Irrigation protocols comparison, an in vitro study

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Introduction

The removal of remaining pulp tissue, microorganisms and bacterial toxins from the root canal system is essential to the success of endodontic therapy. It is generally accepted that the best way to carry out removal is by cleaning and shaping the root canal complex; microorganisms that remain in the root canal after treatment (or for some reason return to colonize the root canal after filling) are the main causes of endodontic failure (Zehnder, 2006). The use of root canal irrigants boosts bacterial elimination and facilitates the removal of necrotic tissue and dentin particles from the canal. Irrigants also prevent the packing of infected hard and soft tissues in the apical part of the root, and even in the periapical area (Haapasalo et al, 2005). But in spite of the use of these agents, intracanal bacteria may remain after biomechanical instrumentation (Naïr et al, 2003). Endodontic infections are based on multiple species of microorganisms and treatment must take into account the increasing resistance of the polymicrobial flora involved. Furthermore, the presence of debris not only reduces the efficacy of irrigant substances and root canal medicaments used for disinfection, but also favors the persistence of these bacteria in the canal system (Pagonis et al, 2010). All these factors can impede the main endodontic treatment objectives: the elimination of these etiologic agents from root canals and its three-dimensional network of dental tubules (Cheng et al, 2012). Failure to do so effectively may provoke endodontic failure.

Enterococcus faecalis (E. faecalis) is a gram-positive facultative anaerobic bacteria and the cause of secondary apical periodontitis. The resistance to treatment of E. faecalis is explained by its potential penetration into dentinal tubules (Molander et al., 1998; Sedgley et al., 2005), its prolonged survival capacity in root-filled teeth (Sedgley et al., 2005) and its inadequate response to antimicrobial irrigation solutions (Estrela C., 2007). In this context, the prevalence of E. faecalis is higher in persistent infections than in primary infections (Stuart et al., 2006).

Different irrigating solutions have been considered to decrease endodontic infection and contribute to canal sanitation, including: halogenated compounds (sodium hypochlorite - NaOCl), chlorhexidine (CHX), detergents (anionic, cationic), chelating agents (ethylenediaminetetraacetic acid [EDTA], citric acid), MTAD (mixture of tetracycline citric acid and detergent), triantibiotic mixture (TAM), apple vinegar (Estrela et al., 2012), propolis (Flaviana et al., 2007) and hydrogen peroxide (Kobayashi et al., 2014). CHX digluconate, which has been proposed as root canal irrigant, is a cationic biguanide made up of two chlorophenoxy rings and two biguanide groups connected by a central hexamethylene bridge with positive charges at each end of the bridge (Iaju & Iaju, 2011). Among its main properties relevant to endodontic application is its broad spectrum of antimicrobial activity, its specific bactericidal and bacteriostatic effects, and the long-term nature of its antimicrobial activity. At low concentrations, it has a bacteriostatic effect. At higher concentrations, it has a bactericidal effect due to the precipitation and coagulation of intracellular constituents (Wang et al., 2007; Xu et al., 2009), exerting its optimal effect on gram-positive bacteria at a concentration of 2%, the concentration recommended in the literature for root canal irrigation (Spangberg et al., 1973).

In root canal therapy, antibiotics can be used as adjunctive medicine. Hoshino and Takusgige (Hoshino & Takushige, 1998) introduced the concept of “Lesion Sterilization and Tissue Repair” or LSTR therapy based on the use of a mixture of antibiotics for disinfecting pulpal and periapical lesions. A combination of 3 MIX-MP in paste form, also known as triantibiotic mixture (TAM), is made by combining a powder composed of ciprofloxacin, metronidazole and minocycline and a liquid composed of polyethylene glycol and propylene glycol. It penetrates the dentinal tubules, and has a potent disinfectant effect through ciprofloxacin’s wide-spectrum bactericidal action against gram-positive and gram-negative bacteria, metronidazole’s...
action against anaerobic infections, and microrganism’s action against an aerobic and aerobic infections (Sato et al., 2002). Helbo® Photodynamic Therapy (PDT) is a natural resinous prod- uct for clinical use and is produced in the form of a clear gelatinous田o, developing an electric field (corona), which causes ozone formation.

The aim of this study was to evaluate the antibacterial effect of 2.5% NaOCl, PDT, 2% CHX, TAMP, propolis, and the association of PDT with in- perimenterally infected root canals of extracted human teeth in vivo.

Materials and Methods
Preparation of the teeth
Extraction of the root canals included the removal of the one previously described by Kauppi and Oestevik (Kauppi & Oestevik, 1993), and sixty extracted, intact, adult, human, single-rooted, mature teeth aged 14-30 years.

The studies were conducted using a stainless steel ultrasonic scaler (Cavitron, Dent- sply Maillefer, Ballaigues, Switzerland; Estrela et al., 2003). The external surface of each tooth was cleaned with sterile water and an ultrasonic probe.

After the teeth were stored in saline-sodium solution for 48 hours, they were decorated with a rotary diamond bur and 1000 rpm under water cooling to facilitate the access to the root channels (Cheng et al., 2012).

Intracanal treatment of the root canals was performed with a No. 10 Hedström K file (Dentsply Maillefer, Ballaigues, Switzerland) used to calculate the working length (70% of the root length). After instrumentation, the canal system continued with a No. 15, 20, 25 Hedström K file (Dentsply Maillefer, Ballaigues, Switzerland) up to 30 mm depending on the length of the canal. Coronal thirds were prepared with the use of a 2% NaOCl solution and 4.3 and 2% (Dentifluy Maillefer, Bal- laigues, Switzerland) lastly, the root canal third instrument was WaveOne® rotary files (Dentifluy Maillefer, Ballaigues, Switzerland) for working length. The use of each file or bur was avoided; the canal was irrigated with 4.3% NaOCl solution, and the irrigation was repeated with the use of 4.3% NaOCl solution until contamination was removed with 17% EDTA (Dentalux®, Dentsply Maillefer, Ballaigues, Switzerland) for the final irrigation. A total of 15 teeth were subjected to the different treatment groups (Figure 1).

The tooth apices underwent retro-grade filling (Komet, Barcelona, Spain) at 700 mW. To perform the treatment, 0.1 mL of normal 85% saline solution (Schafer & Boosman, 2005). For the comparative analysis between groups, two SEM micrographs were obtained along the long axis to expose the root canal, its antibacterial properties increase, its dissolving capability and its pharmacological action has been at- tributed to hydroxyapatite (Farland standard, with a concentra- tion of 0.1 mL of normal 85% saline solution (Schafer & Boosman, 2005). The images were then ana- lyzed to identify the presence or ab- absence of proteins and the destruction of surface of each tooth was cleaned with sterile water and an ultrasonic probe.

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Researchers find new evidence of diet in ancient teeth

By DTI

LEIOA, Spain: Using dental samples, Spanish researchers have applied standard geological techniques and methods at an architectural site in the region of Saragossa to establish the diet of a medieval Muslim community that lived in the region between the eighth and tenth centuries. The study, which also provided new insights into their diet and found that a few of them may have been poisoned by lead.

For their research, Guéde and her colleagues applied geological techniques to learn more about gaps in knowledge that have arisen in other disciplines, such as archaeology and anthropology, regarding the findings at Tauste. Excavations carried out in this municipality disintegrated the skeletons of 44 Muslim individuals who lived between the eighth and tenth centuries. On the basis of this discovery, a research group from the University’s Department of Mineralogy and Petrology undertook to analyse dental samples of these human remains to establish the diet of this medieval Muslim community.

Sampling teeth with a laser technique

Guéde used laser ablation-inductively coupled plasma-mass spectrometry to carry out targeted analyses of the teeth. An advantage of laser ablation is that the sample does not need much preparation, thus it is particularly interesting on the fossil remains. This method therefore allows such remains, which in archaeology are limited, to be preserved for future studies.

The chemical results uncovered the existence of considerable differences in the diet of adult men compared with that of women and younger people. The research suggested that adult males ate more protein of animal origin than women and younger people, whose diets were rarer in pulses and vegetables.

The findings of the research must be interpreted in the context of work by historians, archaeologists and anthropologists. "Numerical data on their own indicate nothing, but they are essential for supporting the hypotheses and discoveries of archaeologists and historians," emphasized Dr Maria Cruz Zuluaga, one of Guéde’s PhD supervisors. For example, even if the analyses do not reveal the origin of the animal protein, “we can assume that it came above all from sheep and goats on the basis of written texts and anthropological knowledge about medieval Muslim society,” she explained.

In this respect, studies of this type provide proof that we are what we eat, according to Samuel Epstein (1995), a geologist famous for developing methods for analysing stable isotopes. "What we eat goes on to form part of our bodies and provides us with very valuable information that ends up recorded in us—in this case in our teeth," Guéde said. The study focused on dentine, as it is more suitable than enamel for discovering age and sex differences. As in the present study, Cheng et al. (2012) used methylene blue as a positive indicator of E. faecalis infected by E. faecalis. As for ozone, most studies of ozone application in endodontics have focused on its antimicrobial activity. Nagayoshi et al. (2004) found that ozonated water was highly effective in killing both gram-positive and gram-negative endodontic species. Moreover, the antibacterial activity of gaseous ozone has been proven to be greater than that of disinfectant solutions such as Potassium titanyl phosphate (KTP/O3), otherwise known as KTP laser (Kustarci et al., 2009).

In conclusion, application of PDT, 2% CHX, TAP, propolis and ozone all showed antibacterial potential similar to 2.5% NaOCl against endodontic infection by Enterococcus faecalis.