Laser-Assisted Amalgam Removal With No Local Anesthetic

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Patient acceptance of the use of the Er,Cr:YSGG laser for the restoration of carious teeth (class I, II, III, IV, V, and VI) without a local anesthetic has been as high as 95%.[1] This article describes a technique for removing defective amalgam restorations with the assistance of the Er,Cr:YSGG laser, without the need for local anesthesia.

This technique is an excellent method to help patients become comfortable, especially those with a phobia for sound and vibrations of the air rotor and those with a fear of needles.

This laser energy is not transmitted through metallic restorations, nor does the laser energy result in any ablative effect on these materials at the setting limits of the system described in this article. When the laser energy reaches the surface of an alloy, it is reflected. To produce analgesia, laser energy must be directed through natural tooth structure to facilitate its absorption and transmission through the enamel and dentin. However, composites can be cut at approximately the same rate as dentin and at the dentin setting.

ARMAMENTARIUM

The technique described uses the Waterlase system (Biolase), which is a free-running pulsed laser with delivery through a zirconium fluoride trunk fiber along with air and water. The photons reach the tissue through easily changeable fiber tips of varying size and material. These tips fit into a swivel handpiece similar to a high-speed handpiece. Air and water are delivered through the hub of the tip

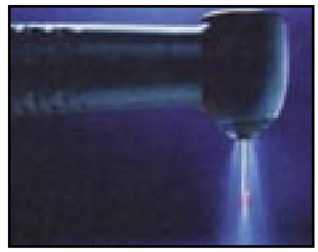

Figure 1. The beam is focused approximately 1.5 mm from the fiber tip. The red color is the aiming beam. The 2780 nm wavelenght is invisible to the human eye. Note how the column diverges as the distance from the tip increases.

Figure 2. Alloy before removal; fractured marginal ridge with decay.

Figure 3. Alloy removed from the first molar with sectional matrix and wedge in place. Some of the decay was removed with the high-speed handpiece. No anesthesia was required.

Figure 4. Composite placed.

Figure 5. Molars prior to removal of alloy with high-speed handpiece. Analgesia established in teeth and gingival tissue prior to placement of rubber dam.

Figure 6. Alloys successfully removed with high speed. No anesthesia required.

Figure 7. White, slightly dehydrated/ablated spots on facial surface of molars. The laser handpiece is brought in toward the tooth until this effect is first noted, then backed away until the white areas are no longer produced. Bathe the surface at this distance outlining the pulp chamber.

in percentages determined by the operator. The Er,Cr:YSGG near-infrared wavelength (2780 nm) energizes the water molecules. These energized water molecules, along with the vaporization of the water in the target tissue, both hard (enamel, dentin, and bone) and soft, produces the desired tissue ablation. Removal of enamel and carious dentin is vibration-free, thus eliminating potential microfractures.

A reduction in pulpal temperature from 0° to 2° C has been reported with the use of the Er,Cr: YSGG hydrokinetic laser system.[2] This compares most favorably with the usual increase in pulpal temperature of 3° to 4° C with a wet bur cut, and an increase of 14 C with a dry bur cut. If pulpal temperatures rise above 5 C, irreversible damage to the pulp will occur.[3] It has been concluded that the use of this laser system will not adversely affect the dental pulp.[2,4]

Transmission of painful impulses along the nerve fibers is effectively blocked with this delivery system. The analgesic-like effect occurs very quickly. As the instrument is slowly advanced to the enamel surface (5 to 10 seconds), absorption of the laser energy into the tooth structure facilitates the cavity preparation with no untoward patient response, in the majority of cases. The analgesic effect is continually being being produced as the fiber tip is advanced through the tooth structure. The effect is sufficiently profound to permit the use of an air-driven or electric handpiece with little or no patient discomfort. It has been hypotesized that the laser energy delivered by this method results in a photo-acoustic effect that is responsible for this favorable neurological response.

Available settings on this free-running pulsed laser system are 0.25 to 6W in 0.25-W increments, 0% to 99% water, and 0% to 99% air. The goal is to achieve the desired tissue effect with a minimal power setting. Four pre-selects are available. They may be set at any level desired and increased or decreased during the procedure.

The usual preselects are the following: (1) 5.5 W, 90% air, 75% water (for enamel); (2) 4 W, 65% air, 55% water (for dentin); (3) 1.5 W, 11% air, 7% water (for soft tissue surgery); and (4) 0.5 W, 11% air, and no water (coagulation).

Unlike the traditional high-speed handpiece, tooth reduction is achieved in a noncontact/off-tooth mode. This position allows sufficient water to reach the fiber tip for optimum hydrokinetic effect. If the laser tip is placed too close to the tooth surface, the water reaching the tip will be insufficient to produce the most efficient cutting/ablation rate.

The highest energy level per setting is achieved approximately 1.5 mm from the fiber tip. On close examination, the laser-energized water column is focused at this point (Figure 1). This is where the power density is at its greatest. The column begins to diverge from this site of highest energy concentration. The farther the target tissue is from the tip, the greater the divergence of the beam and the lower the power density, the weaker the cutting ablation/effect will be.

With an understanding of these basic principles, the dentist may leave the setting at 5.5 W (No. 1 for enamel) and simply defocus the energy beam to achieve an identical result of a 4.0 W setting (No. 2 for dentin). In other words, the same effect may be achieved by lifting the handpiece away from the dentin while keeping the setting at 5.5 W instead of activating the 4 W setting and placing the handpiece tip only 1.5 mm from the dentin. The air and water settings remain the same.

METHOD

Optimal analgesia for the removal of a class I or II alloy may be achieved by introducing the laser energy into the facial and lingual surfaces of the tooth. The photonic effect of the laser must enter the pulp tissue to elicit the desired result—analgesia. Roughly outlining the pulp chamber as the handpiece slowly moves over the tooth surface will provide the optimal outcome. The same fiber tip used to prepare the tooth is used. A 6mm G6, 600 µm tip was used for the preparations shown in this article.

Direct the energy perpendicular to the surface of the tooth. Set the output at 0.5 W with no air and no water. Gradually approach the enamel from the facial aspect of the tooth, until the first sign of dehydration appears. This will be in the form of a very fine white area. Move the handpiece away from the tooth surface until there is no visible sign of any surface change.

Begin to slowly move over the facial surface for 30 to 60 seconds. Then move to the lingual side and repeat the approach and the 30-to-60 second bath of laser energy. If the alloy is small enough, the occlusal surface may be lased while keeping in mind the laser energy must enter the pulp to have any effect. If there is minimal occlusal tooth structure present, it will be ineffective to repeat this process on this surface due to the extensive tooth structure replaced by the alloy.

Immediately after lasing, remove the alloy with a high-speed handpiece in the traditional manner with a water spray for cooling.

Once the alloy is removed, utilize the laser at the dentin setting (4 W, 65% air, and 55% water) and pass the tip over the dentinal floor of the preparation. This will reinforce the laser-induced analgesic effect. Then continue with the decay removal/outline form of the preparation with the laser handpiece. A high-speed handpiece may be used to reach decay that is not easily accessible with the end cutting laser tip. The patient will normally have sufficient analgesia to accomplish this without any need for a local anesthetic. (Figures 2 through 7).

If a composite is going to be placed, it will be possible to dry, etch, rinse, dry, prime, dry and place the bonding material and complete the restoration without any apparent discomfort or request from the patient to be anesthetized.

If a class II restoration is going to be placed, lase over the interproximal gingival surfaces in a defocused manner. Extend this effect onto the lingual and facial soft tissue surfaces. There should be minimal to no surface change in the epithelium. This will allow for the comfortable placement of a band and wedge.

If a class V is subgingival, the gingiva may be cut back or troughed without the need for any anesthesia. This setting may vary from 0.5 – 1.50 W, 11% air, and 7% water. Begin with the setting at 0.5 W and increase as needed. If a troughing effect is desired, the smaller tapered tip works nicely. This smaller tip size will produce a greater power density so begin the cut at the 0.5 W setting and increase if higher power is required to ablate the tissue.

Whenever lasing near a metal surface, the laser energy may be reflected off of the metal surface. The "spark" is simply a reflection of the energy. In a slightly out of contact mode, this can damage the laser tip, rendering it ineffective. The danger of tip damage is very minimal in the highly defocused mode used to obtain analgesia.

RESULTS AND CONCLUSION

I have used this technique successfully to replace over 170 failing alloy restorations for adults and children. Initially, if the decay was very near the pulp, the traditional handpiece was used due to the familiarity of the operator with this technique. With experience, the decay removal and outline form of the restoration can be accomplished entirely with the laser. Even the flare/bevel of the occlusal and proximal areas can be achieved with the laser.

Patient acceptance of this technique has been most enthusiastic. Personally, it has been successfully used in over 93% of the patients on whom it was attempted. It is an excellent method to help patients become comfortable, especially those with a phobia for the sound and vibrations of the air rotor as well as those with a fear of needles. It is also very useful for those patients who wish to return to work after a dental visit without a numb lip or tongue.

References:

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