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Perspective

May laser be a key for endodontics?

¿Puede el láser ser clave para la endodoncia?

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Photonics, understood as the science devoted to light generation, its detection, and manipulation is gaining ground in the ranking of tools used to improve human health and wellbeing. However, this was not so at the beginning; laser was defined as "a solution looking for a problem." The laser was only recognized as a useful tool in medicine several decades after its discovery. In part the growth of laser applications comes from military research. Nowadays the applications of laser far exceed the military field and are applied in a variety of fields, including medicine and dentistry. Bacterial persistence within the root canal system is the main cause of endodontic infection, persistence, and subsequent endodontic failure.[1]

Enterococcus faecalis, a gram-positive, facultative anaerobic coccus, is the most prevalent microorganism isolated in cases of endodontic failure, due to its ability to survive in adverse environments, such as the endodontium, which is characterized by lack of nutrients, alkalinity and dryness. The antiseptic irrigating solutions that are delivered conventionally with end-vented or side-vented needles lack a turbulent flow, limiting the ability to reach complex areas, such as isthmus or lateral canals. It has been demonstrated that endodontic instruments leave at least 35% of dentine surfaces untreated.[2] This leads to decreases rates of success, especially regarding the eradication of persistent infections.

Recently, the use of laser-activated irrigation (LAI) has been proposed as an adjuvant to conventional chemo-mechanical therapy to improve cleaning and disinfection. Erbium lasers (Er, Cr: YSGG 2780nm - Er: YAG 2940nm) are the most commonly used due to the high affinity of their wavelength with water. The absorption of the laser energy generates an instantaneous superheat, causing cavitation vapor bubbles inside the fluid, which expand and implode, generating shock waves and high speed streaming of fluid.[3] The generated pressure waves first move at a supersonic speed (shockwaves) and then at a sonic speed (acoustic waves), and are able to remove bacterial biofilms and the smear layer from complex anatomical areas. Mechanical injury to the membrane of bacterial cells has been demonstrated through atomic force microscopy following LAI.[4] One of the main advantages of LAI is that the laser fiber is placed at the entrance of the root canal during the entire activation, decreasing the possibility of extrusion of the irrigant and minimizing the thermal side effects.

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Sodium hypochlorite (NaOCl) is the "gold standard" of endodontic solutions due to its excellent bactericidal characteristics, and its effective pulpal tissue solvent effect.[5] It is used at concentrations between 0.5 and 6%, and its toxicity is concentration-dependent. Since NaOCl is not selective, dentine and periodontal ligament cells may be damaged, leading to inflammation and pain. Lately, several studies have shown an increase in the bactericidal effectiveness of NaOCl after being activated by laser; mostly these studies have been done using high concentrations of NaOCl[6].

A challenge in endodontics is to find alternatives to reduce the toxicity of NaOCl without losing its antibacterial activity. Thus, the study of eventual synergistic effects between laser and low concentrations of NaOCl becomes a field of great interest. In a recently published study, our group, Betancourt *et al.,*[4] demonstrated through an *in vitro* model a significant increase of the effectiveness of 0.5% NaOCl when activated by a Er,Cr:YSGG laser. Similarly Jaramillo *et al.,*[7] reported that the activation of buffered 0.5% NaOCl improved its antibacterial capacity against a four-weeks-old biofilm of *Enterococcus faecalis* on extracted teeth. Nevertheless, not all contributions are in agreement.

Christo *et al.,*[8] failed to demonstrate an improvement in the use of 0.5% NaOCl in identical biofilms. This disagreement may be a consequence of differences in the power of the laser used. The use of erbium lasers to activate irrigating solutions inside the root canal have opened a new field in endodontics.

Activation systems seems to be a good alternative to improve the irrigant delivery through the root canal system, above all to the areas where the instruments cannot reach.

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