

SHORT COMMUNICATION

A review of the use of laser in periodontal therapy

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	Article Code: IDJSR SE 0168

Quick Response Code

Abstract

The use of lasers has significantly developed in modern dentistry, however the clinical value and awareness on the benefits of their use is limited. Lasers have made their way in dental treatment since 1994. They have been granted Food and Drug Administration (FDA) approval, however the American Dental Association (ADA) is still researching on the outcomes of laser therapy¹. This article reviews the use of laser therapy in the initial non-surgical phase of periodontal therapy.

Introduction

The term “LASER” stands for “light amplification by stimulating emission of radiation”². Lasers were introduced in the field of medicine approximately 50 years ago³. This technology trickled its way to the

field of dentistry with applications in various aspects of clinical practice.

The field of restorative dentistry has utilized lasers, for the removal of tooth decay, and this is where laser therapy evolved from in dentistry. Lasers have been used for the removal of the carious lesion and preparation of the tooth for a restoration. Many restorative materials incorporate laser in their setting/curing system. Lasers help in controlling the spread of pathological and non-pathological lesions as well as acquiring tissue for biopsies. Lastly, tooth whitening has become a quick and easy procedure for patients and practitioners with the use of laser technology. More recently, mechanical debridement of subgingival root surfaces and periodontal pockets are being treated with lasers as an adjunct or substitute⁴.

Laser therapy has greatly advanced in recent years, especially in restorative dentistry, however general dentists are not aware of the many benefits they can receive with the help of this developing therapeutic tool in periodontology.

How Lasers Work

There are various types of lasers in the market and each device emits energy at a specific wavelength. For example, diode (gallium: arsenide) lasers emit wavelengths ranging from 635-950 nm. Carbon dioxide (CO₂) lasers emit wavelengths at 10 600 nm⁴. Secondly, radiation is delivered in different forms. The radiations can be continuous, pulsed or running pulse waveforms. The photon emitted through the collimator for a unidirectional, monochromatic light being emitted in coherence. Thirdly, the laser beam is infrared and invisible; therefore light is incorporated into the device to act as an aiming beam. Upon exposure, the targeted tissue will absorb, reflect or scatter the laser beam⁵. Two variables control this affect; these are the wavelength and the properties of the target tissue. Biologic tissues primarily absorb the beam, while scattering only occurs in deep tissue penetration^{5, 6}.

Applications of lasers in dental procedures:

Restorative Dentistry: Erbium-doped yttrium aluminum garnet (Er: YAG) Lasers are useful in the detection/removal of caries with maximal preservation of healthy mineralized enamel and the cavity preparation for placement of filling materials. Lasers have also been beneficial in the curing of

filling materials such as photopolymerization composite resins^{7,8}.

Oral and Maxillofacial Surgery (OMFS): Lasers in OMFS are generally used for excisional/ incisional, biopsy, ablation and hemostasis. Lasers are used for biopsy in removing tissue for examination/inspection of potential neoplastic tissue. Ablation is a process in which superficial tissue is removed and unnecessary tissue removal could be avoided⁹. Hemostasis is the control of bleeding at the site if surgery.

Endodontics: Laser fibers and endodontic tips carry out the following procedures: diagnosis, pulpotomy, cleaning and obturation of the root canal system, retreatment and apical surgeries. The laser Doppler flowmetry is an advancement in endodontics as it analyzes the blood flow in the canal system. This evaluation was considered as one of the most accurate methods in testing pulp vitality¹⁰.

Periodontal Disease: Periodontitis is a polymicrobial infection caused by multiple types of bacteria, harmfully interacting with the body's immune system. There are various types of bacteria that accumulate in plaque (biofilm), which is found lining the gums of the oral cavity. Inadequate oral hygiene causes migration of these bacteria along the root surface to form a hardened calcified substance known as calculus (tartar). In response to this invasion of bacteria, gum tissues become inflamed and ulcerated. Further neglect may cause periodontal tissue damage with regression of bone around the tooth, ultimately leading to tooth loss¹¹.

Lasers in periodontal therapy: Arresting the disease process is the primary goal of periodontal treatment¹². Initial therapy is the first step to re-establish a healthy oral cavity. This is the process of cleaning and disinfecting the affected root surfaces. Once infection and inflammation in the oral cavity are under control, secondary goals are outlined to help in regeneration of healthy periodontal attachment to the tooth surface, which may include surgical treatment^{12, 13}.

Treatment techniques for initial therapy: Phase 1 of periodontal therapy includes mechanical debridement of the biofilm, which requires removal of bacteria and calculus from the root surfaces of affected teeth. This process is known as "scaling and root planing" or "root debridement"¹⁴. Hand instruments and/or ultrasonic (high frequency) instruments are traditionally used to carry out the procedure and require a high level of skill and tactile sensitivity. An alternative option is non-surgical therapy but this technique is sensitive and also time consuming.

An invasive procedure carried out in the first phase of periodontal therapy known as curettage, where the lining of an inflamed pocket was removed from the tooth or tissue has recently seen advancements in research. Current literature suggests if bacteria are affectively removed, tissue repair can occur without the need for surgical intervention^{12, 14}.

Treatment with lasers: An adjunct for non-surgical debridement of bacteria from root surfaces can now be conducted with the use of lasers. Neodymium: Yttrium-Aluminium-Garnet (Nd: YAG) laser is one example used in the treatment of periodontitis providing the ability to carry out sub gingival curettage, removal of sub gingival plaque and calculus from infected root surfaces¹⁵.

Periodontal tissues have varying water and mineral content, pigment and tissue density, which allows them to absorb beams from Nd: YAG and diode lasers¹⁶. On the other hand, CO₂ lasers are better suited for soft tissue procedures because its energy beam is absorbed mostly by water. Hydroxyapatite is better suited for other types of lasers¹⁷.

Other factors that affect absorption of energy beam into the target include power, pulse duration, duration of exposure, angle of energy delivery and waveform (pulsed or continuous).

When choosing the type of laser, a specific goal should be made in order to achieve the desired results. This is because, energy absorption will cause the target to warm up, coagulate, vaporize or melt and recrystallize as seen in hard tissues.

Periodontal Disease and Lasers techniques: The American Academy of Periodontology (AAP) has suggested that using lasers during scaling and root planing (SRP) may provide improvements in procedures by decreasing bleeding, swelling and discomfort during surgery.

Laser Assisted New Attachment Procedure (LANAP) is a relatively new treatment option that helps remove plaque and calculus, while limiting bacterial infection to help fight periodontitis by regenerating rather than resecting tissues. LANAP helps to remove infection-causing bacteria in a safe and painless procedure that promotes epithelial and periodontal fiber attachments in the affected area¹⁸. Other uses of this technique include removal of caries and preparation of teeth for restorations or crowns.

Caution must be taken when using laser therapy because of varying power levels and wavelengths. Incorrect wavelength and/or power levels can result in damage during periodontal treatment causing more harm than good.

Benefits of Laser Treatment

Modern techniques using lasers can control the spread of harmful bacteria and limit tooth loss compared to standard periodontal treatment options. Some benefits of laser treatment for gum disease include: elimination of cutting and bleeding, soreness and discomfort of the gums. Isolation of deep periodontal pockets. Reduction in tooth loss. Regeneration of bone and ligament tissues. Lastly, increased chances of success with a solution in case of setbacks that may occur¹⁹.

As compared to a dental hand piece, lasers are advantageous in certain conditions causing less pain, anxiety and discomfort for the patient. In addition, soft tissue damage is minimized and the need for anesthesia may be avoided in less invasive procedures.

Conclusion

With all the benefits of laser therapy outlined in this review, we point out the lack of studies supporting its use alone. There is no evidence in the literature to suggest it may control adult chronic periodontitis without conventional SRP and surgical treatment. The advantage of laser therapy in conjunction with traditional therapy are of benefit, yet current challenges include increased operating costs for the dentists and patients coupled with technique sensitivity for operators.

The main advantages of laser therapy over conventional methods are reduced tissue inflammation and bleeding. Sterilization of the affected area leading to a reduction in post-treatment discomfort with higher patient satisfaction. With this in mind, are lasers considered more advantageous than traditional therapy? Current literature is inconclusive.

In order to come up with a final conclusion, evidence-based science provides strict research protocols and parameters to make fair comparisons between various treatments. Studies should have an adequate sample size, be randomized with controls and have specific treatment goals and criteria. To show effectiveness and long-term results, an appropriate time-line should be set.

In a systematic review of the literature on the use of lasers in periodontal therapy, only 8 of 300 studies met the criteria above. Researchers in only 5 out of 8 studies assessed the tissue attachment after treatment, a gold standard in assessing periodontal treatment outcome. The results of the review could not point to any advantages of Nd:YAG lasers over conventional periodontal therapy in the treatment of initial periodontitis.

Initial non-surgical therapy of periodontitis remains the treatment of choice with growing interest in lasers as an adjunct treatment option for gum disease. The benefit of a less invasive treatment option coupled with shorter treatment duration and discomfort for the patient are attractive features of laser therapy but studies have yet to prove its effectiveness. 10-15% of the population that suffer from periodontal disease is treated with long-term daily oral hygiene instructions. Professional monitoring and evaluation with regular periodontal maintenance every 3 months is the desired level of care with no short cuts in the foreseeable future.

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