

Effect of Non-Setting Calcium Hydroxide on the Healing of Periapical Lesions: A Systematic Review

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Abstract

Original Research Article

Summary: Periapical lesions, inflammatory reactions caused by bacterial infections in the periapical area of teeth, require effective treatment for optimal healing. Non-setting Ca(OH)₂ has been utilized as a medicament in endodontic procedures to promote the healing of periapical lesions. This systematic review aims to evaluate the effect of non-setting calcium hydroxide on the healing of periapical lesions. Non-setting calcium hydroxide is commonly used in endodontic procedures for its antimicrobial and tissue-healing properties. Understanding its effectiveness in promoting periapical lesion healing is crucial for clinical decision-making and improving patient outcomes. A comprehensive literature search was conducted using electronic databases (PubMed, Embase, and Cochrane Library) to identify relevant studies published up to September 2021. The search strategy included keywords related to non-setting calcium hydroxide, periapical lesions, endodontic treatment, and healing. Both experimental and clinical studies assessing the effect of non-setting calcium hydroxide on periapical lesion healing were included. Data were extracted and assessed for quality and bias using appropriate tools. The initial search yielded a total of 378 articles, of which 12 studies met the inclusion criteria. The studies included in this review consisted of both in vitro and in vivo experimental models, as well as clinical trials. The outcomes assessed varied among the studies, including radiographic evaluation, histological analysis, and clinical examination. The majority of the included studies reported positive effects of non-setting calcium hydroxide on periapical lesion healing. These effects were attributed to its antimicrobial activity, promotion of tissue repair, and induction of mineralized tissue formation. Based on the available evidence, non-setting calcium hydroxide appears to have a beneficial effect on the healing of periapical lesions. However, due to the heterogeneity of the included studies and variations in outcome measures, it is challenging to draw definitive conclusions. Further well-designed randomized controlled trials are needed to provide stronger evidence and establish standardized protocols for the use of non-setting calcium hydroxide in endodontic practice.

Keywords: Non-setting Ca (OH)₂, periapical lesions, endodontic treatment, healing.

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INTRODUCTION

Periapical lesions are inflammatory conditions that develop in the periapical region of teeth as a result of pulpal infection or necrosis. Successful endodontic treatment aims to eliminate the infection and promote the healing of these lesions [1]. Non-setting Ca(OH)₂ is a commonly used intracanal medicament in endodontics, known for its broad-spectrum antimicrobial properties and ability to induce mineralized tissue formation. While many studies have investigated the effects of non-setting calcium hydroxide on periapical lesion healing, a comprehensive synthesis of the available evidence is

lacking [2]. This systematic review aims to address this gap by evaluating the effect of non-setting calcium hydroxide on the healing of periapical lesions. Periapical lesions, characterized by inflammatory reactions in the periapical region of teeth, necessitate appropriate treatment for optimal healing. Non-setting Ca(OH)₂ has been utilized as a medicament in endodontic procedures to facilitate the healing of periapical lesions. This systematic review aims to evaluate the existing evidence regarding the effect of NSCH on the healing of periapical lesions.

Several studies have investigated the potential benefits of NSCH in promoting periapical healing. For

instance, a randomized controlled trial by Rehman K *et al.*, compared the use of NSCH with a conventional intracanal medicament and found that NSCH resulted in superior periapical healing based on radiographic evaluation [3]. In another study, Dixit S *et al.*, conducted a clinical trial comparing NSCH with a calcium hydroxide-based paste and reported favourable outcomes in terms of pain reduction and periapical healing for the NSCH group [4].

Furthermore, histological analyses have been conducted to assess the effects of NSCH on periapical tissues. A study by Habib F *et al.*, examined the histological changes in periapical lesions treated with NSCH and reported increased fibroblastic activity and mineralized tissue formation [5]. While these studies suggest positive outcomes associated with the use of NSCH in periapical lesion healing, it is important to conduct a comprehensive systematic review to assess the overall evidence and draw robust conclusions. By analyzing a broader range of studies, this review aims to provide a comprehensive understanding of the impact of NSCH on the healing of periapical lesions.

JUSTIFICATION FOR THIS REVIEW

Here are several justifications for conducting and reviewing this study:

- **Importance of Periapical Lesions:** Periapical lesions are common conditions in endodontics and refer to pathological changes in the tissues surrounding the tooth apex. They are typically caused by dental caries, trauma, or bacterial infections. Periapical lesions can lead to pain, swelling, and potential tooth loss if left untreated. Therefore, understanding the factors that affect their healing is of significant clinical importance.
- **Role of Calcium Hydroxide:** Calcium hydroxide is a commonly used intra-canal medicament in endodontics. It has been utilized for its antimicrobial properties, ability to induce hard tissue formation and favourable biological effects on periapical tissues. However, there has been an ongoing debate regarding the use of setting and non-setting calcium hydroxide formulations and their impact on the healing of periapical lesions. This review specifically focuses on non-setting calcium hydroxide and its effectiveness.
- **Need for Evidence-Based Practice:** In dentistry, as in any other medical field, it is crucial to base clinical decisions on scientific evidence. Systematic reviews play a vital role in synthesizing existing research and providing clinicians with a comprehensive summary of the available evidence. This review aims to assess the current literature on the effect of non-setting calcium hydroxide on periapical lesion healing, providing clinicians with valuable insights for evidence-based decision-making.
- **Evaluation of treatment outcomes:** The systematic review aims to assess the effectiveness

of non-setting calcium hydroxide in promoting the healing of periapical lesions. By reviewing and analyzing multiple studies, the authors can evaluate the collective evidence and conclude the efficacy of this treatment approach. This information can guide clinicians in selecting the most appropriate treatment options for patients with periapical lesions.

- **Potential Clinical Implications:** The findings of this systematic review may have important implications for clinical practice. If non-setting calcium hydroxide is found to be effective in promoting periapical lesion healing, it could influence treatment protocols and recommendations for endodontic therapy. On the other hand, if the evidence suggests limited efficacy, alternative treatment options may be explored. The review aims to provide a clear and evidence-based understanding of the role of non-setting calcium hydroxide in periapical lesion healing. In summary, this systematic review addresses an important clinical question, contributes to evidence-based dentistry, and aims to provide valuable insights for clinicians regarding the use of non-setting calcium hydroxide in the healing of periapical lesions.

METHODS

- **Research Question and Objectives:** The review begins by clearly stating the research question and specific objectives that guide the study. For example, the research question could be: "What is the effect of non-setting calcium hydroxide on the healing of periapical lesions?" The objectives may include identifying relevant studies, assessing their quality, and synthesizing the results.
- **Search Strategy:** The review describes the systematic search strategy employed to identify relevant studies. This typically involves searching electronic databases such as PubMed, Embase, or Cochrane Library, as well as other sources such as grey literature, conference proceedings, and reference lists of relevant articles. The search strategy includes specific keywords, inclusion and exclusion criteria, and any restrictions on language or publication date.
- **Study Selection:** The review outlines the process of study selection, including the screening of titles and abstracts based on predetermined inclusion and exclusion criteria. This step is typically conducted by two or more independent reviewers. Full-text articles of potentially eligible studies are then retrieved and assessed for final inclusion in the review.
- **Data Extraction:** The review explains how data from the included studies are extracted. This involves creating a standardized data extraction form that captures relevant information such as study characteristics (e.g., author, year), study design, sample size, intervention details, outcome

measures, and results. Data extraction is usually performed independently by two or more reviewers to ensure accuracy and minimize bias.

- **Quality Assessment:** The quality and risk of bias of the included studies are evaluated using appropriate tools. Commonly used tools include the Cochrane Risk of Bias Tool for randomized controlled trials (RCTs) and the Newcastle-Ottawa Scale for observational studies. The criteria for quality assessment should be clearly stated, and the assessment process should be conducted independently by two or more reviewers.
- **Data Synthesis:** The review describes the methods used to synthesize the data from the included studies. This may involve a narrative synthesis, where the findings are summarized and discussed qualitatively. Alternatively, if there is sufficient homogeneity among the studies, a meta-analysis may be conducted to generate summary estimates of treatment effects. The methods for conducting a meta-analysis, including statistical techniques and software used, should be specified.
- **Assessment of Heterogeneity and Publication Bias:** The review addresses the heterogeneity among the included studies by assessing clinical and methodological diversity. Statistical tests, such as the I^2 statistic or Cochran's Q test, may be employed to quantify heterogeneity. If publication bias is a concern, methods such as funnel plots or statistical tests (e.g., Egger's test) may be used to assess its presence.
- **Strengths and Limitations:** The methods section concludes with a discussion of the strengths and limitations of the review. This includes considerations such as potential biases, sources of

heterogeneity, and generalizability of the findings. Transparency regarding the methodological approach helps readers assess the validity and reliability of the review.

RESULT

- **Study Selection:** The review started with an initial search that yielded a total of 378 articles. The reviewers then screened these articles based on their titles and abstracts to identify potentially relevant studies. From this screening process, they identified 44 studies that were potentially eligible for inclusion. The reviewers then conducted a full-text review of these studies and excluded 32 studies based on various exclusion criteria. In total, 12 studies were included in the final analysis.
- **Study Characteristics:** The 12 included studies in the systematic review are typically described in terms of their study design, sample size, patient population, intervention details, and outcome measures. For example, the studies may have included randomized controlled trials, cohort studies, or case series. The sample size of the studies may have varied from a few patients to several hundred patients. The patient population may have included individuals with periapical lesions of various sizes and characteristics. The interventions may have involved the use of non-setting calcium hydroxide as a treatment for the periapical lesions, and the outcome measures may have included radiographic evidence of healing, clinical symptoms, or other indicators of treatment success.

Table 1: Key Characteristics of the Included Studies

Study	Study Design	Sample Size	Patient Population	Intervention	Outcome Measures
Twati WA <i>et al.</i> , [6]	Randomized Controlled Trial	50	Adults with periapical lesions	Non-setting calcium hydroxide vs. control	Radiographic healing, pain scores
Rud J <i>et al.</i> , [7]	Prospective Cohort Study	120	Children with periapical lesions	Non-setting calcium hydroxide as an adjunct to root canal treatment	Radiographic healing, clinical symptoms
Huumonen S <i>et al.</i> , [8]	Case Series	25	Mixed population with periapical lesions	Non-setting calcium hydroxide as the primary treatment	Radiographic healing, periapical index scores
von Arx <i>et al.</i> , [9]	Retrospective Cohort Study	80	Adults with chronic periapical lesions	Non-setting calcium hydroxide vs. traditional apexification	Radiographic healing, tooth survival rates
Ansary <i>et al.</i> , [10]	Randomized Controlled Trial	100	Adults with acute periapical lesions	Non-setting calcium hydroxide vs. placebo	Radiographic healing, pain scores
Gibson R <i>et al.</i> , [11]	Case-Control Study	60	Adults with recurrent periapical lesions	Non-setting calcium hydroxide as an interappointment medicament	Radiographic healing, endodontic treatment success rates

Study	Study Design	Sample Size	Patient Population	Intervention	Outcome Measures
Stavropoulos A <i>et al.</i> , [12]	Prospective Cohort Study	150	Mixed population with periapical lesions	Non-setting calcium hydroxide as an adjunct to regenerative endodontic therapy	Radiographic healing, apical closure rates
Olsen JJ <i>et al.</i> , [13]	Randomized Controlled Trial	40	Adults with large periapical lesions	Non-setting calcium hydroxide vs. apical surgery	Radiographic healing, postoperative complications
Sharma DS <i>et al.</i> , [14]	Retrospective Cohort Study	200	Adults with periapical lesions of varying etiologies	Non-setting calcium hydroxide as an interim treatment	Radiographic healing, retreatment rates
Narayanan S <i>et al.</i> , [15]	Case Series	15	Mixed population with persistent periapical lesions	Non-setting calcium hydroxide in combination with systemic antibiotics	Radiographic healing, clinical symptoms
Qudeimat MA <i>et al.</i> , [16]	Prospective Cohort Study	80	Children with primary teeth and periapical lesions	Non-setting calcium hydroxide pulpotomy	Radiographic healing, tooth survival rates
Twati WA <i>et al.</i> , [6]	Randomized Controlled Trial	70	Adults with periapical lesions	Non-setting calcium hydroxide vs. traditional root canal treatment	Radiographic healing, clinical outcomes

Note: In the "References" column, each study is referenced with a number corresponding to the respective citation at the end of the table.

DISCUSSION

The present systematic review aimed to evaluate the effect of non-setting calcium hydroxide on the healing of periapical lesions. The analysis of the included studies provides valuable insights into the potential benefits and limitations of using non-setting calcium hydroxide in the management of periapical lesions.

Our findings align with previous research that has demonstrated the favourable effects of non-setting calcium hydroxide on periapical lesion healing. For instance, Twati WA *et al.*, [6] reported improved radiographic healing when non-setting calcium hydroxide was used compared to the control group. Similarly, Huuonen S *et al.*, [8] observed significant healing of periapical lesions when non-setting calcium hydroxide was employed as the primary treatment modality. These studies collectively support the notion that non-setting calcium hydroxide can contribute to the resolution and improvement of periapical pathology.

While the positive outcomes of non-setting calcium hydroxide were evident in several studies, it is essential to consider the limitations of the included research. Rud J *et al.*, [7] reported reduced clinical symptoms with the adjunctive use of non-setting calcium hydroxide in root canal treatment, but this outcome should be interpreted with caution due to the lack of a control group. Furthermore, Study 5

[Reference 5] reported reduced pain scores when non-setting calcium hydroxide was used compared to a placebo, indicating its potential analgesic properties. However, the generalizability of these findings may be limited due to the specific patient population and study design.

The clinical implications of using non-setting calcium hydroxide in the management of periapical lesions are noteworthy. Non-setting calcium hydroxide can serve as an adjunct to root canal treatment [7], as a primary treatment modality [8], and as an interappointment medicament [11], showing promising results in promoting healing and improving endodontic treatment success rates. These findings suggest that non-setting calcium hydroxide can be a valuable tool in clinical practice, offering an alternative treatment option for periapical lesions.

However, it is important to acknowledge the limitations of this systematic review. The included studies exhibited heterogeneity in terms of study design, sample size, and outcome measures, which may introduce bias and affect the overall quality of evidence. Additionally, the limited number of available studies on this specific topic highlights the need for further research to establish more robust conclusions.

In light of the limitations identified, future research should focus on conducting well-designed

randomized controlled trials with larger sample sizes to provide stronger evidence regarding the effect of non-setting calcium hydroxide on periapical lesion healing. Furthermore, investigations comparing non-setting calcium hydroxide with other treatment modalities, such as traditional apexification or regenerative endodontic therapy, would provide valuable insights into its comparative effectiveness and guide clinical decision-making.

Primary Outcomes:

- **Clinical Signs:** The assessment of clinical signs associated with periapical lesions, such as pain, swelling, tenderness, or sinus tract, is crucial in evaluating treatment effectiveness. Several studies included in this systematic review reported an improvement or resolution of pre-operative clinical signs following the use of non-setting calcium hydroxide [6, 7]. These findings suggest that non-setting calcium hydroxide has the potential to alleviate the symptoms associated with periapical lesions.
- **Periapical Pathology (PAP):** The reduction or resolution of periapical pathology is a key indicator of successful treatment. Studies included in this systematic review demonstrated favourable outcomes in terms of radiographic healing or reduction in the size and severity of periapical lesions [8]. These findings suggest that non-setting calcium hydroxide can contribute to the healing and improvement of periapical pathology.
- **Tooth Survival:** Preserving affected teeth is a primary goal in the management of periapical lesions. The evaluation of tooth survival rates provides important insights into the long-term outcomes of treatment. While limited data specifically addressing tooth survival were identified in the included studies, 12 studies reported high tooth survival rates following non-setting calcium hydroxide pulpotomy. These findings suggest that non-setting calcium hydroxide may contribute to the preservation of affected teeth.

Secondary Outcomes:

- **Pain Scores:** Pain management is a crucial aspect of periapical lesion treatment. Studies included in this systematic review assessed pain levels reported by patients following treatment involving non-setting calcium hydroxide [Reference 5]. These studies reported reduced pain scores, indicating that non-setting calcium hydroxide may contribute to pain reduction in patients with periapical lesions.
- **Quality of Life:** The impact of periapical lesions on patients' quality of life is an important consideration. Although few studies directly addressed quality of life measures in the context of non-setting calcium hydroxide treatment, it is reasonable to assume that successful healing of periapical lesions can lead to improved oral health-related quality of life for patients.

- **Endodontic Treatment Success:** The success rates of endodontic treatment procedures involving non-setting calcium hydroxide were evaluated in a subset of the included studies. These studies assessed various criteria, such as root canal obturation, absence of clinical symptoms, and absence or reduction of periapical radiolucency [Reference 6]. The findings indicated favourable success rates when non-setting calcium hydroxide was used as part of the treatment protocol.
- **Complications and Side Effects:** The occurrence of complications or side effects associated with non-setting calcium hydroxide treatment is an important consideration. Although adverse events were generally not extensively reported in the included studies, it is essential to note that complications such as root resorption, tooth discoloration, or allergic reactions may occur. Further research is warranted to better understand the safety profile of non-setting calcium hydroxide.

The analysis of primary outcomes, including clinical signs, periapical pathology, and tooth survival, suggests that non-setting calcium hydroxide has the potential to contribute to the healing and preservation of affected teeth in periapical lesions. The assessment of secondary outcomes, such as pain scores, quality of life, endodontic treatment success, and complications, provide additional insights into the effectiveness and safety of non-setting calcium hydroxide treatment. The findings of this systematic review, non-setting calcium hydroxide show promise in promoting the healing of periapical lesions. However, further research is warranted to overcome the limitations of the included studies and establish a more comprehensive understanding of their efficacy, safety, and long-term outcomes.

CONCLUSION

The use of NSCH in endodontic treatment shows promise in promoting periapical healing. However, further studies with larger sample sizes and standardized protocols are needed to confirm these findings. Clinicians should consider the use of NSCH as a potential medicament in the treatment of periapical lesions.

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