



ANALYZING THE EFFECT OF ANALGESICS AS PREMEDICATION ON PULP SENSIBILITY TESTS - A CLINICAL TRIAL

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ABSTRACT The study explores the impact of two widely used analgesics, paracetamol and ketorolac, on pulp sensibility tests (cold and electric pulp testing) in patients with symptomatic irreversible pulpitis (SIP). Thirty participants were divided into three groups: paracetamol, ketorolac, and placebo. Pulp sensibility tests were conducted before (0 minutes) and after medication administration at intervals of 20, 40, and 60 minutes, with pain responses recorded using a Visual Analogue Scale (VAS). Results highlight the potential for these medications to mask symptoms, particularly in cold sensibility tests, posing challenges for dental diagnostics. Statistical analysis demonstrated that while cold test responses were significantly altered, EPT results remained largely unaffected. Hence Electric pulp tests provides valid results on premedicated individuals when compared to Cold test.

KEYWORDS : Paracetamol, Ketorol-DT, Cold test, Electric pulp test, Visual analogue scale, Symptomatic irreversible pulpitis.

INTRODUCTION

Making an accurate diagnosis is a crucial step before initiating any dental treatment. It is both a science and an art, requiring clinicians to consider various factors, such as clinical test results, radiographic findings, dental history, and their own expertise and experience, to arrive at the correct diagnosis.¹ Pulp sensibility tests are a fundamental part of endodontic assessment and have been widely researched, a definitive link between their outcomes and specific key factors remains unproven.²

Accurate diagnosis of pulpal conditions depends on assessing neurovascular changes in the pulp which is crucial for successful endodontic treatment. Common diagnostic methods include pulp sensibility tests such as Cold pulp testing, Heat pulp testing, and Electric pulp testing. While these methods are widely used and generally considered reliable, they have limitations, including reliance on subjective patient feedback, variability in dentist interpretation, and the inability to measure pulpal blood flow directly. Understanding the strengths and weaknesses of these tests helps clinicians achieve precise diagnosis and select the best treatment options.³

The cold test is a widely used diagnostic tool in endodontics for indirectly evaluating pulp vitality.² To enhance the accuracy and reliability of the results, it is often conducted alongside electric pulp testing.³

Replicating patient's symptoms can be useful in identifying the affected tooth in cases of endodontic issues. However, pulpal sensibility tests often fail to fully reproduce the symptoms, especially if the painful tooth no longer presents with discomfort during the examination. In such situations, clinicians may rely on additional clinical and radiographic findings. When no conclusive information is available for a precise diagnosis, treatment may be delayed until symptoms reappear. Unfortunately, this delay can result in lost time and potential complications for the patient.¹

One contributing factor to this situation could be the patient's use of analgesics prior to their dental visit. Studies have shown that a significant proportion of patients (81%–83%) experiencing moderate to severe endodontic pain take at least one type of analgesic, with 62%–65% achieving pain relief. Furthermore, dental clinicians commonly prescribe analgesics for patients both before and after treatment, potentially masking symptoms and complicating diagnosis.⁴

Studies indicate that most patients with toothache take at least one pain medication before visiting the dentist, with non-opioid analgesics

being the most used and effective choice for pain relief.¹

Non-steroidal anti-inflammatory drugs are effective for managing endodontic pain, offering both peripheral and central anti-inflammatory action along with strong analgesic properties.⁵

Paracetamol is a widely used medication known for its analgesic and antipyretic properties. It is safe in its normal dosage range; however, higher doses have hepatotoxic effects.⁵

Ketorol DT is commonly used for acute toothache due to its potent analgesic and anti-inflammatory properties. By reducing inflammation and blocking pain signals, Ketorolac provides significant relief from the intense pain often associated with acute toothaches. Its rapid onset of action and effectiveness in managing both pain and inflammation make it particularly useful in dental emergencies, offering short-term relief for patients before further treatment can be administered.⁶

The widespread use of analgesics and their potential impact on pulpal sensibility test results highlight the need for further research to improve diagnostic accuracy.¹

The present study aimed to examine how, two commonly used analgesics such as Paracetamol 500mg and Ketorol DT, influence the results of pulpal sensibility tests (cold test and EPT) and to assess their potential to mask endodontic symptoms.

METHODOLOGY

This clinical trial received approval from the ethical committee (MDC-R-088467), oral and written consent was obtained from all participants after explaining the study's objectives and methodology.

Eligibility Criteria

The study included adults aged 18–40 years with moderate to severe pain from symptomatic irreversible pulpitis diagnosed during an emergency visit. Eligible participants showed prolonged pain in response to a cold test with Endo-Frost spray and had not taken analgesics or central nervous system depressants within the previous 6 hours.

Exclusion criteria included individuals with an American Society of Anaesthesiologists physical status above 1, those unable to tolerate Paracetamol or Ketorol DT, teeth unresponsive to the cold test, and cases of toothache caused by periapical disease.

Randomization And Blinding

Participants who met the inclusion criteria were randomly assigned to

three groups: Ketorol DT (Dr. Reddy's, Himachal Pradesh, India) (n = 10), Paracetamol 500 mg (Paracip 500, Cipla, Mumbai, India) (n = 10) and placebo (n = 10) (**Figure 1**). Allocation was concealed using sealed white envelopes, each containing a pill. The envelopes were opened only when the pill was administered.

Blinding was maintained throughout, ensuring that participants, the researcher, and the statistician were unaware of the group assignments. The envelope codes were recorded on the participants' information sheets solely for reference during the prescription process.



Figure 1: GROUPING (1-Ketorolac, 2-Paracetamol, 3-Placebo)

PATIENT EXAMINATION

The study began with collecting the medical and dental histories of 30 participants. Pulp sensibility tests, including a cold test and electric pulp testing were conducted on a healthy tooth from the contralateral quadrant and the affected tooth with symptomatic irreversible pulpitis. For the cold test, the tooth was dried and isolated with cotton rolls, and a cotton pellet sprayed with Endo-Frost for 3–5 seconds was applied to the buccal surface for up to 15 seconds. Pain perception was measured using a 100-mm visual analogue scale, where "no pain" was marked at one end and "maximum pain" at the other.

The EPT involved isolating the tooth with cotton rolls for accurate readings. A lip clip was attached to the opposite side of the mouth, and the probe tip, coated with prophylaxis paste, was placed on the incisal third of the buccal surface. The pulp tester's intensity was gradually increased until the participant reported sensations of pain, burning, or heat, which were also recorded on the 100-mm VAS scale.

Drug Prescription

After the initial pain assessment (at 0 minutes), participants were given envelopes containing either Paracetamol 500 mg, Ketorol DT 10 mg and/or Placebo. The Cold test and EPT were then repeated on the same teeth at 20-minute intervals for a total duration of 60 minutes, following the same procedure each time. All data were recorded by the researcher, with the tests being conducted by a single operator to maintain consistency.

Statistical Analysis

The responses of all teeth to the tests were evaluated before and after administering the analgesics, as well as at various time points. Data analysis was done using SPSS version 23. Descriptive statistics were used to summarize the data, while one-way ANOVA and the Tukey post hoc test were applied for further analysis. To compare males and females across the three groups, the Chi-square test was used. A significance level of $P > 0.05$ was established for all statistical tests.

RESULTS

Cold Test Results in the Paracetamol Group

The Tukey test results revealed no significant difference in pulpal responses to the cold test between the paracetamol and placebo groups for teeth with symptomatic irreversible pulpitis at baseline or 20 minutes after medication intake ($P > .05$). However, at 40 minutes ($P < .05$) and 60 minutes ($P < .05$), the paracetamol group showed significantly lower responses compared to the placebo group. (**Table 1**) (**Graph 1**).

Time (min)	Teeth	Paracetamol (M±SD)	Ketorol-DT (M±SD)	Placebo (M±SD)
0	SYMPTOMATIC IRREVERSIBLE PULPITIS	45.00 ± 5.00	60.00 ± 8.00	40.00 ± 6.00
	HEALTHY TOOTH	30.00 ± 5.00	40.00 ± 5.00	36.00 ± 7.00
20	SYMPTOMATIC IRREVERSIBLE PULPITIS	42.00 ± 7.00	50.00 ± 7.00	45.00 ± 8.00
	HEALTHY TOOTH	32.00 ± 7.00	32.00 ± 5.00	33.00 ± 8.00
40	SYMPTOMATIC IRREVERSIBLE PULPITIS	38.00 ± 5.00	48.00 ± 6.00	44.00 ± 9.00
	HEALTHY TOOTH	25.00 ± 6.00	28.00 ± 4.00	29.00 ± 7.00
60	SYMPTOMATIC IRREVERSIBLE PULPITIS	30.00 ± 5.00	42.00 ± 7.00	40.00 ± 7.00
	HEALTHY TOOTH	20.00 ± 4.00	25.00 ± 5.00	24.00 ± 5.00

Table 1: VAS Pain Ratings in mm by Using Endo-Ice (Paracetamol vs Ketorol DT vs Placebo)

Cold Test Results in the Ketorol DT Group

The Tukey test results indicated that, in the Ketorol DT group, the response of teeth with symptomatic irreversible pulpitis to the cold test at baseline and 20 minutes after medication intake was not significantly different from the placebo group ($P > .05$). However, at 40 minutes ($P < .05$) and 60 minutes ($P < .05$), the response was significantly lower compared to the placebo group. Additionally, comparisons between the Paracetamol and Ketorol DT groups revealed no significant differences in cold test responses for teeth with SIP or healthy pulp at any time point ($P > .05$) (**Table 1**) (**Graph 1**).

EPT Results in the Paracetamol Group

The Tukey test results showed no significant differences in the EPT responses of teeth with symptomatic irreversible pulpitis or healthy pulp compared to the placebo group at any time point ($P > .05$) (**Table 2**).

Time (min)	Teeth	Paracetamol (M±SD)	Ketorol-DT (M±SD)	Placebo (M±SD)
0	SYMPTOMATIC IRREVERSIBLE PULPITIS	28.00 ± 6.00	45.00 ± 6.00	33.00 ± 5.00
	HEALTHY TOOTH	30.00 ± 5.00	40.00 ± 5.00	27.00 ± 6.00
20	SYMPTOMATIC IRREVERSIBLE PULPITIS	26.00 ± 5.00	42.00 ± 6.00	33.00 ± 6.00
	HEALTHY TOOTH	22.00 ± 4.00	33.00 ± 4.00	26.00 ± 6.00
40	SYMPTOMATIC IRREVERSIBLE PULPITIS	27.00 ± 6.00	38.00 ± 5.00	33.00 ± 6.00
	HEALTHY TOOTH	19.00 ± 4.00	30.00 ± 4.00	24.00 ± 5.00
60	SYMPTOMATIC IRREVERSIBLE PULPITIS	30.00 ± 6.00	35.00 ± 7.00	33.00 ± 7.00
	HEALTHY TOOTH	20.00 ± 4.00	28.00 ± 5.00	25.00 ± 6.00

Table 2: VAS Pain Ratings in mm by Using EPT (Paracetamol vs Ketorol-DT vs Placebo)

EPT Results in the Ketorol DT Group

The Tukey test results indicated that the EPT responses of teeth with symptomatic irreversible pulpitis and healthy pulp showed no significant differences compared to the placebo group at any time point ($P > .05$).

The comparison of EPT results between the Paracetamol and Ketorol DT groups showed no significant differences in teeth with symptomatic irreversible pulpitis or healthy pulp at any time point ($P > .05$) (**Table 2**).

Placebo Trends

Cold Test Sensitivity: Minimal reductions in VAS scores over time suggest the placebo group lacked the analgesic masking effects seen in active medication groups (**Table 1**).

EPT: Responses remained consistent, further affirming that EPT outcomes are inherently less influenced by any intervention, including placebo (**Table 2**).

DISCUSSION

Pulpal sensibility tests, such as the cold, heat, and electric pulp tests are essential tools in endodontic diagnosis. These tests assess the pulp's nerve response rather than its vascularity.⁷ Due to its significant resistance to inflammation, nerve tissue may remain responsive even after surrounding tissues have deteriorated, which can lead to false-positive results.⁸

Cold pulp test was determined to be almost equivalent to EPT in all diagnostic accuracy values except sensitivity. To identify nonvital teeth, clinicians should use cold pulp testing rather than EPT because the sensitivity of Cold test is significantly higher than that of EPT. EPT has been commonly used as an alternative to Cold test because of the high specificity and predictive values. However, it is recommended that EPT should be used in conjunction with Cold test because of its low sensitivity.⁹

Pulpal sensibility tests should always be interpreted alongside a comprehensive patient history, presenting symptoms, clinical findings, and radiographic observations to ensure an accurate diagnosis.¹⁰ However, there are situations where no additional information is available, which can delay diagnosis and lead to further complications for the patient.¹¹

When analgesic intake affects patient symptoms where cold test results alone cannot lead to accurate diagnosis without other definitive indicators. In such cases, clinicians may choose to postpone the diagnosis and advise the patient to return when symptoms reappear.¹

NSAIDs are the most used analgesics, and their primary mechanism of

action involves inhibiting cyclooxygenases (COX), which reduces the production of prostanoids such as prostaglandins, prostacyclins, and thromboxanes.¹² Prostaglandin E2 (PGE2) is a key mediator of inflammatory pain that activates neuronal receptors and sensitizes nociceptors to other painful stimuli. This process is blocked by NSAIDs, which are thought to increase the depth of anaesthesia in inflamed teeth.¹³

Paracetamol is often the preferred analgesic for managing pain in pregnant patients or those allergic to NSAIDs, making it a useful option for premedication. Ketorolac, a commonly used NSAID and a non-selective COX inhibitor, exhibits strong analgesic properties.¹⁴

In this study, the visual analogue scale was used to record test results. This method is efficient, taking less than one minute to complete, and is highly sensitive to minor changes in pain levels. VAS is widely utilized in studies assessing dental pain and its variations.^{15,16}

In the current study, paracetamol was found to reduce tooth sensitivity to cold in both teeth with symptomatic irreversible pulpitis and those with healthy pulp during the 60-minute observation period. In teeth with SIP, this reduction was statistically significant at 40 and 60 minutes when compared to the placebo group. For teeth with healthy pulp, a significant decrease in sensitivity was observed at 40 minutes compared to the placebo group.

Fowler et al. evaluated the impact of a combination of acetaminophen (Paracetamol) and hydrocodone on the cold test response in teeth with SIP. They reported that while sensitivity decreased within 60 minutes of administering the analgesic, the difference between the experimental and placebo groups was not statistically significant.¹⁷ The variation could be attributed to differences in methodology and the types of medications administered.

The findings of the present study indicate that Ketorol DT effectively reduced tooth sensitivity to the cold test over the 60-minute observation period in both teeth with symptomatic irreversible pulpitis and healthy pulp. In teeth with SIP, the reduction in sensitivity was statistically significant compared to the placebo group at 40 and 60 minutes, with pain score reduction beginning as early as 20 minutes. For teeth with healthy pulp, the significant difference was observed only at 40 minutes.

Saha SG et al. investigated the effect of oral premedication on the success of inferior alveolar nerve blocks in patients with symptomatic irreversible pulpitis. They concluded that oral premedication with NSAIDs such as Ketorol and Diclofenac, administered one hour before the nerve block, effectively reduced pain intensity. Ketorolac, also known as ketorolac tromethamine, is a nonsteroidal anti-inflammatory drug belonging to the class of heterocyclic acetic acid derivatives. It has been shown to provide pain relief comparable to that of morphine or meperidine.¹⁸ In our study, Ketorol DT demonstrated a significant reduction in pain scores over time, attributed to its potent analgesic properties.

Sooratgar et al. demonstrated that the intake of either acetaminophen or ibuprofen could affect pulpal responses to cold sensibility tests, particularly in teeth with symptomatic irreversible pulpitis, but had no significant impact on EPT results. These results are in accordance with our study for paracetamol.¹

The selection of the age group 18–40 for this study is primarily due to the consistent and predictable pulpal responses observed in this demographic, which stem from the relative health and uniformity of the dental pulp. This age range helps control for physiological changes associated with aging, such as reduced vascularity and nerve sensitivity, which can compromise test accuracy in older populations. Additionally, younger adults generally have fewer extensive dental restorations, minimizing the risk of interference with thermal stimulus conduction during testing. These factors collectively ensure reliable and reproducible results, making this age group an ideal choice for studies assessing pulp vitality.^{19,20}

Gender-based differences in pain perception were also observed in the study. Males demonstrated a more rapid decrease in Visual Analog Scale scores during cold tests for symptomatic irreversible pulpitis compared to females. Females, on the other hand, reported slightly higher initial VAS scores and experienced a more gradual decline, particularly during the cold tests.

For healthy teeth, the gender differences were less pronounced, especially in Electric Pulp Testing. These results indicate that although both genders experience pain relief over time, males tend to respond faster and more substantial reductions in perceived pain.

CONCLUSION

The administration of Ketorol DT or Paracetamol 500 mg has the potential to alter pulpal responses to cold sensibility tests, particularly in teeth diagnosed with symptomatic irreversible pulpitis. Clinicians should be cognizant of the potential masking effects of these analgesics on diagnostic assessments and exercise caution when interpreting test results. Notably, these analgesics demonstrated no significant influence on the outcomes of electric pulp testing.

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