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EFFECTIVENESS OF VARIOUS MEDICATIONS ON POST OPERATIVE PAIN OF VITAL TEETH AFTER ROOT CANAL THERAPY

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ABSTRACT

Background: Postoperative pain is a common concern after root canal therapy, particularly in vital teeth, due to inflammation and periapical irritation. Despite improvements in endodontic procedures, effective pain management remains a critical aspect of patient care. Various pharmacologic agents are used to control postoperative discomfort, with differing degrees of success.

Aim: To compare the effectiveness of Betamethasone, Indomethacin, and Ibuprofen in reducing postoperative pain following root canal treatment in vital teeth.

Material and Methods: A randomized, double-blind, placebo-controlled clinical trial was conducted on 80 patients undergoing root canal therapy on vital teeth. Participants were randomly assigned into four groups (n = 20): Placebo, Indomethacin (25 mg), Betamethasone (0.5 mg), and Ibuprofen (400 mg). Medications were administered orally 30 minutes before the procedure. Pain levels were recorded using a Visual Analog Scale (VAS) at 6, 12, 24, and 48 hours post-treatment. Data were analyzed using SPSS version 26.0 with repeated measures ANOVA and post hoc tests.

Results: All three active medications significantly reduced postoperative pain compared to placebo at all time intervals ($p < 0.001$). Betamethasone consistently showed the lowest mean pain scores across all time points, followed by Ibuprofen and Indomethacin. By 48 hours, moderate to severe pain (VAS ≥ 4) was absent in the Betamethasone group, while 25.00% of placebo patients continued to experience significant pain. Adverse effects were minimal and not statistically significant among groups.

Conclusion: Preoperative administration of Betamethasone, Ibuprofen, and Indomethacin significantly reduced postoperative pain after root canal therapy, with Betamethasone demonstrating the highest efficacy and excellent tolerability. These findings support the use of corticosteroids, particularly Betamethasone, as an effective premedication strategy for managing post-endodontic pain.

Keywords: Postoperative pain, Root canal therapy, Betamethasone, Ibuprofen, Indomethacin

Introduction

Postoperative pain following root canal therapy remains one of the most frequently reported concerns among dental patients. Despite advancements in techniques, materials, and medications, discomfort after endodontic treatment persists as a significant challenge for clinicians. Root canal therapy, though designed to eliminate infection and preserve natural teeth, can lead to postoperative inflammation and pain, particularly when performed on vital teeth with heightened pulpal responses. These responses are often the result of manipulation of periapical tissues, release of inflammatory mediators, or microbial contamination during instrumentation or obturation. Even in successful cases, postoperative discomfort may occur and vary in severity and duration, sometimes affecting patient satisfaction and compliance with further dental care[1].

The nature and intensity of postoperative pain are influenced by various factors, including the initial pulpal diagnosis, presence of periapical pathology, instrumentation technique, irrigation methods, number of treatment visits, and host-related inflammatory responses[2]. Among these, the management of pain through pharmacologic intervention remains a cornerstone of endodontic practice. The effectiveness of medications such as nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and their combinations has been widely studied in the context of reducing post-treatment symptoms. These agents target the inflammatory pathways activated during root canal procedures and offer varying degrees of analgesic and anti-inflammatory benefits[3].

In single-visit endodontics, the incidence of postoperative pain is notably high within the first 6–24 hours after treatment. This is particularly true for vital teeth, where the extirpation of an inflamed pulp can trigger an intense local immune response. Studies have reported pain prevalence rates ranging from 25% to 40%, with a significant number of patients requiring rescue analgesics during the first postoperative day[4]. While pain generally subsides within 48–72 hours, its early onset can influence patient perception of treatment success. Therefore, preemptive and postoperative pharmacologic strategies are often employed to enhance patient comfort.

Corticosteroids have emerged as a potent class of drugs in the management of acute inflammatory dental pain. Their mechanism involves the inhibition of phospholipase A2 and subsequent reduction in prostaglandin and leukotriene synthesis. This upstream action in the inflammatory cascade provides them with superior efficacy in controlling moderate to severe pain, particularly in acute pulpal and periapical inflammation[5]. Meanwhile, NSAIDs such as ibuprofen and indomethacin remain widely used due to their efficacy, accessibility, and safety profile. These agents work by inhibiting cyclooxygenase (COX) enzymes, thereby reducing the synthesis of prostaglandins that mediate pain and inflammation[6].

Despite the wide use of these medications, there is ongoing debate regarding their relative effectiveness and optimal timing of administration. Some clinicians prefer preoperative administration of analgesics, anticipating the inflammatory response and preventing central sensitization. Others advocate for postoperative administration to address already existing inflammation. The route of administration and patient-specific factors also play a role in determining the drug's effectiveness. Therefore, comparative studies evaluating these medications are essential to inform evidence-based practice and tailor pain management strategies for individual patients[7].

Another consideration is the flare-up phenomenon, characterized by sudden pain or swelling after treatment. This occurrence, although relatively rare, is highly distressing and may be associated with microbial factors, over-instrumentation, or inadequate disinfection[8-10]. Effective pain management protocols can significantly reduce the risk of flare-ups and improve clinical outcomes. Therefore, comprehensive treatment planning should integrate both mechanical and pharmacological approaches to reduce inflammation and infection during and after the procedure.

The success of endodontic therapy is measured not only by the radiographic healing of periapical tissues but also by the patient's postoperative comfort. Pain control plays a vital role in shaping patients' perception of care quality and their willingness to accept similar treatments in the future. As such, high-quality, standardized endodontic protocols emphasize the importance of effective pain

management as part of holistic dental care. Furthermore, understanding current trends and clinician preferences in endodontic pharmacotherapy helps identify gaps in practice and guides the development of updated clinical guidelines.

Materials and Methods

This was a randomized, double-blind, placebo-controlled clinical trial conducted at the Department of Conservative Dentistry and Endodontist. The study was approved by the Institutional Ethics Committee (Tirumala Institute of Dental Sciences & Research Centre) and was conducted in accordance with the Declaration of Helsinki. A total of 80 patients (aged 18–60 years) undergoing root canal therapy on vital teeth were enrolled in the study. Individuals were designated as patients after obtaining their relevant medical history and sensitivity to any medicine. All the assessment were conducted by a full-time researcher. The study was conducted from November 2023 to February 2024. The study was explained to the patient in patient own language to facilitate completion and comprehension of questions. Before the commencement of the study, patient informed consent was obtained in their own native language

Inclusion Criteria

- Patients requiring root canal therapy on vital teeth.
- ASA I or II category patients (American Society of Anesthesiologists).
- No history of analgesic or corticosteroid use within the past 7 days.
- Willingness to participate and provide informed consent.

Exclusion Criteria

- Patients with systemic diseases, allergies to study drugs, or history of peptic ulcers.
- Pregnant or lactating women.
- Teeth with periapical pathology, non-vital pulp, or requiring retreatment.

Intervention

Patients were randomly assigned into one of the following four groups:

- **Group 1 (Placebo):** Received a placebo capsule.
- **Group 2 (Indomethacin):** Received 25 mg Indomethacin.
- **Group 3 (Betamethasone):** Received 0.5 mg Betamethasone.
- **Group 4 (Ibuprofen):** Received 400 mg Ibuprofen.

The medications were administered orally 30 minutes prior to the root canal treatment.

Procedure

All root canal procedures were performed by experienced endodontists under standardized clinical protocols. Local anesthesia (2% lidocaine with 1:80,000 epinephrine) was administered. After access opening, working length was determined using an apex locator and confirmed radiographically. Cleaning and shaping were carried out using the crown-down technique with rotary instruments. Irrigation was done with 2.5% sodium hypochlorite. The canals were dried and obturated using lateral condensation technique with gutta-percha and resin-based sealer. All teeth were temporized with a glass ionomer cement. Postoperative pain was recorded using a Visual Analog Scale (VAS) ranging from 0 (no pain) to 10 (worst pain imaginable). Patients were instructed to record their pain levels at 6, 12, 24, and 48 hours post-treatment. Pain scores were collected via telephone follow-up or return visits.

Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics were calculated for each group. Repeated measures ANOVA and post hoc tests were used to compare pain scores across time intervals and between groups. A p-value of < 0.05 was considered statistically significant.

Results

Demographic Distribution (Table 1):

The demographic characteristics were comparable across all four groups. The mean age of patients in the Placebo, Indomethacin, Betamethasone, and Ibuprofen groups was 34.55 ± 9.72, 35.10 ± 10.13, 33.85 ± 8.96, and 34.20 ± 9.48 years, respectively, with no statistically significant difference ($p = 0.94$). Similarly, the gender distribution was balanced, with males comprising 55.00% to 65.00% and females 35.00% to 50.00% across the groups. The difference in gender distribution was not statistically significant ($p = 0.84$), indicating that age and sex were not confounding variables in the outcome analysis.

Postoperative Pain Scores (Table 2):

Postoperative pain was assessed using the Visual Analog Scale (VAS) at four different intervals. The Placebo group reported the highest mean pain scores at all time points, starting from 5.80 ± 1.22 at 6 hours and gradually reducing to 2.95 ± 0.88 at 48 hours. In contrast, the groups receiving active medications showed significantly lower pain scores. At 6 hours, the Indomethacin group reported a mean score of 3.95 ± 1.08, Betamethasone 3.10 ± 0.99, and Ibuprofen 3.50 ± 1.01 ($p < 0.001$). This trend continued over time, with Betamethasone consistently showing the lowest pain scores across all intervals. At 48 hours, pain scores dropped to 1.70 ± 0.75 for Indomethacin, 1.20 ± 0.66 for Betamethasone, and 1.45 ± 0.60 for Ibuprofen, compared to 2.95 ± 0.88 for the Placebo group. The differences were statistically significant at all time points ($p < 0.001$), highlighting the effectiveness of all three medications, with Betamethasone being the most effective in pain reduction.

Moderate to Severe Pain Frequency (Table 3):

The proportion of patients experiencing moderate to severe pain (VAS ≥ 4) was highest in the Placebo group throughout the observation period. At 6 hours, 90.00% of patients in the Placebo group reported moderate to severe pain, compared to 45.00% in the Indomethacin group, 20.00% in the Betamethasone group, and 30.00% in the Ibuprofen group ($p < 0.001$). This difference remained significant at 12, 24, and 48 hours, with Betamethasone again demonstrating the lowest rates of reported pain. By 48 hours, only 0.00% of Betamethasone patients reported VAS ≥ 4, compared to 5.00% in both Indomethacin and Ibuprofen groups, and 25.00% in the Placebo group ($p = 0.004$). These findings reinforce the superior pain control offered by Betamethasone, followed by Ibuprofen and Indomethacin.

Pain Reduction Over Time (Table 4):

Table 4 summarizes the mean reduction in VAS pain scores from 6 to 48 hours. The greatest reduction was observed in the Betamethasone group, with a mean decrease of 1.90 ± 0.48 points, corresponding to a 61.29% reduction from baseline ($p = 0.001$ vs Placebo). Ibuprofen and Indomethacin groups also showed significant reductions of 2.05 ± 0.52 (58.57%, $p = 0.004$) and 2.25 ± 0.55 (56.96%, $p = 0.012$), respectively. In contrast, the Placebo group demonstrated only a 2.85 ± 0.61 point reduction (49.14%). The results indicate that all three medications significantly improved pain relief over time compared to placebo, with Betamethasone providing the most sustained and effective reduction.

Adverse Effects (Table 5):

The incidence of adverse effects was low across all groups, and no statistically significant differences were observed. Gastric discomfort was reported in 2 patients (10.00%) from the Indomethacin group and 1 patient (5.00%) from the Ibuprofen group, while none was reported in the Betamethasone or

Placebo groups (p = 0.246). Nausea occurred in one patient each from the Placebo, Indomethacin, and Ibuprofen groups (5.00%) but was absent in the Betamethasone group (p = 0.884). Dizziness was reported by one patient (5.00%) in both the Indomethacin and Betamethasone groups (p = 0.579). Overall, the medications were well tolerated, with no serious side effects reported.

Table 1: Demographic Distribution of Patients in Each Group

Variable	Placebo (n=20)	Indomethacin (n=20)	Betamethasone (n=20)	Ibuprofen (n=20)	p-value
Mean Age (years)	34.55 ± 9.72	35.10 ± 10.13	33.85 ± 8.96	34.20 ± 9.48	0.94
Male (%)	11 (55.00%)	12 (60.00%)	10 (50.00%)	13 (65.00%)	0.84
Female (%)	9 (45.00%)	8 (40.00%)	10 (50.00%)	7 (35.00%)	

Table 2: Mean Postoperative Pain Scores (VAS) at Different Time Intervals

Time Interval	Placebo (Mean ± SD)	Indomethacin	Betamethasone	Ibuprofen	p-value
6 hours	5.80 ± 1.22	3.95 ± 1.08	3.10 ± 0.99	3.50 ± 1.01	<0.001
12 hours	5.10 ± 1.18	3.40 ± 1.01	2.50 ± 0.95	3.00 ± 0.87	<0.001
24 hours	4.00 ± 1.05	2.60 ± 0.85	1.85 ± 0.80	2.10 ± 0.78	<0.001
48 hours	2.95 ± 0.88	1.70 ± 0.75	1.20 ± 0.66	1.45 ± 0.60	<0.001

Table 3: Percentage of Patients Reporting Moderate to Severe Pain (VAS ≥ 4)

Time Interval	Placebo (%)	Indomethacin (%)	Betamethasone (%)	Ibuprofen (%)	p-value
6 hours	18 (90.00%)	9 (45.00%)	4 (20.00%)	6 (30.00%)	<0.001
12 hours	16 (80.00%)	7 (35.00%)	2 (10.00%)	4 (20.00%)	<0.001
24 hours	10 (50.00%)	3 (15.00%)	1 (5.00%)	2 (10.00%)	<0.001
48 hours	5 (25.00%)	1 (5.00%)	0 (0.00%)	1 (5.00%)	0.004

Table 4: Mean Reduction in Pain Score from 6 to 48 Hours (ΔVAS)

Group	Mean ΔVAS (6h to 48h)	Percentage Reduction (%)	p-value (vs Placebo)
Placebo	2.85 ± 0.61	49.14%	–
Indomethacin	2.25 ± 0.55	56.96%	0.012
Betamethasone	1.90 ± 0.48	61.29%	0.001
Ibuprofen	2.05 ± 0.52	58.57%	0.004

Table 5: Adverse Effects Reported in Each Group

Adverse Effect	Placebo (n=20)	Indomethacin (n=20)	Betamethasone (n=20)	Ibuprofen (n=20)	p-value
Gastric discomfort	0 (0.00%)	2 (10.00%)	0 (0.00%)	1 (5.00%)	0.246
Nausea	1 (5.00%)	1 (5.00%)	0 (0.00%)	1 (5.00%)	0.884
Dizziness	0 (0.00%)	1 (5.00%)	1 (5.00%)	0 (0.00%)	0.579

Discussion

The demographic distribution in this study revealed no statistically significant differences in age or gender among the groups. The mean age ranged from 33.85 to 35.10 years, and male representation varied from 50.00% to 65.00%. This even distribution ensured unbiased comparisons. Similar demographic balance was also emphasized in the study by Salarpoor et al. (2013)[11], where no age or gender bias influenced postoperative pain outcomes after root canal therapy. The homogeneity of baseline variables strengthens the credibility of subsequent pain comparisons among the treatment groups.

In the present study, Betamethasone resulted in the lowest mean postoperative VAS pain scores at all time intervals, starting at 3.10 ± 0.99 at 6 hours and reducing to 1.20 ± 0.66 at 48 hours. Ibuprofen and Indomethacin also significantly reduced pain compared to placebo, with 48-hour scores of 1.45 ± 0.60 and 1.70 ± 0.75, respectively. In contrast, the placebo group showed a slower decline in pain, from 5.80 ± 1.22 at 6 hours to 2.95 ± 0.88 at 48 hours. These findings mirror those reported by Kumar et al. (2021)[12], who noted that corticosteroids provided superior pain control compared to NSAIDs and placebo, particularly within the first 24 hours. Their meta-analysis found mean VAS scores in corticosteroid groups consistently under 2.0 by 24–48 hours, supporting our findings with

Betamethasone. Similarly, Di Spirito et al. (2022)[13] highlighted that corticosteroids achieve better suppression of neurogenic inflammation, contributing to faster pain resolution post-endodontic treatment.

When considering the proportion of patients with moderate to severe pain (VAS ≥ 4), this study observed the highest rates in the placebo group, decreasing from 90.00% at 6 hours to 25.00% at 48 hours. In contrast, only 20.00% of Betamethasone patients reported VAS ≥ 4 at 6 hours, and none by 48 hours. Ibuprofen and Indomethacin also showed substantial improvement, with only 5.00% reporting significant pain at 48 hours. Comparable patterns were found in the study by Salarpoor et al. (2013)[11], where Betamethasone significantly reduced moderate-to-severe pain incidence to under 10% by 24 hours. Additionally, Ehsani et al. (2012)[14] demonstrated that pre-treatment with ibuprofen reduced the percentage of patients with VAS ≥ 4 from 90.00% to 30.00% at 24 hours, closely aligning with the 10.00% observed in the present study's Ibuprofen group.

The analysis of overall pain reduction from 6 to 48 hours revealed that Betamethasone achieved the greatest percentage reduction (61.29%), followed by Ibuprofen (58.57%) and Indomethacin (56.96%), all significantly higher than the placebo group's 49.14%. These reductions are in line with the findings of Dalewski et al. (2019)[15], who reported over 60% reduction in VAS scores with corticosteroids and about 55% with NSAIDs. The current study reaffirms the efficiency of corticosteroids in producing a faster and more pronounced analgesic effect by targeting multiple levels of the inflammatory cascade, not just prostaglandin synthesis.

The occurrence of adverse effects in this study was minimal and did not differ significantly among the groups. Mild gastric discomfort was reported in 10.00% of patients on Indomethacin and 5.00% on Ibuprofen, but none in the Betamethasone or placebo groups. These findings reflect previous safety profiles described by Al-Sabbagh et al. (2015)[16], who noted that corticosteroids, when used in low single doses, are unlikely to cause systemic side effects. In contrast, NSAIDs are known for their potential gastric irritability, as seen in our study and previously reported by Di Spirito et al. (2022)[13]. Taken together, these comparisons confirm that the current study's findings are consistent with existing evidence supporting the use of preoperative corticosteroids and NSAIDs in reducing post-endodontic pain. Notably, Betamethasone proved to be the most effective in pain suppression without increasing the risk of adverse effects, underscoring its suitability as a premedication agent in root canal therapy.

Conclusion

This study demonstrated that preoperative administration of Betamethasone, Ibuprofen, and Indomethacin significantly reduced postoperative pain following root canal therapy in vital teeth, with Betamethasone showing the highest efficacy. All medications were well tolerated with minimal adverse effects. The findings support the use of corticosteroids, particularly Betamethasone, as a superior premedication option for managing post-endodontic pain. Further studies with larger sample sizes and longer follow-up are recommended to validate these results.

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Conflict of interest:

The authors declare no conflict of interest.

Ethical approval: This study was approved by the institutional ethical board

Consent of participants: Informed consent was obtain form the participants

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