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Effect of Intracanal Cryotherapy on Post-Endodontic Pain in Single Visit Root Canal Treatment: A Randomized Controlled Clinical Trial

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ABSTRACT

Objective: To compare post endodontic pain scores among patients irrigated with cold saline v/s room temperature saline as an adjunctive final irrigation regime in single-visit root canal treatment. **Methodology:** Ninety patients requiring single-visit root canal therapy for vital teeth were randomly allocated into three groups. Group 1 had the intracanal cryotherapy with 15 ml of 2.5°C cold saline for 5 minutes. Group 2 received 15 ml of room-temperature saline for 5 minutes and the control group received no final saline irrigation. Post-operative pain was assessed using a Visual Analogue Scale at 6, 24 and 48 hours. **Results:** A statistically notable difference in pain scores was observed among the groups at all time points. The cryotherapy group had the lowest mean pain scores at 6 hours (2.13 ± 0.86) (P = 0.009), 24 hours (1.50 ± 0.50) (P < 0.001) and 48 hours (0.87 ± 0.81) (P < 0.001). **Conclusion:** There was a significant difference in post-endodontic pain perceived by the patient when cold saline was used as a final root canal irrigant when compared to control arm.

INTRODUCTION

Endodontic treatment is effective in easing pain associated with inflammation of dental pulp. Nevertheless, it can sometimes be linked to a postoperative flare-up that can manifest as moderate to severe pain. Other signs may encompass swelling, throbbing pain, as well as an overall feeling of uneasiness, which might start a few hours post-treatment as well as may persist for 3 days. Flare-ups usually arise from mechanical as well as chemical irritation occurring during root canal treatment. Four Multiple approaches have been outlined to mitigate postoperative pain for patient. [1-4] The relationship within pulp status and frequency of flare-ups has become a subject of ongoing debate. A person's degree of stress as well as anxiety is an underlying contributor to preoperative pain, along with a patient experiencing pain prior to treatment has become more likely to experience pain post-treatment.[5, 6]

To minimize the possibility of post-endodontic flare-up, multiple strategies can be implemented. These techniques include proper instrumentation, complete cleaning of the canal, use of intracanal medications, and disocclusion of tooth.[7] Certain procedures for treatment are implemented for patients who present with post-endodontic pain, that may include the prescription of NSAIDs along with the application of cold packs. Traditional techniques employed to mitigate pain, demonstrate specific drawbacks. Intracanal medicaments, which include calcium hydroxide, as well as occlusal reduction exhibit contradictory effects on reduction of post-operative complications. Research suggests NSAIDs can have negative impacts on gastric mucosa.[8]

The primary focus of these approaches is to address inflammation with the goal to alleviate post-endodontic pain. New techniques have demonstrated encouraging outcomes in reducing endodontic flare-ups. Cryotherapy, often referred to as cold therapy, involves application of low temperatures for medicinal reasons, specifically to alleviate pain and minimize swelling following tissue injury or surgical procedures.[9, 10] Cryotherapy is utilized in dentistry for surgical procedures, tooth extractions, as well as dental implant placements. The mechanism decreases leukocyte attachment to capillary wall along with induces vasoconstriction, thereby contributing to inflammation decline. Additionally, it results in a localized

temperature reduction, which aids in lowering conduction velocity of pain impulses.[11, 12]

Cold therapy has demonstrated effectiveness in reducing pain sensitivity; nonetheless, due to a lack of scientific validation, we will implement cryotherapy to alleviate post-endodontic pain. Postoperative endodontic pain afterwards a single-visit root canal treatment negatively impacts patient quality of life. Additionally, it necessitates an extra visit to dental practice, which could undermine the patient's trust in both operator and treatment provided. To reduce the likelihood of post-endodontic flare-ups, new techniques such as use of 15ml of cold saline and room temperature saline appear to be beneficial as well as warrant further investigation as a final root canal irrigation protocol.

METHODOLOGY

This randomized controlled trial was conducted in the department of operative dentistry and endodontics, Hamdard university dental hospital, after obtaining ethical approval. There were 90 patients in this study, the sample was selected using pain score for cold saline from a previous study[13] 0.071 with SD 0.26 and control group's pain score 2.49 with SD 2.93, significance level 5% and power of test 90%. A non-probability consecutive sampling technique was used.

Patients aged 18 to 50, were presented with vital teeth suitable for single-visit, non-surgical root canal therapy. Patients who required endodontic retreatment, teeth with complex root canal anatomy such as severe curvature exceeding 30 degrees, evidence of root resorption, an open apex or sclerosed canals observable radiographically. Patients who had consumed analgesics or anti-inflammatory medication prior to treatment, those with pre-existing periapical pathosis, pregnant or lactating patients, teeth with cracks or fractures and patients with systemic illnesses (Diabetes, cardiovascular illness and hypertension) or allergies were not enrolled.

Patients were randomly allocated using computer-generated random sequence, each group having 30 patients. The study was conducted as a single-blind trial, where participants were blinded to group allocation. Local anesthesia was given using 2% lidocaine with 1:100,000 epinephrine (Medicaine, Huons Co.Limited South Korea). After rubber dam isolation, access cavities were prepared and single canal was negotiated. Chemo-mechanical debridement was performed using 5.25% sodium hypochlorite delivered with a double-side vented needle. Working length was determined with an apex locator using K-files sizes #10 and #15 (Mani Inc, Japan) and confirmed radiographically. Hand instrumentation was performed till #25 of K file EDTA (Meta Biomed) was used as lubricant. Canal preparation was done using ProTaper Gold rotary files up to size F2 or F3 with continuous recapitulation with #10 K file and irrigation with NaOCI between each instrument to maintain patency. Following the final irrigation patients were assigned to three groups assignment. In Group 1 which had cryotherapy the final irrigation involved the administration of 15 ml of sterile normal saline cooled to 2.5°C. This chilled irrigant was delivered to the full working length using a double-side vented needle over a continuous period of five minutes. The syringes containing the saline were stored in a refrigerated unit until use and the temperature was consistently monitored with a digital thermometer. Group 2 received a final irrigation with 15 ml of 0.9% normal saline maintained at room temperature which was delivered over five minutes. Group 3 served as the control, which did not receive irrigation. All root canals were dried with paper points (GAPADENT) and obturated using the cold lateral compaction technique with gutta-percha (GAPADENT) and Sealapex sealer (Kerr Sybron). The access cavities were then restored with direct composite resin (RubyDent). Postoperatively photographs were taken to evaluate the quality of canal.

Each patient was given a questionnaire with VAS scale to assess and record their pain at 6, 24 and 48 hour. The practitioner called the patients to report their pain score after 48 hours to avoid follow up loss. Patients were asked to return their questionnaires in their follow up visits.

For the statistical analysis, we used SPSS 23. Age and pain scores were calculated using mean and SD. Gender, occupation, residence, marital status and medical history were evaluated with frequency and percentages. We use ANOVA to assess the pain score between the groups. ANOVA was used for stratification of pain score in the groups with age and gender. P value less than or equal to 0.05 was deemed significant.

RESULTS

We had 90 patients in this study, they were divided in three groups, of 30 patients each. The group receiving cold saline had mean age of 30.63 ± 9.29 years, while the room temperature saline and control groups had mean ages 37.20 ± 9.73 and 32.93 ± 10.73 years, respectively.

In the cold saline group 20 patients (66.7%) were male and 10 (33.3%) were female. The room temperature saline group consisted of 21 males (70.0%) and 9 females (30.0%) and the control arm included 19 males (63.3%) and 11 females (36.7%) (Table 1).

Regarding postoperative pain, a statistically significant difference was observed among the groups at all time intervals. At the 6-hour, the mean pain score in the cold saline group was 2.13 ± 0.86, which was lower than the room temperature saline group at 2.77 ± 1.16 and the control arm at 3.07 ± 1.41. At 24 hours the cold saline group reported a mean pain score 1.50 ± 0.50, compared to 2.30 ± 0.83 in the room temperature group and 2.53 ± 1.25 in the control group. By 48 hours post-treatment, the cold saline group had the lowest mean pain score at 0.87 ± 0.81, while the room temperature and control groups reported scores of 1.67 ± 1.12 and 2.23 ± 0.81, respectively (Table 2). Table 3 and 4 presents the stratifications.

Table 1

Demographics

Demographics		Groups					
		Cold saline		Room temperature saline		Control arm	
		n	%	n	%	n	%
Gender	Male	20	66.7%	21	70.0%	19	63.3%

	Female	10	33.3%	9	30.0%	11	36.7%
Occupation status	Employed	17	56.7%	16	53.3%	14	46.7%
	Unemployed	13	43.3%	14	46.7%	16	53.3%
Area of residence	Rural	11	36.7%	12	40.0%	17	56.7%
	Urban	19	63.3%	18	60.0%	13	43.3%
Marital status	Married	17	56.7%	13	43.3%	21	70.0%
	Unmarried	13	43.3%	17	56.7%	9	30.0%
Medical history	Yes	10	33.3%	9	30.0%	7	23.3%
	No	20	66.7%	21	70.0%	23	76.7%

Table 2

Comparison of pain score at 6, 24 and 48 hours

		N	Mean	Std. Deviation	P value
Pain score at 6 hours	Cold saline	30	2.13	.860	
	Room temperature saline	30	2.77	1.165	0.009
	Control arm	30	3.07	1.413	
Pain score at 24 hours	Cold saline	30	1.50	.509	
	Room temperature saline	30	2.30	.837	< 0.001
	Control arm	30	2.53	1.252	
Pain score at 48 hours	Cold saline	30	.87	.819	
	Room temperature saline	30	1.67	1.124	< 0.001
	Control arm	30	2.23	.817	

Table 3

Stratification of comparison of pain score with age

Age groups (years)			N	Mean	SD	P value
18 to 35	Pain score at 6 hours	Cold saline	23	2.22	.850	0.03
		Room temperature saline	10	3.10	.994	
		Control arm	20	3.00	1.338	
	Pain score at 24 hours	Cold saline	23	1.52	.511	0.0001
		Room temperature saline	10	2.80	.422	
		Control arm	20	2.30	1.218	
	Pain score at 48 hours	Cold saline	23	.87	.815	0.0001
		Room temperature saline	10	1.80	1.135	
		Control arm	20	2.40	.681	
> 35	Pain score at 6 hours	Cold saline	7	1.86	.900	0.12
		Room temperature saline	20	2.60	1.231	
		Control arm	10	3.20	1.619	
	Pain score at 24 hours	Cold saline	7	1.43	.535	0.005
		Room temperature saline	20	2.05	.887	
		Control arm	10	3.00	1.247	
	Pain score at 48 hours	Cold saline	7	.86	.900	0.14
		Room temperature saline	20	1.60	1.142	
		Control arm	10	1.90	.994	

Table 4

Stratification of comparison of pain score with gender

Gender			N	Mean	SD	P value
Male	Pain score at 6 hours	Cold saline	20	1.95	.887	
		Room temperature saline	21	2.57	1.165	0.02
		Control arm	19	3.00	1.374	
	Pain score at 24 hours	Cold saline	20	1.45	.510	
		Room temperature saline	21	2.33	.796	0.0001
		Control arm	19	2.68	1.250	
	Pain score at 48 hours	Cold saline	20	.75	.716	
		Room temperature saline	21	1.67	1.155	0.0001
		Control arm	19	2.21	.787	
Female	Pain score at 6 hours	Cold saline	10	2.50	.707	
		Room temperature saline	9	3.22	1.093	0.32
		Control arm	11	3.18	1.537	
	Pain score at 24 hours	Cold saline	10	1.60	.516	
		Room temperature saline	9	2.22	.972	0.25
		Control arm	11	2.27	1.272	
	Pain score at 48 hours	Cold saline	10	1.10	.994	
		Room temperature saline	9	1.67	1.118	0.41
		Control arm	11	2.27	.905	

DISCUSSION

The findings our study contribute to the role of intracanal cryotherapy in the management of post-endodontic pain. Our results demonstrated a statistically notable reduction in pain scores at 6, 24 and 48 hours in patients who received a final irrigation with 2.5°C cold saline compared to those who received room temperature saline or no saline at all.

A central finding of our study was the analgesic effect of cryotherapy at different intervals. The mean pain score in the cold saline group was 2.13 ± 0.86 at 6 hours which was notably lower than the 3.07 ± 1.41 in the control arm. This early and significant pain reduction is consistent with

the results reported by Ghabraei et al. who in their trial on endodontic retreatment found a potential difference in pain favoring cryotherapy only at the 6-hour mark.[14] They hypothesized that the major benefit of cryotherapy might be short-lived. While they found no notable differences beyond 6 hours our study observed persistent and significant differences at 24 and 48 hours. This discrepancy could be attributed to the different clinical scenarios, as our study involved teeth with symptomatic apical periodontitis whereas Ghabraei et al. focused on retreatment cases where pre-existing chronic inflammation and different microbial profiles might modulate the response to cryotherapy.[14]

The sustained effect seen in our study at 24 and 48 hours finds stronger alignement with the work of Keskin et al. who also reported notably lower pain levels in their cryotherapy group at both 24 and 48 hours following single-visit root canal treatment of teeth with vital pulps.[3] The mechanism behind this prolonged relief may extend beyond immediate vasoconstriction and reduced nerve conduction velocity. It is possible that by lowering the temperature of the periradicular tissues cryotherapy reduces the inflammation. This is supported by Keskin et al. in a later study where they reported that cryotherapy led to a significant reduction in inflammatory cytokines and proteolytic enzymes in periapical tissues.[15] This anti-inflammatory mechanism could explain why the pain reduction in our cohort was not merely transient but persisted for a longer duration preventing the escalation of inflammation that typically contributes to postoperative discomfort.

When comparing the cryotherapy group to the room temperature saline group our results showed a consistent though less pronounced advantage for the cold saline. Our findings are in agreement with those of Ali et al. and Bashir et al. who both concluded that while cryotherapy was effective the difference compared to room temperature saline was not notable in all scenarios.[16,17] Ali et al. found that both cryotherapy and room temperature saline were potentially better than using no saline but were not different from each other.[16] Bashir et al. similarly reported that both types of saline significantly decreased pain but the type of saline did not notably impact the overall pain scores differently between the groups.[17] This suggests that the simple act of a final flush with the room-temperature solution may have a beneficial effect possibly by diluting and removing any residual irritants like sodium hypochlorite or debris. However the additional incremental benefit of cooling the saline as evidenced by our results indicate that the thermal component provides a distinct non-pharmacological analgesic boost.

In the context of our findings and their alignment with the aforementioned studies, we suggest that intracanal cryotherapy is a simple yet cost-effective and safe therapy to single-visit root canal treatment. Its most significant application appears to be in cases with pre-operative symptomatic apical periodontitis where the potential for severe postoperative pain is higher.

CONCLUSION

It was observed that there was a significant difference in post-endodontic pain perceived by the patient when cold saline was used as a final root canal irrigant in comparison to that of control.

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