VOLUME-7, ISSUE-3, MARCH-2018 • PRINT ISSN No 2277 - 8160

Original Research Paper | Dental Science

TIME CHANGES IN LASER DENTISTRY.

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KEYWORDS :

Introduction

An amazing transformation is occurring in dentistry with a technology breakthrough that provides dentists with the capability to perform a wide range of clinical procedures with improved patient outcomes, less trauma, reduced post-op complications and in most cases with no need for injections. Plus, this new technology greatly expands the scope of procedures a dentist can offer their patients[1].

Dentists are now successfully integrating Er,Cr:YSGG laser technology (Waterlase® YSGG laser, BIOLASE Technology, Inc.) into practice with the broadest indications for use of any other laser in medicine or dentistry[2].

While lasers have been involved in dentistry for more than 20 years, until recently, no single laser had been cleared for and is capable for use on all oral tissues, including hard tissue, soft tissue, endo, perio, and bone. That all changed with the introduction of the YSGG laser[3].

This laser was the first to obtain marketing clearances for use on all oral tissues, and it has emerged as the pinnacle of the dental laser revolution. Dentists now have access to a single instrument that can be utilized in all areas of their clinical practice, and provide new opportunities for increased ROI and improved patient care[4].

The present article reviews a brief history of dental lasers, and the evolution of these systems from the first ruby laser to the YSGG laser. This article reviews the wide range of clinical applications using the YSGG laser, including hard tissue, soft tissue, endo, perio, and bone, as well as new applications that continue to shape an emerging standard of preventive and minimally invasive care in dentistry[5].

Although lasers have not yet replaced conventional instrumentation in all applications, this article of the clinical uses of the YSGG laser clearly demonstrates that no other instrument in dentistry has the versatility and clinical utility of this device.

Lasers are usually named for the "active medium" that is charged with energy inside the laser unit to create laser light. For example, the YSGG laser receives its name from the elements that compose the crystal medium inside the laser system – yttrium, scandium, gallium and garnet, doped with erbium and chromium[6]. When the crystal is pumped with energy, a specific, monochromatic wavelength of light is emitted from the crystal and transferred to the target tissue through a delivery system. In the case of the YSGG laser, the wavelength delivered from the laser through a fiber optic cable is 2,780 nanometers. Other lasers, such as the Nd:YAG lasers operate at 1,064 nanometers, CO2 lasers at 10,600 nanometers, Erbium:YAG at 2,940 nanometers, and so on

Another key concept is that different lasers react with tissue in different ways. Depending on their "absorption coefficient," laser light has properties that cause it to interact and absorb differently with target tissue. For example, the laser light from a diode laser is most effectively absorbed in darker pigment and melanin, which makes it an ideal tool for use in cutting and coagulating soft tissue. The YSGG laser is well absorbed in water and hydroxyapatite Absorption which makes it an excellent tool for cutting enamel, dentin, bone, and soft tissue[7].

A Brief History of Lasers

The first laser was developed by Theodore H. Maiman. Using a theory originally postulated by Einstein, Maiman created a device where a crystal medium was stimulated by energy, and radiant, laser light was emitted from the crystal. This first laser was a Ruby laser. One year later, Snitzer released the neodymium laser (Nd:YAG) was largely ignored during the early years. Experiments by Stern and Sognnaes found that the Ruby laser was not an effective wavelength for cutting enamel and dentin. Additional work by Stern suggested a possible role for lasers in caries prevention, but overall, hard tissue applications for the Ruby laser were not promising[7-9].

Research then focused on soft tissue, where several of the early lasers proved to be successful. The argon, carbon dioxide, and Nd:YAG laser proved effective for cutting and coagulating soft tissue. The first reported oral surgical application using a C02 laser occurred in 1977 (Lenz, et al, 1977). Because of the thermal nature of these soft-tissue lasers, injections were required in most cases.. The stage was set for a new round of research and investigations into lasers for broader applications such as cutting enamel, dentin, and bone[8].

The search for a laser system with broader applications in dentistry led Dr. Terry Meyers and his brother William, an ophthalmologist, to select the Nd:YAG laser for experiments on the removal of incipient caries (Meyers, Meyers, 1985). Soon after, they began developing the first true dental laser system,. Their product, the D-Lase 300, led to the founding of American Dental Laser (acquired by BIOLASE Technology, Inc. in 2003), the creation of several dental laser associations, and the first widespread exposure of lasers to dentistry[10]. In May 1991, the FDA granted a marketing clearance to American Dental Laser for soft tissue uses.

Following American Dental Laser, a number of other companies, including Luxar, HGM, Excel and BIOLASE offered Nd:YAG, CO2, and argon lasers for use in soft tissue. In 1988 in Europe and 1989 in the United States, BIOLASE filed patents for the novel use of lasers with water in dentistry. The company began development of a laser device exclusively for this purpose[11].

In May 1997, Premier Laser obtained the first marketing clearance from the U.S. FDA to cut enamel and dentin in adults using an Er:YAG laser, a device readily available in dermatology and plastic surgery. Later, other companies, including OpusDent, Hoya ConBio, Kavo, Deka and Fotona adapted the Er:YAG technology as well, making additional strides for laser use in dentistry.

In 1998, after more than ten years of research and investigation, BIOLASE obtained a marketing clearance for cutting hard tissue in adults using an all-new laser designed by the company exclusively for use in dentistry[12].

BIOLASE's first YSGG laser, called the "Millennium," used a patented combination of YSGG laser energy, water and air to safely and effectively ablate enamel and dentin in adults. The YSGG laser was then cleared for use on patients of all ages[13].

Researchers at BIOLASE had also worked on soft tissue with the YSGG laser. With the water spray minimized or turned off, the laser could effectively cut and coagulate soft tissue with more control, and in many cases, much faster. By 2000, greatly expanded FDA clearances for soft tissue indications had been obtained by BIOLASE, and clinicians were able to work across both hard and soft tissue[14].

Also in 2000, BIOLASE released its second YSGG laser, the "Waterlase," The company quickly obtained a series of ground-breaking marketing clearances from the FDA for complete laser endodontics (2002), apicoectomy (2002), cutting and shaving oral osseous tissues (2003), as well as the most complete list of procedures related to periodontal therapy, including laser curettage and osseous crown lengthening (2004)[15].

Research also continues for future indications, including crown and veneer preparations, orthodontic applications, advanced new implant therapies including sinus augmentation and bone grafting, gingival tissue resurfacing, and even low-level laser therapy applications using the YSGG laser[16].

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The YSGG laser was cleared for Class I, II, III, IV, and V cavity preps, as well as caries removal in adults in 1999, with a similar clearance for children soon thereafter (1999). Since then, published reports have demonstrated the laser's ability to reduce and even eliminate the smear layer associated with traditional rotary instruments which can improve surface adhesion and bond strength for restorations (Gutknecht, Apel, et. al, 2001). Also, because the laser reacts at a cellular level and helps to prohibit the pain response (Tuner and Hodes, 2002), most hard tissue procedures can be completed without the aid of injected anesthetic. The YSGG laser also allows the precise treatment of pits and fissures on the occlusal surfaces of molars, which has aided in the growing discipline of "micro" and "minimally invasive" dentistry[15,16].

Soon after obtaining the first hard-tissue clearances for the YSGG laser, BIOLASE obtained a collection of clearances related to soft tissue (July 2001), including sulcular debridement. The YSGG laser demonstrated the capability to atraumatically treat soft tissue with little to no bleeding, little edema, and positive post-operative results. The YSGG laser was the first hard-tissue laser cleared for soft tissue indications such as treatment of aphthous ulcers, herpetic lesions, and leukoplakia. In addition, the laser was cleared for oral surgical applications such as frenectomy ,gingivectomy , fibroma al, and bloodless troughing around a prep prior to taking an impression.

With hard tissue and soft tissue procedures cleared by the FDA, research and development turned to other disciplines where lasers had already showed some potential for disinfection, sterilization, and other benefits. The YSGG laser was the first laser cleared for root canal, including tooth preparation to obtain access to the canal, root preparation, and canal enlargement and cleaning. The smear layer was eliminated and debris were dramatically reduced, and the dentinal tubules remained free and clear, which may aid in improved obturation and sealing of the canal. The YSGG laser was also the first cleared for bone, including cutting, shaving, contouring and resecting oral osseous tissues (February 2002). The laser was later cleared for osteoplasty, ostectomy, and osseous recontouring to correct defects and create physiologic osseous contours necessary for ideal clinical results. In 2003, the YSGG laser was the first laser device cleared for osseous crown lengthening to achieve biologic width which can be completed without laying a flap, suturing, or damage to the bone (Wang, 2002).

Other advanced endodontic applications include the YSGG's ground-breaking clearance for apicoectomy (2003), which, for the first time, allowed a clinician to use a single instrument for all major steps of an apicoectomy procedure, including flap preparation, cutting bone, amputating the root tip, removing pathological tissue and hyperplastic tissue from around the site, and preparing the site for retrofill amalgam or composite

The YSGG laser is the first and only laser cleared for the major indications in laser periodontal therapy. While other lasers such as the diode laser and Nd:YAG laser are cleared for soft tissue applications related to perio, none have been cleared for cutting oral osseous tissues. The YSGG laser was recently cleared by the FDA for a wide array of indications related to periodontal health, including laser curettage, sulcular debridement , ostectomy, osteotomy, soft tissue flap elevation, removal of pathological tissues from bony sockets, and many other important clinical applications[17].

Innovations and Future Applications

Researchers continue to explore new applications for the YSGG Laser. In regard to implant therapy and applications, one of the first YSGG laser users in the world, Dr. Robert Miller, has created ground-breaking techniques to treat failing and ailing implants (Miller 2002), and Dr. Norberto Berna of Italy created the first system for placing implants in a single visit (Berna 2003). Dr. Berna's research has spawned hybrid techniques that have appeared in the U.S. In regard to low-level laser therapy and "soft" laser applications, Drs. Arun and Rita Darbar of England, and Dr. Jon Karna of California have led the way in the research for "soft" laser therapy and photobiomodulation. Finally, Professor Paul Bradley of Nova Southeastern University is currently studying the analgesic and anesthetic effects of the YSGG laser[8].

Conclusion

The benefits of a versatile instrument such as the YSGG laser are clearly evident..

The dramatic reduction of pain in most cases reduces the need for injected anesthesia and frees up chair time for a busy practice (Shulkin, 1991), and can generate increased word-of-mouth referrals among your patients. According to various reports, 100 million patients fear a visit to the dentist because of fear of the drill and the needle. The ADA recently reported that at least 82% of patients think it "somewhat important, important, or very important," that a dental office have a dental laser, which allows a practice to offer a different type of dentistry[12].

The laser dramatically reduces the need to apply a high-speed drill to the tooth surface for any reason; however, it has yet to completely replace the drill because a laser cannot effectively cut reflective surfaces such as metal and porcelain. Still, the fact that a single instrument can remove bulk amounts of enamel, dentin and decay, then cut soft tissue around the site, return to removing enamel, and then etch the surface in the time it typically takes for anesthetic to take effect – it hearkens to an exciting new era of efficient, minimally invasive laser dentistry[18-19].

Lasers can no longer be considered a niche tool for only the most cutting-edge dentists.

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