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APPLICATIONS OF LASERS IN DENTISTRY: A REVIEW

[1]Manish Kumar, [2]Deepak Meena, [3]Smitesh Patel, [4]Bhavesh Kumar Meena

[1]Senior Resident, Department of Dentistry, S P Medical College, Bikaner, Rajasthan, India.
[2]Medical Officer, Department of Dentistry, S P Medical College, Bikaner, Rajasthan, India.
[3]PG Student, Department of Oral Medicine and Radiology, Ahemdabad Dental College, Ahemdabad.
[4]Department of Dentistry, Goenka Research Institute of Dental Sciences, Gandhinagar, Gujarat.

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ABSTRACT

Lasers were introduced into the field of clinical dentistry with the hope of overcoming some of the drawbacks posed by the conventional methods of dental procedures. Since its first experiment for dental application in the 1960s, the use of lasers has increased rapidly in the last couple of decades. At present, wide varieties of procedures are carried out using lasers. Laser dental care is possible in all of the disciplines of dentistry. The public has an expectation that their dentist should be up to date and wants the most modern, advanced care possible. The future of lasers in dentistry is promising, and new applications and procedures are being developed. Laser treatment in dentistry has replaced many traditional electrosurgical and scalpel procedures and is beginning to replace the dental handpiece. Compared with conventional techniques, laser treatment has many advantages. These advantages include reduced overall treatment time, decreased bacterial contamination & reduced swelling, scarring, and wound contraction at of the surgical site, excellent hemostasis.The aim of this review is to describe the application of lasers in dental hard tissue and soft tissue procedures.

INTRODUCTION

The use of lasers in dentistry has increased over the past few years. The first laser was introduced into the fields of medicine and dentistry during the 1960s (Goldman *et al*., 1964). Since then, this science has progressed rapidly. Because of their many advantages, lasers are indicated for a wide variety of procedures (Frentzen and Koort, 1990; Aoki *et al*., 1994; Pelagalli *et al*., 1997; Walsh, 2003). Conventional methods of cavity preparation with low and high speed handpieces involve noise, uncomfortable vibrations and stress for patients. Although pain may be reduced by local anaesthesia, fear of the needle and of noise and vibration of mechanical preparation remains causes of discomfort. These disadvantages have led to a search for new techniques as potential alternatives for dental hard tissue removal [1]. The aim of this review is to describe the application of lasers in dental hard tissue procedures and soft tissue procedures.

Corresponding Author

Manish Kumar
Email: - drmanishagarwalmds@gmail.com

Types of Lasers

1. Hard tissue- LASERs for hard tissue procedures show good absorption by hydroxyapatite and water making it more efficient in ablating enamel and dentine. It causes water to evaporate into steam in tissues and result in micro explosions of hard tissue [2].

a) Er:YAG

b) Er,Cr:YSGG: There is absence of melting, charring and carbonization (char formation)

c) Nd:YAP (Wavelength 1340) It has absorption coefficient in water approximately 20 times greater than Nd: YAG.

2. Soft tissue- LASERs for soft tissue are smaller and less expensive. They considerably have greater applications [3].
a) Argon (488nm,514nm wavelength, fiber diameter 300µm,0.05 sec pulse duration, 0.2 second between pulses)
b) CO2 (5-15 w) it may be absorbed by water component of dental hard tissue which could lead to thermal damage therefore contact with these tissues must be avoided. It leaves a char layer on root surface [4].
c) Nd:YAG (1064nm wavelength, 0.2- 1.2mm diameter tips, 3 w power,20 pulses per second) Nd:YAG penetrates water to a depth of 60mm before it is attenuated to 10% of its original strength. Energy is scattered rather than absorbed. If pigmented scattering is twice as great as absorption. Therefore ideal for ablation of hemorrhagic tissue. It penetrates soft tissues to a depth of 2 plus or minus 1. It leaves a char layer on root surface.
d) Diode (800nm to 830nm, 980nm wavelength, fiber diameter 300µm, 2-10 w power)
e) Erbium LASERs in contact mode can be used to cut soft tissue with hemostasis, and then tooth should be protected.

Table 1. Classification based on light spectrum

UV Light	100 nm - 400 nm	Not used in dentistry
Visible light	400 nm to 750 nm	Most commonly used in dentistry (Argon & Diagnodent Lasers)
Infrared light	750 nm to 10000 nm	Most dental lasers are in this spectrum

Use of lasers on hard tissues
Lasers for caries detection- While laser fluorescence has demonstrated good sensitivity and excellent reproducibility for detecting caries, it is not able to quantify the extent of decay. Laser fluorescence also has performed well in the detection of residual caries [5]. While safety is not a concern with this low-power laser application, more data is required to aid in the clinical interpretation of the results and to develop a clinically useful sense of the limits of this technology.

Lasers for removal of carious lesions and cavity preparation- Laser systems can be used for effective caries removal and cavity preparation without significant thermal effects, collateral damage to tooth structure, or patient discomfort. Er-based laser system can achieve effective ablation at temperatures well below the melting and vapourization temperatures of enamel. To date, alternative laser systems, including super-pulsed CO2, Ho:YAG, Ho:YSGG, Nd:YAG, Nd:NLF, diode lasers and excimers, have not proven feasible for use for cavity preparation in general practice settings. Other than caries removal, this is a range of other well established laser hard tissue procedures include desensitization of cervical dentine (using Nd:YAG, Er:YAG, Er,Cr:YSGG CO2, KTP,and diode lasers), laser analgesia (using Nd:YAG, Er:YAG, and Er,Cr:YSGG lasers), laser-enhanced fluoride uptake (using Er:YAG, Er,Cr:YSGG, CO2, argon, and KTPlasers) [6].

Laser Bleaching- In October 1998, the ADA Council concluded that because of concerns regarding pulpal safety and a lack of controlled clinical studies, the CO2 laser could not be recommended for tooth-whitening applications. The council indicated, however, that the argon laser might be an acceptable replacement for the conventional curing light if the manufacturer's suggested procedures are followed carefully [7].

Use of lasers on soft tissues
Laser curettage- Both the Nd:YAG and gallium-arsenide (or diode) lasers are promoted for curettage [8]. A critical review of the best available evidence, however, strongly indicates that there is no added benefit to the patient when this procedure is performed after traditional mechanical scaling and root planing. Proponents of laser curettage point to the ability of these lasers to kill microorganisms. Er:YAG laser posses suitable characteristics for various surgical and non-surgical procedures but randomized controlled clinical trials have to be encouraged to confirm its status as an adjunct or alternative to convectional periodontal therapy [9].

Use of Lasers in Prosthetic Dentistry:
Lasers are now being used in a variety of procedures in prosthetic dentistry [10].

A. Fixed prosthetics/esthetics
i. Crown lengthening
ii. Soft tissue management around abutments
iii. Osseous crown lengthening
iv. Troughing
v. Formation of ovate pontic sites
vi. Altered passive eruption management
vii. Modification of soft tissue around laminates
viii. Bleaching

B. Implantology
i. Second stage uncovering
ii. Implant site preparation
iii. Peri-implantitis

C. Removable prosthetics
i. Tuberosity reduction
ii. Torus reduction
iii. Soft tissue modification
iv. Epulis fissurata
v. Denture stomatitis
vi. Residual ridge modification

Lasers in pediatric dentistry

One of the benefits of laser use in pediatric dentistry is the selective and precise interaction with diseased tissues. Less thermal necrosis of adjacent tissues is produced with lasers than with electrosurgical instruments [11]. During soft tissue procedures, hemostasis can be obtained without the need for sutures in most cases. With the benefit of hemostasis during soft tissue treatments, wound healing can occur more rapidly with less post-operative discomfort and a reduced need for analgesics. Little to no local anesthesia is required for most soft-tissue treatments. Reduced operator chair time has been observed when soft tissue procedures have been completed using lasers. Lasers demonstrate decontaminating and bacteriocidal properties on tissues, requiring less prescribing of antibiotics post-operatively [12]. Lasers can provide relief from the pain and inflammation associated with aphthous ulcers and herpetic lesions without pharmacological intervention. The erbium lasers can remove caries effectively with minimal involvement of surrounding tooth structure because caries-affected tissue has higher water content than healthy tissue. The noise and vibration of the conventional high-speed dental handpiece has been postulated as stimulating discomfort, pain, and anxiety for the pediatric patient during restorative procedures [13]. The non-contact of erbium laserswith hard tissue eliminates the vibratory effects of the conventional high-speed handpiece allowing tooth preparations to be comfortable and less anxiety provoking for children and adolescents. Nd:YAG and erbium lasers have been shown to have an analgesic effect on hard tissues, eliminating injections and the use of local anesthesia during tooth preparations [14].

Advantages of Lasers

1. Increased coagulation that yields a dry field
2. Better visualization
3. Tissue surface sterilization
4. Reduction in bacterial counts
5. Decreased swelling, edema and scarring
6. Decreased pain
7. Faster healing
8. Increased patient acceptance

CONCLUSION

LASERs are thus a captivating technology and one of the best inventions of the twentieth century. The application of LASERs in dentistry will definitely alter the clinical practice with numerous uses in the nonsurgical as well as surgical aspects of therapy. There is a leaning curve in the use of lasers in dentistry. As long as the clinician has completed a training course & proceeds through the learning curve at a comfortable pace, the rewards will quickly be noticed by the patient and the dental team. Lasers can prove to be a blessing in Disguise if used safely and properly.

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