Er:YAG & Nd:YAG dual wavelength laser From everyday dentistry to advanced photoacoustic endodontic applications (PIPS)

By Dr Lawrence Kotlow, Dr Enrico Di Vito, USA, & Dr Giovanni Olivi, Italy

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, perio 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—children, the geriatric 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’s (Er:YAG) development and success has made the treatment of children safer and quicker.

Plainly 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 many procedures without anesthesia, alter 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 may be treatments dentists historically refer to other specialists, however, if you understand how to use your laser efficiently, you will discover that many of these are procedures that every dentist can easily complete.

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, you will easily pay premiums on your investment, and the cost factor becomes a non-issue.

The purchasing of lasers 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 now rethink and often modify G.V. Black’s principle of 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 Technology4Medicine. The Er:YAG produces its effect at 2,940 nm and has as its primary tissue target water and hydroxyapatite. It is very safe, relatively quiet, eliminates the smells and vibrations associated with the dental handpiece and, most importantly, is much more comfortable for the patient, significantly reducing the need for local anaesthesia.

The use of the new generation erbium lasers for repair of incipient hard tissue damage allows the dentist to provide a stress-free means of restoring teeth in a minimally invasive manner, most often with no shot and no numb lip, without the need for any local anaesthetics.

The erbium laser can be used for restoring primary and permanent teeth, eliminating or reducing the amount of local anaesthetics. In most cases, the patient will not require numbness for Class I [some times], II, II*, III, III*, IV*, restorative procedures using bonded restorative materials. Using the concept of minimally invasive restorative procedures, the Er:YAG laser allows the operator to remove only diseased tissue and thus preserves much more of the healthy unaffected tooth.

In cases where alloy is preferred, the laser’s desensitization effect may also allow the dentist to create a restorative preparation using a conventional hand

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 periconical pain or infection, removal of hyperplastic tissue because of drugs or poor oral care in orthodontic patients, biopsies, treatment of apthous ulcers and herpes labialis, pulpotomies, removal of impacted teeth and in adults apicoectomies and bone contouring.

Pulpotomies: Patients often express concern about the need to take radiographs because of the nature of X-rays and their possible side effects on their child’s over all health. They question the use of alloys because of the chemical make-up of the alloy. 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 by many, although not as loudly, about the effect of various pulpotomy procedures medicaments 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 (2,940 nm) laser provides 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 anaesthesia. Patients who have medically induced hyperplastic tissue, such as patients requiring dilatation, can also have their tissue reduced and reshaped with the erbium.

In addition to the many examples described in this article, lasers can be used for additional procedures not usually requested 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 contouring, apicoectomies, removal of bone exostoses, removal of third molar impactions, removal of root remnants, incising and draining soft tissue infections, advanced periodontal treatments and the latest in advanced endodontic treatment via photoinduced microablation streaming.

Photacoacoustic endodontics using PIPS: The goal of endodontic treatment is to obtain effective cleaning and the containment of the smear layer, bacteria and their byproducts in the root canal system. Clinically, traditionally 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 fail short of successfully removing all of the infective microorganisms and debris. This is because the complex root canal anatomy and the inability for common immigrants 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-73 and has become more widely used since the ‘90s.

Different wavelengths have been shown to be effective in significantly reducing the bacteria in infected canals, and important studies have confirmed these results in vitro. Studies reported that near infrared
The laser activation method resulted in a significant activation of the irrigant in root canals compared with the mechanical debridement. This activation process is related to the production of ultrasound, which leads to the formation of an effective debridement and disinfection of the root canal system. Systems that produce ultrasound are capable of removing debris and disinfecting the root canal surface.

Discussion

The profound and distant effects of ultrasound have been extensively studied in various medical disciplines. Ultrasound can be used for a wide range of applications, including debridement, disinfection, and tissue ablation. In endodontics, ultrasound has been used to remove debris from the root canal surface and create a typical morphological damage. Moreover, ultrasound is not able to thoroughly remove the smear layer.

The root canal surfaces are covered with a smear layer, which is formed by organic and inorganic debris, bacteria, and debris. The smear layer is a significant barrier to the effective disinfection of the root canal system. The smear layer can be removed by mechanical debridement, chemical debridement, and laser activation.

Conclusion

Laser dentistry is a valuable tool for the effective debridement and disinfection of the root canal system. Laser dentistry is a safe and effective technique that can be used in many instances instead of conventional mechanical debridement. The use of lasers in endodontics has been shown to be effective in removing debris and disinfecting the root canal system.

References


The full list of references is available from the publisher.