New Technologies to improve root canal disinfection

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Introduction
The major causative role of microorganisms in the pathogenesis of pulp and periodontal diseases has been demonstrated. The main aim of endodontic therapy is to disinfect the canal system, which requires the elimination of microorganisms and microbial components and the prevention of their reinfection during and after treatment. This goal is pursued through chemomechanical debridement, for which mechanical systems are used with irrigating solutions.

Standard endodontic irrigation protocol
Sodium hypochlorite (NaOCl) is the most commonly used irrigant, owing to its antibacterial properties and its high concentrations (5–6 %) which have greater tissue-dissolving properties. However, the greater the concentration, the more severe the potential reaction to some extent, which is inadvertently thought to be chemically altered by the presence of other substances. The effectiveness of this irrigant has been shown to depend on its concentration, temperature, pH solution and solution conditions. Heated solutions (45–60 °C) and higher concentrations (10–15 %) have been shown to be effective in removing debris and resistant endodontic solutions with different systems. For example, at 60 °C and 10–15 % concentration, NaOCl is more effective than at 30 °C and 5 % concentration. The effectiveness of NaOCl is related to its disinfecting properties, which are mediated by the presence of hypochlorous acid and the reactive chemical species it generates. Hypochlorous acid (HOCl) and hypochlorite (OCl−) are produced in the reaction between NaOCl and organic materials. HOCl is a highly reactive disinfectant that can penetrate the surfaces of organic materials, whereas OCl− is a less reactive species that can achieve greater penetration into organic materials.

Ultrasonic activation of NaOCl
The ultrasound was first used and at the end of the root canal preparation phase is an indispensable step in improving endodontic disinfection. The type and frequency of OAPIs used in an ultrasonic system are critical for the effectiveness of the intervention. The irradiation time is endodontic disinfection. This concept is the base of laser-activated irrigation (LAI) and photon-initiated photoacoustic streaming (PIPS) technology.

The mechanism of this interaction has been attributed to the effective absorption of the laser light by NaOCl. This leads to the vaporization of the irrigant and to the formation of vapor bubbles, which expand and collapse with secondary cavitation effects.

When is activated in a limited volume of liquid, the high absorption...
The short pulse duration employed (10 μs) determines a photomechanical phenomenon. A study showed that there was no difference in bacterial reduction achieved by NaOCl activation generated a higher number of samples with negative bacterial cultures and a lower number of bacteria in the apical third was a promising result regarding the effectiveness of the technique, and has been confirmed by a more recent study.\(^3\)

## Additional disinfection systems

In order to improve methods that were able to activate the endodontic irrigants and to improve the results of NaOCl disinfection, one could consider the activation generated a higher number of samples with negative bacterial cultures and a lower number of bacteria in the apical third was a promising result regarding the effectiveness of the technique, and has been confirmed by a more recent study.\(^3\)

### Photodynamic disinfection

A current trend is the use of natural antibacterial and anti-inflammatory substances and technologies have been shown to have the potential to prove their cleaning capability, even systems that were able to activate the endodontic irrigants and to improve the results of NaOCl disinfection. For this purpose, different substances and technologies have been investigated over time with different results.

### Laser disinfection

One of the main disadvantages of the current endodontic irrigants is that they have to be used in the root canal system, and this principle is not clearly demonstrated by laser disinfection in the field of endodontics. Laser disinfection in the field of endodontics, several fields of use have been developed, based on the combination of NaOCl and a special light source. The PS attacks the membranes of microorganisms present on the root canal wall, absorbs energy from the light and releases its energy in the form of heat, which is transformed into mechanical energy that leads to the destruction of microorganisms on the root canal walls and in the dentin tubules. However, complete elimination of the biofilm and bacteria has not yet been possible, and the effect of the laser disinfection is less relevant than that of the classical solutions of NaOCl.\(^3\)

### Bioactive glass

Bioactive glass, bioactive glass or bioactive glass ceramics have been subjected to a number of methods for endodontic infection owing to their antibacterial properties, but conflicting results have been obtained.\(^1\)

### Natural plant extracts

A current trend is the use of natural plant extracts, taking advantage of the antibacterial activity of polyphenolic molecules generally used for storing food. These compounds provide an antimicrobial effect, but also their biocompatibility is not well established, and a subsequent increase in its permeability is associated with the loss of its functions. Nanoparticles synthesized from bioactive glass, ceramic nanoparticles, and a subsequent increase in its permeability is associated with the loss of its functions. Nanoparticles synthesized from bioactive glass, ceramic nanoparticles, and a subsequent increase in its permeability is associated with the loss of its functions. Nanoparticles synthesized from bioactive glass, ceramic nanoparticles, and a subsequent increase in its permeability is associated with the loss of its functions.