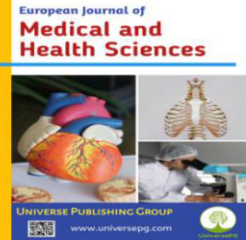




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Comparative Study of Different Irrigating Solutions on Post-Operative Tenderness on Percussion in Single-Visit Root Canal Treatment of Patients with Chronic Periapical Periodontitis

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Abstract

Previous studies have indicated that tenderness in single-visit root canal therapy in teeth with chronic periapical periodontitis is directly related to the irrigating solution used. To compare different irrigating solutions in terms of postoperative tenderness after single-visit root canal treatment of chronic apical periodontitis patients with pulp necrosis. The one way ANOVA test was used to compare the intensity of tenderness with 4 groups; a value of $p < 0.05$ is considered as statically significant. No patients reported severe tenderness at all observation period. However, mild to moderate tenderness was found at early stages in B, C & D groups. At 7 days observation period, 1 (2.2%) of 5.25% NaOCl group reported mild tenderness. On the other hand, tenderness was not observed in any teeth of group A. There were statistically significant differences at 24 hours postoperative tenderness evaluation among the normal saline, 2% chlorhexidine, 2.5% NaOCl & 5.25% NaOCl groups as well as 2.5% NaOCl and 5.25% NaOCl also significant with normal saline, furthermore 2% chlorhexidine with 5.25% NaOCl group at 24 hours and normal saline with 5.25% NaOCl at 48 hours ($p < 0.05$) but not significant any other evaluation time period ($p > 0.05$). The rate of postoperative tenderness following single-visit endodontic treatment for chronic apical periodontitis with necrotic pulp was consistently low, irrespective of which irrigant was used.

Keywords: Irrigating, Post-operative tenderness, Single-visit root canal, and Chronic periapical periodontitis.

1. Introduction

Post-operative tenderness following endodontic treatment defined as tenderness of any degree that occurs

after the commencement of root canal therapy (Sathom, 2007). A flare-up, defined as a sub-set post-operative tenderness, is characterized by the develop-

ment of tenderness, swelling or both which commences within a few hours or days after root canal procedures and is often of sufficient severity to require an unscheduled visit for emergency treatment (Siqueira *et al.*, 2007). It is an undesirable and distressing situation since it not only causes serious discomfort but may also disrupt the patient's confidence in the outcome of the treatment (Tanalp *et al.*, 2007; Mondol *et al.*, 2018).

Although post-operative tenderness associated with root canal therapy is a poor indicator of long-term success. The occurrence and the control of tenderness are of clinical interest in endodontic. Three major factors affect the healing of apical periodontitis. First, therapeutic factors such as different regimens of NSRCT or the quality of subsequent restorations are thought to be critical in treatment outcomes (Salehrabi and Rotstein, 2004; Moshonov *et al.*, 2005). Second, host factors such as diabetes and, possibly, are associated with a decreased response to treatment (Fouad and Burleson, 2003). Third, microbial factors, such as the presence of *Enterococcus faecalis*, are associated with cases having a poor clinical outcome. Single-visit endodontic therapy has many advantages e.g. (a) it reduces the number of patient appointments (b) it eliminates the chance for interappointment microbial contamination (c) it allows for the immediate use of the canal space for retention of a post.

Infection control is directly associated with the success of endodontic treatment (Petets *et al.*, 2006; Figini *et al.*, 2008). Rotary, hand, or hybrid instrumentation-even when performed correctly-cannot remove all organic and inorganic debris from the root canal system (Peters *et al.*, 2003; Van der Sluis *et al.*, 2007). For this and other reasons, irrigating solutions are essential: they compensate for the limitations of mechanical preparation and enhance endodontic disinfection procedures (De-Deus and Garcia-Filho, 2009). Sodium hypochlorite (NaOCl) remains the primary irrigant for root canal cleaning and disinfection, owing to its antimicrobial activity and tissue-dissolving (histolytic) properties (Okino *et al.*, 2004; Shahan *et al.*, 2019; Saidy *et al.*, 2023).

Sodium hypochlorite (NaOCl) can be toxic to periradicular tissues, especially at high concentrations. Therefore, when concentrated NaOCl is used in single-visit treatment of nonvital teeth, there is concern about postoperative tenderness due to possible extrusion of the irrigant into surrounding tissues. For necrotic teeth, some researchers have recommended 2% chlorhexidine gel (CHX) because of its antimicrobial properties, substantivity, and lower toxicity. However, although CHX is generally less caustic than NaOCl, Mhammedi and Abbott cautioned that it can still be cytotoxic and, rarely, may cause allergic reactions.

Fungi are sometimes present in infected root canals that have never undergone endodontic treatment, but they occur more frequently in previously filled canals that become reinfected or fail to respond to treatment. To enhance antisepsis in single-visit endodontic procedures, it has been recommended to irrigate and/or "soak" the canals with chlorhexidine (CHX) or iodine (IKI) solutions after initial irrigation with sodium hypochlorite (NaOCl). Aqueous chlorhexidine (CHX) has a broad spectrum of antimicrobial activity at low concentrations and is particularly effective against *Candida albicans*. A recent clinical study found that canals receiving a final rinse with 2% CHX were significantly more often free of cultivable microorganisms than controls irrigated with NaOCl alone. One in vitro study evaluated seven *C. albicans* strains against four disinfectants-IKI, CHX-acetate (0.5%), NaOCl (5% and 0.5%) and $\text{Ca}(\text{OH})_2$ -testing each solution individually and in all possible pairwise combinations. All strains showed similar susceptibility: they were highly resistant to $\text{Ca}(\text{OH})_2$; NaOCl and IKI killed all cells within 30 seconds; and CHX-acetate achieved complete killing after 5 minutes. Combinations of disinfectants were either as effective as, or less effective than, the better component of the pair.

A randomized clinical comparison of 2.5% NaOCl, 5.25% NaOCl and 2% CHX with respect to their effect on postoperative tenderness has not been sufficiently explored. Therefore, a direct comparison of these irrigants in single-visit root canal treatment for chronic apical periodontitis is warranted.

2. Materials and Methods

The prospective randomized clinical trial was done at Department of Conservative Dentistry and Endodontics, Faculty of Dentistry, Bangladesh Medical University (BMU). Patients with asymptomatic chronic periapical periodontitis attending the outpatient department included in the study. 130 patients were needed with 80% power and level of significance. These 130 samples were divided into four groups by randomly allocating group.

To assess postoperative tenderness were administered at 24, 48 and 72 hours and 7 days after the procedure. A total of 130 patients with chronic apical periodontitis and pulp necrosis were randomly assigned into 4 groups (45 patients in group B & D, 20 patients in group A & C) according to the solution used for irrigation: group A normal saline (control group), B 2% chlorhexidine, C 2.5% & D 5.25% sodium hypochlorite. A normal saline 20 patients, B 2% chlorhexidine 45 patients, C 2.5% sodium hypochlorite 20 patients & D 5.25% Sodium hypochlorite 45 patients. Patients were allocated in different group by Simple random sampling by lottery method. Standard protocol for root canal treatment by pro taper (hand ProTaper universal files (Dentsply/ Maillefer, Ballaigues, Switzerland) was followed to prepare the teeth. Then the canal was obturate by zinc oxide sealer and corresponding

gutta-percha point of final finishing file following permanent restoration.

Tenderness was classified on a 4 point score, where 0 stands for no tenderness, 1 stands for mild tenderness (not requiring analgesia), 2 stands for moderate tenderness (relieved by analgesia) and 3 stands for severe tenderness (not relieved by analgesia) (Almedia et al., 2012). For evaluation of tenderness on percussion 0 indicates absent of tenderness on percussion, 1 indicates present of tenderness on percussion. After completion, the data was presented in the form of tables as necessary and statistical analysis of the results was done by using computer based statistical software, SPSS 20.00 version (SPSS Inc. USA). The result was expressed as mean ± SD (standard deviation). One-way ANOVA test was done to compare among the groups. Independent sample t-test was done for comparison.

3. Results

Result shown in the **Table 1** stated that after 24 hours of treatment, in group A (Normal saline, control), tenderness on percussion was absent of all 20 patients. Tenderness on percussion was present 2(4.4%) of 45 patients in group B (2% chlorhexidine), 2(10%) of 20 in group C (2.5% sodium hypochlorite), and 7(15.6%) of 45 patients in group D (5.25% sodium hypochlorite). And the remaining patients, tenderness on percussion was absent.

Table 1: Distribution of samples by evaluation of tenderness on percussion (n=130).

Evaluation period	Score	Groups			
		A (n=20)	B (n=45)	C (n= 20)	D (n=45)
24 hours	0	20(100%)	43(95.6%)	18(90%)	38(84.4%)
	1	0(0.0%)	2(4.4%)	2(10%)	7(15.6%)
	Mean ± SD	0.00 ±0.00	0.04±0.208	0.10 ± 0.308	0.16±0.367
48 hours	0	20(100%)	44(97.8%)	19(95%)	40(88.9%)
	1	0(0.0%)	1(2.2%)	1(5.0%)	5(11.1%)
	Mean ± SD	0.00 ±0.00	0.02±0.149	0.05 ± 0.224	0.11±0.318
72 hours	0	20(100%)	45(100%)	20(100%)	44(97.8%)
	1	0(0.0%)	0(0.0%)	0(0.0%)	1(2.2%)
	Mean ± SD	0.00 ±0.00	0.00±0.000	0.00 ± 0.000	0.02±0.149
7 days	0	20(100%)	45(100%)	20(100%)	44(97.8%)
	1	0(0.0%)	0(0.0%)	0(0.0%)	1(2.2%)
	Mean ± SD	0.00±0.00	0.00± 0.00	0.00 ± .000	0.02±0.149

Data were expressed as Mean ± SD. Group A = Normal saline (control group). 0 = absent, 1 = present, Group B = 2% Chlorhexidine. n = number of samples. Group C = 2.5% Sodium hypochlorite. Group D = 5.25% Sodium hypochlorite. UniversePG | www.universepg.com

Statistical analysis of the data revealed that significant differences were found only between group A & D. After 48 hours of treatment, Tenderness on percussion was present, 1(2.2%) of 45 patient in group B (2% chlorhexidine), 1(5.0%) of 20 in group C (2.5% sodium hypochlorite), and 5(11.1%) of 45 patients in group D (5.25% sodium hypochlorite). And the remaining patients, tenderness

on percussion was absent. After 72 hours and 7 days of treatment, Tenderness on percussion was present, 1(2.2%) of 45 patient in group D (5.25% sodium hypochlorite). And the remaining patients, tenderness on percussion was absent. Statistical analysis of the data revealed that significant differences were not found between and among the groups at 48 hours, 72 hours and 7 days after treatment.

Table 2: Statistical analysis of the results.

Groups	P value			
	24 hours	48 hours	72 hours	7 days
A Vs B Vs C Vs D	0.125ns	0.180ns	0.601ns	0.601ns
A Vs B	0.551ns	0.714ns	1.000ns	1.00ns
A Vs C	0.255ns	0.483ns	1.000ns	1.00ns
A Vs D	0.038*	0.068ns	0.350ns	0.350ns
B Vs C	0.456ns	0.647ns	1.000ns	1.00ns
B Vs D	0.059ns	0.063ns	0.234ns	0.234ns
C Vs D	0.456ns	0.314ns	0.350ns	0.350ns

For statistical analysis, one-way ANOVA was performed for comparison among the groups and independent sample t-test was done for comparison between the groups. ns = not significant. * = $p < 0.05$. The mean difference is significant at the 0.05 level.

4. Discussion

In this present study, postoperative tenderness was measured at base line, at 24, 48, 72 hours and 7 days after canal irrigation by normal saline, 2% CLX, 2.5% NaOCl and 5.25% NaOCl in single visit root canal treatment for apical periodontitis with pulp necrosis. The technique followed in this study is originally based on by a questionnaire and a 4 point tenderness intensity scale according to some of the previous studies (Glennon *et al.*, 2004; DiRenzo *et al.*, 2002; Yoldas *et al.*, 2004).

It was found that in group A (normal saline), no any tenderness on percussion was found at 24 hours, 28 hours, 72 hours and 7 days observation period. However the result of 2% chlorhexidine, 2.5% sodium hypochlorite & 5.25% sodium hypochlorite showed that tenderness levels increased at 24 hours, and then gradually decreased. The results found in this present study were corresponded to the study of UniversePG | www.universepg.com

Almeida *et al.* (2012). Although the reason of tenderness at 24 hours observation period is not clarified in this present study, but it may occur due to high concentration of irrigating solution, over instrumentation or extrusion of debris into the periapical areas.

This is also supported by Almeida *et al.* (2012) who indicated that tenderness may be due to concentration of irrigation solution used or by their periapical extrusion as well as apical extrusion of other debris too. At 24 hours observation period, in 2% Chlorhexidine group, 6 (13.33%) of 45 teeth had mild tenderness and 2 (4.4%) reported moderate tenderness. In 2.5% sodium hypochlorite group 2 (10%) of 20 had mild tenderness, 3(15%) of 20 reported moderate tenderness. On the other hand, 8(17%) of 45 teeth showed mild tenderness followed by 7(15%) moderate tenderness in 5.25% NaOCl group. No severe tenderness was reported at any

stages of both groups. However, at 7 days observation period, except in one case of 5.25% NaOCl group, none of other groups reported tenderness. Comparing the results of tenderness between NaOCl and CLX groups revealed that the incidence of tenderness in NaOCl group, were higher than that of CLX group at the early period of observation. However, statistically no significant differences were noted at any events of observation. Another comparison between two concentration of NaOCl revealed that in early stages 5.25% NaOCl showed higher tenderness than that of 2.5% NaOCl group then it gradually decreases and statistically no significant difference were found.

The results found in the present study also corresponded to that of previous studies; no significant differences were found between the two groups except early period, reported by the previous studies of Bashetty and Hedge 2010 (Bashetty and Hegde, 2010). The reason of similarity between results found in the present with that of previous studies is unknown. But it may be due to concentration of NaOCl and the crown down technique of root canal preparation used in the present study. However, the adverse effect may be reduced after elapse of the time. Therefore, it was found that at 7 days following treatment, there were no differences between 2.5% NaOCl, 5.25% NaOCl and CLX irrigating solution. It can be considered that CLX could be an alternative irrigating solution to NaOCl. Furthermore, sample selection for the present study was restricted to patients with chronic apical periodontitis without any preoperative tenderness (Glennon *et al.*, 2004; and Siqueira *et al.*, 2007).

Another important factor is single visit root canal treatment. In the present study, single visit root canal treatment was performed, which is previously considered effective in the treatment of patients with chronic periapical periodontitis (Petets and Wesselink, 2002; Waltimo *et al.*, 2005; Weiger *et al.*, 2000; Gesi *et al.*, 2006; Molander *et al.*, 2007; Penesis *et al.*, 2008).

5. Conclusion

The incidence of postoperative pain following single-visit endodontic treatment in teeth diagnosed

with chronic apical periodontitis and pulp necrosis was consistently low across cases, irrespective of the type of irrigant used during the procedure. This finding suggests that, when proper biomechanical preparation and aseptic protocols are followed, the choice of irrigating solution may not play a decisive role in influencing postoperative discomfort in such clinical scenarios. Chronic apical periodontitis is typically characterized by a long-standing, low-grade inflammatory response, often associated with reduced acute symptoms prior to treatment. As a result, the periapical tissues may be less reactive, which could contribute to the minimal incidence of postoperative pain observed. Additionally, in cases of pulp necrosis, the absence of vital pulp tissue eliminates the possibility of acute inflammatory flare-ups originating from within the canal space. Single-visit endodontic therapy, when carefully executed, minimizes inter-appointment contamination and may further reduce the risk of postoperative complications. Although different irrigants-such as sodium hypochlorite, chlorhexidine, or saline-possess varying antimicrobial properties, their impact on postoperative pain appears to be limited in this context.

Overall, these findings highlight that effective canal debridement and adherence to sound clinical techniques are more critical determinants of patient comfort than the specific irrigant selected.

6. Author Contributions

B.R.N.: Conceptualization, methodology and data analysis, M.A.K.A.; M.A.N.; K.M.I.; and S.M.: Contributed to data collection and investigation, writing and editing the manuscript. All authors involved in this research read and approved the manuscript for publication.

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8. Conflicts of Interest

The author(s) declare that there is no conflict of interest regarding the publication of this paper.

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