Outcomes of Single versus Multiple Visit Endodontic Therapy in Non-Vital Teeth: A Systematic Review

Dr. LalitaGauri Mandke[1], Dr. Sumita Bhagwat[2], Dr. Rashmi Misra[3],
Dr. Avantika Pawar[4], Dr. Sahil Kawale[5], Dr. Rashmitha Reddy[6]
[1,2,3]*BDS, MDS, Professor, Department of Conservative Dentistry and Endodontics, Dy Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India*
[4,6]*BDS, Post Graduate Student, Department of Conservative Dentistry and Endodontics, Dy Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India*
[5]*BDS, MDS, Lecturer, Department of Conservative Dentistry and Endodontics, Dy Patil University School of Dentistry, Nerul, Navi Mumbai, Maharashtra, India*

Abstract*—Background: Single-visit and multiple-visit endodontic therapy are established approaches for the management of infected and non-vital teeth, but the relative effects of visit number on postoperative pain, flare-ups, periapical healing, and long-term success remain debated. Aim: This systematic review evaluated and compared the clinical and radiographic outcomes of single-visit versus multiple-visit endodontic therapy. Materials and method: The review followed PRISMA methodology and was registered in PROSPERO (CRD420250651055). PubMed/MEDLINE, Scopus, Cochrane Library, Web of Science, Embase, and Google Scholar were searched. Eligible comparative clinical studies with at least six months of follow-up were selected, data were extracted in duplicate, and risk of bias was assessed using RoB 2 and the Newcastle-Ottawa Scale. Result: Thirteen studies were included. Most studies reported no statistically significant difference in postoperative pain between single- and multiple-visit therapy. Pain, when present, generally peaked within 24–48 hours and declined by one week. Radiographic periapical healing and clinical success were also broadly comparable. Calcium hydroxide was the most frequently used intracanal medicament in multiple-visit protocols, while contemporary rotary instrumentation and sodium hypochlorite-based irrigation were common across studies. Conclusion: Current evidence indicates comparable clinical and radiographic outcomes for single- and multiple-visit endodontic therapy when adequate chemo mechanical disinfection and obturation are achieved. Single-visit therapy may be a clinically acceptable and efficient option in appropriately selected cases, whereas treatment should remain individualized according to symptoms, periapical status, anatomy, and operator proficiency.

***Index Terms*—Single-visit endodontics, Multiple-visit endodontics, non-vital teeth**

I. INTRODUCTION

Root canal treatment (RCT) of non-vital teeth aims to eliminate microbial infection, prevent reinfection, and promote healing of the periapical tissues [1,2]. Non-vital teeth often harbor complex microbial communities within the root canal system, making effective cleaning, shaping, and disinfection essential for successful treatment [3]. Traditionally, treatment has been performed over multiple visits, with intracanal medicaments such as calcium hydroxide used between appointments to enhance microbial reduction before obturation [4,5]. However, multiple-visit treatment requires additional appointments and may increase the risk of inter-appointment contamination. Single-visit endodontic treatment involves complete cleaning, shaping, disinfection, and obturation in one appointment and has gained popularity with advances in instrumentation and irrigation techniques [6,7]. It offers reduced treatment time and fewer appointments but remains controversial regarding postoperative pain, flare-ups, microbial reduction, and periapical healing compared with multiple-visit treatment [8,9]. Although several studies have compared these approaches in non-vital teeth, their findings remain inconsistent. Therefore, this systematic review aims to compare the clinical and biological outcomes of single-visit versus multiple-visit endodontic therapy in non-vital teeth,

focusing on postoperative pain, treatment success, microbial reduction, periapical healing, and flare-up incidence.

II. METHODOLOGY

A systematic review was conducted to evaluate the clinical and radiographic outcomes of single-visit versus multiple-visit endodontic therapy in non-vital teeth. The review was structured according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and included a comprehensive literature search, study selection, data extraction, and critical appraisal of included studies.The review protocol was registered in the PROSPERO database (Reference ID: CRD420250651055).

Search Strategy

A systematic and extensive literature search was conducted across multiple electronic databases to identify relevant studies comparing single-visit and multiple-visit endodontic therapy in non-vital teeth. The following databases were searched:

The electronic databases searched were PubMed/MEDLINE, Scopus, Cochrane Library, Web of Science, Embase, and Google Scholar. The search combined MeSH terms and free-text keywords for single-visit endodontics, multiple-visit endodontics, non-vital teeth, postoperative pain, flare-up, treatment outcome, clinical success, and periapical healing using Boolean operators.

Eligibility Criteria

Studies were selected based on predefined inclusion and exclusion criteria formulated using the PICO (Population, Intervention, Comparator, Outcomes) framework.

Inclusion Criteria:

Studies involving permanent non-vital teeth undergoing root canal treatment.

- Studies directly comparing single-visit and multiple-visit endodontic treatment.
- Randomized controlled trials and comparative prospective, retrospective, or observational clinical studies.
- Studies reporting clinical and/or radiographic outcomes, including postoperative pain, flare-ups, healing, or treatment success.
- Studies with a minimum follow-up period of six months for long-term outcome assessment.
- Full-text peer-reviewed studies published in English.

Exclusion Criteria:

Studies involving vital teeth or procedures other than primary root canal treatment.

- Retreatment studies, case reports, case series, reviews, editorials, and laboratory or animal studies.
- Studies without a clearly defined single-visit or multiple-visit comparison.
- Studies lacking relevant clinical or radiographic outcome data.

Study Selection Process

The selection of studies was performed in three phases:

Title and Abstract Screening: Two independent reviewers screened the titles and abstracts of retrieved records for relevance. Irrelevant studies were excluded at this stage.

Full-text Screening: The full texts of potentially eligible studies were obtained and screened for inclusion based on the predefined eligibility criteria.

Final Selection: Any discrepancies in study selection between the two reviewers were resolved through discussion or consultation with a third reviewer.

The selection process was documented in a PRISMA flow diagram, outlining the number of studies identified, screened, included, and excluded at each stage

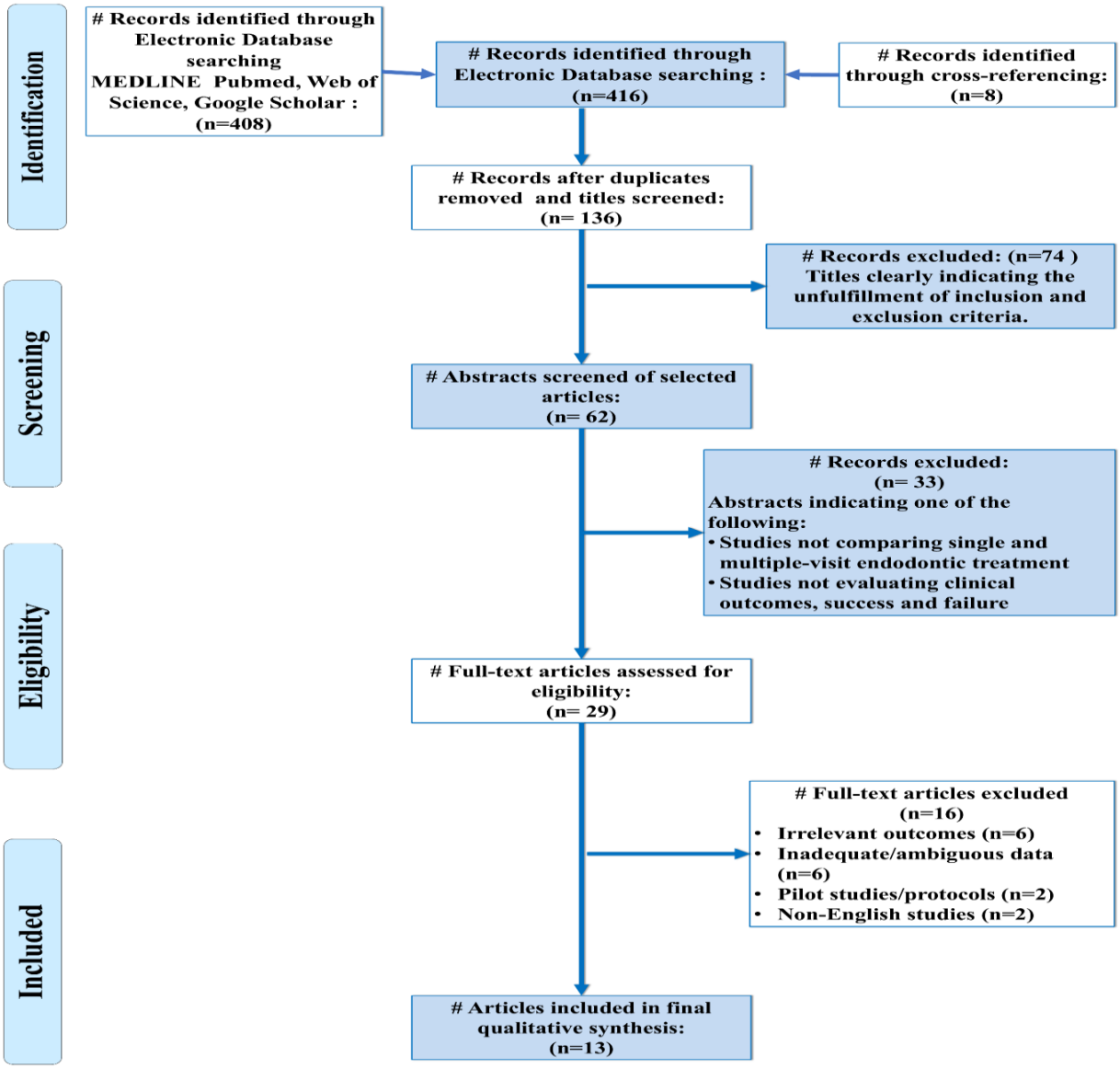

Figure 1: PRISMA flow diagram indicating the selection process of articles in the present systematic review.

Data Extraction

Data was extracted independently by two reviewers using a standardized data extraction form. The following key information was collected:

The extracted variables included study characteristics, population details, intervention and comparator details, postoperative pain at 24, 48, and 72 hours and 7 days, clinical success, radiographic healing assessed using PAI/radiographs/CBCT, flare-ups and complications, microbial reduction, follow-up duration, and key findings. Data were extracted in duplicate and discrepancies were resolved through discussion or consultation with a third reviewer.

Risk of Bias Assessment

The methodological quality of the included studies was assessed using appropriate risk of bias tools:

Randomized controlled trials were assessed with the Cochrane RoB 2 tool for bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Non-randomized studies were assessed using the Newcastle-Ottawa Scale for selection, comparability, and outcome domains.

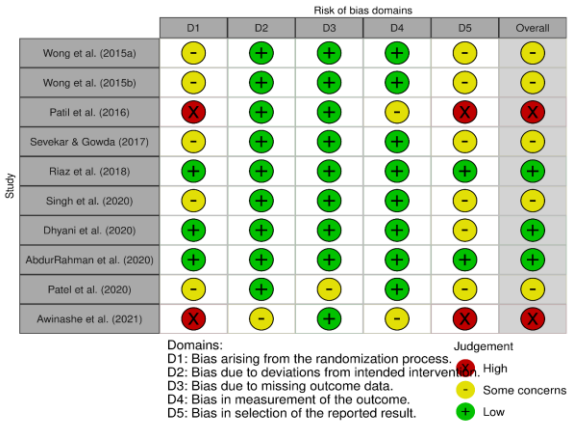

Figure 2: Traffic signal plot indicating the risk of bias in the included randomized controlled trials.

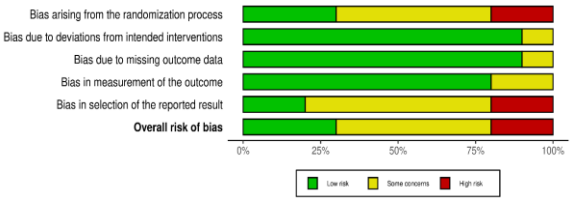

Figure 3: Overall distribution of risk of bias across the assessed domains.

Data Synthesis and Statistical Analysis

A structured qualitative and quantitative synthesis was performed.

Studies were grouped based on study design, intervention type, and reported outcomes.

Key findings were summarized in tables to present treatment effects and methodological differences.

III. RESULTS

A total of 13 studies were included in this systematic review, evaluating the clinical and radiographic outcomes of single-visit versus multiple-visit endodontic therapy in non-vital teeth. These studies were conducted in various countries, reflecting a diverse geographic distribution of research on this topic. The majority of the studies were from India (n=7), followed by Pakistan (n=2), and one study each from Sudan (n=1), Egypt (n=1), and Hong Kong (n=2).

Figure 1: PRISMA Flow diagram indicating the selection process of articles in the present systematic review

Study Designs and Methodologies

Among the included studies, Randomized Controlled Trials (n=8) represented the most frequent study design, establishing a high level of evidence across most included data. Two studies were Randomized Clinical Trials, and one study each used Prospective Observational, In vivo Comparative, and Experimental designs. This range of methodologies allowed for a comprehensive assessment of both short-term and long-term post-operative outcomes.

Tooth Vitality and Clinical Presentation

The review encompassed a spectrum of pulp conditions. Most studies included both vital and non-vital teeth, though some exclusively assessed non-vital teeth with apical periodontitis or acute irreversible pulpitis. Specifically, the vitality status was defined as follows:

- Vital and non-vital teeth were included in two studies,
- Non-vital necrotic teeth with or without periapical pathology were assessed in seven studies,
- Only vital teeth (e.g., with acute pulpitis) were evaluated in one study, and
- Mixed groups with specific vitality ratios were analyzed in three studies.

This variation enabled analysis of how vitality status influenced outcomes like pain, healing, and flare-ups.

Types of Teeth Treated

A wide range of tooth types were included. The majority of studies included anterior and posterior teeth (n=2), while others focused on specific groups such as:

- Anterior, premolar, and molar teeth (n=1),
- Primary molars in pediatric patients (n=1),
- Mandibular or maxillary single-rooted teeth (n=2),
- Permanent first molars (n=1),
- Central incisors (n=1), and
- Several studies broadly categorized as involving anterior and posterior teeth in both arches.

This variation provided insight into how anatomical complexity might influence the incidence of post-operative symptoms and overall outcomes.

Postoperative Pain and Healing Outcomes

Post-operative pain was the most commonly reported outcome across all studies. Pain incidence ranged from 0% to 66.7% in the single-visit group and 0% to 68.2% in the multiple-visit group within the first 24 to 48 hours. In general, most studies reported no statistically significant difference in pain levels between the two groups. However, a few studies noted slightly higher pain scores in the single-visit group within the initial 24 hours, which subsided with time and did not persist beyond one week.

Radiographic healing was reported in a subset of studies, typically evaluated after follow-ups ranging from 6 weeks to 9 months. Again, no significant differences were observed between groups in terms of periapical healing or clinical success. Both treatment modalities showed favorable outcomes when standardized instrumentation and irrigation techniques were used.

Instrumentation and Medicaments

Instrumentation methods varied but were mostly rotary NiTi systems like ProTaper Universal, Protaper Next, or K3 NiTi, often using the crown-down technique. In multiple-visit groups, calcium hydroxide was the most frequently used intracanal medicament, applied in seven of the studies. A single study evaluated Triple Antibiotic Paste (TAP).

Irrigation protocols commonly involved 2.5–5.25% sodium hypochlorite, often combined with EDTA and lubricants like RC Prep or EDTA gel. Obturation techniques included cold lateral condensation, Thermafil, and in a few cases, were not explicitly reported but were standardized across comparison groups.

IV. DISCUSSION

This systematic review evaluated the clinical outcomes of single-visit versus multiple-visit endodontic therapy in non-vital teeth. Thirteen studies from India, Pakistan, Hong Kong, Sudan, and Egypt were included, comprising mainly randomized clinical trials and comparative studies [10-23]. The included studies evaluated postoperative pain, flare-ups, microbial reduction, radiographic healing, and treatment success.

Postoperative pain was the most frequently assessed outcome. Although some studies reported slightly higher pain during the first 24–48 hours following single-visit treatment, pain generally decreased with time and was largely resolved by Day 7 [14,16]. Overall, no consistent significant difference in postoperative pain was observed between the two treatment protocols. Preoperative pain was also associated with greater postoperative discomfort, suggesting that the patient's initial clinical condition may influence treatment outcomes [16,20]. Variations in pain assessment methods, including VAS, Heft-Parker VAS, and numerical rating scales, may partly explain differences between studies [24,25].

The instrumentation and irrigation protocols were relatively similar across the studies. Rotary NiTi systems, crown-down preparation, sodium hypochlorite, and EDTA were commonly used, emphasizing the importance of effective chemo mechanical preparation in microbial control [31-38]. Obturation techniques included cold lateral compaction and thermoplastic zed systems, with no clear evidence that one technique produced superior postoperative or healing outcomes [39-42].

Calcium hydroxide was the most commonly used intracanal medicament in multiple-visit treatment, while one study used triple antibiotic paste [17,43]. However, the use of intracanal medicaments did not consistently result in better pain reduction, healing, or overall treatment outcomes compared with single-visit therapy. This suggests that thorough cleaning, shaping, and irrigation may be more important determinants of success than the number of treatment visits.

Radiographic and long-term outcomes were comparable between single- and multiple-visit treatments in the available studies, with similar periapical healing reported during follow-up [10,11,15]. Single-visit treatment may additionally reduce treatment time and eliminate the risk of inter-appointment contamination. However, multiple-visit therapy may still be appropriate in selected cases, such as teeth with persistent exudation, extensive periapical lesions, complex anatomy, or where additional intracanal disinfection is required.

Overall, the findings indicate that both treatment approaches can provide favorable outcomes in non-vital teeth when adequate chemo mechanical preparation, irrigation, obturation, and aseptic protocols are followed. The choice between single- and multiple-visit therapy should therefore be based on case characteristics, periapical status, patient

factors, and clinical judgment. Further well-designed studies with standardized outcome measures and longer follow-up are required to strengthen the available evidence.

V. CONCLUSION

This systematic review concludes that both single-visit and multiple-visit endodontic therapies are effective and clinically acceptable modalities for the treatment of non-vital teeth. The comparative analysis of postoperative pain, incidence of flare-ups, radiographic healing, and long-term clinical success revealed no significant difference between the two approaches when standard disinfection and obturation protocols were followed. Although minor variations in early postoperative pain were observed in some studies, these were transient and did not influence long-term outcomes. The use of intracanal medicaments in multiple-visit protocols did not consistently demonstrate superior results, suggesting that thorough chemo mechanical preparation remains the cornerstone of successful endodontic therapy.

The clinical implications of these findings are significant, supporting the adoption of single-visit endodontics in appropriately selected cases. This approach offers advantages in terms of patient convenience, reduced chair time, and improved compliance, especially in pediatric patients and individuals with logistical constraints. However, the decision to opt for single- or multiple-visit treatment must be individualized, taking into account factors such as tooth vitality, presence of periapical pathology, patient symptoms, and operator proficiency.

Future research should aim to standardize outcome measures, incorporate patient-centered endpoints such as quality of life and satisfaction, and assess healing through advanced imaging techniques over extended follow-up periods. Until such data become available, clinicians are encouraged to employ a flexible, evidence-informed approach in endodontic treatment planning that aligns biological goals with patient-specific needs.

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