Hard Tissue Lasers: Improving Restorative Dental Treatment

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Patients often avoid dental care due to the fear of pain that they perceive they will feel either related to the local anesthetic injection or during drilling to remove caries. This can be especially traumatic for pediatric patients who can be uncooperative following the sensation of the injection.[1] Frequently; the hard tissue laser allows treatment without the need for local anesthetic. Additionally, the vibration and sound associated with the dental handpiece during caries removal increases patient stress while in the chair for needed treatment. This may lead to treatment avoidance until the actual intraoral pain surpasses the feared pain of treatment. Providing a more comfortable experience for the patient aids in patients accepting and following through on dental care at an earlier stage. This can also be a significant practice builder.

A hard tissue laser allows the practitioner to remove carious tooth structure while preserving healthy enamel and dentin for truly minimal invasive dentistry. The more of the native tooth structure that can be preserved, the better the long-term prognosis.

Given the larger pulps of deciduous teeth, there has been a concern that use of hard tissue laser energy may cause pulpal changes that can ultimately require endodontic treatment. However, several recent studies have demonstrated that the Er:YAG hard tissue laser was appropriate for caries removal in primary teeth.[2] As lower energy is required for the photo-ablation of primary enamel and dentin (compared to permanent enamel and dentin) due to a higher presence of water and lower presence of minerals, adverse pulpal changes have not been reported.[3]

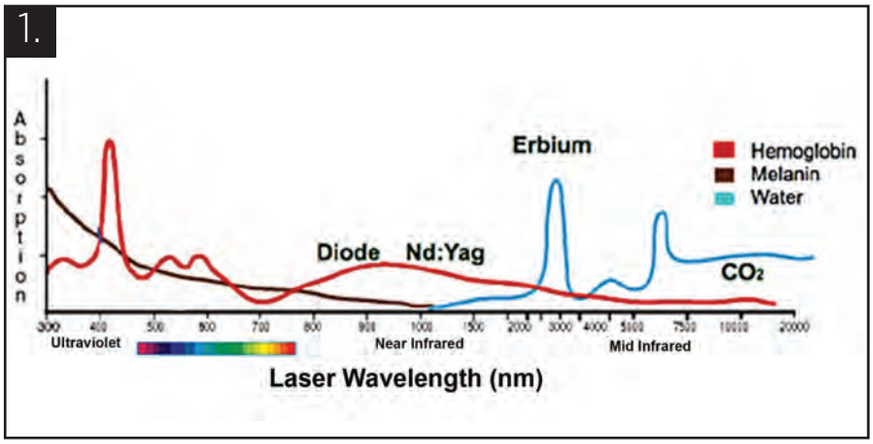
Ceballos reported that the Er:YAG laser irradiation resulted in a 56% reduction in primary enamel surface lesion depth (vs the acid-etched group) and a 39% decrease in root surface lesion depth.[4] This appears to be related to the laser's bactericidal effects in the caries-affected dentin and beyond.[5] There is also less post-treatment sensitivity in teeth treated with the Er:YAG laser (vs traditional cavity preparation methods). Lasers can also treat hypersensitive root surfaces with minimum invasiveness, demonstrating effective results.[6,7]

Laser Usage in the Modern Dental Practice

Lasers have become a standard feature in the dental practice, enhancing treatment in both hard and soft tissue applications. Diode lasers (i.e. Picasso, AMD LASERS, Indianapolis, IN) are designed for *soft tissue applications*. These allow the practitioner to remove gingival tissue to expose root caries, esthetically recontour gingival tissues, to treat periodontal pockets and a range of other applications that present daily in the typical practice. Er:YAG lasers are suited for use in *hard tissue treatment* as their wavelength (2940 nm) has an affinity for hydroxyapatite and water. Diodes at 810nm have an affinity for hemoglobin and melanin, making them ideal for soft tissue applications. Although, Er:YAG lasers will cut soft tissues and diodes faster with superior coagulation benefits **(Fig. 1)**.

Er:YAG hard tissue lasers, such as the LiteTouch™ (Syneron, distributed by AMD LASERS), **(Fig. 2)** are utilized for caries removal, frequently without the need for local anesthesia; the laser is used in a non-contact mode and desensitizes the odontoblastic processes in the dentin. Both the vibration and the sound of the dental drill are completely eliminated. The laser preparation has no bur vibration; hence there is no micro-fracturing of the surrounding enamel. Unlike the smear layer left by rotary burs on the treated dentin surface, the laser ablates both dentin and enamel without leaving a carbonized surface behind[8] **(Fig. 3)**.

1.

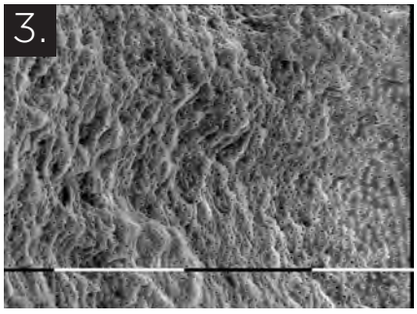


Lasers used in dentistry and their affinity to oral materials.

2.

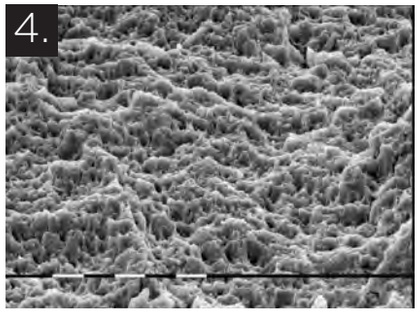
LiteTouch Er:YAG laser (AMD LASERS).

3.



Dentin surface following caries removal with the LiteTouch Er:YAG laser demonstrating a lack of smear layer. (Courtesy of Prof. Georgi Tomov, Plovdiv University-Bulgaria).

4.



Enamel surface following treatment with the LiteTouch Er:YAG laser showing an enhanced bondable surface with a uniform roughen surface. (Courtesy of Prof. Georgi Tomov, Plovdiv University-Bulgaria).

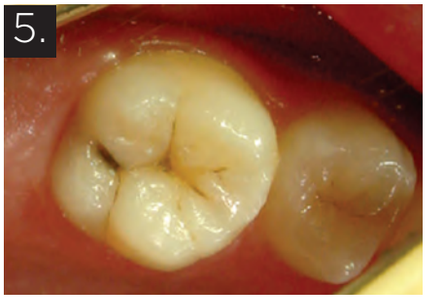
Enamel and dentin have different water contents. Thus, the energy used to ablate (remove) dentin with its higher water content is different from that of enamel. Typically, 25 Hz is optimal for enamel and 30 Hz for dentin.[9] Additionally, lasers have a bactericidal effect on dentin, leaving a sterile surface for the bonded restoration. This decreases the pulpal flare-ups that can cause tooth sensitivity and the possible need for endodontic treatment.

Treatment of the enamel margins with the LiteTouch laser yields a surface with an enhanced bonding surface (no need for acid etching). The Er:YAG removes the prismatic substance around the rods **(Fig. 4)** Increased retention has been found when demineralized enamel was prepared with laser compared to acid etching.[10] Er:YAG lasers are effective for ablation of hard tissues, creating an irregular and microretentive morphological pattern without hard tissue damage.[11]

Prior to sealants, the laser conditions the enamel for better bonding and eliminates the less-than-pleasant taste of the etching gel.[12] This facilitates pediatric patient management by eliminating the child's major objections. The laser eliminates bacteria within the pits and fissures, decreasing the potential for recurrent decay under the sealant. Laser enamel conditioning before sealant application appears to reduce sealant fracture and loss. This is possibly related to the micro-morphological changes that the laser leaves on the enamel surface.[13]

The hard tissue laser is more conservative than a traditional bur in developing cavity access **(Figs. 5 & 6)** In clinical situations where soft tissue has invaded the cavity, or needs to be excised to expose the decay, the Er:YAG removes the tissue, coagulating the bleeding margin that often interferes with the placement of an adhesive restoration **(Figs. 7 & 8)**.

The hard tissue laser removes old composite restorations as effectively as it removes tooth structure.[14] A failing amalgam is better addressed by a handpiece and bur. The laser then cleanses the preparation surface, sterilizing the dentin, and conditioning

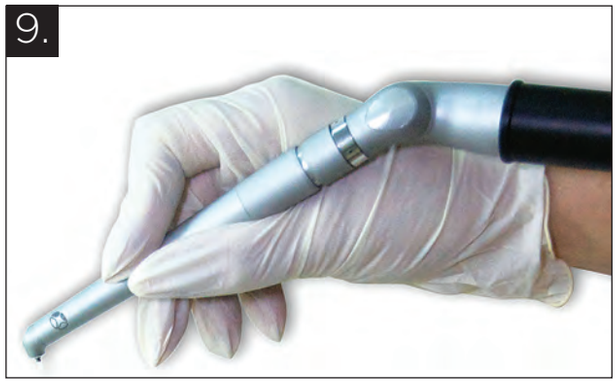


Caries noted in the distal pit of a first molar. (Courtesy of Makoto Kamiya, DDS Matsumoto City, Japan).

Preparation following caries removal with the LiteTouch Er:YAG hard tissue laser demonstrating a minimally invasive preparation performed without the need for local anesthetic ready for restoration placement. (Courtesy of Makoto Kamiya, DDS, Matsumoto City, Japan).

Significant caries noted on the mesial of a deciduous molar with soft tissue ingrowth into the area. (Courtesy of Makoto Kamiya, DDS, Matsumoto City, Japan).

Caries and soft tissue removal with the LiteTouch Er:YAG laser without application of local anesthetic ready for restoration placement. Note an absence of bleeding at the altered soft tissue margin. (Courtesy of Makoto Kamiya, DDS, Matsumoto City, Japan).



LiteTouch Er:YAG handpiece held in a similar manner to a traditional dental handpiece.

both the enamel and dentin for the adhesive restoration. Lasers are effective in debonding orthodontic brackets and the removal of the remaining luting resin on the teeth.[16]

Dentin hypersensitivity can cause discomfort and even severe pain. A two-minute Er:YAG laser application to the exposed cervical root areas has been found to provide lasting desensitization of the hypersensitive dentin, with no detrimental pulpal effects. Laser treatment has been shown to be efficacious and typically demonstrates relief at the first appointment.[15]

Conclusion

Hard tissue lasers such as the LiteTouch Er:YAG have many clinical applications. These include anesthetic-free caries removal and the conservative removal of old composites or orthodontic resin. This preserves more natural tooth structure, increasing the long-term prognosis of the tooth. As the laser handpiece is similar to a traditional dental handpiece, its incorporation into the practice has a short and easy learning curve **(Fig. 9).** **OH**

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Oral Health welcomes this original article.

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