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Introduction
Lasers provide an exciting new technology that allows the dentist the ability to give patients optimal care without many of the “fear factors” found in conventional dental techniques. Used with proper understanding of laser physics, lasers are extremely safe and effective.

Using lasers for caries removal, peri treatment, endodontic treatment, bone management, cutting, and shaping, and soft tissue procedures can reduce postoperative discomfort, infection and provide safe, simple in-office treatment. As a result, we can improve our efficiency, expand what we can do, achieve better results and increase production.

Lasers represent a real quantum leap forward in the treatment of our patients, including the pediatric patient. The US Food and Drug Administration (FDA) gave approval for the use of the Er:YAG laser in 1997 for both hard- and soft-tissue procedures. The erbium doped (erbium particles placed within the YAG crystal) crystal of Yttrium-Aluminum-Garnet (Er:YAG) development and success has made the treatment of children safer and quicker.

Flamboyantly stated, a laser is a piece of equipment that creates a concentrated monochromatic beam of visible or infrared light that can be absorbed by a specific target. Since then, laser-assisted dental care has changed forever the way dentists can perform various dental procedures that ablate bone and soft tissue to ablate bone and treat soft tissue abnormalities and disease. An entire new standard of care is becoming a reality.

Lasers and paediatric dentistry are a perfect fit. There are a wide range of hard and soft dental procedures that may be completed using lasers as an alternative to conventional dental care on adults and, especially, children. Many of these procedures, which can be performed in the comfort of the surgery, may be performed by children of all ages. The use of lasers for children is a new frontier in dental treatment.

The question that is often the major concern and barrier to investing in lasers is the how this investment will pay for itself, more recently described as return on your investment (ROI). Will it pay for itself? We prefer to speak of this as the secondary effect. If you understand your laser, it will easily pay premiums on your investment, and the cost factor becomes a nonissue.

The purchasing of a laser is an investment, not an expense, for any dental practice.

Lasers represent a fundamental change in the entire way dentistry has been taught. We can rethink and often modify G.V. Black’s principles of treatment for prevention with the concept of minimally invasive micro-dentistry. We need to understand that laser dentistry is one portion of an entire new way of practicing conservative, pain-free dentistry.

The laser that we call the “all-purpose” laser is the Lightwalker Er:YAG Nd:YAG laser, manufactured by Fotona and distributed in the United States by TechnologyMedicine. The Er:YAG produces its effect at 2,940 nm and has as its primary tissue target water and hydroxyapatite. It is very safe, very quiet, and eliminates the smell and vibrations associated with the dental handpiece and, more importantly, is much more comfortable for the patient, significantly reducing the need for local anesthesia.

The use of the new generation erbium lasers for repair of incipient hard tissue disease allows the dentist to provide a stress-free means of re-shaping teeth with a minimum invasive manner, most often with no shot and no numb lip, without the need for any local anesthetics.

The erbium laser can be used for restoring primary and permanent teeth, eliminating or reducing the amount of local anesthetics. In most cases, the patient will not require numbing for Class I (some times). 4-5-6 restorative procedures using bonded restorative materials. Using the concept of minimally invasive restorative procedures, the Er:YAG laser allows the operator to use very minimal amounts of the tooth substance that is not meant for bonding. The erbium laser is effective because of its effect on its target, water within the tooth structure. This effect occurs when the laser heats up water within the target tissue, causing it to create small microscopic explosions (photothermal followed by photoacoustic effects). When applied to soft tissue, bone or teeth and cavities, the explosions then cause the areas to be vaporized.

Er:YAG Laser 2,940 nm: Soft-Tissue procedures
There is a wide array of soft-tissue procedures that are able to be completed using the all-purpose laser. Maxillary and mandibular frenum revisions, lingual frenum revisions, treatment of periodontal pain or infection, removal of hyperplastic tissue because of drugs or poor oral care in orthodontic patients, biopsies, treatment of aphthous ulcers and herpes labialis, pulpotomies, removal of impacted teeth and in adults apicectomies and bone recontouring.

Pulpotomies
Patients often express concern about the need to take radiographs because of the age of X-rays and their possible side effects on their child’s overall health. They question the use of alloys because of the chemical make-up of the alloys. Whether these should be a real concern in today’s dental care is open to debate, depending on your individual beliefs. There are also concerns about the fear of the various pulpotomy procedure medications used in pulpotomy procedures such as formocresol.

Lasers provide a safe, non-chemical effective alternative treatment for pulpotomies. During eight years, post-treatment results on more than 4,000 pulpotomies using the erbium laser provide ample evidence that this method is both effective and safe for children without the need for introducing chemicals or using electrosurgery methods.

When the final result of orthodontic positioning of the front teeth results in gingival hypertrophy, the laser can be a useful tool to increase crown length and give the patient a more aesthetic smile. This may often be accomplished without the need for local anesthetics. Patients who have medically induced hyperplastic tissue, such as patients requiring dilatation, can also have their tissue reduced and reshaped with the erbium laser.

In addition to the many examples described in this article, lasers can be used for additional procedures not usually required in paediatric dentistry, such as revisions of the abnormal maxillary frenum, often avoiding the need for soft tissue grafts. Crown-lengthening procedures where bone requires recontouring, apicectomies, removal of honey combs, removal of third molar impacted or root remnants, incising and draining soft tissue infections, advanced periodontal treatments and the latest in advanced endodontic treatment via photoinduced photoacoustic streaming.

Photacoagulative endodontics using PIPS
The goal of endodontic treatment is to obtain effective cleaning and the contamination of the smear layer, bacteria and their byproducts in the root canal system. Clinically, traditional endodontic techniques use mechanical instruments, as well as ultrasonic and chemical irrigation, in an attempt to shape, clean and completely decontaminate the endodontic system but still fall short of successfully removing all of the infective microorganisms and debris. This is because the complex root canal anatomy and the stability for common organisms to penetrate into the lateral canals and the apical ramifications. It seems, therefore, appropriate to search for new materials, techniques and technologies that can improve the cleaning and the decontamination of these anatomical areas.

Among the new technologies, the laser has been studied in endodontics since the early 1970s.5-6 has and more recently used widely since the “photocoagulation”.

Different wavelengths have been shown to be effective in significantly reducing the bacteria in the infected canals, and important studies have confirmed these results in vitro.6 Studies reported that near infrared
laser are highly efficient in disinfecting the root canal surfaces and the dentinal walls (up to 790 microns through the dentinal tubules to the ND-YAG 1,064 nm). On the other hand, these wavelengths did not show effective results in debridging and cleansing the root canal surfaces and achieving aseptic morphologic alterations of the dental wall. The smear layer was only partially removed and the dentinal tubules primarily closed as a result of inorganic dental structure alterations.

Other studies reported the ability of the medium infrared laser in debrid- ing and cleansing root canal walls.10–14 The bacterical load reduction after erbium laser irradiation, demonstrated high on the dentin surfaces, but low in depth of penetration because of the high absorption of laser energy on the dentin surface.15 Also, the laser activation of conventionally irrigated root canals (LAI) resulted in statistically more effective removal of debris and smear layer in root canals compared with traditional techniques (CI) and ultrasonic irrigation (PIU).11, 12 Additionally, the laser activation method resulted in a strong modulation in reaction rate of NaOCl significantly increasing the production and consumption of available oxygen, in comparison to ultrasound activation.13

A recent study has reported how the use of an Er:YAG laser, equipped with a newly designed radial and stripped tip, could achieve 70% per cent removal of the smear layer and debris with low energy (50 microsecond pulse duration) or less) generates only minimal or no thermal damage to the organic dentin structure through a photoacoustic technique called PIPS elimination.16, 17 Photoacoustic streaming or “PIPS.”14, 15 Also noted, the treatment of canal patency closure with Nd:YAG laser in 7 second-long pulses at 971 nm was seen with those techniques placed into the root canal system. The root canal surfaces irrigated with 17 per cent EDTA and laser activated showed brief the experimental back- ground and methodology for the LAD/PIPS laser activated decontamination (LAD) method.

The purpose of this article is to pre- sent briefly the experimental back- ground of the laser technique and to introduce the clinical protocol.

Scientific background

The macrophotographic recording of the LAD studies suggested that the effect of a laser in irrigant-filled root canals generated a streaming of fluids at high speed through a cavit- ation effect.18 The laser thermal effect generates the expansion-implosion of water molecules of the irrigant solution, generating a secondary cavitational effect on the intracanal fluids.19, 20 As the laser beam is focused, it is suggested the fiber be placed in the middle third of the canal, 5 mm from the apex and stationary.21 This concept greatly simplifies the laser technique and allows the user to reach the apex and to negotiate radicular curves.

Also, the recorded video of the new technique, PIPS, showed a strong ag- gregating action in the pulpal cavity. It differs from the already cited LAD technique by activating the irrigant solution in the endodontic system through a profound photoacoustic and photomechanical phenomena. The use of low energy (50 microsec- ond pulse, 20 mJ at 5 Hz, 0.3 W av- erage power, or less) generates only a minimal thermal effect. The study with thermocouples applied to the radicular apical third revealed only 1.2 °C of temperature rise up to 10 seconds and 1.5 °C after 40 seconds of continu- ous irradiation.22

When the erbium laser is utilized at only 50 microsecond pulse duration through a special designed tapered and stripped 400 microns tip (Fotona Laser, Technology, PIPS, 4McMeter), it produces a large peak power of 400 watts when compared to a longer pulse duration of each pulse, absorbed by the water mol- ecules. This water molecule water vaporization that leads to the formation of an effec- tive streaming of fluids inside the canal while allowing the underlying thermal effects seen with other methodologies. The placement of the tip in the coronal portion only of the treated tooth allows for a more minimally enlarged canal prepara- tion effect.17 The laser thermal effect on the intracanal fluid molecules, creates a strong “shock wave” effect.23 The laser thermal effect of the water molecules of the irrigant leads to a longer pulse duration. Each im- pulsation effect.17 The laser thermal effect on the intracanal fluid molecules, creates a strong “shock wave” effect.23 The laser thermal effect of the water molecules of the irrigant leads to a longer pulse duration. Each im- pulsation effect.17 The laser thermal effect on the intracanal fluid molecules, creates a strong “shock wave” effect.23 The laser thermal effect of the water molecules of the irrigant leads to a longer pulse duration. Each im- pulsation effect.17 The laser thermal effect on the intracanal fluid molecules, creates a strong “shock wave” effect.23 The laser thermal effect of the water molecules of the irrigant leads to a longer pulse duration. Each im- pulsation effect.17 The laser thermal effect on the intracanal fluid molecules, creates a strong “shock wave” effect.23 The laser thermal effect of the water molecules of the irrigant leads to a longer pulse duration. Each im- pulsation effect.17 The laser thermal effect on the intracanal fluid molecules, creates a strong “shock wave” effect.23

**Discussion**

The bacterial load reduction after erbium laser irradiation is a common tech- nique used in endodontics to im- prove root canal therapy while facilitating the search for the apical terminus, debridging and maintaining patency. At the efficiency of PIPS the final size required for canal shaping can be significantly reduced, often to a size 25/04, allowing for a more minimally invasive and biomimetic preparation which can then be obtu- rated three dimensionally.

**Conclusion**

Lasers are an extremely versatile ad- dition to the dental practice and can be used in many instances instead of the conventional methods em- ployed by the vast majority of den- tists. Laser endodontic treat- ment should be viewed as an investigational tool, useful not only in the tapering and stripping 400 microns tip or the Nd:YAG 1,064 nm). On the other hand, the erbium lasers are used for their effective smear layer removal. Also, there are the advantages observed in long, nar- row and curved canals.

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