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# Comparision of Calcium Hydroxide, Chlorhexidine Gel and Silver Nanoparticles Paste as Intracanal Medicaments in Reducing Post Operative Pain : an Invivo Study

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***Abstract***:

***Aim:*** *This research seeks to assess the efficacy of calcium hydroxide paste($Ca(OH)_2$), chlorhexidine gel(CHX Gel) , and silver nanoparticle paste as intracanal medicaments in minimizing postoperative discomfort.*

***Materials and Methods:*** *30 patients presenting with emergency pain were randomly assigned to 3 groups: G I received $Ca(OH)_2$ paste, GII received CHX gel, and G III received silver nanoparticle paste as intracanal medicaments. Preoperative pain levels were recorded using a visual analog scale (VAS). Postoperative pain was assessed at 6 hours, 48 hours, and 7 days after treatment using the same VAS.*

***Statistical Analysis*** *Data was statistical analysed using Kruskal-Wallis Test and Friedman Test.*

***Results:*** *At the 3-day (72-hour) mark, significant differences in pain reduction were observed among the groups. Patients treated with silver nanoparticle paste reported the greatest reduction in pain, followed by those who received calcium hydroxide paste.*

***Conclusions:*** *Silver nanoparticle paste seems to be the most effective intracanal medicament for alleviating postoperative pain, while calcium hydroxide paste also demonstrates positive effects.*

## INTRODUCTION

Postoperative discomfort following endodontic therapy is a significant concern for both patients and healthcare providers. From the patient's perspective, pain management is often prioritized over the overall success of the treatment. Various factors can contribute to postoperative pain, including over-instrumentation, overfilling of the root canal and the displacement of debris into the periapical tissues. (1)

A key factor affecting endodontic success is the presence of bacteria within the root canal system. Effective microbial elimination requires thorough mechanical instrumentation. However, research has shown that some microorganisms can survive even after mechanical preparation. To minimize bacterial load and prevent reinfection, the application of intracanal medicaments between treatment sessions is recommended. (1)

Hermann first introduced $Ca(OH)_2$ as an intracanal medicament in 1920. While it remains one of the most commonly used agents, studies indicate it often fails to fully eliminate bacteria from the dentinal tubules. Additionally, limited evidence makes it difficult to definitively assess its effectiveness in reducing postoperative pain, sparking ongoing debate about its role in pain management. (2)

Chlorhexidine is a safe antimicrobial agent often preferred over antibiotics due to its low risk of fostering bacterial resistance, allowing for prolonged use without significant microbial adaptation. Additionally, it has broad-spectrum antimicrobial activity, effectively targeting bacteria, fungi, and viruses, which helps reduce the risk of opportunistic infections.(3,4)

Silver nanoparticles (AgNPs) have gained significant attention in recent years for their unique properties, making them valuable in dental materials. Their high surface-to-volume ratio and antibacterial characteristics make them a promising addition to endodontic treatments. AgNPs have been explored as an intracanal medicament, either alone or with $Ca(OH)_2$, demonstrating effectiveness in reducing bacterial counts in root canals infected with Enterococcus faecalis.[5,6,7,1)]

However, despite their antimicrobial potential, clinical trials assessing their impact on postoperative pain are lacking.

**AIM** This study seeks to evaluate and compare the effectiveness of calcium hydroxide paste, chlorhexidine gel, and silver nanoparticle paste as intracanal medicaments in minimizing postoperative pain after root canal treatment.

## METHODOLOGY

### Ethical Approval and Protocol Registration

The research proposal received approval from the Research Ethics Committee .

### Randomization and Allocation Concealment

Patient allocation was carried out by my COPG, who had no involvement in my study.

### Sample size calculation

The sample size was based on a previous study. 30 sample size, 10 in each group.

### Blinding

In this study, both patients and outcome assessors were kept blind to the treatment to reduce bias. An independent investigator, not involved in the study, handled randomization and allocation concealment. However, the operator was not blinded due to the distinct texture differences among the intracanal medicaments.

A total of 30 patients presented to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain.

**Inclusion criteria:**

- Patients experiencing pain due to pulp necrosis and symptomatic apical periodontitis
- Single-rooted teeth with a single canal
- Patients aged between 18 and 55 years

**Exclusion criteria:**

- Presence of an acute apical abscess
- Retreatment cases
- Internal or external resorption
- Open apex
- Calcified or curved canals

The study's nature and potential risks were thoroughly explained to the patients, and informed consent forms were signed prior to the start of treatment.

Preoperative pain was recorded of the patient using Visual Analog Scale.

Score 1: No pain to mild pain, requiring no analgesic medication

Score 2: Moderate pain requiring analgesic for relief

Score 3: Severe pain, pain not relieved by analgesics

Score 4: Extreme pain, pain not relieved by any measure taken

A rubber dam was applied to isolate the tooth and prevent contamination by oral flora. Access opening was performed using a #2 round bur. The working length was measured using an apex locator and verified through a radiographic examination. Biomechanical preparation (BMP) was carried out using #10, #15, and #20 K-files, followed by ProTaper Gold rotary files up to size 30/.06.

Irrigation was carried out using a 5.25%NaOCl , followed by a final rinse with sterile saline. The canals were subsequently dried with sterile paper points.

The teeth were randomly assigned to three groups, with 10 samples in each group:

- **G I**: Calcium hydroxide paste
- **GII**: Chlorhexidine gel
- **G III**: Silver nanoparticle paste (Fig a, b , c )

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FIG. (a) Calcium hydroxide ,(b) CHX Gel and (c) Silver nanoparticle

**Preparation of Silver Nano-Calcium Hydroxide Paste**

Viscous carriers like glycerine, polyethylene glycol, and propylene glycol are water-soluble substances that slowly release $Ca^{2+}$ and $OH^-$ ions over time. These carriers are ideal for root canal treatment, as the paste can stay in the canal for an extended period. The silver nano-calcium hydroxide paste was prepared by mixing silver nanoparticles and calcium hydroxide powder with a viscous aqueous medium (a 1:1 blend of propylene glycol and glycerine), achieving a consistency similar to toothpaste. [8]

The designated intracanal medicament was carefully inserted and compacted into the canal, and the access opening was sealed with cotton and a temporary restoration. Postoperative pain levels were assessed using a visual analog scale (VAS) at 6 hours, 3 days, and 7 days following treatment.

**STATISTICAL ANALYSIS**- Statistical analysis was performed using the Kruskal-Wallis Test and the Friedman Test.

## RESULT

There was no significant difference in pain reduction among the groups at the 6-hour and 7-day intervals. However, a statistically significant difference in pain levels was observed on the 3rd day among the groups. Based on the mean rank, silver nanoparticle paste demonstrated the greatest effectiveness in reducing pain, followed by calcium hydroxide paste.

Their was Significant Reduction in Pain during successive time period in all the 3 groups group

**Ranks**

| | Group | N | Mean Rank | Kruskal-Wallis Test value | P value |
|---|---|---|---|---|---|
| preoperative | Calcium hydroxide | 10 | 15.30 | | |
| | Chlorhexidine | 10 | 14.95 | 0.153 | 0.927 |
| | silver nanoparticle paste | 10 | 16.25 | | |
| | Total | 30 | | | |
| 1hour | Calcium hydroxide | 10 | 16.20 | | |
| | Chlorhexidine | 10 | 18.35 | 3.085 | 0.214 |
| | silver nanoparticle paste | 10 | 11.95 | | |
| | Total | 30 | | | |
| 3days | Calcium hydroxide | 10 | 16.25 | | |
| | Chlorhexidine | 10 | 19.40 | 6.370 | 0.041* |
| | silver nanoparticle paste | 10 | 10.85 | | |
| | Total | 30 | | | |
| 7days | Calcium hydroxide | 10 | 15.50 | | |
| | Chlorhexidine | 10 | 15.50 | 0.000 | 1.000 |
| | silver nanoparticle paste | 10 | 15.50 | | |
| | Total | 30 | | | |

Table : Distribution of Pain according to Groups in different Time Periods

## DISCUSSION

Pain is a subjective experience, and its evaluation largely depends on patients' verbal reports. Several scales and methods have been used to assess pain following endodontic treatment. Among these, the Visual Analog Scale (VAS) is commonly considered a simple, precise, and reliable tool for measuring pain intensity. Therefore, VAS was employed in this study to evaluate interappointment pain.[9]

VAS is a valid and reliable method for assessing postoperative pain following endodontic therapy, reinforcing its use in clinical settings. Due to its proven reliability, the VAS was selected for this study to accurately measure and compare postoperative pain among different intracanal medicament groups. To improve patient understanding and enable a more precise assessment, VAS scores were categorized into four levels, allowing for a clearer evaluation of interappointment pain and aiding in the development of more effective pain management strategies in endodontic therapy.[9]

Assessing postoperative pain at various intervals is crucial for evaluating the effectiveness of intracanal medicaments used during root canal treatments. The following time points are commonly utilized:

**Immediate Postoperative Period (6 Hours):** This initial assessment ensures that the effects of local anesthetics have completely worn off, providing a baseline for evaluating the onset of postoperative pain.[10,11]

**Short-Term Follow-Up (72 Hours):** The 24 to 72-hour window post-treatment is typically when patients experience peak discomfort. Monitoring pain during this period allows for the assessment of the medicament's effectiveness in managing acute postoperative pain. It's advisable to measure tissue reactions and inflammation during this timeframe.[12]

**Seven-Day Long-Term Follow-Up:** Evaluating pain relief at the one-week mark helps determine the sustained effectiveness of the intracanal medicament and identifies any delayed complications.[9,13]

By systematically evaluating pain at these critical intervals, healthcare providers can ensure effective pain management and enhance patient comfort throughout the healing process.

Silver nanoparticle (AgNP) paste has shown enhanced effectiveness in alleviating postoperative pain when utilized as an intracanal medicament in root canal treatments. This enhanced performance is attributed to several key factors:

**1. Antibacterial Properties:** AgNPs possess potent antimicrobial effects, effectively eliminating Enterococcus faecalis, a bacterium commonly associated with root canal infections. By reducing bacterial load, AgNPs help prevent post-treatment infections that can lead to pain.[1]

**2. Anti-Inflammatory Effects:** Beyond their antibacterial action, AgNPs exhibit anti-inflammatory properties. They modulate the immune response, potentially reducing inflammation within the periapical tissues, which is a significant contributor to postoperative pain.(6)

**3. Enhanced Tissue Healing:** AgNPs have been shown to promote tissue regeneration and healing. By facilitating faster healing of the periapical tissues, they can reduce the duration and intensity of postoperative pain.[14]

**4. Synergistic Effects with Calcium Hydroxide:** When combined with calcium hydroxide, AgNPs enhance the antimicrobial efficacy of the medicament. This combination not only improves bacterial elimination but also contributes to better pain management outcomes.[7]

The superior performance of AgNP paste in reducing postoperative pain is due to its multifaceted actions, including potent antibacterial effects, anti-inflammatory properties, promotion of tissue healing, and synergistic interactions with other medicaments. These combined effects make AgNP paste a promising option for enhancing patient comfort following root canal treatments

Calcium hydroxide is commonly used as an intracanal medicament in endodontic procedures because of its antimicrobial properties.However, its effectiveness in reducing postoperative pain has been a subject of debate.

Some research indicates that $Ca(OH)_2$ alone may not significantly reduce post-treatment pain. For example, a systematic review found that while $Ca(OH)_2$ is not highly effective in managing post-treatment pain on its own, its effectiveness can be enhanced when combined with other medicaments, such as chlorhexidine and camphorated monochlorophenol (CMCP)..[15]

The limited effectiveness of $Ca(OH)_2$ in reducing postoperative pain when used alone may be due to its high pH, which can be neutralized by dentin buffering, thus reducing its antimicrobial properties. Furthermore, some bacteria present in the root canal system are resistant to the elevated pH of $Ca(OH)_2$.[3]

In contrast, combining $Ca(OH)_2$ with other medicaments, such as chlorhexidine, has shown improved outcomes in reducing postoperative pain. The synergistic effect of these combinations enhances antimicrobial efficacy and may contribute to better pain management.[15]

Chlorhexidine (CHX) gel is known for its broad-spectrum antimicrobial properties and is frequently utilized as an intracanal medicament in endodontic procedures. However, its effectiveness in reducing postoperative pain has shown mixed results in clinical studies.

A RCT by Angın et al. compared the effects of different intracanal medicaments, including CHX gel, on postoperative pain and flare-ups in retreatment cases. The study found no significant differences in pain levels between the medicaments. However, one flare-up occurred in the CHX gel group, while no flare-ups were observed in the other groups, suggesting that CHX gel may not provide superior pain reduction compared to other medicaments.[16]

Menakaya et al. examined postoperative pain incidence after using calcium hydroxide with either normal saline or 0.2% CHX digluconate as intracanal medicaments. The CHX group had a higher occurrence of postoperative pain than the normal saline group, though the difference was not statistically significant. This suggests that CHX may not significantly improve pain reduction as an intracanal medicament.[17]

The reasons for these observations could be multifaceted. While CHX gel is effective against a broad range of microorganisms, its inability to form a physical barrier and lack of radiopacity may limit its efficacy in certain clinical scenarios. Additionally, CHX's antimicrobial action does not neutralize endotoxins, which are significant contributors to periapical inflammation and postoperative pain. This limitation could result in persistent inflammation and discomfort following treatment.

This study has several limitations: the small sample size may limit generalizability and the focus was solely on pain reduction without considering the microbial status of the root canals before and after treatment. Including microbiological assessments in future research could offer insights into the relationship between bacterial reduction and pain relief, thereby enhancing the validity and applicability of the findings regarding intracanal medicaments and postoperative pain management.

## CONCLUSION

Given the limitations of the current study, it can be concluded that silver nanoparticle paste is the most effective intracanal medicament for reducing postoperative pain, followed by calcium hydroxide paste.

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