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Effect of intracanal cryotreated sodium hypochlorite on postoperative pain and antimicrobial efficacy after root canal treatment - An Invivo study

[1]Dr. Suman C., Postgraduate, Raja Rajeswari Dental College and Hospital, Bangalore.

[2]Dr. Thokala Dhamodaran, Professor, Raja Rajeswari Dental College and Hospital, Bangalore.

[3]Dr R Vinay Chandra, Professor, Raja Rajeswari Dental College and Hospital, Bangalore

[4]Dr. Swetha H., Professor, Raja Rajeswari Dental College and Hospital, Bangalore.

Corresponding Author: Dr. Suman C., Postgraduate, Raja Rajeswari Dental College and Hospital, Bangalore.

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Abstract

Aim: The Aim of this study is to evaluate and compare the effect of cryotreated sodium hypochlorite and room temperature sodium hypochlorite on postoperative pain and antimicrobial efficacy after root canal treatment**.**

Materials And Methods: THIRTY patients were selected according to inclusion criteria and baseline VAS score was recorded.

After obtaining consent, the access cavity was opened under local anesthesia..before cleaning and shapimg first micobial sample was taken.

the patients were randomly divided into two groups: Group 1: Normal Room temperature NaOCl and Group 2: Cryotreated

NaOCl (2°C–4°C), each of the canals further received 20 ml of the respective irrigants based on the groups allocated. The final rinse was done with saline, and canals were dried and second microbial sample taken and obturated in the same appointment. Postoperative visual analogue scale pain levels were recorded at 24. microbial samples be incubated aerobically and anaerobically at 37°C for 24–48 h. Then, the number of colony forming units (CFUs)/ml of each specimen was estimated.

Results: The results of the study showed that cryotherapy group showed a statistically significant reduction in postoperative pain levels at 24 hrs and reduced microbial CFUs.

Keywords: Cryotheraphy, Sodium Hypochlorite, Antimicrobial Efficacy, Post Operative Pain.

Introduction

The goal of endodontic treatment is to completely clean and shape the root canal system and to provide a hermetic seal with no discomfort to the patient, thereby

providing optimum conditions for periradicular healing.[1]

Even with utmost care while performing root canal treatment, postoperative pain and flare-ups are commonly encountered by the clinicians. The incidence of postoperative pain ranges from 1.4% to 53%.[2]

The postendodontic pain is caused by either microbial, mechanical or chemical factors or combinations of these.[3] Therefore, postoperative pain is a synergistic effect of the above-stated causes and cannot be exclusively attributed to a single definite cause.[4]

Management of postendodontic pain is a crucial factor for a successful practitioner. Several techniques have been tried to reduce the incidence of postoperative pain ranging from prescribing preprocedural analgesics, administering long-standing local anesthesia, optimal instrumentation, and appropriate use of irrigants and occlusal reduction, psychological management.[5]

Cryotherapy is a new therapeutic option applied in sports medicine and general surgery for the management of pain and for postoperative care. According to Van't Hoff 's law, application of cold to the tissues causes vasoconstriction, decreases cellular metabolism, and inhibits the neural receptors in the skin and subcutaneous tissues.[6]

In dentistry, cryotherapy was employed for postoperative pain control in intraoral surgical procedures.but its antimicrobial efficacy was not studied invivo .

Hence the Aim of this study was to evaluate and compare the effect of cryotreated sodium hypochlorite and room temperature sodium hypochlorite on postoperative pain and antimicrobial efficacy after root canal treatment.

Study Design: A total of 30 patients will be selected from the Outpatient department of conservative dentistry and endodontics, RajaRajeswari Dental College and Hospital Bengaluru.

Inclusion criteria

1. The age group of 18–40 years who signed the informed consent
2. Teeth that will be diagnosed with symptomatic irreversible pulpitis/apical periodontitis.
3. Healthy patients without systemic disease
4. Patients with pain score ranging from moderate to severe (3–10) on a visual analog scale (VAS) (0–10).

Exclusion Criteria

1. Patient who are medically compromised
2. Pregnant patients
3. Teeth with incomplete apex formation
4. Teeth with calcified canals
5. Teeth with Sinus opening
6. Teeth with Periapical abscess
7. Patients on antibiotic therapy
8. Patients on analgesics

Treatment Protocol

- Consent for the treatment will be taken from the patient.
- Thorough aseptic protocols will be maintained throughout the procedure.
- Single visit root canal therapy will be performed under rubber dam isolation.
- The access cavity preparation will be performed.

The first microbial sampling (Pre Rx) will be taken from the root canal after access cavity preparation. Canal is irrigated using 1 ml sterile saline solution and the sample will be taken using successive sterile paper points that is introduced into the full length of the canal and kept in place for 60 s until absorb all the fluid inside the canal. The paper point sample will be immediately transferred into tube containing 1 ml of thioglycollate broth as a transport medium.

All the canals the chemomechanical preparation will be done and the irrigation protocol will be categorized into

Group 1: Irrigation using normal room temperature sodium hypochlorite.

Group 2: irrigation using cryotreated sodium hypochlorite (2°C–4°C).

The temperature of the cold hypochlorite is preserved for 5 min irrigation period by keeping the irrigation syringes, which will be used one by one, in a special box filled with ice after removal from the refrigerator with thermocouple inserted inside to confirm the 2°C–4°C temperature range.

After the final irrigation procedure of canal with saline the second microbial sample (post Rx) will be taken.

Next, paper points is used to dry the root canals followed by obturation by cold lateral compaction.

All microbial samples (S1, S2) will be transported to a media which will be incubated aerobically and anaerobically at 37°C for 24–48 h. Then, the colonies that developed on each plate will be counted and multiplied to give the number of colony forming units (CFUs)/ml of each specimen.All participants will be receiving a sheet containing VAS after the procedure. After 24 and , patients will be called by telephone and asked for their general feeling in the area of the root canal, pain intensity on VAS.

Figure 1: Access Opening Endo Access Bur 1

Paper Point Sample (Pre Rx)

Cryotreated Sodium Hypochlorite (2°C–4°C).

Figure 2: Paper Point Sample (Post Rx)

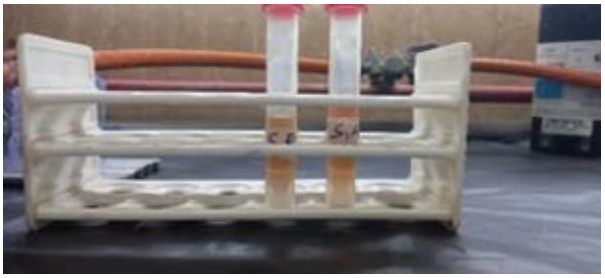


Figure 3: Thioglycollate Broth (Transport Medium)

Figure 4: Blood Agar (Culture Media)

Results

Kruskal Wallis test followed by Mann Whitney Post hoc analysis will be used to compare the mean CFUs between 2 groups before and after using different Irrigation protocol.

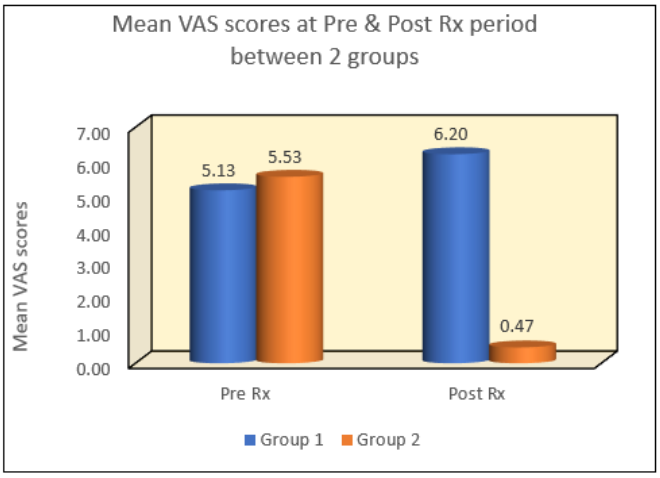
The statistical analyses for postoperative pain values were performed using IBM® SPSS® Statistics 20 software (IBM SPSS Inc., Chicago, IL, USA) at 5% significance level (p=0.05).

The Kruskal-Wallis test was used to compare postoperative pain values among the groups.

Comparison of mean VAS scores at Pre & Post Rx period between 2 groups using Mann Whitney Test after 24 hrs						
Time	Groups	N	Mean	SD	Mean Diff	p-value
Pre Rx	Group 1	15	5.13	0.92	-0.40	0.23
	Group 2	15	5.53	0.83		
Post Rx	Group 1	15	6.20	0.78	5.73	<0.001*
	Group 2	15	0.47	0.52		

Table 1

The mean VAS scores during the Pre-treatment period for Group 1 was 5.13 ± 0.92 and for Group 2 was 5.53 ± 0.83. However, there was no significant mean difference observed between 2 groups [p=0.23]. During the Post treatment period, Group 2 showed significantly lesser VAS scores [0.47 ± 0.52] as compared to Group 1 [6.20 ± 0.78] and the mean difference between 2 groups was statistically significant at p<0.001.

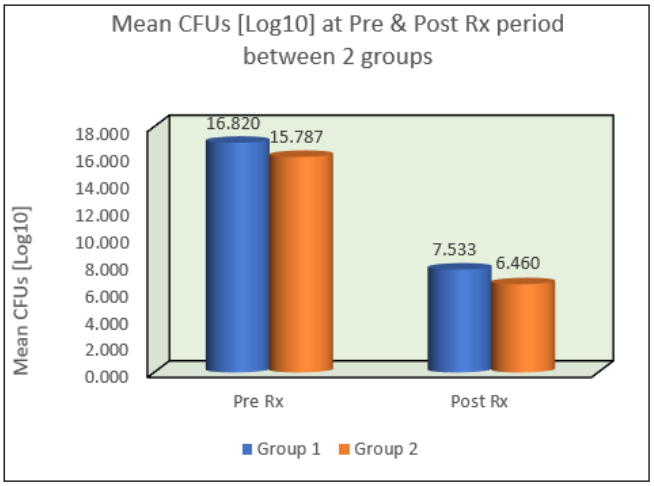


Graph 1

Comparison of mean CFUs [Log10] at Pre & Post Rx period between 2 groups using Mann Whitney Test						
Time	Groups	N	Mean	SD	Mean Diff	p-value
Pre Rx	Group 1	15	16.820	1.819	1.033	0.15
	Group 2	15	15.787	2.507		
Post Rx	Group 1	15	7.533	1.122	1.073	0.007*
	Group 2	15	6.460	0.679		

Table 2

The mean CFUs during the Pre-treatment period for Group 1 was 16.820 ± 1.819 and for Group 2 was 15.787 ± 2.507. However, there was no significant mean difference observed between 2 groups [p=0.15]. During the Post treatment period, Group 2 showed significantly lesser CFUs scores [6.460 ± 0.679] as compared to Group 1 [7.533 ± 1.122] and the mean difference between 2 groups was statistically significant at p=0.007.

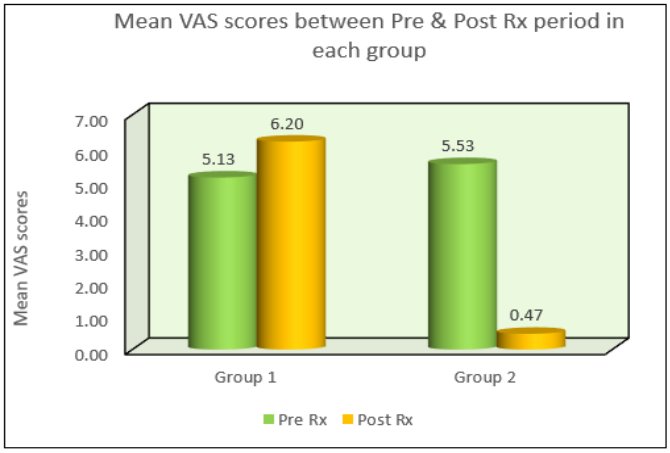


Graph 2

Comparison of mean VAS scores between Pre & Post Rx period in each group using Wilcoxon Signed Rank Test						
Groups	Time	N	Mean	SD	Mean Diff	p-value
Group 1	Pre Rx	15	5.13	0.92	-1.07	0.003*
	Post Rx	15	6.20	0.78		
Group 2	Pre Rx	15	5.53	0.83	5.06	0.001*
	Post Rx	15	0.47	0.52		

Table 3

The mean VAS scores in Group 1 during the Post-treatment period was significantly increased [6.20 ± 0.78] as compared to Pre-treatment period [5.13 ± 0.92] and the mean difference in the VAS scores between 2 time intervals in Group 1 was statistically significant at p=0.003. In Group 2 during the Post-treatment period, the mean VAS scores was significantly decreased [0.47 ± 0.52] as compared to Pre-treatment period [5.53 ± 0.83] and the mean difference in the VAS scores between 2 time intervals in Group 2 was statistically significant at p=0.001.

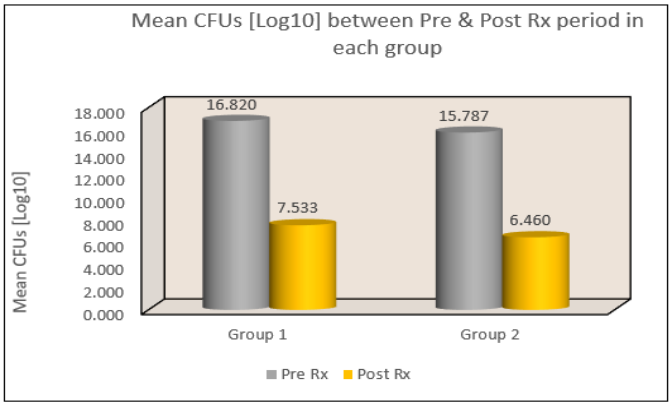


Graph 3

Comparison of mean CFUs [Log10] between Pre & Post Rx period in each group using Wilcoxon Signed Rank Test						
Groups	Time	N	Mean	SD	Mean Diff	p-value
Group 1	Pre Rx	15	16.820	1.819	9.287	0.001*
	Post Rx	15	7.533	1.122		
Group 2	Pre Rx	15	15.787	2.507	9.327	0.001*
	Post Rx	15	6.460	0.679		

Table 4

The mean CFUs in Group 1 during the Post-treatment period was significantly lesser [7.533 ± 1.122] as compared to Pre-treatment period [16.820 ± 1.819] and the mean difference in the CFUs between 2 time intervals in Group 1 was statistically significant at p=0.001. In Group 2 during the Post-treatment period, the mean CFUs was significantly lesser [6.460 ± 0.679] as compared to Pre-treatment period [15.787 ± 2.507] and the mean difference in the CFUs between 2 time intervals in Group 2 was statistically significant at p=0.001.



Graph 4

Group 1

Figure 5: CFU-Pre Rx

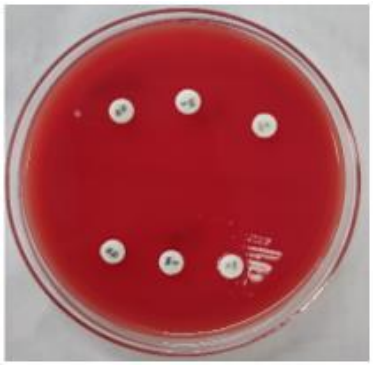


Figure 6: CFU-Post Rx

Group 2

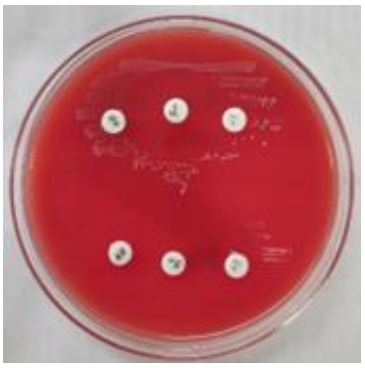


Figure 7: CFU-Pre Rx

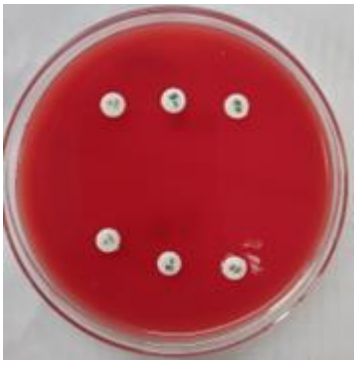


Figure 8: CFU-Post Rx

Discussion

The primary goal of endodontic treatment is to completely clean and shape the root canal system and to provide a hermetic seal with no discomfort to the patient, thereby providing optimum conditions for periradicular healing.[7]

Even with utmost care while performing root canal treatment, postoperative pain and flare-ups are commonly encountered by the clinicians. The incidence of postoperative pain ranges from 1.4% to 53%.[2]

The postendodontic pain is caused by either microbial, mechanical or chemical factors or combinations of these.[3] Therefore, postoperative pain is a synergistic effect of the above-stated causes and cannot be exclusively attributed to a single definite cause.

The involvement of several factors in the perception of postoperative pain makes it difficult to investigate the role of only one factor in postoperative pain. For instance, preoperative pain is indicative of a previous injury to the periradicular area and has been reported to be an indicator of more frequent and pronounced postoperative pain [8]

Therefore, in our study, we limited to symptomatic teeth with moderate pain level (VAS score of 3–6) for two reasons: one was to standardize all the patients and second was to evaluate the effect of cryotherapy in an actual clinical scenario because most of the clinical situation demands for managing symptomatic teeth rather than asymptomatic teeth.

In this study, we administered 10 cm VAS scale ranging from 0 to 10 to measure the postoperative pain intensity. the time interval for the evaluation of pain was 6 h, 24 h, and 48 h, to assess and evaluate the dynamics of pain reduction after endodontic treatment.

Management of postendodontic pain is a crucial factor for a successful practitioner. Several techniques have been tried to reduce the incidence of postoperative pain ranging from prescribing preprocedural analgesics, administering long-standing local anesthesia, optimal instrumentation, and appropriate use of irrigants and occlusal reduction, psychological management [9]

Cryotherapy is derived from a Greek word, “cryos” meaning cold. Cryotherapy is a long-standing therapeutic procedure applied in sports medicine and in surgery to minimize postoperative discomfort and controlling pain and inflammation.[9] Cryotherapy has been reported to be effective at reducing edema, pain, inflammation, and recovery time with short term applications in orthopedic,abdominal, gynecological and hernia operations.[10]

Though cryotherapy refers to lowering or reducing the tissue temperature for therapeutic purposes, it does not imply only implementing cold but rather extracting heat.[11] The magnitude of temperature applied governs the type of biophysical alterations that occurs in the tissues. Furthermore, exposure time, the thermal conductivity of the tissues, and type of the heat or cold agents employed influence the intensity of the therapeutic effect on the

target tissues.[12]

Vera *et al*. was the first to describe the use of cryotherapy in endodontics. In their *in vitro* study, they had assessed the effect of cold saline solution (2.5°C) as a final irrigant for 5 min and concluded that the use of cold saline caused the reduction of external root surface temperature by more than 10°C.[13]

The first clinical trial employing this concept was done by Keskin *et al*. The outcome of this study revealed that 2.5°C cold saline irrigation as a final irrigant resulted in a significant reduction of postoperative pain levels.

The rationale for using sodium hypochlorite is that it is the most common irrigant used for its excellent tissue dissolving property and antimicriobial activity.

hence the study is done to evaluate and compare the effect of cryotreated sodium hypochlorite to room temperature sodium hypochlorite on postoperative pain and antimicrobial efficacy after root canal treatment.

In the present study, sodium hypochlorite was cryotreated to the temperature of 2.5°C–4°C and was used for irrigating each canal for 4 min.

Intra group comparison

The mean VAS scores during the Pre-treatment period for Group 1 was 5.13 ± 0.92 and for Group 2 was 5.53 ± 0.83. However, there was no significant mean difference observed between 2 groups [p=0.23]. During the Post treatment period, Group 2 showed significantly lesser VAS scores [0.47 ± 0.52] as compared to Group 1 [6.20 ± 0.78] and the mean difference between 2 groups was statistically significant at p<0.001.

Inter group comparison

The mean VAS scores in Group 1 during the Post-treatment period was significantly increased [6.20 ± 0.78] as compared to Pre-treatment period [5.13 ± 0.92] and the mean difference in the VAS scores between 2 time intervals in Group 1 was statistically significant at p=0.003. In Group 2 during the Post-treatment period, the mean VAS scores was significantly decreased [0.47 ± 0.52] as compared to Pre-treatment period [5.53 ± 0.83] and the mean difference in the VAS scores between 2 time intervals in Group 2 was statistically significant at p=0.001.

The results of the present study showed that cryotherapy group showed a significant reduction in postoperative pain levels at all tested time intervals, which is 6 h, 24 h, and 48 h.

This could be attributed to the anti-inflammatory effect in the periradicular tissues.

The possible reason for the reduction of postoperative pain by cryotherapy was that cold causes vasoconstriction with antioedematic effect, also reduces the blood supply and oxygen supply to that region, thereby reducing cellular metabolism and limiting the tissue damage. Cold also diminishes the number of leukocytes migrating to the affected site, thereby reducing endothelial dysfunction and inflammatory response. In addition, it affects the peripheral nerve endings by diminishing the threshold needed to activate the tissue nociceptors and the speed of painful nerve impulses.

The antimicrobial assesemnet of cryotreated and normal temperature sodium hypochorite was done by calculating CFUs count before and after chemomechnical preparation.

Intragroup comparison

The mean CFUs during the Pre-treatment period for Group 1 was 16.820 ± 1.819 and for Group 2 was 15.787 ± 2.507. However, there was no significant mean difference observed between 2 groups [p=0.15]. During the Post treatment period, Group 2 showed significantly lesser CFUs scores [6.460 ± 0.679] as compared to Group 1 [7.533 ± 1.122] and the mean difference between 2 groups was statistically significant at p=0.007.

Inter group comparison

The mean CFUs in Group 1 during the Post-treatment period was significantly lesser [7.533 ± 1.122] as compared to Pre-treatment period [16.820 ± 1.819] and the mean difference in the CFUs between 2-time intervals in Group 1 was statistically significant at p=0.001. In Group 2 during the Post-treatment period, the mean CFUs was significantly lesser [6.460 ± 0.679]

as compared to Pre-treatment period [15.787 ± 2.507] and the mean difference in the CFUs between 2 time intervals in Group 2 was statistically significant at p=0.001.

Intra group comparison the Post treatment period, Group 2 showed significantly lesser CFUs scores [6.460 ± 0.679] as compared to Group 1 [7.533 ± 1.122] and the mean difference between 2 groups was statistically significant.

In a study done by N. Mandras1, V. Allizond the result indicated that cryo-instrumentation after NaOCl irrigation significantly reduced the number of bacteria in the root canal compared to NaOCl alone and it can reach the desired depth, causing immediate freezing of bacterial cells and their subsequent cryodestruction.

An invitro Study done by Yamamoto and Harris. The results showed that the antimicrobial activity of cryotreated sodium hypochlorite against *Enterococcus faecalis* showed a significant reduction in the number of *E. faecalis* compared to normal sodium hypochlorite.

This was explained that process of freezing and thawing induces injury in micro-organisms, in part, through membrane or cell wall disruption, causes leakage of intracellular constituents and changes in protein conformation.

In another study done by Braitt GR, it was proved that there was a significantly higher amount of free chlorine released from sodium hypochlorite stored in the refrigerator than at room temperature, a higher amount of active chlorine indirectly implies higher the antimicrobial efficacy.

Conclusion

The ultimate goal of endodontic treatment is to completely clean and shape the root canal system providing optimum conditions for periradicular healing. Even with utmost care while performing root canal treatment, postoperative pain and flare-ups are commonly encountered by the clinicians.results of the study has shown that cryotherapy has reduced postoperative pain and also increased antimicrobial efficacy following root canal treatment compared to normal temperature sodium hypochlorite.

Hence we can conclude that cryotherapy is simple theraphy , cost-effective, and non-toxic option for postoperative pain management and also to achieve an increased antimicrobial efficacy after root canal treatment.

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