

SCIENTIFIC ARTICLE

Lasers in Prosthodontics: Clinical Realities of a Dental Laser in a Prosthodontic Practice

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Steven D. Spitz, is a Prosthodontist and has just celebrated his 12-year anniversary as owner and practitioner of *SmileBoston Cosmetic and Implant Dentistry*. He received his undergraduate degree at Tufts University School of Dental Medicine, attended a general practice residency in Miami in the Jackson Memorial Hospital/VA program and received his prosthodontic training in the Harvard School of Dental Medicine/VA program. He continues to teach part-time in Harvard's postdoctoral prosthodontic department. Dr. Spitz has lectured locally, nationally and internationally for over 10 years on the topics of implant dentistry, laser dentistry, and more recently on the development and technique of digital impressions. In 2004 he received the award for 'Leadership and Outstanding Contributions in Advancing Dentistry through Laser Technology' at the World Clinical Laser Institute Symposium for developing a technique of placing dental implants through the use of the Waterlase laser. At that time, he also received his Masters certificate in the use of dental lasers. Dr. Spitz is currently president and regent of the Boston AO Alumni chapter, is on the board of Bright Spirit Children's Foundation and has been extensively involved in the Boys and Girls Club of Chelsea, MA. He lives in Needham, MA with his wife Laurie and their three children Hayden, Jocelyn and Kayla.

The specialty of prosthodontics takes all concepts of dentistry and integrates effective comprehensive treatment planning. The practice will necessarily include a wide variety of patients seeking a diverse range of care. These include individuals who are highly fearful of dentistry and have long-term neglected care and those who have complex medical histories and require more specialized, advanced procedures. Some also have phobias and/or allergies to anesthetics. Lasers have become an integral part of treatment for these patients.

In the beginning, oral surgeons used carbon dioxide lasers in a limited fashion for soft tissue procedures such as incisions, gingival troughing, aesthetic contouring of gingival tissue, frenectomies, gingivectomies, and de-epithelialization.¹ In 1997, the Erbium family of lasers, consisting of Er:YAG and Er,Cr:YSGG wavelengths, was introduced in the United States.^{2,3} These instruments have indications for use for both soft and hard tissue. The author uses the 2780-nm Waterlase Er,Cr:YSGG laser (Biolase Technologies, Irvine, CA). This all-tissue laser has been extremely effective in the field of prosthodontics, because it opened the door for tooth preparation and soft tissue management.

Procedures such as class I through V restorations, crown and veneer preparations, gingival contouring, and various implant procedures, including surgical placement, can be performed comfortably and effectively, often with little or no anesthesia.⁴⁻⁶ More complex treatments like osseous crown lengthening and implant placement usually re-

quire anesthesia, but the laser still offers many benefits such as bacterial reduction and reduced tissue trauma compared to conventional instrumentation.^{7,8}

CROWN PREPARATION

Case 1. A medical doctor and allergist referred a 46-year-old female in good health to the practice because they knew of the all-purpose laser use in the office. At her last dental visit to her primary dentist, she was given 1 carpule of lidocaine with epinephrine 1:100,000 in the maxillary bicuspid region. Thirty seconds following the administration of the anesthetic, she swelled in the area and then reported difficulty breathing. She was immediately treated in the emergency room of the local hospital for an allergic reaction. After much testing, she was told that she was allergic to all known dental local anesthetics on the market. Her only option for future dental treatment was to "tough it out," because anesthetic could not to be used.

Her immediate concern upon coming to our office was pain in



Figure 1. Preoperative radiograph.

tooth #7, the radiograph is shown in Figure 1. Upon examination, the pulp was necrotizing and endodontic therapy was recommended. The therapy was performed with the laser with no anesthetic. The access was achieved with 6 W of power, 90% air and 75% water, and a C-6 tip (Figure 2). The necrotic tissue was removed with a zirconium tip at 1.5 W 30% air and 30% water. Rotary instruments finished the cleaning and shaping of the root canal treatment. The zirconium tip

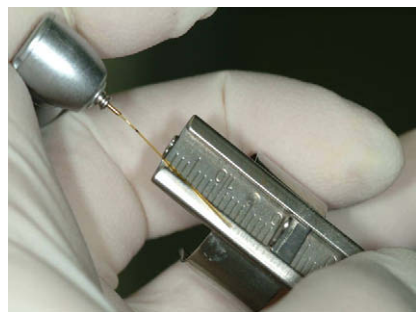


Figure 2. Calibration of length of laser tip of tooth #7.



Figure 3. Radiograph of gutta percha cone fit.

was then placed back into the canal 2 mm from the apex and laser energy was fired as the final disinfection.⁹ Figure 3 shows the trial fit of gutta percha, and the canal was then filled. The patient was so impressed with the success and painless root canal treatment that she decided to complete several other procedures. After a comprehensive examination was performed, an onlay and crown were recommended for teeth #12 and #13, respectively.

On a subsequent visit, the patient presented for preparation of crown #13 and onlay #12 because of failing



Figure 4. Preoperative view.



Figure 5. Preoperative facial view.

restorative material margins and recurrent caries (Figures 4 to 6). She reported no discomfort, a vitality test reported a normal response, and periodontal probing was found within normal limits. Preliminary impressions were previously taken for fabrication of the provisional restoration.

Because anesthetics were not permitted, the laser was used for the procedure. A setting of 6 W with 90% air and 75% water was used to “anesthetize” the tooth. This laser anesthesia creates a cold sensation often equated to a “brain-freeze” on the tooth. The energy was started 2 mm from the tooth structure and held in place until the initial anesthetic feeling set in, taking approximately 1 minute. The laser tip was then brought closer to the tooth surface to begin the preparation. The laser energy removes tooth structure in small increments. Because the laser is most efficient cutting across the enamel rods, occlusal reduction



Figure 6. Preoperative view.



Figure 7. Amalgam removed.

was accomplished by starting 2 mm down on the buccal side of the



Figure 8. Carious lesions removed.



Figure 9. Core build-ups placed. Interproximal soft tissue was contoured with the laser and retraction cord inserted into sulcus.

tooth. This was followed by 2-mm deep cuts on the buccal surface; then from the occlusal, these depth cuts were connected until the proposed margin was met. This procedure was then followed on the lingual, then completed interproximally. Most of the old amalgam fell out during the tooth preparation, and a high-speed handpiece was used to remove the remainder (Figures 7 and 8).

The wattage is then lowered to 2.25 W, 65% air and 55% water, and the laser tip is angled to shave the tooth structure slowly and accurately in order to smooth the surface. The “anesthetic” feeling lasts for approximately 1 to 2 minutes after the laser energy is stopped, leaving sufficient time to perform final finishing of the preparation with a high-speed handpiece. Core build-ups were then placed, the interproximal bleeding soft tissue was ablated with settings of 1 W,



Figure 10. Completed crown preparation.

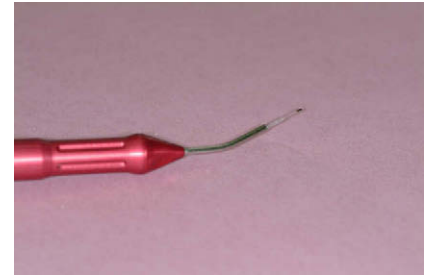


Figure 11. Diode laser with 300-µm fiber.

7% water and 11% air (Figure 9), and a retraction cord was placed. The laser can also be used at this wattage or slightly lower at 0.75 W to trough around the entire preparation; however, care must be taken not to nick the margin of the preparation. Alternatively, a diode laser can also be used to trough, because that wavelength will not interact with tooth structure. Figures 10 through 12 show that how that instrument is used.

Impressions were taken with a poly-vinylsiloxane impression material light body wash and regular body material (Figure 13). All-ceramic restorations were fabricated and bonded to the teeth with bonded composite cement (Figures 14 and 15).

VENEER PREPARATION, GINGIVAL CONTOURING, AND CROWN LENGTHENING

Case 2. A 33-year-old female in good health presented for veneers



Figure 12. Tissue retraction completed with excellent hemostasis.

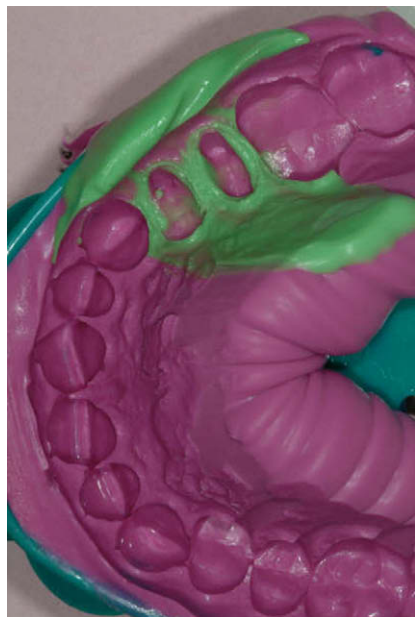


Figure 13. Final impression.

because of what she described as her “unattractive smile and small teeth” (Figure 16). After a comprehensive examination, a treatment plan was presented that included crown



Figure 14. Occlusal view of final restorations.



Figure 15. Facial view of final restorations.

lengthening to reduce her “gummy” smile and the placement of porcelain veneers on teeth 4 through 13. Because of the high cost of these procedures, the patient chose to first have veneers placed on the anterior teeth and postpone restoring the bicuspids to a later date. The teeth and gingival were measured for “golden proportions” and a diagnostic wax up was ordered.

The first procedure was to mark the gingival tissues with the laser without anesthesia (Figure 17). The patient was therefore able to see her longer tooth size without numb lips. Then the soft tissue was contoured and a frenectomy was performed using 1 W of power, 7 % water and 11% air (Figure 18). She liked and approved the new smile line, and then 1 carpule of



Figure 16. Preoperative view.



Figure 17. Tissue contouring, beginning contouring, and maxillary frenectomy.

septocaine local infiltrate was used to anesthetize the anterior teeth.

Veneer preparations were accomplished in a similar manner to a crown preparation.¹⁰ Six watts of power, 90% air and 75% water for 1 minute, approximately 2 mm away from the tooth was used for an added anesthetic effect. The occlusal or incisal was removed, followed by depth cuts on the facial. After gross reduction was achieved on the facial, the wattage was then reduced to 1.5 W, 60% air and 55% water, and the preparation was smoothed. The marginal area was marked under the lower power to aid in control and texture. The preparations were smoothed with a high-speed bur and fine diamond bur (Figure 19). Impressions were taken at this time. Interim veneers were made with a vacuform template and a bis-acryl material.



Figure 18. Completed tissue.



Figure 19. Completed preparations.

Periodontal probing was performed, and less than 1 mm was recorded. If the patient was left like this, her gingival would overgrow because of a violation of the biologic width. The bone was removed in a closed fashion using the laser and a zirconium tip. The tip was marked 3 mm from the tip with a permanent black marker. The laser energy was set at 2.5 W, 75% water and 65% air. The bone was removed from the facial until the black marker line on the zirconium tip was just below the current gingival margin. To assure that no bone fragments were left behind, a scaler was used to check the site, and Figure 20 shows the occlusal view of the final tissue contour.

Three weeks later, the veneers were delivered. They were bonded with veneer cement. One year later, the tissue is healthy (Figure 21) and the patient is very pleased with her smile.



Figure 20. Final tissue appearance after osseous contouring.



Figure 21. One-year postoperative view.

VENEER REMOVAL

When removing bonded porcelain restorations in the past, a high-speed drill with a diamond bur was the only option. With laser technology, the restoration can now be removed without cutting it off. The laser energy passes through porcelain glass unaffected and is absorbed by the water molecules present in the adhesive. It appears that this debonding occurs at the silane–resin interface because the underlying tooth structure appears to be unaffected.¹¹ The technique takes approximately 5 to 30 seconds for feldspathic, and 2 seconds to 2 minutes for pressed, as the time will vary upon the thickness of the restoration. The restoration can often be removed intact, which can aid the lab technician on color matching. Figure 22 shows a fractured restoration on the lower right lateral incisor. Beginning at the gingival aspect, 4 W, 20% water and 40% air was used to initiate removal (Figure 23), and the process proceeds quickly, with minimal re-



Figure 22. Fractured veneer.



Figure 23. Removal of restoration beginning at gingival.

moval of any tooth structure (Figure 24).

UNCOVERING IMPLANTS

Case 3. Implant procedures can be accomplished with precision and ease for the practitioner with significant patient comfort.¹² To remove soft tissue, the laser energy can be set for 1 W, 11% air and 7% water. The laser is tipped at a 45° angle toward the implant. The general outline establishes the emergence profile.

An 82-year-old male presented with an uncemented fixed prosthesis, previously retained by 6 Corevent (Dentsply International, York PA) implants with gold abutments cemented into the implants. His implants had been integrated for 18 years and were secure. However, the abutments were fractured below the free gingiva and pieces of the abutments remained inside the implants. There was severe gingival irritation (Figure 25). He was taking Coumadin (Bristol-Meyers Squibb,



Figure 24. Removal complete.

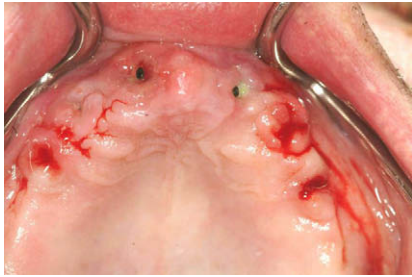


Figure 25. Preoperative view of broken prosthesis.

New York, NY) daily, and epinephrine was not to be used. He reported that this had happened before. He was apprehensive to treatment because of the need for flap surgery and the subsequent drilling to remove the broken posts. He also mentioned that he had the implants placed because of a severe gag reflex and the inability to wear a complete denture. After careful and extensive examination and discussion, it was decided to uncover the implants with the laser without anesthetic, create custom abutments, and splint the implants together for a palateless overdenture fabrication.

The laser was used at 1.5 W, 7% water and 11% air to remove the infected gingival that was covering the implant openings. The tissue was contoured with precision around each implant without any bleeding, and the remaining gold inside the implants was removed with the high-speed drill (Figure 26). Be-



Figure 26. Abutments uncovered and debris removed.



Figure 27. Postoperative radiograph.

cause these components were no longer available on the market, GC resin was used to fabricate custom abutments in the same manner a custom cast post, and the core would be fabricated.

These were cast and cemented into the implants, a bar was fabricated to splint the abutments, and a removable overdenture was made with locator attachments. Figure 27 shows the postoperative radiograph, which depicts good healing and osseointegration. The patient had been in good function with the overdenture for 3 years following the completion of the procedure.

IMPLANT PLACEMENT

Case 4. Minimally invasive implant placement, using the tissue punch method, has become a popular way to place implants when proper bone height and width are available. A typical site is shown in Figure 28. Moreover, using a laser to remove the soft tissue and the cortical plate of bone leads to quick healing time, fast integration, mini-



Figure 28. Preoperative view of molar implant site.



Figure 29. Surgical guide in place.

mal patient discomfort, and potentially more bone-to-implant contact. A study of rats by Kessler, Ramanos, and Koren¹³ showed that there was significantly more bone contact and faster bone contact when comparing laser implant placement to implants placed with a conventional drill.

The procedure was accomplished using a surgical guide prepared for laser placement of the implant (Figure 29). The area was anesthetized by local infiltration. The surgical guide was placed in the mouth and the soft tissue was removed using 1.5 W, 7% water and 11% air. Once the soft tissue was removed, the power was reset to bone mode that was 4 W, 80% water and 70% air. The bone was then removed in a circular pattern until approximately 2 to 3 mm of bone had been removed.

The metal guide sleeve (Figure 30) was introduced through the surgical



Figure 30. Radiograph of metal guide, used to verify placement of surgical bur.

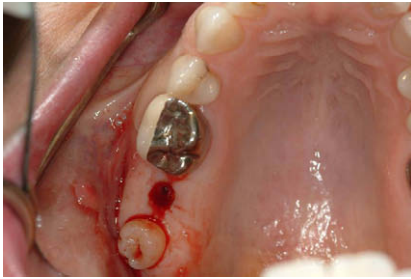


Figure 31. Osteotomy completed. Note that the bleeding is from the bone.



Figure 32. Healing cap in place.

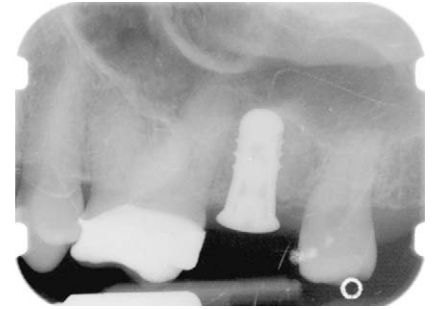


Figure 33. Radiograph showing good osseointegration.

guide, and the soft tissue and bone that were removed with the laser and a 2.0 initial depth bur is used to prepare the length of the osteotomy. The surgical guide is removed and the osteotomy is finished with the 3.5×10 mm implant drill (Figure 31). A 4.8×10 mm Lifecore Stage I implant is placed (Lifecore Biomedical, Chaska, MN). Note the condition of the soft tissue at the time of placement (Figure 31). Sutures were not needed, and the patient was instructed to take Tylenol for discomfort. Figure 32 shows the healing cap and Figure 33 shows the radiograph of the implant fixture in place.

CONCLUSION

There are many clinical, aesthetic, and psychological reasons to use lasers in all aspects of dentistry, including the reduction or elimination of anesthetics. Patients present with varied medical histories, including allergic reactions to anesthetics, heart conditions, and extreme fear of the needles used for anesthetics.

Because patient comfort is always a priority and painless dentistry is always a goal, with the use of lasers in the dental practice a multitude of procedures can be performed. The laser is not merely a “high-tech” gadget: it is an extremely useful piece of equipment for the dental practice.

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