Research Article

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A Comparative Evaluation of Antimicrobial Efficacy of Sodium Hypochlorite by Using Ultrasonic and Passive Irrigation

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ABSTRACT

Background: In dentistry, Ultrasound was first used for preparation of cavities. In comparison to sonic irrigation, ultrasonic irrigation has proved to be more powerful and able to eliminate more debris, and so it is claimed that passive ultrasonic irrigation is significantly more efficient than sonic activation. Hence; we planned the present study to evaluate the antimicrobial efficacy of sodium hypochlorite in passive method of irrigation and active ultrasonic method.

Materials & methods: The present study included assessment of antimicrobial efficacy of different irrigating solutions using ultrasonic device. A total of 40 freshly extracted mandibular first premolars were used in the present study. Division of all the tooth samples was done randomly and broadly into two study groups: Group A- Included samples that received 2 ml of 2.5% NaOCl irrigation after each instrument used for canal preparation Group B: Extra agitation of the irrigant with a file #15 fitted on to Generic Ultrasonic Scaler Handpiece VDW. All the samples were collected by paper points and were sent to laboratory in appropriate transporting media were they were streaked in Sabaraud dextrose medium and MacConkeys medium for assessing the antimicrobial efficacy. All the results were summarized in Microsoft excel sheet and were analyzed by SPSS software.

Results: Significant results were obtained while comparing the mean CFUs of S. mutans, C.albicans and E.faecalis among Group A and Group B.

Conclusion: Antimicrobial efficacy of irrigation solutions is increased by the used of ultrasonic devices.

Keywords: Antimicrobial, Irrigating solution, Ultrasonic device.

INTRODUCTION

In dentistry, Ultrasound was first used for preparation of cavities. The concept of "Minimally Invasive Dentistry" and the desire for small-sized cavity preparations meant a new application of US for cavity preparation.[1] There are two types of ultrasonic irrigations systems described in the literature. Simultaneous combination of ultrasonic irrigation and instrumentation is the first type of ultrasonic irrigating device, while without simultaneous instrumentation is the second and is known as passive ultrasonic irrigation (PUI).[2- 4] The first one has been almost discarded in the clinical practice, because of the difficulty of controlling the cut of dentin and subsequently the final shape of the prepared canal, being present the possibility of making aberrant conformations. When ultrasonic-activated files are used, canal deviations, apical zips

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and radicular perforations can be present, especially in curved canals.[5-7]

In comparison to sonic irrigation, ultrasonic irrigation has proved to be more powerful and able to eliminate more debris, and so it is claimed that passive ultrasonic irrigation is significantly more efficient than sonic activation.[8,9]

Hence; we planned the present study to assess antimicrobial efficacy of different irrigating solutions using ultrasonic device.

MATERIALS & METHODS

The present study was planned in the department of conservative dentistry of the dental institute and it included assessment of antimicrobial efficacy of different irrigating solutions using ultrasonic device. Ethical approval was obtained from the institutional ethical committee in written before the starting of the study by explaining in detail the entire research protocol. A total of 40 freshly extracted mandibular first premolars were used in the present study.

Before the starting of the study, all the teeth were stored in the normal saline until used in the study. Using a diamond disc, all the teeth were decoronated. Then all the canals were infected with *C. albicans* suspension, S. mutans and E.faecalis. *C. albicans* was collected from the oral cavity of a patient and was cultured after confirmation by using API methods. *C. albicans* was prepared using 0.5 McFarland standard, and the subsequent 1:50 dilution was prepared using RPMI-1640. This was followed by preparation of the root canals with K- files by using 2.5 % NaOCl as root canal irrigant. Drying of the root canal space was done using paper points followed by sealing the apex with autopolymerizing acrylic resin.

Division of all the tooth samples was done randomly and broadly into two study groups:

Group A- Included samples that received 2 ml of 2.5% NaOCl irrigation after each instrument used for canal preparation

Group B: Similar irrigation as in Group 1, along with extra agitation of the irrigant with a file #15 fitted on to Generic Ultrasonic Scaler Handpiece VWD, placed passively 1 mm short of working length for 10 s, every time the root canal was irrigated. For collecting the bacterial samples from the root canals, sterile paper points were used. The bacterial contents of each root canal were sampled with five paper points by placing them in the canal for approximately 1 min. all the samples were sent to laboratory in appropriate transporting media where they were streaked in Sabaraud dextrose medium and MacConkeys medium for assessing the antimicrobial efficacy. All the results were summarized in Microsoft excel sheet and were analyzed by SPSS software. Chi- square test was used for assessment of level of significance. P- value of less than 0.05 was taken as significant.

Graph 1: Mean colony-forming units (CFU) of Streptococcus mutans (S. Mutans), Candida albiancs (C. Albicans) and Enterococcus faecalis (E. Faecalis)

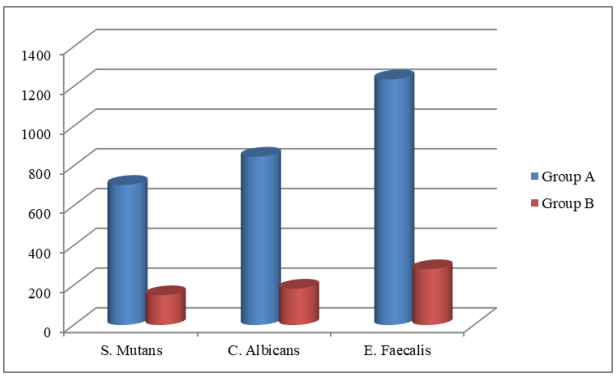

Table 1: Comparison of Mean colony-forming units (CFU) of Streptococcus mutans (S. Mutans), Candida albiancs (C. Albicans) and Enterococcus faecalis (E. Faecalis).

Pathogen	Group A	Group B	P- value
S. Mutans	705	150	0.01*
C. Albicans	847	183	0.02*
E. Faecalis	1236	281	0.00*

*: Significant

RESULTS

Mean colony forming units for S. mutans in group A was 705, while it was 150 in group B. While comparing the mean CFUs of S. mutans among group A and group B, Significant results were obtained. Mean CFUs of C.albicans of group A and group B was found to be 847 and 183 respectively. Significant results were obtained while comparing the mean CFUs of C.albicans of group A and Group B. Mean CFUs of E.faecalis of group A and group B was

found to be 1236 and 281 respectively. Significant results were obtained while comparing the mean CFUs of E.faecalis of group A and Group B.

DISCUSSION

Passive ultrasonic irrigation (PUI) is the most widespread method used to activate irrigation solutions. Concerns have been raised that PUI is less effective in curved root canals and is not passive at all.[6- 8] In the present study, mean colony forming units for S. mutans in group A was 705, while it was 150 in group B. While comparing the mean CFUs of S. mutans among group A and group B, Significant results were obtained. Mean CFUs of C.albicans of group A and group B was found to be 847 and 183 respectively. Numerous researchers have shown that the use of PUI after manual and rotary instrumentation significantly reduces the number of bacteria, achieving significantly better results than needle and syringe irrigation. These positive results could be due to two main factors, firstly high power ultrasound produces a disagglomeration of bacteria biofilms in the root canal by the action of the acoustic current. The deconstruction of bacterial biofilms gives rise to planktonic bacteria that are more susceptible to the bactericidal activity of NaOCl. Cavitation may also produce a temporary weakening of the cell membrane making bacteria more permeable to NaOCl.[10, 11]

In the present study, significant results were obtained while comparing the mean CFUs of C.albicans of group A and Group B. Mean CFUs of E.faecalis of group A and group B was found to be 1236 and 281 respectively. Significant results were obtained while comparing the mean CFUs of E.faecalis of group A and Group B. Neuhaus KW et al compared a novel passive sonic irrigation (PSI) device (6000 Hz) with PUI and manual irrigation (MI) with respect to their efficiency in removing different endodontic microorganisms from curved and straight root canals. They performed 2 experiments as follows. In a 3-day infection model, we included 8 groups of single or dual microbial species that were rinsed with 0.9% sodium chloride using PSI, PUI, or MI. Colony-forming units (CFUs) were counted after incubation, and log10 transformations were performed for statistical comparisons. In a 21-d infection model, we tested the same irrigation protocols on 4 groups of microorganisms and used 1.5% sodium hypochlorite as an irrigant. Infection control samples were taken at day 0, 3, 5, and 7 after treatment and were subsequently reincubated. Using sodium chloride as an irrigant, the amount of reduction in CFUs compared with the negative control was approximately 3 log10 units for PSI at 6000 Hz, 2 log10 units for PUI, and 1 log10 unit for MI. PSI reduced the microorganism CFUs significantly better than PUI. Using sodium hypochlorite led to a significant reduction in microorganism CFUs even with MI. After 3 days, compared with MI, microorganism regrowth significantly reduced after PSI and PUI treatment, but in these groups, in at least half of the samples, microorganisms were detectable after 7 days. PSI at 6000 Hz might be at least equal to PUI with respect to reduction of the microbial load in curved and straight root canals.[12] Spoleti P et al evaluated the influence of passive ultrasonic activation on root canal disinfection. Sixty human teeth (group A: upper incisors, group B: upper canines, and group C: distobuccal root of first upper molars) were selected and sterilized in an autoclave. A standardized inoculum was placed into the canals, and they were incubated for 72 h at 37 degrees C.

Then, they were divided into subgroup 1, which received sterile saline (SS) as an irrigant, and subgroup 2, which received sterile saline with passive ultrasonic activation (SU). The endodontic treatment was performed with a crown-down technique. Bacteriological identification of surviving colonies was carried out. Surviving colonies were higher when ultrasonics was not used (group A: SS: x 32.13, SU: x 13.53; group B: SS: x 53.70, SU: x 44.60; group C: SS: x 39.16, SU: x 29.40). The homogeneity proportion tests to compare the results of both subgroups showed that the surviving proportions were higher ($p = 0.01$) when the ultrasonic activation was not used.[13]

CONCLUSION

From the above obtained results, the authors concluded that antimicrobial efficacy of irrigation solutions is increased by the used of ultrasonic devices. However; further studies are recommended.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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