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LASERS: THE NEW AGE HELIOTHERAPY

Dental Science

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ABSTRACT

Effects of laser are dependent on the type of laser used and on the type of tissue it is used. The rapid development in the field of laser technology, modern lasers with a wide range of characteristics are now available and being used in the field of dentistry, most importantly in the field of conservative dentistry and endodontics.

KEYWORDS

Laser, irrigation, laser applications in dentistry, laser application in endodontics

INTRODUCTION:

Effects of laser are dependent on the type of laser used and on the type of tissue it is used.[1,2] The rapid development in the field of laser technology, modern lasers with a wide range of characteristics are now available and being used in the field of dentistry, most importantly in the field of endodontics.[3,4]

History:

1917: Albert Einstein first postulated Stimulated Emission in 1917
1971: Weichman & Johnson[5] attempted to seal the apical foramen in vitro by means of a high power-infrared (CO_2) laser. Although their goal was not achieved, sufficient relevant and interesting data were obtained to encourage further study.[6]

1990: It was not until that this laser was available for dental use. Early studies with this laser was in its application for soft tissue procedure as well as inhibition of caries.[7]

Laser Basics:

Dental lasers are named depending based on the active medium that is stimulated.

The active mediums contain atoms whose electrons may be excited to a metastable energy level by an energy source. The active medium may be excited by excitation mechanisms that pump energy into the active medium by one or more of three basic methods; optical, electrical or chemical.[8] (Figure 1)

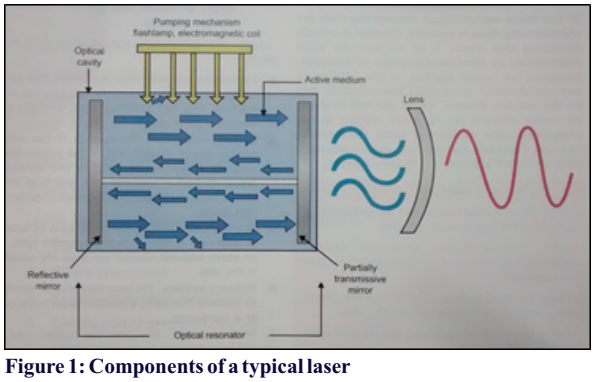

Figure 1: Components of a typical laser

Laser light is unique in that it is monochromatic (light at one specific wavelength), Directional (Low divergence) and coherent (all waves are in a certain phase relationship to each other).[9]

These highly directional and monochromatic laser lights can be delivered on to target tissue as a continuous wave, Gated-pulse mode or free running pulse mode.

Effect of Lasers on the Tooth:

The first experiment with lasers in dentistry was reported in a study about the effects of a pulsed ruby laser on human caries.10 The results of that study showed that the effects varied from small 2-mm deep holes to complete disappearance of the carious tissue, with some whitening of the surrounding rim of enamel, indicating extensive destruction of carious areas along with crater formation and melting of dentine.

Clinical Application of Lasers in Endodontics:

Pulpal Diagnosis [11,12]

Laser Doppler flowmetry, which was developed to assess blood flow in microvascular systems, also can be used for diagnosis of blood flow in the dental pulp.

This technique uses helium-neon and diode lasers at a low power of 1 or 2 mW. The laser beam is directed through the crown of the tooth to the blood vessels within the pulp. Moving red blood cells causes the frequency of the laser beam to be Doppler shifted and some of the light to be backscattered out of the tooth. The reflected light is detected by a photocell on the tooth surface

The main advantage of this technique, in comparison with electric pulp testing or other vitality tests, is that it does not rely on the occurrence of a painful sensation to determine the vitality of a tooth

Dentin Hypersensitivity [13]

Middle output power lasers (Nd:YAG and CO2 lasers): Several authors have investigated the He–Ne laser emitting at 632.8 nm (Senda et al. 1985, Matsumoto et al. 1986, Gomi et al. 1986, Wilder-Smith 1988b).

Output powers used for this treatment ranged from 0.5 to 3 W, and a success rate of over 90% was reported. The mechanism causing a reduction in hypersensitivity is mostly unknown, but it is thought that the mechanism for each laser is different.

In the case of low-power lasers (He–Ne and GaAlAs lasers), a small fraction of the laser's energy is transmitted through enamel or dentine to reach the pulp tissue (Watanabe et al. 1991, Watanabe 1993).

It has been suggested that He–Ne laser irradiation may affect the electric activity (action potential) and not affect peripheral A∂ or C-fiber nociceptors (Rochkindet al. 1987, Jarvis et al. 1990).

Endodontic Surgery: [14]

Surgical endodontic therapy is the treatment of choice when teeth have responded poorly to conventional treatment or when they cannot be treated appropriately by nonsurgical means.

The goal of endodontic surgery is to eliminate the disease and to prevent it from recurring. The surgical option should be considered only when a better result cannot be achieved by nonsurgical treatment. Nd:YAG lasers have shown a reduction in the penetration of dye or bacteria through resected roots.

Root Canal Obturation using Gutta percha and Laser:[14]
Gutta-percha is thought to be melted by laser heat energy.

Anic and Matsumoto, attempted to investigate whether it is possible to perform the root canal filling using sectioned gutta-percha segments and a pulsed Nd:YAG laser.

This was shown to be possible by the vertical condensation method, but the technique required too much time. At present, this technique is not practical. Although a method combining an argon laser and light-curable resin is in the literature, proper application of this method requires further research.[15]

Lasers in pulpotomy and pulpectomies [14]
The ability of CO_2 Laser to arrest bleeding, disinfect dentinal wound exposures of 1sq.mm makes it an ideal choice for pulp capping.

Studies have shown a success rate of over 91% in younger age groups of 10-20-year-old as compared to 68% where $Ca(OH)_2$ was used 2 years after. Pulpotomies too have shown a high success rate following CO_2 Laser therapy.[19]

Sterilization of root canals:
In the course of the root canal infection, the micro environment favours the selection of relatively few bacterial types which can survive and proliferate being out of reach of the host's immune response.

Rinsing solutions applied during conventional root canal treatment act through direct contact with the bacteria targeted. Due to the insufficient penetration depth of the bactericidal solutions microorganisms in the deeper layers of dentin cannot be affected.[16,17]

In general, dental lasers provide greater accessibility of formerly unreachable parts of the tubular network due to their better penetration into dentinal tissues.[18]

Laser light which penetrates up to > 1000µm into the dentin thus has scope for complete canal sterilization.

The laser is an effective tool for killing microorganisms because of the energy and wavelength characteristics. Infected root canals are an indication for this laser treatment, but its application in extremely curved and narrow infected root canals appears difficult.[19]

Laser assisted apical sealing [20]
A study evaluated the ability of four different laser systems to seal the apical portion of the root canal and to fuse a dentinal plug in the apical foramen.

Through the irradiation procedure, mechanically stable plug formation was achieved, but leak tightness was observed in selected samples only.

When the Nd:YAG laser was used at a setting of 1.5 W, which corresponds to the established standard setting for the endodontic procedure, leak tightness was achieved to a high extent. The ability of this wavelength to seal dentinal tubules has already been described in previous studies.[21,22]

Instrument Retrieval: [23]
At present, various methods exist for the removal of a fractured instrument.[24] However, no standardized procedure for safe and consistently reproducible removal has prevailed. Most common methods operate with ultrasonic instrumentation, and microtube delivery methods, but they also have disadvantages despite their advantages.

However, the process of accessing the fractured instrument frequently necessitates destruction of healthy tooth substance, since there must be enough space to grip the fractured instrument in a minimum length, or to get by the instrument. Tooth fractures[25,26] and the occurrence of "fausse routes"[27] are negative consequences. Techniques for removing fractured instruments without destroying healthy tooth substance have not yet been established

CONCLUSION:
During the last decade lasers have shown rapid strides in technology advances. The emergence of lasers with variable wavelengths and the ability to be used for various applications in dentistry have influenced the treatment of dental patients. When used efficaciously and ethically, lasers have been an essential tool in many dental treatments. With the development of thinner, more flexible and durable laser fibres, laser applications in endodontics will increase. With the advent of Lasers in dentistry, the complex procedures have become easier and time saving. Thus, the ability to care for patients has improved.

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