resting lip line. On smile, all maxillary incisors were displayed with excessive gingival display, and her smile arc was consonant. How could we treat her crowding and the gummy smile? One approach might include orthodontic intrusion of maxillary anterior teeth. Although this would decrease gingival display, it would also flatten her smile arc. The critical measurement in this patient was her incisor crown height, which was 8 mm for the central incisors.

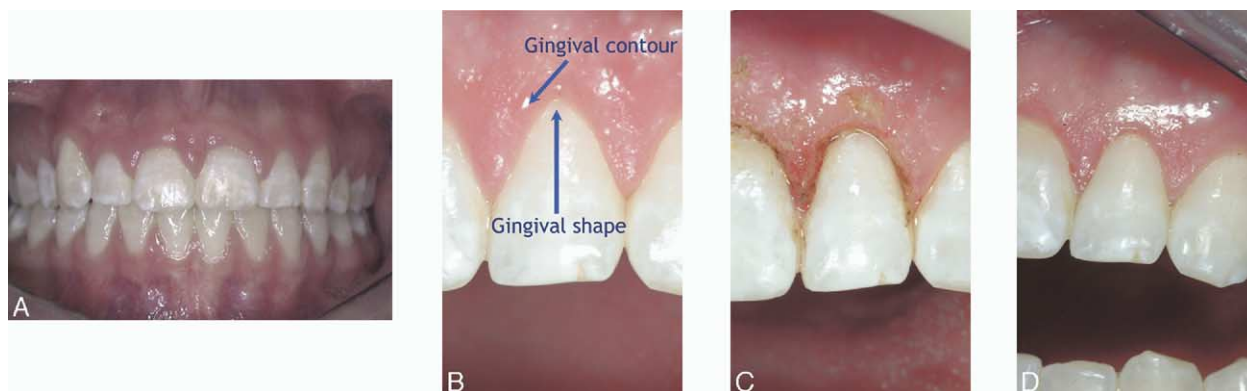


Fig 3. **A**, Patient had finished treatment 1 year earlier and still had fibrotic gingival margins and short crown height. She was referred for periodontal crown lengthening. **B**, Gingivectomy successfully lengthened anterior teeth, but lateral incisor emphasizes narrow gingival apex (gingival shape) and gingival contours that were rounded and unesthetic. **C**, Immediately after recontouring with diode laser. **D**, Three weeks after gingival shaping and contouring, with much improved appearance.



Fig 4. **A**, Patient had disproportionality of width and height of maxillary incisors, with gingival encroachment. Appropriate bracket placement is difficult because entire crown is not visible. **B**, Through laser gingivectomy, excess tissue was removed and crown visualized. **C**, Four weeks after gingivectomy. Properties of laser prevent bleeding; thus brackets can be placed immediately, and healing occurs quickly.

Because the average height of maxillary central incisors is in the 10-mm range, the gummy smile was judged to be due to short crown height; therefore we aligned the teeth with mechanics that would maintain the smile arc while bringing the canines down. We simulated this treatment digitally so that we and the family could both see how we could protect the smile arc while reducing gingival display (Fig 5, *B*). This also allowed us to visualize the proportional tooth-size relationships in terms of height-width relationships. After the teeth were leveled and aligned (Fig 5, *C*) and before appliances were removed, the patient was referred to her dentist for laser crown lengthening and contouring; the final results were excellent (Fig 5, *D*).

Another excellent application of crown lengthening is when a canine is substituted for a congenitally missing lateral incisor. When the first premolar is in the canine position, its crown height looks too short. Some clinicians recommend intrusion of the premolar and

placement of a laminate veneer to restore length. Another option, however, is to lengthen the premolar crown by laser gingivectomy.

Crown height asymmetry

The patient in Figure 6 was treated to an excellent occlusal and esthetic result. However, the smile line was asymmetric because of differential crown heights between the maxillary right central and lateral incisors, relative to the left side. Using the laser, we excised the gingiva on the right central and lateral incisors, and, 3 weeks later, the smile was more symmetric and greatly improved (Fig 6, *B*).

Contouring of gingival and interdental margins

Hypertrophic gingival margins are often seen in orthodontic treatment secondary to marginal gingival inflammation, both acute and chronic. The patient in Figure 7 had not maintained adequate oral hygiene

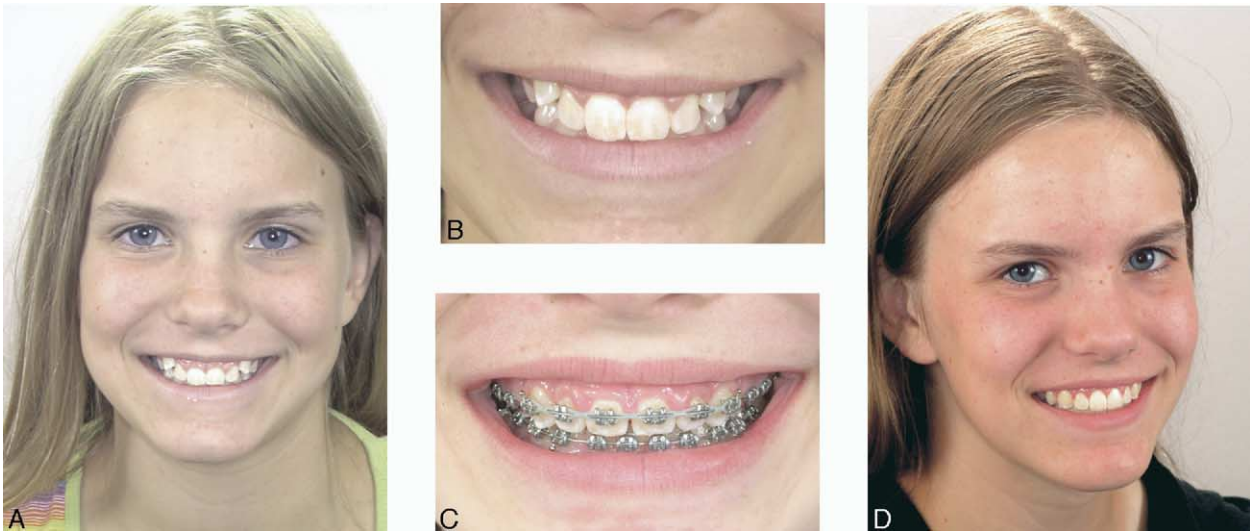


Fig 5. **A**, Patient had excessive gingival display, but smile arc was consonant. Intrusion of maxillary incisors would reduce gummy smile but would also flatten smile arc. **B**, Digital image modification demonstrated effect of crown lengthening on reducing gingival display while maintaining smile arc. **C**, After canines were brought down and leveling completed, patient was referred to dentist for laser gingivectomy. **D**, After appliances were removed, excellent crown proportionality, gingival shapes, and contours were present.

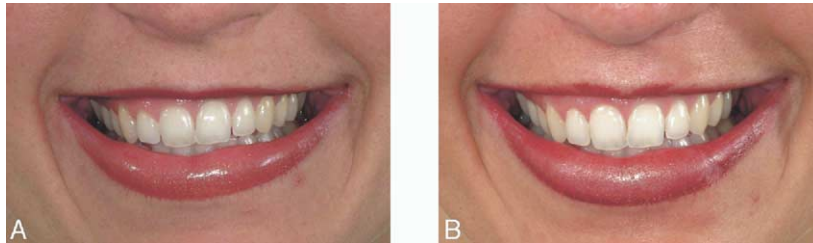


Fig 6. **A**, Patient's smile line was asymmetric because of differential crown heights between maxillary right and left central and lateral incisors. **B**, Three weeks after right central and lateral incisors were lengthened with laser, much better smile symmetry was attained.



Fig 7. **A**, Patient had not maintained adequate oral hygiene during treatment. After appliance removal, interdental papillae and gingival margins were enlarged and fibrotic. **B**, Immediate response after ablation of hypertrophic papillae and beveling of gingival margins. **C**, Four weeks later, tissues had healed and gingival contours improved.

during treatment, and, after appliance removal, the interdental papillae and gingival margins were enlarged and fibrotic. The hypertrophic papillae were ablated

and the rolled gingival margins beveled to sharpen their contour adjacent to the crown of the tooth. When we are removing bulky papillae, we do not use the laser as

we would when we make an incision. Instead, we wipe the tip across the bulky tissue, and the bulk is reduced by ablation. Fig 7, *B*, shows the immediate response to laser surgery, and the precise control of the laser permitted contouring and beveling of the gingival margins. Four weeks after the procedure, the gingival margin was greatly improved (Fig 7, *C*).

CONCLUSIONS

This article described how the laser works and how it can be used on gingival soft tissues. We have also presented some of the most common uses of the soft tissue laser in refining the esthetic finishing of our orthodontic patients. Part 3 in this series will describe how the soft tissue laser can lead to orthodontic efficiencies and discuss some practical issues with other dental colleagues.

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