The Er,Cr:YSGG Laser: A Perfect Fit with Implant Dentistry

Edward R. Kusek, DDS, DABOI, FAAID, MAGD, FALD, MWCLI, DICOI, Sioux Falls, South Dakota

J Laser Dent 2010;18(3):132-134

Edward R. Kusek, DDS

Figure 1: Flap reflection with an Er,Cr:YSGG laser

Figure 3: Keratinized tissue placed into an area of nonkeratinized tissue

Figure 2: Creating a split thickness flap with an Er,Cr:YSGG laser

Figure 4: Laser tissue welding with an Er,Cr:YSGG laser

The Er,Cr:YSGG laser has indications for use in cutting bone, enamel, dentin, and soft tissue. In a study using rabbits, the reported advantage for this laser use with soft tissues is a reduction in bleeding.[1] A recent clinical study with implant patients discussed further soft tissue benefits from laser surgery of less postoperative pain and swelling.[2] In studies using animal tissue, the laser has been shown to be effective in ablating bone with precision and control, without producing carbonization;[3-4] one of the investigations also reported no melting or fusing.[3] Furthermore, thermal damage in tissue adjacent to the surgical site is minimized.[3-4] The author uses an Er,Cr:YSGG laser (Waterlase®, Biolase Technologies, Irvine, Calif.) with an emission wavelength of 2780 nm.

SOFT TISSUE PROCEDURES

The laser can be used to reflect tissue instead of the traditional scalpel blade (Figure 1) and hemorrhaging can be controlled. The author has observed that the soft tissue maintains its elasticity, allowing for primary closure. In cases of implant dentistry, the flap for a block graft can be closed without releasing or filleting the tissue.

Tissue welding with the Er,Cr:YSGG laser allows the dentist to fuse tissue edges together using heat. At temperatures between 60 to 80°C, vascular tissue can be welded,[5] allowing the placement of a piece of keratinized tissue on an area of nonkeratinized tissue. The author has observed that those layers stick together.

As reported by Kirsch and Ackermann,[6] the presence of keratinized tissue is one important criterion for implant health. One recent article demonstrated the usefulness of this wavelength for using this wavelength in the treatment of insufficient gingival tissue around an implant.[2]

This procedure is accomplished by forming a split-thickness pocket on the facial of an area of nonkeratinized tissue. The pocket is formed by using a 6-mm Z-tip, allowing the periosteum to cover the bone but loosening the tissue to an area of 6 mm in depth (Figure 2). Laser energy is "painted" over the two tissues (Figure 3) and welds them together, giving the tissues a white, blanched look (Figure 4). The area is then glued together using a dental cement (PeriAcryl®, GluStich Inc., Delta, British Columbia, Canada). The tissue usually heals within one week, with a resulting gain in attached tissue.

HARD TISSUE PROCEDURES

Block grafting of a monocortical piece of autogenous bone is used to rebuild a deficient width or height to gain optimum function and aesthetics, and it can be harvested from the ascending ramus or in the symphysis areas. In the author's experience, problems associated with this procedure include the necrosis of bone and surrounding tissue from the donor site. The patient can experience pain, swelling, limited paresthesia, wound scarring, and tissue recession. Primary closure can be difficult to achieve.

One study demonstrated how the Er,Cr:YSGG laser was successfully used in harvesting ramus grafts.[7] That article, along with the author's clinical observations,[8] show that the laser reduced the aforementioned problems. The laser is entirely an end-cutting device and is used as a noncontact surgical instrument.

Figure 5 shows the laser used on the symphysis to remove bone, using the noncontact turbo handpiece at 3.5 Watts, 20 Hz, with 30% air and 60% water. This setting will ablate osseous tissues efficiently to a depth of approximately 4 mm. Once the outline of the osteotomy is made, the author progressively cuts deeper into the cancellous bone. The graft is then removed with a

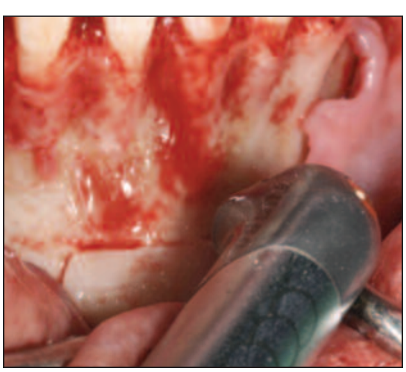

Figure 5: Laser turbo handpiece being used to cut bone from symphysis

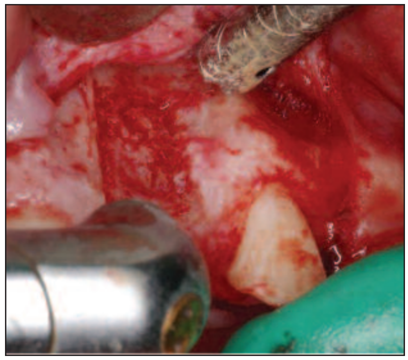

Figure 6: Site preparation with an Er,Cr:YSGG laser

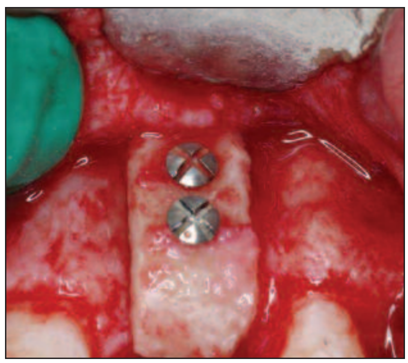

Figure 7: Block graft fixated with screws

straight chisel. With this technique, the cuts are narrower than when conventional burs are used.

The site preparation is also completed using the same settings as above (but in a defocused mode), which decorticates the receptor site, as indicated in Figure 6. Figure 7 shows the graft secured in place. Postoperatively, the author has observed a dramatic increase in healing and a decrease in swelling and pain. To date, none of the patients has had any paresthesia. Their pain index rating given is a 3.5 (with 0 indicating no pain and 10 most extreme pain) as compared to traditional methods when their pain rating was a 7.

IIMPLANT PLACEMENT

Using the Er,Cr:YSGG laser to decorticate and detoxify the osteotomy site, the author has observed two dramatic effects. First, with an MZ5 tip with settings of 0.5 Watts, 20 Hz, 7% air and 14% water, the laser

Figure 8: Laser being used to decorticate osteotomy site

energy is initiated at the apex of the osteotomy site and then moved coronally in a clockwise pattern (Figure 8). Using this technique, the author concludes that there seems to be an increase in the amount of fibroblasts forming around the implant. This statement was postulated from the values that were displayed from an electromechanical percussive device designed to assess the osseointegration of dental implants (PERIOTEST®, Medizintechnik Gulden e.K., Modautal, Germany). This instrument's scale ranges from -8 to +50; the lower the value, the higher the stability of the implant. The author's study resulted in a 40% improvement in stability values provided by the device. Areas that traditionally had a value of -3 decreased with this laser procedure to -5 to -6. For areas in the symphysis where the normal value was -6, the value decreased to -8. A soft surface or mobile object gives a higher value than a rigid object. Misch[9] describes an integrated implant obtaining a range of -8 to +9. Thus more bone-to-implant contact results when this laser technique was employed.

Second, in another study, the author demonstrated the laser's ability to detoxify the osteotomy site. In this study, bacterial cultures were taken after the extraction of the tooth and following the use of laser energy in the osteotomy site.[10] An MZ4 tip was inserted to the apex of the socket and then fired at 0.5 Watt, 20 Hz, 7% air and 14%

water in a clockwise fashion, moving coronally, with a total duration of approximately 1 minute. The tip was in contact with the walls of the osteotomy.

All 10 of the treated cases had significantly reduced the bacterial counts found in the osteotomy sites of infected teeth. All 10 cases were successful, and have been in function for more than 2 years. Nine of the 10 cases demonstrated a noticeable reduction in anaerobic bacteria, and no specifically virulent types were observed in the cultures. The implants were tested with a PERIOTEST device at the 3-month healing period. The readings were from -7 to -1 and were performed to determine whether the implants had osseointegrated. The numbers represent more bone density around the implant.

DISCUSSION

In the study using the Er,Cr:YSGG laser, traditional methods for dealing with infected potential implant sites have involved treatments performed in stages. The first stage, which takes place within the extraction site of the involved tooth, entails curetting the infected site and placing a graft material of choice to maintain the ridge. Subsequent healing may take up to 4 months. Stage two is planning the proposed implant treatment. To do this, a computerized tomography (CT) scan is performed to give a 3-D visualization and create a surgical guide for an ideal implant placement. Stage three is the proper placement of the implant in the most functional and aesthetic location. Often, a 6-month healing period is necessary to assure integration of the implant fixture. Stage four involves progressively loading the implant to complete the treatment, and this may take an additional 3 months.

Most often, patients find it difficult to deal with the prolonged treatment time required for the traditional implant protocol. The author has completed treatment in less time with the use of the laser, and has been especially successful in disinfecting sites of bacteria that could otherwise cause failure of the implant.

CONCLUSION

The usefulness of the Er,Cr:YSGG laser in implant dentistry has been shown. Soft tissue surgery is accomplished with ease of tissue manipulation along with control of hemostasis and a decrease in the postoperative swelling, discomfort, and pain. Osseous procedures can also proceed with a precision technique that produces a disinfected site. The author expects that total treatment time can be shortened because of these benefits.

AUTHOR BIOGRAPHY

Dr. Edward R. Kusek is a 1984 graduate of the University of Nebraska School of Dentistry. He has been a general dentist for more than 26 years in Sioux Falls, S.D. He is a Diplomate of the American Board of Oral Implantology/Implant Dentistry and the International Congress of Oral Implantologists, a Fellow of the American Academy of Implant Dentistry and Academy of Laser Dentistry, and has earned Mastership in the Academy of General Dentistry and the World Clinical Laser Institute. Dr. Kusek is an adjunct professor at the University of South Dakota and lectures on implants and dental lasers. He is the author of several dental articles. Dr. Kusek can be contacted by e-mail at implantdental@midconetwork.com.

Disclosure: *Dr. Edward Kusek has no commercial or financial interests to disclose for this article.*

REFERENCES

1. Rizoiu IM, Eversole LR, Kimmel AI. Effects of an erbium, chromium:yttrium, scandium, gallium, garnet laser on mucocutanous *[sic]* soft tissues. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996;82(4):386-395.
2. Arnabat-Domínguez J, Bragado-Novel M, España-Tost AJ, Berini-Aytés L, Gay-Escoda C. Advantages and esthetic results of erbium, chromium:yttrium-scandium-gallium-garnet laser application in second-stage implant surgery in patients with insufficient gingival attachment: A report of three cases. *Lasers Med Sci* 2010;25(3):459-464.
3. Kimura Y, Yu D-G, Fujita A, Yamashita A, Murakami Y, Matsumoto K. Effects of erbium, chromium:YSGG laser irradiation on canine mandibular bone. *J Periodontol* 2001;72(9):1178-1182.
4. Wang X, Ishizaki NT, Suzuki N, Kimura Y, Matsumoto K. Morphological changes of bovine mandibular bone irradiated by Er,Cr:YSGG laser: An *in vitro* study. *J Clin Laser Med Surg* 2002;20(5):245-250.
5. Springer TA, Welch AJ. Temperature control during tissue welding. *Appl Optics* 1993;32(4):517-525.
6. Kirsch A, Ackermann KL. The IMZ osteointegrated implant system. *Dent Clin North Am* 1989;33(4):733-791.
7. Lee CYS. A new method to harvest ramus bone using the erbium, chromium:yttrium-scandium-gallium-garnet laser. *J Oral Maxillofac Surg* 2005;63(6):879-882.
8. Kusek ER. Use of the YSGG laser in dental implant surgery: Scientific rationale and case reports. *Dent Today* 2006;25(10):98, 100, 102-103.
9. Misch CE. An implant is not a tooth: A comparison of periodontal indices. Chapter 41 in: Misch CE. *Contemporary Implant Dentistry.* 3rd ed. St. Louis, Mo: Mosby Elsevier, 2008:1059.
10. Kusek ER. Immediate implant placement into infected sites: Bacterial studies of the photoacoustic effects of the YSGG laser. *J Oral Implantol* (Submitted for publication, Manuscript number AAID-JOI-D-10-00014R3, to be published June 2011).