

Super-Oxidized Solution (SOS) irrigation in Root Canal Treatment

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Introduction

Root canal infections, an infectious disease of bacterial etiology, is an important cause of tooth loss in the world. Current therapeutic modalities include scaling and root planing of the surfaces of the teeth to eliminate bacterial plaque and calculus, and the use of antiseptic solutions to combat the infectious process caused by a wide spectrum of oral micro-organisms. These antiseptics, however, have high toxicity and consequently cannot be used for prolonged periods. In addition, some of the commonly used antiseptics have adverse side effects such as distortion of taste and staining of teeth. Among the numerous alternative antiseptics so far proposed, super-oxidized solutions (SOS) could be a good option. Horiba *et. al.* (1998) showed that a neutral pH- SOS was effective against bacterial isolates obtained from infected root canals. A second publication in the area showed that acidic electrolyzed water could be an acceptable treatment for rinsing hydrocolloid impressions (Nakagawa *et.al.*, 2002). Unfortunately no further information was published.

The SOS herein tested (Microcyn™, Oculus Innovative Sciences, USA) has been shown to exert a broad microbiocidal activity, including bacteria, viruses, fungi and spores (Landa et al, 2005). The broad spectrum can not be explained on the basis of chlorine species alone since their concentration is very low (total chlorine content < 80 ppm). Biocompatibility tests were also passed as per the Food and Drug Administration requirements for wound care products in the USA. The latter included cytotoxicity, sensitization, irritation/intracutaneous reactivity tests and even genotoxicity tests. After its approval in Mexico, this SOS has been widely and safely used in all kinds of open wounds and mucosa lesions for the past 24 months. The only side effect so far reported has been a burning sensation in hypersensitive patients, particularly in those with venous stasis ulcers. Our experience in odontology started with the successful treatment of periodontal disease with the irrigation of this SOS with an ultrasonic scaler (Flores MA, 2005). Since this newly available super-oxidized solution was neither sensitizing nor irritating in periodontal disease and its chlorine content was at the most 80 ppm, it offered an improved approach to treat root canal infections. Therefore this study was conducted to evaluate the efficacy of SOS versus 2.5% sodium hypochlorite irrigation in the prevention of acute reactions after root canal treatment. Altogether these results favour SOS therapy in comparison to diluted sodium hypochloride as the irrigation solution in root canal treatment. A prospective, controlled, multicenter study needs to be conducted to further confirm these initial observations.

Patients and Methods

Patients

All consecutive patients seen at the Universidad Michoacana de San Nicolás de Hidalgo in Morelia Mexico, from October 2003 to April 2005 and with a diagnosis of root canal infection were included in the SOS group. Acute root canal was defined as an X ray image showing a periapical lesion in addition of negative vitality and positive percussion clinical tests. Retrospective analysis of paired-cases presenting similar root canal infections between 2002 and 2003 at the same Institution was undertaken for the control group.

Superoxidized solution (SOS)

The antimicrobial activity of a neutral pH solution with a controlled amount of reactive chlorine and oxygen species (Microcyn™, Oculus Innovative Sciences, USA) was investigated in Mexican patients with acute root canal infections. This newly available super-oxidized solution (SOS) for wound care, offers a radically improved approach to treatment of root canal. This neutral pH, no-rinse, SOS was initially certified as an antiseptic for wound care in México in 2004. Animal tests were first conducted to show that this SOS does not induce irritation or sensitization in skin and mucosas (Gutiérrez, 2006). The active components of this solution include 99.98% superoxidized water and < 0.02% of various reactive species of chlorine and oxygen including hypochlorous acid, sodium hypochlorite, sodium chloride, ozone, and chlorine dioxide. Of note, the overall content of free available chlorine is low and ranges between 50 and 80 ppm. This SOS has bactericidal, virucidal, fungicidal and sporocidal activities and it is ready to use with no further dilution or mixing (Landa *et.al.*, 2006). In addition, it does not require special handling or disposal and has an extended shelf life of >12 months.

Dental manipulation with SOS

During the process the ducts are isolated to avoid contamination. The cavity is opened and the root drilled. Proper duct localization is needed to guarantee an efficient manipulation. SOS flush starts with the drilling process instead of using water or saline solution. Instrumentation is conducted according to the crown down technique using rotatory NiTi instruments. Instrumentation is according to the extension of the duct as measured by the X ray. Duct irrigation is conducted with the SOS after using each instrument. A final irrigation of SOS to the root cavity is conducted for up to 15 minute (contact time); injection of SOS with a hypodermic needle to infiltrate the soft tissue surrounding the root with SOS is also an alternative to fully decontaminate the duct. The latter is dried out with dental paper and the occlusion is done by lateral condensation with calcium hydroxide and epoxy resin. The outpatient treatment consists of oral rinse with SOS for 30 days, 3 times daily for 2 minutes (exchange 15 mL every 30 s). After 30 days, oral rinse is recommended once daily indefinitely. None of the patients treated with SOS therapy received antibiotics or analgesics.

Dental manipulation with 2.5% sodium hypochlorite (2.5% SH)

Typical treatment procedure with sodium hypochlorite was conducted for root canal treatment (Walton & Torabinejad, 2002). Particular care was paid to avoid infiltration of the solution to the periapical region during the manipulation. All patients in this group received ampicillin (500 mg tid) or cephalexin (500 mg bid) for 7 days as well as anti-inflammatory drugs (naproxen 500 mg bid) as necessary.

Results

A study was completed in 238 patients with root canal treatment with either, 2.5% SH (129 pts) or SOS (109 pts). Demographic characteristics were similar for both groups (Figures 1 & 2). The average age was 42.5 (range 17-68y) and 40 years (range 13-67y) for the control and SOS groups, respectively. The male:female ratio was also similar for the control and SOS groups (44:56 vs 39:61, respectively).

Only 2 patients had an acute local reaction after the root canal treatment with SOS whereas 16 patients did it with 2.5% SH. However, the results are more significant considering the total number of affected teeth in SOS group (2) versus those in the 2.5% SH group (23). Dental losses only occurred in the hypochlorite group and none in the SOS group. This could be possible because re-treatment with SOS was feasible and successful. Therefore, even in those two cases with acute reactions, it was possible to preserve the teeth.

Pain resolved within 24 hours in most cases. Patients could also chew within 24 hrs, when it usually takes 72 hrs with the use of other antiseptics.

Ten patients out of 109 experienced a slight burning sensation on the tongue when gargling with SOS. In these cases, the burning sensation occurred only in the first two days of application and it was only necessary to instruct the patients to spit out the solution without further rinsing. The burning then dissipated without any other secondary effect. There were no contraindications noted for the use of SOS.

Figure 1.- SOS irrigation in root canal treatment.

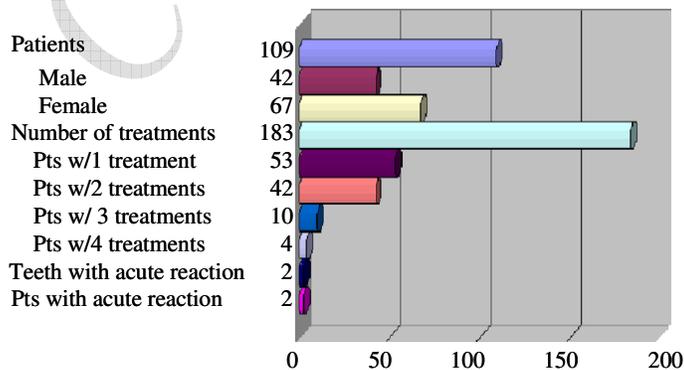
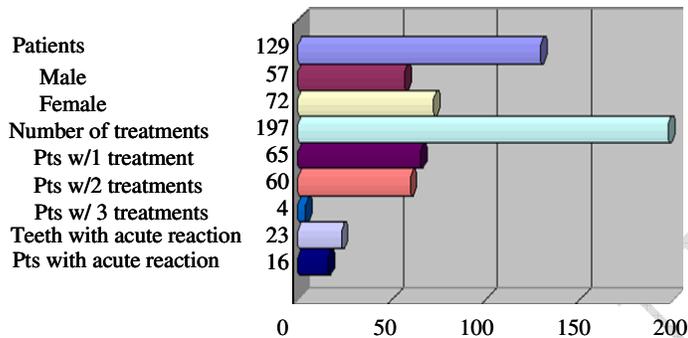


Figure 2.- 2.5% sodium hypochlorite irrigation in root canal treatment.



Discussion

Infection due to a canal not being cleaned or filled completely is a complication that can occur from 10 to 30% of the cases undergoing root canal treatment. This may be due to the complexity of the root canal system, for example some root canals may be very narrow or curved. Infection can also be due to a canal not being cleaned or filled at all, if the X-ray did not show all of a tooth's canals. Additionally, certain bacteria may not respond to root canal therapy, so it may fail (Walton & Torabinejad, 2002). Since SOS exerts a wide antimicrobial activity without sensitizing or irritating skin and mucosae (Gutiérrez AA, 2006) it was therefore assumed that it could be useful for the prevention of acute reactions after root canal therapy.

Infection control in root canal has been traditionally based upon irrigation with hypochlorite or chlorhexidine. In both cases, the limiting applications are side effects. Sodium hypochlorite 2.5% solution, for example, is very irritating to the root canal and cannot contact surrounding soft tissue due to potential for necrosis. SOS irrigation, in contrast, has the advantage of not being irritant or sensitizing to skin and mucosae. For example, SOS has been safely used in the treatment of diverse wounds (e.g. venous stasis, burns, diabetic foot ulcers, etc) as well as in the peritoneal cavity (Dalla Paola, 2005; Miranda, 2005; Barrera *et.al.*, 2006). In comparison to chlorhexidine, SOS tastes better, does not stain the teeth and could be used for at least 30 days as a mouthwash after the procedure.

Patients treated in this study with SOS did not receive antibiotic, anti-inflammatory or analgesic medications. In contrast all patients treated with sodium hypochlorite received antibiotics and an anti-inflammatory agent was added as necessary. Despite that, SOS therapy was superior in reducing the incidence of acute reactions after root canal therapy in comparison to 2.5% sodium hypochlorite solution. Furthermore, patients with

failures in the SOS group could be successfully re treated with the solution. Therefore, none of the subjects in the SOS group lost teeth. Of note, the aggressive irrigation and infiltration procedures conducted with SOS could not have been done with any other antiseptic currently in use due to possible necrosis of surrounding tissues.

Unfortunately, the control group treated with sodium hypochlorite was a historical one. It will be then necessary to conduct a proper controlled, prospective, randomized study to fully validate these results. However, these results support the efficacy and lack of toxicity of SOS for the prevention of acute reactions after root canal treatment.

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