Integrating Laser Dentistry Into Aesthetic Dentistry

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Since its invention in 1960, the laser has found a wide range of applications in medicine. It took more than 25 years to see the first dental laser, with very limited use, in our office. Since then, various types of lasers for dental treatments (Nd YAG, CO^2, Diode, Er,Cr:YSGG and ErYAG) have been developed and applied clinically.

More and more dentists show interest in the possibilities lasers may provide to treat soft tissues as well as hard tissues. This interest is primarily based on investigation done in past years by dental researchers in various universities worldwide (Brasil, France, Germany, Italy, United States) to prove the effectiveness of such a device on the oral tissues. As they continue to gain acceptance and recognition within the dental community, lasers are becoming an integral part of the everyday practice.

Parallel to common scalpel surgery, laser systems are suitable for many clinical applications in oral surgical procedures. Depending on the tissue quality (inflamed, hyperplastic, edematous) and the laser parameters, it is now possible to accomplish a complication-free surgical procedure without any scar tissue formation.

Effective cutting, sufficient coagulation, shortened operating time and efficient hemostasis are the aims of laser therapy. In addition, laser operations are rapid, bloodless and have excellent cosmetic and functional results in the oral cavity.

BACKGROUND KNOWLEDGE

The basic components of a laser are straightforward and are always similar regardless of the type of equipment. They include an active lasing medium within an optical cavity (resonator) and a pumping source (energy source). The optical cavity consists of two mirrors placed on either side of the laser medium. Due to this arrangement, photons resulting from the stimulated emission will form a continuous avalanche process. As long as the pumping energy maintains the population

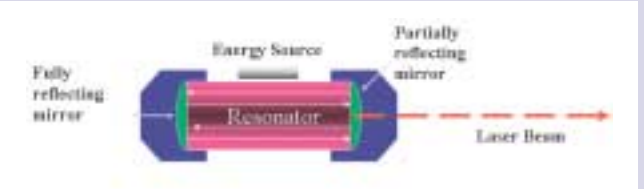

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FIGURE 7

inversion in the active medium, more stimulated photons are created thus producing energy. The energy is absorbed and emitted in the resonator, and with the aid of mirrors, is reflected and resonates within this chamber, and ultimately produces laser light. Because one of the mirrors is partially transmissive, some of the laser energy escapes at one end of the device into a delivery system (Fig. 1).

Consequently, a laser is just a source to generate a high energetic beam of light, which is monochromatic, collimated and coherent. In medical applications, the dominant laser-tissue interaction

FIGURE 8

FIGURE 9

FIGURE 10

FIGURE 11

FIGURE 12

is the photothermal effect in the range of msec to sec of irradiation time. The light energy is converted into thermal energy, which is locally cooled by water that irrigates the irradiated and surrounding tissue. As the temperature increases at the surgical site, the tissues can be warmed up to (37-50°C), coagulated (60-70°C), welded (70-90°C), and vaporized (100-150°C). If the laser energy continues to be absorbed by the tissue, carbonization occurs (>200°C) and with it the possibility of significant tissue damage. Consequently, both target and surrounding tissues can be subjected to these harmful effects.

With this in mind, successful treatment depends upon proper monitoring of the energy delivered, beam diameter and duration of exposure, so that the operator respects the characteristics of the target tissue.

Lasers can achieve a combination of results in the target tissues: a) reflection (no effect on target tissue), b) transmission (no effect on target tissue), c) refraction (obscure effect on target tissue) and d) absorption (profound effect on target tissue). The human body, which is composed of many different pigmented tissues, will have all of these effects occurring at one time, depending on the tissue type and the laser wavelength. In addition to unique absorptive optical properties, all wavelengths have different depths of penetration through tissue. The Erbium family of lasers (Er,Cr:YSGG and ErYAG) and Carbon Dioxide laser (CO^2) are essentially absorbed on the surface of the intended target zone, whereas the Diode and Nd YAG lasers are not well absorbed at the surface due to the surface tissue color, and as such, are absorbed in deeper layers of tissue.

There are several benefits of using dental lasers but each application requires a precise definition of the parameters, in regards to the properties of the target tissue, the laser, and the interaction type. Such parameters include hemostasis, bactericidal effect (by destroying bacterial load in the surgical field), no edema, and a reduction of post-operative pain.

LASERS AND AESTHETIC DENTISTRY

In recent years, dentistry has become accustomed to addressing the lifestyle needs of its clientele. Well-being, self-esteem, and personal image have become increasingly important, and

FIGURE 13

FIGURE 14

FIGURE 15

such influential television shows as Extreme Makeover, The Swan, and SOS Beauté lead viewers to explore how they can boost their own self-esteem. Although dentistry represents only one component of such transformations, the general population is discovering the many dental options available to them for improved oral health and image.

Patients are now increasingly interested in aesthetics, creating a market for treatment plans that are more complex than those simply offering veneers or crowns. During the intra- and extra-oral exam, the practitioner must consider how the smile forms a whole within the rest of the face. The smile, gum line, shape of the lips, and shape and colour of the teeth, are all important factors in achieving a harmonious result.

Often, to achieve a successful outcome, the supporting structures (gum and/or bone) will need to be modified. If a classical approach — periodontal flap surgery — is used, these changes can require several visits.

Employing certain lasers, such as the Diode, Er,Cr:YSGG and ErYAG lasers, offer an attractive alternative to such classical methods of periodontal surgery. These lasers can be used for crown lengthening procedures, either for aesthetic improvement or for exposure of additional tooth structure. Since precision and details are very important, they can easily remove soft tissue without raising a flap where the aesthetic result is critical. The Er,Cr: YSGG and the ErYAG lasers can also be used to expose additional root structure or osseous recontouring of one or more tooth. The reader should note that tissue removal must be carefully planned to generate an ideal biological width.

CASE PRESENTATIONS

CASE 1: Soft Tissue Crown Lengthening — Using the Diode Laser

A 26-year-old patient requested porcelain veneers for cosmetic improvement of her smile. Although her teeth were quite white, she wanted to correct her tooth alignment and reduce the appearance of her gums (Fig. 2).

To accomplish this result, a Diode laser of 810nm was used for soft tissue crown lengthening without raising a flap. By its thermal effect the laser seals vascular and lymphatic vessels at the same time it vaporize the excess gingival tissue. After creating an ideal biological width, preparation for veneers were done on the anterior teeth (from #14 to #24), the impression was taken and the temporary veneers were put in place, all in the same appointment (Fig. 3).

Since no flap was required for this surgery, sutures were not necessary and the wound healed by secondary intention. After three weeks, healing was excellent, the aesthetic recontouring was achieved and the biological width was maintained. The veneers were inserted and bonded (Fig. 4).

CASE 2: Soft Tissue Crown Lengthening — ErCr:YSGG Laser

This 30-year-old female patient's chief complaint was the appearance of her upper anterior teeth. Though she had a lower lip paresthesia due to Bell's Palsy on the right side, she was concerned about the space in between her teeth and also the rotation of the incisors (Fig. 5).

Her goal was to improve her look by closing the spaces and straighten her teeth for a more natural look. She was advised that her midline was off by about 2mm and she was interested in correcting this as well (Fig. 6).

For this case the Er,Cr:YSGG laser was used to create a reduction of the gingival margin and lengthen the crowns of the teeth in the aesthetic zone. Since this particular wavelength (Er,Cr:YSGG — 2,78µm) is absorbed on the surface of the tissue, there is no charring or carbonization on the intended target or surrounding tissue (Fig. 7).

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This all-purpose laser is minimally invasive. The profound benefits it provides for both patient and clinician are: perfect hemostasis, no edema, shorter healing period and minimal post-op pain.

Using this minimally invasive procedure we were able to perform the crown lengthening surgery, the preparation of the 6 anterior veneers, the final impression, and the placement of the temporary veneers at the same appointment (Fig. 8).

Because the surgery was done without raising a flap, sutures were not necessary and the wound healed by secondary intention. After three weeks, because healing was excellent, the aesthetic recontouring was achieved, and the biological width was preserved, the veneers were inserted and bonded (Fig. 9). Since then, her self-esteem has improved and she doesn't hide her smile any more.

CASE 3: Osseous and Soft Tissue Crown Lengthening-Er,Cr:YSGG Laser

(This case appears courtesy of Dr. David Eshom, La Jolla, California)

Among many of the ground breaking new instruments and technologies in aesthetic dentistry, the Er,Cr:YSGG is at the head of the class. This groundbreaking laser wavelength can be used in anterior crown lengthening procedures with osseous and soft tissue involvement using a closed flap situation where the aesthetic result is critical. For this case, the Er,Cr:YSGG laser was used to expose additional tooth structure which required osseous contouring of the 6 upper anterior.

The patient requested a reduction of the gingival margin to lengthen the crowns of the teeth in the aesthetic zone. Note the bulbous soft tissue on the maxillary arch (Fig. 10). The laser was used to trim 1.0 to 1.5mm of excess gingival with perfect hemostasis. This cosmetic tissue sculpting is done before the osseous crown lengthening. Then with a scaler, the trimmed tissue was gently removed prior to the osseous contouring (Fig. 11).

After removing the excess gingiva, a periodontal probe was applied to sound the bone. It is imperative to note the distance from the gingival margin to the bone structure to carefully plan the osseous tissue removal to generate the ideal biological width. A medical-grade felt tip pen was applied to mark the laser tip to indicate the distance to the bony crest (Fig. 12).

The laser tip was introduced into the sulcus to the mark, and by using lower power settings, the practitioner removed bone safely with no zone of necrosis, bleeding, or discomfort to the patient (Fig. 13). A scaler was used again to smooth the roots and remove any bone fragments to prevent unwanted vertical defects after contouring. A procedure that was formerly painful and lengthy was completed in a single appointment with little to no discomfort for the patient (Fig. 14). At the three months post-op recall (Fig. 15), the exam showed excellent adaptation of the gingival tissues and the aesthetic improvement was achieved without any restoration.

CONCLUSION

After several years of stagnation, laser dentistry has now emerged. The new generation of therapeutic lasers such as the Er,Cr:YSGG, has differentiated itself in the dental field by providing a higher

standard of care for our patients. Less invasive than its predecessors, this device is extremely useful for any kind of surgical procedure including cosmetic tissue sculpting and hard tissue contouring.

However, one thing remains: all surgery should be preceded by an appropriate diagnosis. The final result will always depend on good surgical foresight and predictable treatment, based on acquired knowledge and innovative techniques.

Dr. André Chartrand maintains a private practice in Longueuil, PQ. He first incorporated laser therapy in his practice in 1990. Recognized as an expert in laser therapies, he is frequently invited to participate in conferences nationally and internationally.

Oral Health welcomes this original article.

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