Clinical Uses of Diode Lasers in Orthodontics

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Orthodontists have long been challenged by tissue problems that can occur during or after treatment. Until now, their only viable option for the more severe cases has been to refer them to the periodontist—to say nothing of the many other soft-tissue discrepancies that are not significant enough for referral, but do affect the final results, especially esthetic appearance.

The diode soft-tissue laser is a highly effective and predictable new device for simple recontouring of tissue, requiring only a topical anesthetic. In our opinion, the diode laser will soon gain wide acceptance in orthodontics because of its ease of use, reasonable cost, positive patient response, and impact on esthetic results.

How the Laser Works

Laser is an acronym for light amplification by stimulated emission of radiation. Laser light has four properties that make it different from ordinary light: it is monochromatic (composed of a single wavelength), columnated (the light waves run parallel to one another rather than being divergent), uniphasic (the light waves have synchronous peaks and valleys), and intense (able to change the nature of targeted tissues). These properties make laser light extremely focused and powerful.

Lasers have come into widespread usage in general dentistry in the last decade. What makes the diode laser particularly applicable in orthodontics is that its wavelength is between 800 and 980 nanometers—appropriate for removing soft tissues, due to their pigmentation and hemoglobin content. Energy from the laser is converted in a photothermal reaction, making it possible to "paint away" targeted soft tissue in a controlled and focused manner without unwanted side effects on the surrounding teeth. Of course, there are lasers of higher wavelength and intensity that can target hard tissues.

A diode laser suitable for orthodontics can cost $8,000-15,000. Although this might seem expensive, the laser's functionality and ease of use make it cost-effective. There are several

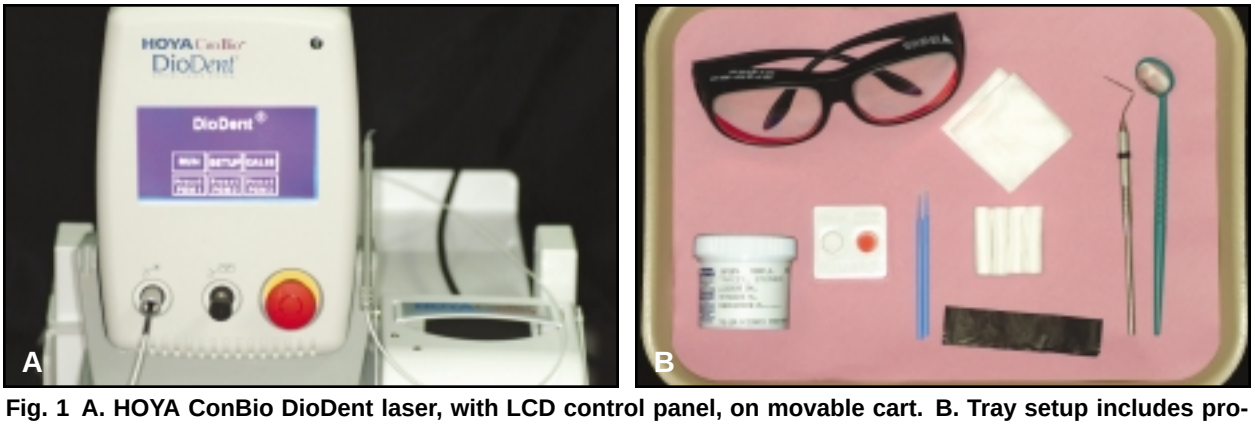

Fig. 1 A. HOYA ConBio DioDent laser, with LCD control panel, on movable cart. B. Tray setup includes protective eyewear, mirror, periodontal probe, carbon articulating paper, compounded TAC 20% topical anesthetic, foam applicators, and application plate with wells holding hydrogen peroxide and anesthetic. Gauze 2" × 2" sponges saturated with water (not alcohol, which is combustible under laser light) can be used for charred tissue debridement.

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diode lasers on the market; we have chosen the HOYA ConBio DioDent* (Fig. 1).

Operative Procedure

To prevent unnecessary thermal degeneration, the Academy of Laser Dentistry advises using the least amount of power that can effectively accomplish a desired procedure. A setting of 1 watt at a continuous pulse (as opposed to a gated or intermittent pulse) has proved effective for most soft-tissue procedures. A setting of 1.25 watts may be required with more fibrous tissues or lengthier procedures, but we have not found it necessary to exceed that amount.

A 400-micron optical fiber is recommended over a 300-micron fiber, which is slightly more friable and breakable. Before each patient use, 2-3mm should be cut off the end of the fiber to avoid cross-contamination (Fig. 2). A small cleaving stone is used to nick the fiber before it is broken off; care should be taken to cut cleanly, so that the laser light source is focused rather than dispersed. The optical fiber is then inserted into a plastic wand with a disposable tip for use in the mouth (Fig. 3). The fiber is activated by pulsing the laser on a dark surface such as carbon articulating paper (Fig. 4).

The anesthetic of choice is a compounded topical TAC 20% (Tetracaine 4%, Phenylephrine 2%, and Lidocaine 20%). The combination of the two local anesthetics has a profound effect, while Phenylephrine promotes local hemostasis to reduce systemic absorption and thus prolong the duration of action. After the mucosal area is dried, the peppermint-flavored topical gel is applied to the target tissues with a Q-tip or cotton roll and left in place for three minutes before the laser procedure is initiated. Its peak effect will

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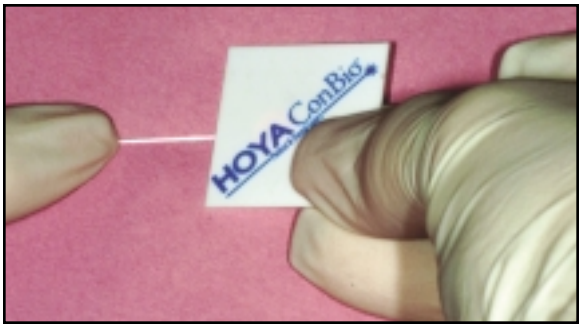

Fig. 2 Before each patient use, 2-3mm on end of optical fiber nicked with small cleaving stone and cut off cleanly.

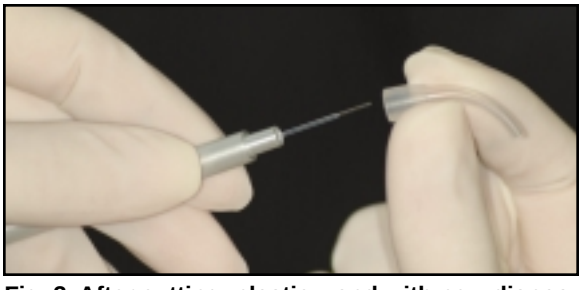

Fig. 3 After cutting, plastic wand with new disposable tip fitted over optical fiber for use in mouth.

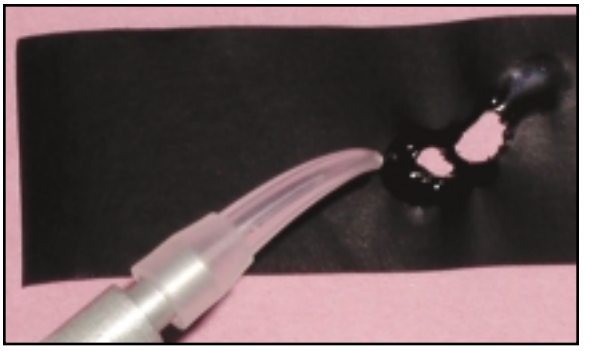

Fig. 4 Optical fiber activated by tapping it lightly on dark surface. Small holes on carbon articulating paper indicate laser is ready for use.

Fig. 5 16-year-old female patient with impacted upper left cuspid that had been brought into position. Redundant tissue at cervical cuff did not diminish after several months of treatment, and root positions create esthetic asymmetry that is apparent in patient's smile.

occur within six minutes and last a minimum of 20-30 minutes.

When recontouring numerous anterior teeth, particular attention should be paid to the overall smile line. Many patients have an asymmetrical tissue drape (Fig. 5). The most attractive smiles show 100% of the anterior teeth, although 1-2mm of gingival display is generally not displeasing. The zenith, or highest point of contour, of the tissue on the tooth should be slightly distal to the center of the long axis. Laying dental floss across the height of the tissue contours can be helpful in evaluating a gingival smile line.

A periodontal probe is used to measure the depth of the sulcus (Fig. 6A). A biological width of at least 2-3mm, as determined by bone sounding, should normally be maintained, but as little as .5mm of tissue will regenerate over time. Scribing a line with pinpricks of the periodontal probe will help the operator maintain the appropriate biological width and provide an exact indication of the amount of tissue to be reduced (Fig. 6B).

Fig. 6 A. Periodontal probe used to measure depth of gingival sulcus. Bone sounding determines biological width, which should be at least 2-3mm. B. Pinpricks made in tissue with tip of periodontal probe indicate precise amount of tissue to be removed.

The vaporization and removal of target tissue is referred to as "ablatement". Safety goggles are imperative for patients, surgical staff, and any observers to prevent inadvertent exposure to reflected energy or stray light (Fig. 7A). These goggles are not sunglasses, but wavelength-specific eyewear manufactured especially for laser light. The near-infrared laser light is not visible to the operator; the visible red-wavelength light is an aiming beam that indicates where the laser is being focused.

The diode laser is activated with a foot pedal. The operator gently moves the fiberoptic wand over the target tissue, using a light brush stroke to "paint away" the desired amount of tissue (Fig. 7B). The tip is held at a slight angle to provide a beveled, natural contour, instead of an abrupt ledge. Care should be taken to avoid excessive contact, which might cause unwanted collateral damage. An assistant should hold an aspirator at the ablatement site to remove charred tissue and associated odors.

Fig. 7 Diode laser tissue ablatement procedure. A. Operatory team and patient wear wavelength-specific protective goggles. B. Assistant holds aspirator close to target tissue to remove charred tissue and odors. Red light is aiming beam that indicates where invisible laser light is focused.

Fig. 8 Ablatement area cleaned with hydrogen peroxide to remove charred tissue.

Fig. 9 Patient seven days after ablatement. Composite veneer was added to facial surface of cuspid immediately after laser procedure. Note improved occlusion and esthetic balance in patient's smile.

After the laser procedure is completed, a cotton pledget soaked in hydrogen peroxide is used to debride the area of charred tissue, allowing the clinician to check the shape and bevel of the gingival cuff (Fig. 8). Although most patients report almost no pain, an over-the-counter pain medication such as ibuprofen or acetaminophen is recommended. The patient should be given an ultrasoft toothbrush to use while the surgical site is healing. Gentle brushing will promote healing, but the patient should be made aware that some light post-operative bleeding is not unusual for several days after the procedure. The diode laser is especially effective at killing bacteria at the surgical site, which also promotes effective and rapid healing (Fig. 9).

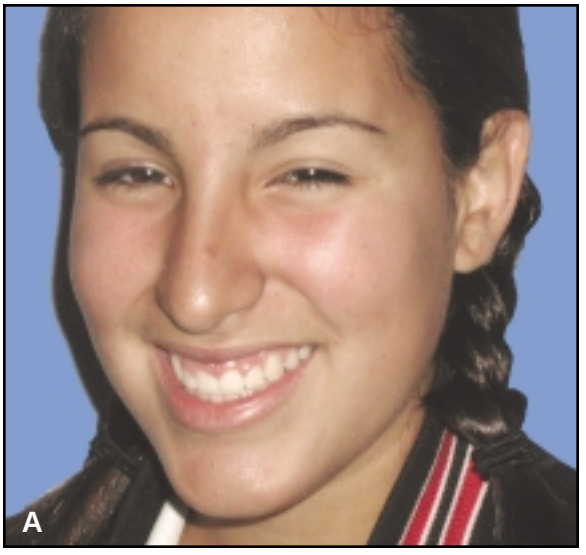

Fig. 10 A. 13-year-old female patient showing uneven crown display, especially in maxillary central incisors, after orthodontic treatment. B. Improvement in tissue drape immediately after diode laser surgery. C. Post-operative healing six weeks later.

Clinical Uses of the Diode Laser

1. Gingival Recontouring and Sculpting (Fig. 10)

Orthodontic tooth movement often creates uneven tissue levels. The tissues will normally adjust to the reconstituted bone heights once the appliances are removed, gingival swelling subsides, and oral hygiene improves. Occasionally, however, the tissue levels will not align properly due to the distance of tooth movement, root positions, hormonal changes, periodontal response, or poor hygiene. This problem is especially unat-

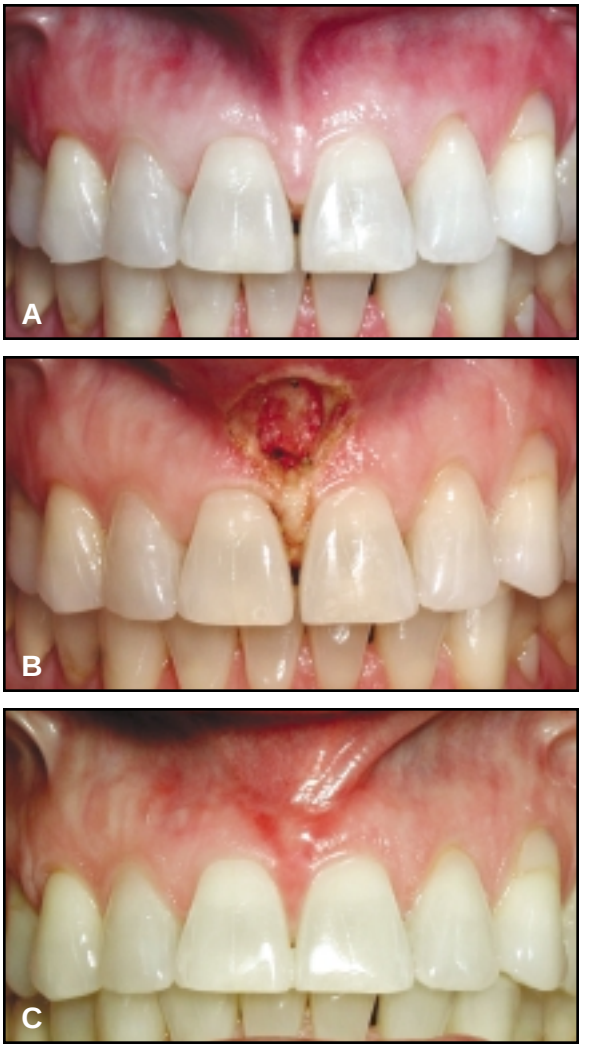

Fig. 11 A. 44-year-old female patient with low and thick frenum attachment resulting in diastema. B. Frenum removed with diode laser. C. Healing 22 days later, with little post-operative discomfort.

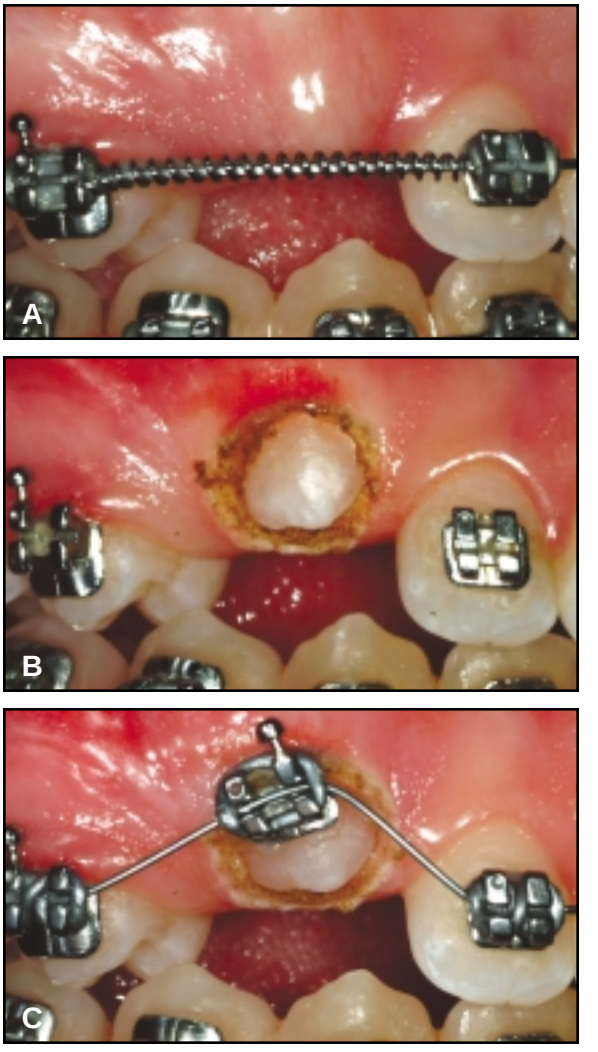

Fig. 12 A. Five months after space creation, upper right cuspid had not broken through gingival tissue. B. Access gingivectomy performed with diode laser. C. Bracket placed and wire engaged immediately after surgery.

tractive in the upper anterior teeth. Sculpting or reshaping the tissue once swelling has subsided can create a more pleasant smile and improve periodontal health where residual gingival hypertrophy exists.

2. Frenectomy (Fig. 11)

Although complex frenectomies that require removal of fibrous interseptal tissue should be referred to the periodontist, simple frenum removal is well within the capability of the diode laser.

3. Access Gingivectomy (Figs. 12,13)

When a tooth resists eruption, with a thin layer of tissue covering its surface, treatment can

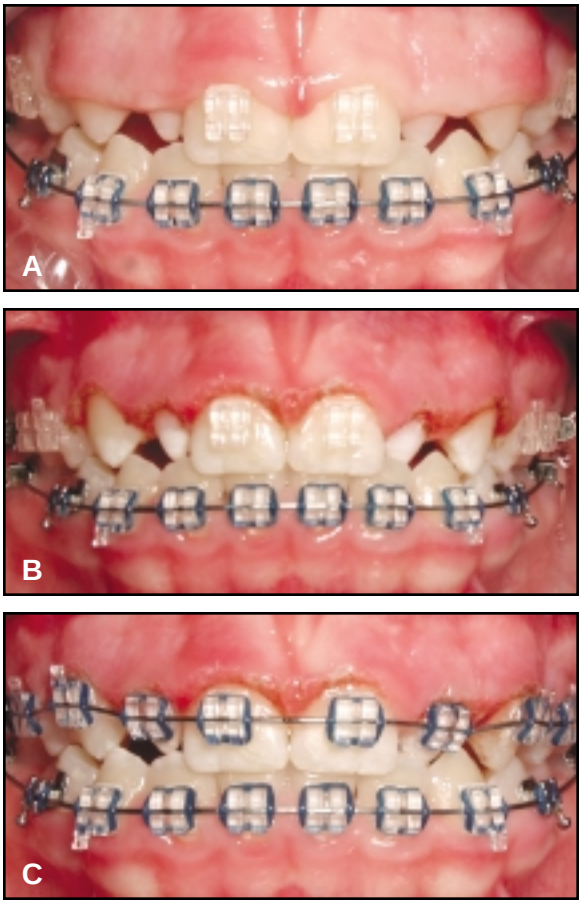

Fig. 13 A. 12-year-old female patient with incompletely erupted peg lateral incisors preventing bracket placement. B. Access gingivectomy performed with diode laser. C. Brackets in place.

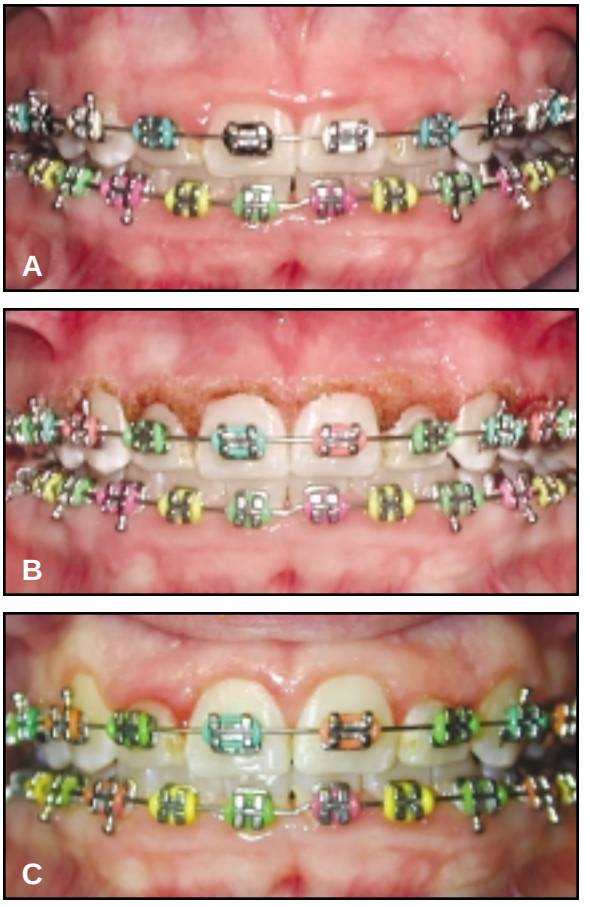

Fig. 14 A. 12-year-old female patient showing hypertrophy of tissue around brackets. B. Excess tissue removed with diode laser. C. Healing two months later, demonstrating marked improvement in tissue health and esthetics.

be delayed for months. One of the most common uses of the diode laser is for the removal of tissue covering unerupted teeth. Ablatement of such tissue should be performed judiciously, so that the tooth is exposed only to the extent needed to place a bracket. The diode laser vaporizes the tissue without bleeding, allowing the tooth to be etched, sealed, and bonded. Once the exposed tooth has been erupted sufficiently, more excess tissue can be removed.

4. Gingivectomy of Hypertrophic Tissue (Fig. 14)

Hypertrophic tissue can swell around orthodontic brackets, inhibiting hygiene and slowing tooth movement. Even prodigious tooth brushing may not be enough to make this excess tissue recede, and the orthodontist has had few options short of appliance removal. The diode laser can quickly and easily remove swollen tissue without undue patient discomfort.

5. Operculum Removal (Fig. 15)

Another common laser procedure is the removal of the operculum covering erupting teeth. This tissue can inhibit band or bracket

Fig. 15 A. 15-year-old male patient with operculum covering distolingual aspect of lower left second molar. B. Operculum removed with diode laser. C. Placement of bonded buccal minitube immediately after surgery.

placement, slowing treatment.

6. Other Uses

Preparations for veneers and treatment of aphthous ulcers and herpetic lesions have also shown promising responses to the diode laser.

Conclusion

As orthodontists become increasingly focused on esthetics, new tools that can greatly improve the quality of their treatment results are becoming available. Clinicians are finding diode laser soft-tissue ablatement to be an amazingly simple procedure. Advantages of diode laser therapy in orthodontics include:

- Single-appointment procedure, using only a topical anesthetic, with little pain or bleeding.
- Cost-effective for both patient and practice.
- Reduces treatment time.
- Vastly improves esthetic results.
- Enhances the practice's high-tech image.

We highly recommend that any orthodontist interested in pursuing diode laser surgery attend a one-day accreditation program, sponsored by the Academy of Laser Dentistry, which is offered frequently at various U.S. locations.

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