Research Paper

Volume : 4 | Issue : 10 | October 2015 • ISSN No 2277 - 8179

Comparison Between Magnetized Water and Sodium Hypochlorite as Disinfectant in Root Canal Instrumentation (In Vitro Study)

Medical Science

KEYWORDS : magnetized water, sodium hypochlorite, root canal disinfection

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ABSTRACT

Aim of the study

To measure effect of magnetized water irrigation with the use of 5.25% sodium hypochlorite solutions on bacterial load on the dentine walls in prepared canals in vitro.

Material and methods

Sixty-four extracted teeth were evaluated and divided into two groups. In Group 1, after gaining access to the root canal, bacteria found on the canal walls was sampled using endodontic files. A further sample was taken after apex location and initial widening of the canal had been completed and magnetized water irrigation was done. At the end of the procedure a last bacterial sample was gained, In Group 2, the initial sample was taken as described previously. A second sample was taken after conventional preparation using 5.25% sodium hypochlorite solutions irrigant , and a third sample was taken as in group 1. All samples were cultured for facultative anaerobic bacteria.

Results:

In Group 1 only two of the 23 canals showed bacteria after the use of magnetized water irrigation and of these two canals, one was free of bacteria on completion of conventional treatment but the other still contained bacteria. In Group 2, four canals of the 23 infected initially, remained contaminated after conventional treatment.

Conclusions:

The results of the study indicate that the use of magnetized water as a cleaner and disrupter of the biofilm is an effective alternative to the use of hypochlorite as a root canal cleaning system

Introduction

For the effective treatment of the root canal, a proper instrumentation to shape the canal and the disinfecting of the walls and lumen of the canal are essential for a successfulreslut.[1] Bacterial contamination of the canals is a cause failure.[2,3,4] Therefore bacterial presence in the canal after chemo-mechanical preparation must be eliminated to have excellent result.

It is well known that the effective disinfection must include initial cleaning of the canal by removal of the smear layer[5,6] and the biofilm leaving the bacteria accessible to the disinfecting agent. There are a range of materials which will remove the smear and/or the biofilm structure. These include sodium hypochlorite, EDTA, citric acid and polyacrylic acid.[7, 8,9,10,11,12] Sodium hypochlorite is currently preferred by most clinicians as it exhibits a proteolytic effect as well as being a disinfectant.

Sodium hypochlorite antibacterial effect depends on the duration of time that it remains in the canal and the use of copious volumes of the solution since it is the free chlorine which acts as the disinfecting agent and this is used up rapidly. Because of the fact that 20-30 minutes is required to clean and debride a canal.[13] A small volume used for a short contact time will have a limited effect.,NaOCl is not effective against all pathogenic bacteria specifically *Enterococcus faecalis* which is associated with seconadary infection.[14]

Because of the microbial resistance [15,16,17,18,19] effective bactericidal activity needs high concentrations where normal tissue toxicity is significant . This can lead to adverse tissue reactions.

Also, the more concentrated the solution, the more the surface tension which will result in not wetting the surface of the walls of the canal well.[20,21,22] This will affect the disruption of any biofilm layer present on the surface of the canal wall and limits penetration of the solution into the lateral canals or dentinal tubules. Citric acid can also be used as root canal cleaners. [23]

Water magnetization has been used for many years and was found that magnetization of water alters the properties of water and has been used worldwide in many different fields and research many fields of medicine. A recent study that was conducted on magnetized water showed that there was a significant increase in the mean number of corpus lutea and the height of epithelial cells in fallopian tube comparing the case with the control group whereas uterus epithelial cells of the case group showed insignificant increase in height, in compare with the control group .[26]

In another study on the benefit of magnetized water ,it was found that the supplementation of magnetized water not only decreased the blood glucose and glycated hemoglobin levels but also reduced blood and liver DNA damages in STZ-induced diabetic rats. From the above results, it is suggested that the long-term intake of the magnetized water over 8 weeks may be beneficial in both prevention and treatment of complications in diabetic patients.[27]

A research was conducted on magnetized water as an irrigant to treat supragingival calculus,it was concluded that a magnetic device properly attached to an oral irrigator appears to greatly reduce the formation of supragingival calculus and its accompanying plaque.[24]

The magnetized water oral irrigator could be a useful adjunct in the prevention of calculus accumulation in periodontal patients, but appears to have minimal effect on plaque reduction. The results indicated a clinical improvement in the gingival index[25].

So till now no study has been conducted on the antibacterial and mechanical effect of magnetized water in root canal preparation.

Materials and methods:

Sixty-four extracted teeth were studied in total. The distribution of teeth within each group was similar.. In all teeth a periapical radiograph was taken to determine approximate canal length and canal morphology. In all teeth, access to the pulp chamber was gained. Once the canals had been identified, accessed and canal patency ascertained, a size 15 sterile nickel-titanium hand file was placed within the lumen of the canal at a point where resistance to the instrument's progress was just felt. It was filed backwards to remove debris from the canal walls and this instrument together with the swarf sample (dentine debris) obtained was placed in a sterile bottle as described previously.[23] Great care was taken in multi-rooted teeth to ensure that no cross contamination occurred between the canals during the sampling process as each canal was regarded as a test unit. The initial sample was transported immediately to the laboratory for culturing. This was identified either as sample X in Group 1 or Sample A in Group 2. Thirty-two canals were evaluated in both Groups 1 and 2.In Group 1, once the canal working length had been determined , the coronal aspect of the canal was prepared using ProTapers using a crown down approach working to 2 mm short of the working length. Copious irrigation (more than 20ml of each irrigant per canal) was used between instrumentations. The irrigants were injected down the canal using a sterile (gauge 27) endodontic micro-needle. The canal was then washed thoroughly with sterile water to remove any irrigant and dried with sterile paper points.The magnetized water was introduced into the canal using an endodontic micro-needle. The irrigant was agitated in each canal for 60 seconds using a size 25 nickel-titanium hand file to ensure that the fluid passed to the working length and that any trapped air introduced into the canal was removed. A new sterile size 35 nickel-titanium hand file was inserted to the working length and a further sample of swarf was obtained in the same manner from the full length of the canal. This was transferred to a fresh sterile bottle (Sample Y). Profiles were then used to prepare the apical two millimeters of the canal to completion. Copious irrigation was used between instrumentations (again more than 20ml of the irrigant per canal) .the irrigant was used at ambient temperature. The canal wall was then sampled as before using a nickel-titanium hand file one size larger than the master apical file (MAF.) This file with the swarf sampled was deposited in a fresh sterile bottle (Sample Z.) Samples Y and Z were transported immediately to the Microbiology Department for culturing. The maximum time between collecting the samples and plating in the microbiological laboratory was 30 minutes.

In Group 2, after the canal working length had been determined as described above, the canals were prepared in a similar fashion working to 2 mm short of the working length. Profiles .04 were then used to prepare the apical two millimeters. Copious irrigation (more than 20ml of sodium hypochlorite5.25%) was used between instrumentations using the same irrigation techniques as described previously.

The canal was then washed thoroughly with sterile water to remove any residual irrigant and then sampled as before using a nickel-titanium hand file one size larger than the master apical file. This file with the dentine sample was deposited in a fresh sterile bottle (Sample B) and the canal dried with sterile paper points. At this stage the canal was considered to be prepared and ready for obturation.

Then 5.25% sodium hypochlorite solution was then injected into the canal using a sterile endodontic micro-needle (gauge 27) ensuring that the fluid passed to the working length. The liquid was agitated in each canal for 60 seconds using a nickel-titanium hand file, two sizes smaller than the master apical file (MAF.) then a new sterile nickel-titanium hand file two sizes larger than the MAF was inserted and a further sample of swarf from the canal wall was obtained in the same manner. This was transferred to a fresh sterile bottle (Sample C) and the canals dried with sterile paper points. Samples B and C were again transported immediately to the microbiology laboratory for culturing.

The objective of the assay was to assess the microbial load of facultative anaerobes at the various sampling times during the treatment. Facultative anaerobes were chosen because they are the predominant organisms in the human mouth, and are frequently implicated in infected dental root canals. Furthermore even with the most stringent anaerobic isolation techniques with prereduced media, it is often impossible to grow strict anaerobes. Root canal infections are polymicrobial. The culture media was selected to facilitate the culture of common endodontic bacterial pathogens. No attempt was made to identify specific species.

On arrival at the microbiological laboratory a sterile swab was moistened with sterile nutrient broth and excess fluid expressed. This swab was used to collect the swarf from the full cutting length of the file and rolled onto a fresh blood Agar plate. A sterile loop was used to streak five lines from the well. They were then examined and scored. If growth occurred in the well area, a score of one was allocated. If the growth occurred in both the well and the first five streaked lines, this was scored two and so on up to a maximum score of five. The greater the extent of growth observed then the greater bacterial load present.

Magnetized water preparation was prepared using a special unit synthesized for this purpose using multiple electromagnetic units each water unit is surrounded by two electromagnets with South Pole and North Pole facing each other and the water is kept in this powerful magnetic field for 15 minutes and then was used as magnetized water

Results:

The distribution of bacterial load scores for the culture taken at the times indicated in the procedure is shown in Table(1 and 2).The initial cultures immediately after accessing the canal, (Samples A and X,) the scores ranged from four to zero. In Group 1, nine of the 32 teeth showed an initial score of zero; in Group 2 a similar number were bacteria free. These canals initially uninfected were excluded from the study. In both groups there remained 23 canals with initial bacterial load. In Group 1, after the earlier magnetized water irrgiation, all of the canal wall cultures (Sample Y) except for two had a score of zero (Fig 1) After the completion of the endodontic preparation, the cultures taken from the walls of the canal in these remaining two canals scored one and zero. In Group 2, after hypochlorite irrigation on completion of the conventional treatment, four of the canals contained culturable material (Fig 2). The subsequent use of NaOCl irrigation eliminated all culturable bacteria in three of the four canals. A comparative statistical analysis of the two treatment modalities comparing canals with bacteria with those with no culturable material showed that there was a highly significant reduction in bacterial load with each treatment modality between samples X and Y and between samples A and B. The level of reduction of load after Y and B were not significantly different.

Table 1: Bacterial load scores per canal at each sample for Group 1 excluding initially uninfected canals. Sample X=at access, Sample Y= after crown down and magnetized water irrigation, Sample Z=completion of treatment.

Score bacterial load	Sample X	Sample Y	Sample Z
0	0	21	22
1	12	1	1
2	6	1	0

Volume : 4 | Issue : 10 | October 2015 • ISSN No 2277 - 8179

3	3	0	0
4	2	0	0
5	0	0	0
Total infected canals	23	2	1

Table 2: Bacterial load scores per canal for each sample time in Group 2 excluding initially uninfected canals. Sample A=at access,Sample B=after 5.25% Sodium hypochlorite,Sample C =completion of treatment

Score bacterial load	Sample A	Sample B	Sample C
0	0	17	20
1	7	3	1
2	8	1	0
3	7	0	0
4	1	0	0
5	0	0	0
Total infected canals	23	4	1

Figure 1: Bar chart showing number of canals with bacteria at each sampling time after magnetized water irrigation.

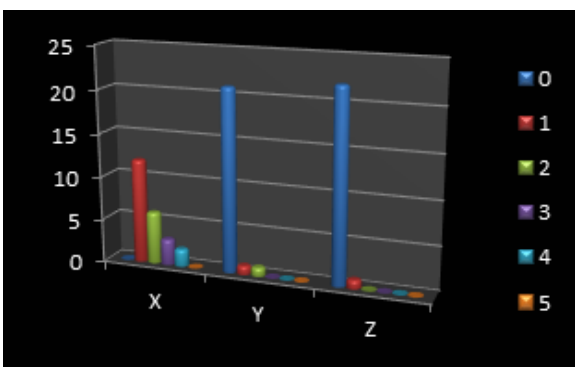
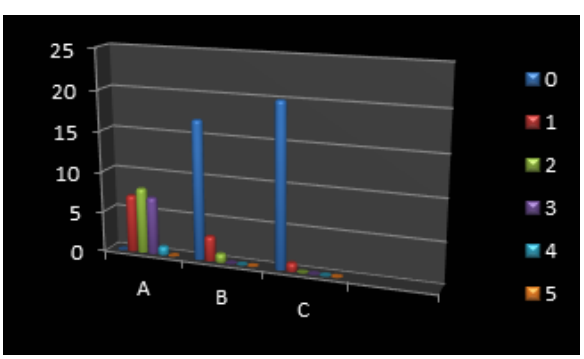


Figure 2: Bar chart showing number of canals with bacteria at each sampling time after 5.25% sodium hypochlorite irrigation.



Discussion:

Sodium hypochlorite is regarded as the solution of choice for irrigating canals, there are concerns as to the ability of the sodium hypochlorite to wet the canal walls adequately and disrupt the biofilm. The disadvantage is the time taken and volume of the irrigant required for effective disinfection also prolongs the treatment time.This follows previous work in which it was established that the use of hypochlorite was successful in eradication of bacteria from the walls of the canals in only 76% [23]

In Group 1, the use of magnetized water irrigation has successfully reduced the bacterial load in all but two cases (91%). The effect of this procedure would appear to be effective debridement being achieved in the crown down procedure permitting penetration of the canal walls by the irrigating fluid. This supports the theory that magnetized water has new additional properties that make it acting as a potent irrigant.

In Group 1 there was one case which still showed a bacterial load after use of magnetized water .There had been a considerable reduction in bacterial load after Magnetized water irrigation but there was no further effect thereafter. This is acceptable as an irrigant with no toxicity and is safe to use in the oral cavity.

The 93% of the cases in Group 1 which were free of bacteria after the crown down procedure was considered to be complete as a result was better than that achieved in Group 2 where the conventional techniques achieved only a 76% success rate using conventional chemo-mechanical methods.

Because this irrigant (magnetized water) is a novel way for irrigation in root canal preparation so there are to compare the results with.

The alternative technique described here indicates that it would be possible to disinfect the root canal system without the use of sodium hypochlorite. Magnetized water has been shown to be as effective as conventional chemo-mechanical techniques but is more biocompatible and could potentially decrease the time spent disinfecting the root canal system.

Conclusions:

It was found that the use of magnetized water as an irrigant in root canal disinfection is as effective as sodium hypochlorite in reducing or eliminating bacterial load in the canals. However further studies are required to confirm these results and look for more uses of magnetized water in conservative dentistry.

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