A Clinical Innovation

Lasers in Dentistry Part II : What a Consumer Should Know?

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Abstract:

Dentistry is one of the most inventory-intense profession that involves lot of finances, management and clinical skills. As Laser educators, often, we are asked what best laser is and what is best wavelength to work with? Honestly, till date there is no one answer to this question. Each wavelength has its own unique qualities. This article is an insight about all the wavelengths used in clinical dentistry so it can be helpful to the clinician to decide what to invest in his or her clinical practice to strengthen existing. Lack of expertise and skill can hinder to achieve desired results so proper education is a must.

Keywords: Laser wavelength, Diode, Er:Yag, Er:YSGGNd:Yag, CO_2

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INTRODUCTION

The word LASER (Light Amplification by Stimulated Emission of Radiation) has a magic impact on society as the treatment is thought to be modern and providing a cutting edge to dentistry. All lasers work by delivering energy in the form of light. When used for dental procedures, the laser acts as a cutting instrument or a vaporiser of the tissue that it comes in contact with. When used for teeth-whitening procedures, the laser acts as a heat source and enhances the effect of tooth-bleaching agents whereas a cutting or ablating tool when used for surgical excision of a lesion .

Dental lasers are most often categorized by the types of tissues on which they can be used. This usually means they are separated into soft tissue lasers and lasers designed for cutting both hard and soft tissues. They also can be classified by the medium used to create the laser energy with diode lasers being the most common, and other options such as Diode ,CO_2, Nd:YAG and Erbium also available. Even though there have been many classifications of lasers, Professor Vipul Kumar Srivastava et al. proposed a new simplified classification of lasers based on the clinical use (Fig 1).

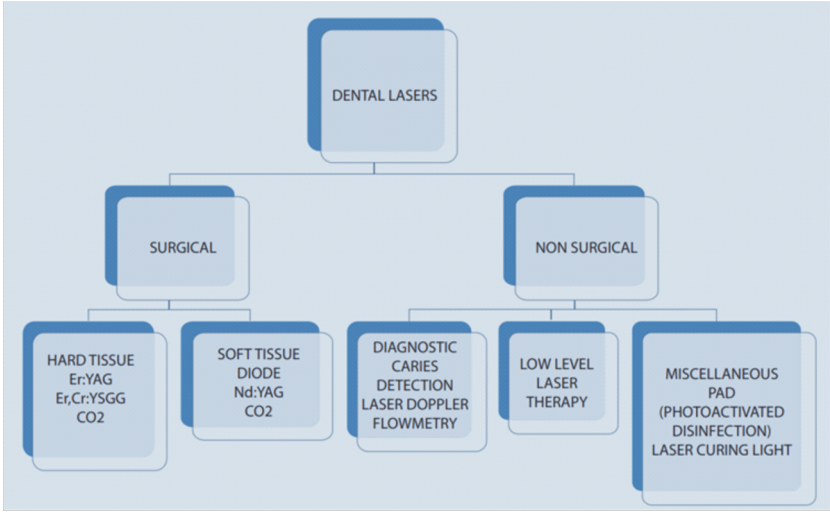

Figure 1: Dental Laser Classification by Prof. Dr Vipul Srivastava et al

Deciding what type of laser is best for your practice comes down to how you plan to use the laser, and how large of an investment you plan to make.

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Types of Lasers:

Er:YAG Lasers

Erbium lasers are hard and soft tissue lasers built with two different crystals, the Er:YAG (yttrium aluminum garnet crystal) and Er,Cr:YSGG (chromium sensitized yttrium scandium gallium garnet crystal). They have FDA clearances for most of the dental procedures They do have different wavelengths, Er:YAG has 2940 nm and Er,Cr:YSGG has 2780 nm. Though similar, there is a significant water absorption difference between these two wavelengths. Er:YAG wavelength is at the peak of water absorption in the infrared spectrum whereas the Er,Cr:YSGG exhibits approximately one third less absorption. The Er,Cr:YSGG has also been shown to have significantly deeper thermal penetration in tooth structure as well. They can be used for tooth preparation, smear layer removal, bone cutting, soft tissue surgeries.

They can be used anywhere a scalpel is employed including periodontal procedures, gingival contouring, biopsies, frenectomies, pre-prosthetic procedures and the like. Erbium lasers can also be used to safely scale root surfaces during periodontal procedures which has the added benefit of root surface decontamination.

Nd: YAG Lasers

Nd: YA Glasers were the first types of true pulsed lasers to be marketed exclusively for dental use in 1990. They are a near infrared wavelength of 1064 nm. This wavelength is absorbed by pigment in the tissue, primarily hemoglobin and melanin. Photo thermal interaction predominates and the laser energy can penetrate deeply into tissues. Contact and non-contact mode are both utilized depending on the procedure being performed. Nd: YAG lasers is a highly efficient tissue cutter and coagulator and is used primarily for laser-assisted periodontal therapies. Nd:YAG also have excellent biostimulative properties It offers the benefit of killing black-pigmented bacteria, separating connective tissue from epithelium in the periodontal pocket, and creating a fibrin clot that can contain a variety of growth factors to enhance bone and soft-tissue healing. The ability to form fibrin is also utilized when forming clots in extraction sites which can help prevent alveolitis and enhance osteogenesis. The deep penetration and the near infrared wavelength of these lasers also make them ideal for photo biomodulation procedures.

Diode Lasers

Diode lasers are soft tissue colour absorptive soft tissue lasers. They are becoming quite popular due to their compact size and relatively affordable pricing. Diode lasers comprise of specialized semiconductor that produces monochromatic light when stimulated electrically. Diode wavelengths typically range from 450 nm to 1064 nm. Diode lasers can be used in both contact and non-contact mode and can function with continuous wave or gated pulse modes. They are not capable of free running pulsed mode. Diode lasers are invisible near infrared wavelengths and current machines range from 450–1064 nm. The chromophores are pigments such as hemoglobin and melanin, similar to the Nd:YAG absorption spectrum. However, most surgical procedures with diodes are not as a result of laser photons in.teracting with tissue. Diode laser fibres are "initiated" by burning articulating paper on the tip. This initiation causes the light energy to be absorbed by the burnt material on the tip, effectively making it a hot piece of quartz being called as “Hot Tip Effect”. Diode lasers are quite effective for intraoral soft tissue procedures such as gingivectomy, biopsy, impression troughing, and frenectomy. Diode lasers also exhibit bactericidal capabilities and can be used for adjunctive periodontal procedures. They also are used for laser assisted tooth whitening and biostimulation.

CO_2 Lasers

CO_2 lasers are very efficient soft tissue lasers, and they exhibit excellent hemostasis The CO_2 gas is in a chamber with nitrogen and helium and the active medium is pumped with an electrical current. Articulated arms or hollow waveguides are used to transmit CO_2 laser beams and quartz optical fibers cannot be used. The superpulsed gated modes of these lasers offer improved surgical control with less charring of tissue. They are an excellent tool for incising tissue for multiple purposes. Incisional and excisional biopsies, frenectomy, gingivectomy, pre prosthetic procedures, and the like are all achieved with excellent hemostasis. Sutures are rarely needed and the controlled thermal effects and sealing of nerve endings often makes for a very comfortable post-operative experience for the patient. Lasers are also water absorption type at10,600 nm infrared wavelength. This wavelength is also very effective for ablation and vaporization of leukoplakia and dysplasia.

Hard tissue capableCO_2laser became available recently. This laser's CO_2 molecule uses an oxygen isotope that crates a beam at 9300 nm. This wavelength has a high absorption affinity for hydroxyapatite that allows for efficient vaporization of tooth structure. Its water absorption is much lower than Erbium lasers so hydroxyapatite absorption and vaporization predominates when cutting enamel, dentin, and bone. Hard tissue ablation with the 9300 nm CO_2 laser is a photothermal event, not photoacoustic. As a result much higher temperatures are generated and much higher pulse rates are needed to cut.

What Before Buying ?

Before hurrying in the process, the first and foremost thing a clinician should ask himself or herself is-

“Will it be a value addition to my practice?”

“Will it be of any benefit to my patients?”

“Will it add something new to my practice which I never had before?”

“Will I be able to perform procedures which I never attempted like fear of blood or surgery?”

The clinician before buying a laser should think what his or her practice is based on? Sometimes we get carried away with social media and campaigns by marketing people and thus make hasty decisions that tax us both financially as well as emotionally. Think your practice is based soft tissue, hard tissue or both? If the practice is predominantly soft tissue

based then any of diode, Co2 or Nd: Yag laser can be bought. But if the practice is based on hard tissue like an oral surgeon or a prosthodontist, then Er:Yag is best option for them. Also if the practitioner is into visiting consultation or multichain practice then portability and manageability is prime concern.

Proper Knowledge and Education

Dental lasers are now well-established dental tool. Various clinical and ongoing research areshowing the many benefits of laser therapy. The ability to perform less invasive procedures with greater patient comfort makes laser dentistry something the modern practitioner should consider. A thorough understanding of laser physics and biological effects is mandatory for any provider. Remember there is no wavelength which is perfect laser wavelength. Comprehensive beginner and ongoing training is imperative to use these devices effectively and safely. Various Universities and academies all over the world like University of San Francisco, California(UCSF), ALD (Academy of Laser Dentistry), SOLA, Aachen, WCLI etc offer Standard competency and fellowship certification programmes (Figure 2). These certification programmes follow the "Curriculum Guidelines and Standards for Dental Laser Education" that was developed in 1993 and are conducted under an extensively trained and certified mentor. There can also be local study clubs, Continuing Dental Education Programmes, major dental conferences feature presentations and workshop courses.

CONCLUSION

In today's digital era where everything is served on a click of a button, how to and where to invest wisely as a clinician is a major challenge. Proper knowledge is the key that can minimize errors and help us lead a stress free and patient and patient beneficial practice.

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Figure 2: Standard Competency Course in laser Dentistry by University of San Francisco (UCSF), California and Laser Education International (LEI), USA