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Lasers And Its Advantages In Endodontics- A Review

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ABSTRACT

Since Maiman's invention of the ruby laser in 1960 and Weichman's use of the laser for endodontics in 1971, various papers have been written about possible applications of laser endodontics. This paper seeks to outline laser applications, such as in pulp diagnostics, dental hypersensitiveness, pulp-capping and pulpotomy, root canal sterilization, root canal forming, and shielding and apicectomy. The laser results are also reviewed on the walls of the root canal and periodontal tissue. The article discusses the role Lasers have played in endodontics since the early 1970s, provides a summary of several recent scientific papers and outlines how the endodontic laser future could hold. With several new laser wavelengths and modes of possible supply, a lot of interest is growing in this exciting area.

KEY WORDS: lasers technology, endodontics, ND-YAG, pulp capping, pulpotomy.

INTRODUCTION

Laser is a system which converts light from different wavelengths in the visible, infrared and ultraviolet regions into chromatic radiation with a wave step that mobilizes immense heat and energy in a close range. The first to examine possible applications of ruby laser in dentistry [1]. They started their laser experiments on hard dental tissue by exploring the potential use of a ruby laser to minimize the depletion of the base. Following the original trials of the Ruby Laser, the health care practitioners started to use other lasers, for example, Argon (Ar), Carbon Dioxide (CO2)., who tried to screen the apical foramen in vitro with a high intensity infrasound (CO2) layer, registered the first laser in endodontics. Though their objective was not accomplished, adequate and appropriate data were collected to enable further research. Afterwards the apical foramen with the laser Nd: YAG is attempted to seal [1,2]. At that time, several articles have been published on laser applications in

dentistry, with increasing interest in the subject over the last 5 years [3, 4]. Many articles have been written and a lot of knowledge has been collected on endodontic applications. Nonetheless, the adoption of this technology by practitioners in dentistry and in endodontics in particular remained restricted, possibly partly because the boundary of technical, biological, and dental science is broken by it. This review article aimed at highlighting laser applications in endodontics.

DIAGNOSIS OF THE DENTAL PULP

Diagnosis of dental pulp blood supplying microvascular structures such as the retina, laser Doppler flowmetry (LDF) has been developed for the evaluation of blood flow, gut mesentery, renal cortex and skin. This novel method used a light beam from a helium–neon (He-Ne) laser emitting at 632.8 nm that, when dispersed by travelling red cells, shifted in frequency according to the Doppler principle. This redirected a fraction of the light dispersed back from the illumined field. This light had been sensed and analyzed to generate a signal based on the red cell stream (a volume of cells illuminated by the mean cell speed). This data can be used as a blood flow metric, expressing the meaning as a percentage of total deflection (FSD percentage) at a given level.Under physiological conditions, it has not been proven that laser Doppler flow meters provide a consistent indicator of changes in red cell flux of pulp tissue due to issues such as artifacts, such as indicator of changes in gingival tissue red cell flux or changes in ambient light strength, and activity artifacts.

PULP CAPPING AND PULPOTOMY

Conventional pulp therapy choices in advanced adult teeth include pulp capping or root canal treatment. The result of the pulp capping process, whether direct or indirect, is uncertain, with recorded success rates ranging from 44 to 97 %. If pulp capping techniques are not specified, pulp extraction and root canal treatment are performed. Devitalization and root canal care are not recommended in premature permanent teeth until complete apex development and completion have occurred[5]. Thus, the preferred endodontic therapy is pulpotomy followed by calcium hydroxide dressing. Because of the laser's ability to vaporize tissue as well as coagulate and close small blood vessels, a bloodless field would be easier to obtain. Furthermore, the wound surface will be sterilized[6]. Became the first to characterize laser treatment of exposed pulp tissues in dogs using the CO2 laser to induce hemostasis; [7] used the Nd: YAG laser in rats and dogs. Their findings revealed that lasers aided pulpal healing after 2 W of irradiation for 2 seconds. [8] announced that the CO 2 laser was a useful tool for direct pulp capping in human patients[6].

MODIFICATION OF ROOT CANAL WALL

Endodontic instrumentation creates organic and mineral residue on the root canal wall. While this smear coating can be advantageous in that it blocks tubules and reduces dentine permeability, it can

also harbor bacteria and bacterial items. As a result of these factors, laser removal of the smear layer and replacement with an uncontaminated chemical sealant, or sealing by melting the dentine surface, has become a priority.[9] were the first to use a laser in the root canals, trying to close the apical foramen in vitro with a high-power CO2 laser. Despite the fact that the target was not met, enough evidence was collected to warrant further investigation. SEM and confocal laser scanning microscopy were often used in other research into the effects of CO2 laser irradiation on dentine [7,8].

STERLIZATION OF ROOT CANALS

Numerous experiments have been conducted using CO2 and Nd: YAG lasers to sterilize root canals. There seems to be a risk of bacterial infection spreading from the root canal to the patient and the dental team by the smoke emitted by the laser, which can result in bacterial dissemination [9]. When using lasers in the root canal, steps such as a powerful vacuum pump system must be taken to prevent infection transmission.Laser sterilization of root canals is troublesome because thermal damage to periodontal tissues is likely. It is important to choose a suitable laser parameter.

ROOT CANAL SHAPING AND OBTURATION

Root canal forming is a critical stage in the endodontic process because it helps in the elimination of organic tissues and allows for drainage and canal obturation. Various approaches have been proposed to accomplish these aims, including the removal of anomalies from the canal walls.Root canal orifices were primed with an Er: YAGlaser. The root canal surface looked smooth in the light microscope and scale-like in the SEM after being irradiated with an Er: YAG laser. Since Nd: YAG laser irradiation will produce clean and normal root canal walls, this modality has been proposed for root canal forming.An Ar laser emitting at 477 and 488 nm can be used to photo polymerizecamphor Quinone-activated resins for obturation, according to the findings, an Ar laser attached to an optical fiber may be a useful modality in endodontic therapy. Similar research has been conducted with the obturation substance AH-26 and composite resin.Laterally compacted resin fillings had less voids than vertically compacted resin fillings, according to SEM study. The Ar, CO2, and Nd: YAG lasers have all been used to soften gutta-percha, and the results show that the Ar laser can be used to achieve a strong apical seal[10,11].

EFFECT ON PERIODONTAL TISSUE

The periodontal membrane and ligament connect the tooth root to the alveolar bone. Thermal damage to periodontal tissues is a risk when using a laser for intracranial applications. Several experiments on laser-induced thermal effects on the pulp have been reported, but few have addressed the effects of energy introduced into the root canal on the periradicular tissues. Eriksson

and Albrektsson discovered that the critical temperature for bone survival was 47 °C for 1 minute.The first study on the effect of the Nd: YAG laser on periodontal tissues was conducted on dogs. The findings revealed that the laser-treated. Ankylosis, cemental lysis, and significant bone remodeling were observed in the teeth. The parameters used in this analysis, however, were excessive (3 W and 25 pps for 30 s). Many other researches on the periodontal impact of lasers on Dogs and Rats have been conducted since that time. Lasers had no negative effects on periodontal tissues when the necessary criteria were used. Laser systems can run in a variety of modes, including continuous wave, pulsed wave, chopped wave, and Q-switched.The root surface temperature increase stayed below 2.2 °C while the Ho: YAG laser was used inside the root canal at a parameter of less than 1 W, 5 Hz, and total energy of 58 J. The implications on periodontal tissues must be understood in order for the procedure to be effective. It is critical to choose the correct parameter and procedure [12,13].

FULL ROOT CANAL TREATMENT

Several researchers studied the Nd: YAG laser for therapeutic endodontic therapy. Clinical analysis of infected teeth 3 or 6 months after laser irradiation and root canal filling showed that postoperative irritation or pain was greatly decreased in the laser-treated community relative to the nonlaser-treated group .The effect of the Nd: YAG laser on apical postoperative exudative status was studied, and the findings revealed that 60 percent of irradiated cases had no or moderate inflammation, while 70 percent of nonirradiated teeth had extreme inflammation .The immediate drying impact of the Nd: YAG laser may be attributable to the irradiation's evaporating effect on the exudate, causing the suspended materials to precipitate within the canals, accompanied by a hemostatic and healing reaction, with corresponding suppression of the periapical lesion's inflammatory state.Gutknecht et al, recorded an 82 percent clinical success rate based on the following criteria: objective reduction of apical translucence after 3–12 months; freedom from symptoms after therapy completion (negative percussion, occlusal load without discomfort). Lasers can be used as an alternative to traditional medicine, but they cannot be used for treatment of their own[14].

APICECTOMY

Apicectomy is a surgical technique that removes the root apex while both removing and curetting the surrounding periapical tissues. The indications for resection are mostly where prior root canal therapy has failed. Because of the laser's ability to vaporize tissue as well as coagulate and close shallow blood vessels, a bloodless surgical area should be easier to obtain. As the cut surface is irradiated, it is sterilized and sealed. Furthermore, the Er: YAG laser's ability to sever rough dental tissues without causing any thermal or structural damage will reduce the need for mechanical

drills.Clinical research into the use of lasers for apicectomy started with the CO2 laser, which was successfully used to treat a secondary apical abscess. The laser was supposed to seal the dentinal tubules in the apical portion of the root and sterilize the infected region. Following that, the suitability of the CO2 laser for this function was investigated using extracted teeth in vitro and dogs in vivo. The use of lasers during surgery did not seem to have any impact on patient outcomes or regeneration. When this laser was used on patients undergoing apicectomies, however, it did not enhance the healing process. The Nd: YAG laser was first used in clinical trials. The Nd: YAG laser was observed to limit dye or bacteria penetration inside resected roots when used on removed teeth in vitro. The laser was used following root resection in the preceding studies.In clinical trials, the use of this laser resulted in faster recovery and less postoperative pain. The use of this laser for retrograde cavity preparation in extracted teeth revealed that the working time with the Er: YAG laser is substantially less than with ultrasonic tools, but no major variations in dye penetration were identified between the groups treated with the Er: YAG laser and the ultrasonic tools [15]**.**

OTHER APPLICATION FOR ENDODONTIC TREATMENT

A calcified attached denticle was removed using a pulsed dye laser emitting at 504 nm. After removal, SEM analysis revealed a sharp surface at the base of the pulp stone.For the treatment of root fractures, CO2 and Nd: YAG lasers have been used. However, fusion of the broken root halves was not achieved regardless of the re-approximating process, laser type, electricity, or other parameters used.Lasers have been successfully used to sterilize dental devices. The results showed that all three lasers (Ar, CO2, and Nd: YAG lasers) would sterilize selected dental instruments; however, only the argon laser could do so reliably at the lowest energy level of 1 W for 2 minutes. Before applying this expertise in a clinical setting, suitable irradiation systems must be built. Other therapies can be available for lasers, but before they can be recommended, their results must be studied [16,17]**.**

CONCLUSION

Laser applications in endodontics can develop as laser fibers get thinner, more compact, and more robust. Laser instruments are also relatively expensive, so access to them is restricted. Ideally, the laser of the future will be able to deliver a wide range of wavelengths and pulsewidths, each tailored to a specific application. If we have a full understanding of the appropriate laser parameters for and treatment modality, lasers that will allow dentists to care for patients with better procedures and equipment will be created.

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