

Different pharmacological solutions in intracanal irrigation

KR Paudel,¹ A Jaiswal,² U Parajuli³ and M Bajracharya³

¹Department of Clinical Pharmacology, Kathmandu Medical College and Teaching Hospital (KMCTH), Kathmandu, Nepal, ²Department of Dentistry, Universal College of Medical Sciences (UCMS), Bhairahawa, ³Department of Dentistry, National Academy of Medical Sciences (NAMS), Bir Hospital, Kathmandu, Nepal

Corresponding author: Dr Keshab Raj Paudel, Lecturer, Department of Clinical Pharmacology, Kathmandu Medical College and Teaching Hospital (KMCTH), Kathmandu, Nepal; e-mail: keshabpaul@gmail.com; phone: 977-9849024853

ABSTRACT

Irrigation of root canals during endodontic therapy is an important step. Sodium hypochlorite (NaOCl), hydrogen peroxide (H₂O₂), chlorhexidine (CHX) and normal saline are commonly used intracanal irrigants to disinfect and clean the root canals. This prospective study was set to observe the efficacy of normal saline (0.9% NaCl) irrigation with sequential irrigation of 3% H₂O₂, 5.2% NaOCl and 0.9% NaCl. A total number of 228 dental patients were screened and 104 patients fulfilling the inclusion criteria were enrolled for the endodontic therapy of mature permanent teeth for the period of one year. Two treatment groups were constituted in which patients were randomly allocated equally in each treatment group. Post-obturation pain, swelling, analgesic use and eight weeks post-obturation radiological evaluation of the patients were carried out as the measurement of clinical and radiological success of the endodontic treatment. No statistically significant differences were observed in the measured treatment outcomes between two groups. However, studies involving larger sample size and longer post-obturation follow up are recommended for the further either confirmation or rejection of present findings.

Keywords: Endodontics, irrigation, obturation, normal saline, root canal treatment

INTRODUCTION

Dental caries is the global dental public health problem in all age groups and its prevalence ranges from 13% to 96%.¹⁻⁴ Inappropriate brushing techniques, sticky food habits, low socioeconomic status and lack of public awareness towards oral health are the major factors that lead to the bad corollary of the dental caries. Dental caries may progress to reversible pulpitis that results in irreversible pulpitis which entails endodontic therapy.^{5,6} Endodontic therapy itself is quite expensive, requires more chair side time and, in most of the cases, multiple visits to the dental clinic or hospital. Concurrent use of antibiotics, analgesics, intra-operative root canal irrigants and medicaments are partly accountable for the high cost of endodontic treatment. Among many intracanal irrigation solutions,⁷ 3% hydrogen peroxide (H₂O₂), 5.2% sodium hypochlorite (NaOCl)⁸⁻¹⁰ and 0.9% normal saline NaCl and chlorhexidine (CHX)⁷ are very popular and commonly used conventional intracanal irrigants. 5.2% NaOCl has the solvent action on the organic debris of pulp tissue. Similarly, the effervescent reaction of 3% H₂O₂ pushes debris out of the root canals through the least resistant orifice into the pulp chamber. Besides the above actions of these two irrigants, the disinfecting, bleaching and antimicrobial action by both solutions helps disinfect the root canals.⁷ However, 0.9% NaCl has no antibacterial action,¹¹ but has only the cleaning effect during intracanal irrigation.

In this study, efficacy of 0.9% NaCl irrigation alone was compared with the sequential irrigation of 3% H₂O₂, 5.2% NaOCl and 0.9% NaCl during root canal treatment.

METHODS

As certain conditions or factors in the patients may influence the treatment outcomes especially analgesic use and healing capacity, and the patients' co-operation, following exclusion criteria and inclusion criteria were set up during the selection of the samples.

Exclusion criteria:

Patients with odontogenic abscesses or cellulitis, psychiatric diseases, neuropathic pain, uncontrolled diabetes mellitus, immune deficiency and concurrent systemic diseases which warrant the use of analgesic agents such as arthritis, myalgia, cancer, burn, etc were excluded from the study. Moreover, patients, who required endodontic treatment with concurrent fractures in the oral or other regions, were under systemic corticosteroids or other immunosuppressant and analgesic therapy, needed more than one endodontic treatment and were not willing for the treatment, were not enrolled.

Inclusion criteria:

Patients with acute or chronic irreversible pulpitis of mature permanent teeth with or without acute apical periodontitis and without exclusion criteria were

Table-1: Post-obturation swelling in the treatment groups

Swelling	Conventional group (3% H ₂ O ₂ + 5.2% NaOCl + 0.9% NaCl) N=52	0.9% NaCl group N=52	P value (Fisher exact two tailed)
Mild swelling	5 (9.6%)	2 (3.8%)	0.436
Moderate	0	0	-
Severe	0	0	-

included in this study.

A total number of 228 patients requiring endodontic therapy- on clinical and radiographic evaluation- were screened and only 104 patients met the inclusion criteria who were enrolled in the study prospectively for the period of one year from 3rd January 2009 to 2nd January 2010. Informed consent from the patients and ethical clearance was obtained before the commencement of the study. Two treatment groups were constituted and patients were divided into these groups. First group received sequential irrigation of 3% H₂O₂, 5.2% NaOCl and 0.9% NaCl during the endodontic therapy which was named as conventional (3% H₂O₂ + 5.2% NaOCl + 0.9% NaCl) group and the second group consisted of only 0.9% NaCl irrigation, and this group was designated as normal saline group. Root canals were prepared by step-back (flare or telescopic) method in conjunction with circumferential filing with the use of files and reamers. Intra-oral periapical (IOPA) radiograph was used to determine working length of the root canals and periapical pathology. Calcium hydroxide [Ca(OH)₂] was used as intracanal medicament during different sittings for the treatment and sterile cotton pellet and Cavit were used for temporary dressing. Root canals were obturated with zinc oxide eugenol sealer cement and gutta-percha by lateral condensation method. Root canal treatment was completed in three sittings on every alternate day by the dental surgeons and after one week post-obturation restoration was given.

To compare the efficacy of 0.9% NaCl with other three intracanal irrigants the following parameters were observed; post-obturation swelling, post-obturation pain, post-obturation use of analgesic agents and IOPA radiograph eight weeks post-treatment. Post-obturation swelling within 48 hours was assessed by a questionnaire distributed to the patients.^{5,12} To record the post-obturation pain, visual analog scale (VAS) was used which consisted of no pain (0), mild pain (1), moderate pain

(2), severe pain (3), very severe pain (4) and worst pain possible (5). So pain levels were assessed by VAS questionnaire given to the patients who recorded pain levels after 4, 24, and 48 hours of root canal obturation. Patients were advised to take tablet ibuprofen 400 mg eight hourly, if needed, and to stop when pain is relieved. The number of ibuprofen tablets taken by the patients

to relieve the pain was recorded. Patients were followed up after 48 hours to collect the questionnaire and eight weeks post treatment for radiographic evaluation by giving a telephone call.¹² Patients were asked to report immediately if they faced any severe swelling and/or pain. As the data observed were qualitative in nature, Chi square test was used to test the significance level which was set at 5% by using Epi Info 2000.

RESULTS

Out of 104 patients, 58 (55.8%) were males and 46 (44.2%) were females. Age range of the patient was 15 to 60 years and age group 35-40 years was most prevalent (48%). Percentage of posterior and anterior teeth was 76.9% and 23.1% respectively. No statistically significant difference was observed between two treatment groups on observed treatment outcomes. Tables-1, 2, 3 and 4 show findings on post-obturation swelling, post-obturation pain, post-obturation use of analgesics and post-obturation healing which was evident on eight weeks post-obturation IOPA radiograph respectively.

DISCUSSION

Present study showed no significant difference in the post-treatment swelling, pain and analgesic use though there was higher incidence of swelling (9.6% vs 3.8%) and post-operative pain level in VAS score in the first 48 hours (32.6% vs 23.1%) in 3% H₂O₂ + 5.2% NaOCl

Table-2: Post-obturation pain during the first 48 hours in the treatment groups

Pain*(VAS score)	Conventional group (3% H ₂ O ₂ + 5.2% NaOCl + 0.9% NaCl) N=52	0.9% NaCl group N=52	P value (Yates corrected)
No pain (0)	36 (69.3%)	39 (75%)	0.661
Mild pain (1)	14 (26.9%)	10 (19.3%)	0.485
Moderate pain (2)	3 (5.7%)	2 (3.8%)	1

* In conventional group, two patients experienced intolerable pain intra-operatively after irrigation with 3% H₂O₂ because of which treatment had to be discontinued immediately for the day, which is not included here as the table findings represent post-operative outcome only.

Table-3: Post-obturation use of analgesics by the patients

No. of ibuprofen tablets	Conventional group (3% H ₂ O ₂ + 5.2% NaOCl + 0.9% NaCl) N=52	0.9% NaCl group N=52	P value (Yates corrected)
1-3	8 (15.4%)	5 (9.7%)	0.653
4-6	8 (15.4%)	5 (9.7%)	0.653
7-9	1 (1.9)	1 (1.9%)	0.475

+ 0.9% NaCl group than in 0.9% NaCl group. The possible explanation for this occurrence might be due to the extrusion of irrigation solutions beyond the apical constriction which may result in postoperative pain. NaOCl can cause severe tissue irritation and necrosis outside the root canal system if extruded into the periodontal ligament (PDL) space.¹² Studies have shown that though NaOCl is most commonly used to clean and disinfect root canals,^{8,9,13} it is a toxic and corrosive product.¹³ Similarly, H₂O₂ can react with pulp debris and blood to produce gas which may get entrapped within the tooth and cause incessant pain.⁷

Nowadays, commonly used irrigation solutions include NaOCl, ethylenediamine tetraacetic acid (EDTA), citric acid, chlorhexidine (CHX), and electrochemical activation (ECA) of different solutions. However, the potential toxicity of NaOCl and the effects of the chlorates (ClO₃⁻ and ClO₂⁻) should be recognized. In humans, these chemical substances are the products of oxidative damage to red blood cells, hemolytic anemia and methemoglobin formation and are also cytotoxic for fibroblasts. Therefore, new study for the alternative irrigants includes ozonization and electrochemical activation of different solutions such as ozonized water, ozonized NaOCl, ECA water, ECA NaCl solution, ozonized ECA water and ozonized ECA NaCl solution which reduce formation of chlorates and enhance smear layer removal.¹⁴ Nevertheless, this study showed that normal saline alone is the potential irrigant in the root canal therapy and warrants further study to confirm its clinical and economical superiority among others.

The major objective in root canal treatment is to debride and disinfect the entire root canal system. This requires that the pulpal contents be eliminated as sources of infection. This goal may be succeeded by adopting mechanical instrumentation and chemical irrigation, along with medication of the root canal

between treatment sessions.⁸ The success of endodontic treatment depends on the removal of microbes from the root canals and avoidance of reinfection.¹⁵ In the present study, 0.9% NaCl was found as effective as sequential use of 3% H₂O₂, 5.2% NaOCl and 0.9% NaCl although normal saline has no antibacterial activity as it did not inhibit the growth of

Streptococcus faecalis, *Str. mutans* and *Staphylococcus aureus* in the ditch plate method in antimicrobial susceptible testing.¹¹ Additionally, antimicrobial spectrum of different irrigation solutions in the patient is equivocal as the irrigation of infected human root canals with *Enterococcus faecalis* with ozonated water, 2.5% NaOCl, 2% CHX and the application of gaseous ozone for 20 min was not sufficient to inactivate *Enter. faecalis*.¹⁰ So during irrigation, the contact time of irrigation solution also determines its antimicrobial activity. Hence, whether the main goal of irrigation solution is for cleansing, antimicrobial action or both is elusive. Based on the study, it can be postulated that proper mechanical debridement of the root canals and cleansing with 0.9% NaCl and intracanal medication with Ca(OH)₂ between treatment sessions is enough to disinfect the root canals. Ca(OH)₂ has antimicrobial effect and is also active against *Enter. faecalis*.¹³ In immunocompetent patients host defense suffices to clear up the remaining pathogenic bacteria, if any, in the root canals once the bulk of the source of infection is removed mechanically. Therefore, mechanical debridement of inflamed and necrotic pulpal tissue, microbes and other debris from the root canals is the crux in endodontic therapy.¹⁵

Table-4: Eight weeks post-obturation intra-oral periapical (IOPA) radiographic evaluation of the patients

Comparison of post-treatment radiograph with pre-treatment radiograph	Conventional group (3% H ₂ O ₂ + 5.2% NaOCl + 0.9% NaCl) N=52	0.9% NaCl group N=52	P value (Yates corrected)
No periapical radiolucency in both	9 (17.3%)	11 (21.2%)	0.803
Decreasing periapical radiolucency	36 (69.2%)	36(69.2%)	0.831
Increasing periapical radiolucency	0	0	-

In this study, eight weeks post operative radiographic evaluation of the treated patients showed progressive healing in the periapical region and insignificant difference between two groups. Data in the literature have asserted that success of endodontic therapy depends upon the prevention of complications such as tooth extraction as a result of endodontic problems and radiographic failure after 1 year, postoperative discomfort, swelling, analgesic use, or draining sinus. However, no root canal treatment can prevent 100% of short-term and long-term complications.¹⁶ Additionally, it is interesting fact to note that whether or not the root canal treatment for irreversible pulpitis is required is the matter of debate and research as no significant difference in the clinical success was observed in pulpotomy with a calcium-enriched mixture (PCEM) compared with one visit root canal treatment (RCT). Moreover, the radiographic success rates were significantly greater ($P < 0.001$) in the PCEM ($n=205$) than in the single sitting RCT ($n=202$).⁵ This finding in literature has instigated comprehensive research work in this debatable issue.

No matter what techniques, irrigants and intracanal medicaments are used during endodontic therapy, the clinical and radiological success is the definite measurement of clinicians' and patients' satisfaction level, and the quality of the treatment. Limitation of this study includes small sample size and short duration of post-treatment follow-up. However, present study has opened the door for the future research with large sample size and long duration follow-up i.e. at least for one year. Present study showed no significant differences between the two groups. However, based on only this study no recommendations can be made as this study included smaller sample size and shorter duration of post-obturation follow up. So studies involving more sample size and longer duration of post-obturation follow up and meta-analysis of such studies are recommended to conclude whether normal saline alone can be a potential intracanal irrigant or not.

REFERENCES

1. Perinetti G, Varvara G, Esposito P. Prevalence of dental caries in schoolchildren living in rural and urban areas: results from the first region-wide Italian survey. *Oral Health Prev Dent* 2006; 4: 199-207.
2. Lo EC, Holmgren CJ, Hu DY, Wan HC. Dental caries status and treatment needs of 12-13-year-old children in Sichuan province, southwestern China. *Community Dent Health* 1999; 16: 114-6.
3. Warren JJ, Cowen HJ, Watkins CM, Hand JS. Dental caries prevalence and dental care utilization among the very old. *J Amer Dent Assoc* 2000; 131: 1571-9.
4. Yee R, Sheiham A. Caries experience of 5-6-year-old and 12-13-year-old schoolchildren in central and western Nepal. *Int'l Dent J* 2002; 52: 453-60.
5. Asgary S, Eghbal MJ. A clinical trial of pulpotomy vs. root canal therapy of mature molars. *J Dent Res* 2010 [online]. Available from: URL:<http://jdr.sagepub.com/cgi/framedrapidpdf/0022034510374057v1> [cited 2010 Jun 18]
6. Shafer WG, Hine MK, Levy BM. A textbook of oral pathology. 4th ed. USA: WB Saunders Company, Philadelphia 2000; 406-78.
7. Grossman LI, Oliet S, DelRio CE. Endodontic practice. 11th ed. USA: Lee and Febiger 600 Washington Square, Philadelphia 1991; 179-225.
8. Mohammadi Z. Sodium hypochlorite in endodontics: an update review. *Intl Dent J* 2008; 58: 329-41.
9. Guida A. Mechanism of action of sodium hypochlorite and its effects on dentin. *Minerva Stomatol* 2006; 55: 471-82.
10. Estrela C, Estrela CR, Decurcio DA, Hollanda AC, Silva JA. Antimicrobial efficacy of ozonated water, gaseous ozone, sodium hypochlorite and chlorhexidine in infected human root canals. *Intl Endod J* 2007; 40: 85-93.
11. Almas K. The antimicrobial effects of seven different types of Asian chewing sticks. *Odonto-Stomalogie Tropicale* 2001; 96: 496-500.
12. Gondim EJ, Setzer FC, Dos CB, Kim S. Postoperative pain after the application of two different irrigation devices in a prospective randomized clinical trial. *J Endod* 2010; 36: 1295-1301.
13. VanDer JM, Botha FS, Marais JT. Root canal cleaning, bacteriostatic effect of irrigation solutions and calcium hydroxide. Oral/poster presentations for the preliminary program for XXXVII scientific meeting of the South African division of International Association for Dental Research (IADR) 2003. [online] Available from: URL: <http://iadr.confex.com/iadr/safdiv03/preliminaryprogram/index.html> [cited 2010 June 19]
14. Steier L. Novel irrigants for canal disinfection. *Roots* 2008; 3: 44-9. [online] Available from: URL: <http://www.endoexperience.com/documents/Irrigants-Steier.pdf> [cited 2010 June 19]
15. Haapasalo M, Shen Y, Qian W, Gao Y. Irrigation in endodontics. *Dent Clin North Amer* 2010; 54: 291-312.
16. Figini L, Lodi G, Gorni F, Gagliani M. Single versus multiple visits for endodontic treatment of permanent teeth: a Cochrane systematic review. *J Endod* 2008; 34: 1041-7.