

Review Article

Postoperative Pain in Endodontics: A Systematic Review of Randomized Controlled Trials

Kawther Belhaj Salah^{1*} , Mariem ElArem², Imen Gnaba³, Souha Ben Youssef⁴ 

¹Assistant Professor, Department of Conservative Dentistry and endodontics, Faculty of Dental Medicine, University of Monastir, Avicenne Avenue, Monastir 5019, Tunisia. Research Laboratory: LR 12SP10: Functional and Aesthetic Rehabilitation of Maxillary, University of sousse, khalifa karoui Avenue, sousse, Tunisia

²Doctor, Private practice. Research Laboratory: LR 12SP10: Functional and Aesthetic Rehabilitation of Maxillary, University of sousse, khalifa karoui Avenue, sousse, Tunisia

³Professor, Department of Conservative Dentistry and endodontics, Faculty of Dental Medicine, University of Monastir, Avicenne Avenue, Monastir 5019, Tunisia. Research Laboratory: LR 12SP10: Functional and Aesthetic Rehabilitation of Maxillary, University of sousse, khalifa karoui Avenue, sousse, Tunisia

⁴Professor, Department Oral Surgery, Faculty of Dental Medicine, University of Monastir, Tunisia. Research Laboratory: LR 12SP10: Functional and Aesthetic Rehabilitation of Maxillary, University of sousse, khalifa karoui Avenue, sousse, Tunisia

Article History

Received: 11.08.2026

Accepted: 05.10.2026

Published: 07.10.2026

Journal homepage:

<https://www.easpublisher.com>

Quick Response Code



Abstract: Aim & Background: Postoperative pain is a multifactorial phenomenon, influenced by patient-related factors, tooth characteristics, and procedural aspects. This systematic review aims to identify and analyze the factors influencing the occurrence of postoperative pain following conventional endodontic treatments. **Materials and Methods:** The protocol was developed according to the guidelines established by the PRISMA statement. An electronic search was conducted in two databases, MEDLINE via PubMed and Web of Science, using the Boolean operator "AND" with the following MeSH terms: "root canal therapy" and "postoperative pain", as well as keywords including "root canal preparation", "endodontics," and "apical debris extrusion". A standardized data extraction grid was developed, and Risk of bias was assessed through the Cochrane Risk of Bias 2.0 tool. The review protocol was registered on PROSPERO (CRD420251027137). **Results:** Of the 72 initial articles, 11 clinical trials were included. The selected studies investigated various procedural variables, such as shaping kinematics, irrigation dynamics, and obturation technique. Postoperative pain was assessed using the Visual Analog Scale (VAS), Numerical Rating Scale (NRS), Verbal Rating Scale (VRS), and OHIP-14. Ten studies were rated as having a low risk of bias, and one showed moderate risk. **Conclusion:** Postoperative pain after root canal treatment is a multifactorial phenomenon influenced by various procedural parameters. Although some techniques, such as continuous rotation shaping, negative pressure irrigation, and adjunctive use of photodynamic therapy, appear to be associated with lower pain levels, the current evidence does not support a definitive superiority of one protocol over another. Further high-quality clinical trials are needed to standardize pain assessment and clarify the most effective strategies for minimizing postoperative discomfort. **Clinical Significance:** Postoperative endodontic pain is a multifactorial outcome influenced by several procedural factors. This systematic review indicates that canal preparation, irrigation, and obturation techniques play a relevant role in postoperative pain occurrence. Optimizing these clinical procedures may help reduce periapical irritation and improve postoperative patient comfort following conventional endodontic treatment.

Keywords: Endodontic Treatment, Postoperative Pain, Visual Analog Scale.

Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

*Corresponding Author: Kawther Bel Haj Salah

180

Assistant Professor, Department of Conservative Dentistry and endodontics, Faculty of Dental Medicine, University of Monastir, Avicenne Avenue, Monastir 5019, Tunisia. Research Laboratory: LR 12SP10: Functional and Aesthetic Rehabilitation of Maxillary, University of sousse, khalifa karoui Avenue, sousse, Tunisia

INTRODUCTION

Endodontic pain remains a central concern in dental practice, as pain is one of the primary determinants influencing patients' perception of treatment success and overall satisfaction. Despite major advances in endodontic instruments, materials, and techniques, pain associated with endodontic pathology and its management continues to represent a significant clinical challenge. In particular, the anticipation of pain is often a major source of anxiety for patients and may negatively affect their willingness to undergo or complete endodontic treatment [1].

Among the various clinical symptoms encountered in dental practice, preoperative pain stands out as a predominant reason for patient consultation [2]. Endodontic treatment involves the management of symptoms before, during, and after the procedure, including postoperative endodontic pain, which is regarded as a potential treatment-related complication and remains a major source of concern for patients [1].

Postoperative pain is a multifactorial phenomenon, influenced by patient-related factors, tooth characteristics, and procedural aspects [3]. It is generally due to acute inflammation of the periradicular tissues, triggered by mechanical, chemical, or microbial causes [4].

Numerous studies have investigated the influence of different canal shaping, irrigation, and obturation technique on postoperative pain [5-7]. However, despite the growing body of literature on postoperative endodontic pain, existing evidence remains fragmented, with substantial heterogeneity in study designs and outcomes, and no recent synthesis has comprehensively focused on the incidence and procedural determinants of postoperative pain following conventional endodontic treatment.

In this context, the objective of our systematic review was to analyze the incidence of postoperative pain associated with conventional endodontic treatments, identify contributing factors, and propose recommendations to minimize their occurrence.

METHODS

1. Protocol and Reporting

The protocol of the present systematic review was developed a priori according to the guidelines established by the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [8], and after implementation of the search strategy was registered in PROSPERO (identification N° 2025 CRD420251046339). (Appendix 1)

2. Eligibility Criteria

The research question was established according to PICOS criteria, as follows:

P (population): patients with mature permanent teeth who underwent root canal treatment; I (Intervention): assessment of postoperative pain and complications following endodontic treatment; C (Comparison): no comparator was applied; O (Outcome): postoperative pain levels. S (study design) : randomized clinical trials.

The exclusion criteria were as follows: Case reports and case series, in vitro or animal studies, studies without sufficient clinical data on treatment outcomes, and studies involving primary teeth, permanent immature teeth or previously treated teeth. Articles with insufficient data or not meeting the objectives of this review were also excluded.

Based on this approach, our research question was formulated as follows:

“What are the factors involved in the occurrence of postoperative pain following conventional root canal treatment ? ”

3. Search strategy

An electronic search of published literature was conducted using 2 databases: Medline via Pubmed and Web of Science. The search was limited to the last 10 years (from 2015 to 2025), using the following MeSH terms: "root canal therapy" and "postoperative pain." In addition to these, the following keywords were selected to broaden the search strategy: "root canal preparation," "endodontics," and "apical debris extrusion." Subsequently, using the Boolean operator AND, the following search equations were formulated:

- **Equation 1:** (root canal therapy [MeSH Terms]) AND (postoperative pain [MeSH Terms]).
- **Equation 2:** (root canal preparation) AND (endodontics) AND (apical debris extrusion).

Additional literature was searched through hand search by reviewing the references of articles selected through the electronic search process, and has enabled the identification of 2 articles. Two calibrated reviewers independently conducted the search and screening process. When disagreements or discrepancies arose, a third examiner was consulted. All conflicts were discussed and resolved through consensus among the three reviewers.

Duplicates were removed, and all titles and abstracts for studies that met the eligibility criteria were screened. Questionable titles were discussed until consensus was reached. After the screening process, the full texts of the selected studies were obtained.

4. Data Collection Process (Reading Grid)

The relevant data contained in the articles selected for this study were extracted according to a standardized grid. This grid included the study design,

sample size, clinical and radiological features used in each article. (Appendix 2).

Thus, the data were extracted by two reviewres and reexamined by a third.

5. Quality Assessment of Included Studies

The risk of bias was assessed for all included studies using the Cochrane Risk of Bias tool (RoB 2). This tool evaluates five critical domains where bias may arise : the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and the selection of reported results. Each domain includes signaling questions designed to guide reviewers toward a structured and transparent judgment, ultimately classifying the study as having a "low risk," "some concerns," or "high risk" of bias [9]. Two independent reviewers conducted the assessments based on predefined criteria. Any disagreements were resolved through discussion and, if necessary, consultation with a third reviewer to ensure objectivity and consensus.

RESULTS

1. Search details

A total of 71 records were initially identified through electronic searches across two databases and manual search. After the removal of 2 duplicate-records, title and abstract screening resulted in the exclusion of 49 articles that were not relevant to the research objectives. The full texts of the remaining 20 articles were assessed for eligibility. Following full-text evaluation, 9 articles were excluded. Finally, 11 clinical trials met the inclusion criteria and were included in the review (Fig.1). Details of excluded full-text articles along with reasons for exclusion are provided in Appendix 3.

2. General Characteristics of Included Studies

Detailed data from studies included in this review are summarized and provided in Tables 1 and 2.

All included studies were randomized clinical trials, mainly investigating instrumentation kinematics [4-12], irrigation dynamics [13-17], and obturation techniques in relation to postoperative pain [5-18].

In this review, baseline diagnoses were categorized according to standardized endodontic terminology and encompassed pulp necrosis, symptomatic and asymptomatic irreversible pulpitis, symptomatic and asymptomatic apical periodontitis, and chronic apical abscess.

Postoperative pain was assessed using different validated scales across the included clinical trials. The

most commonly used tools were the Visual Analog Scale (VAS) [18], and the Numeric Rating Scale (NRS) [4]. While the other studies also employed the Verbal Rating Scale (VRS) [14], which categorizes pain intensity from none to unbearable, and the OHIP-14 questionnaire, used to evaluate the impact of oral health on quality of life [14].

3. General Outcomes of Included Studies

Overall, no significant differences in postoperative pain intensity were observed among the different shaping systems. However, during the first two postoperative days, pain intensity was significantly higher in the reciprocating group compared with the crown-down group. This difference was not maintained at subsequent time points [4-12].

Regarding sodium hypochlorite concentration, no significant differences in postoperative pain were observed among the various concentration [16, 17].

Concerning irrigation activation methods, passive irrigation was associated with significantly higher postoperative pain compared with negative pressure irrigation at 6, 24, and 48 hours; however, this difference was no longer significant at 3 and 7 days [13]. No significant differences in postoperative pain were found between laser-activated irrigation and passive irrigation protocols [15]. When patients receiving adjunctive photodynamic therapy experienced significantly lower postoperative pain levels [14].

Finally, postoperative pain did not differ significantly between cold lateral compaction and single-cone techniques when used with AH Plus [12], nor between single-cone and vertical compaction with different sealers (AH Plus, EndoFill, MTA Fillapex) [18]. When comparing cold lateral compaction, thermoplasticized solid-core carrier (GuttaCore), and GuttaFlow2 techniques, GuttaFlow2 showed the highest proportion of pain-free patients, whereas GuttaCore was associated with a greater overfilling rate, which correlated with increased pain on postoperative days 1 and 2 [5].

4. Results of Quality Assessment

The quality assessment of the 11 clinical trials included in this review indicated a low risk of bias for 10 studies and a moderate risk of bias for one study [15]. These studies met the methodological criteria established by the Cochrane Risk of Bias 2.0 tool and were judged to present a low risk across the assessed domains, indicating a high level of internal validity. (Table 4) (Fig.2)

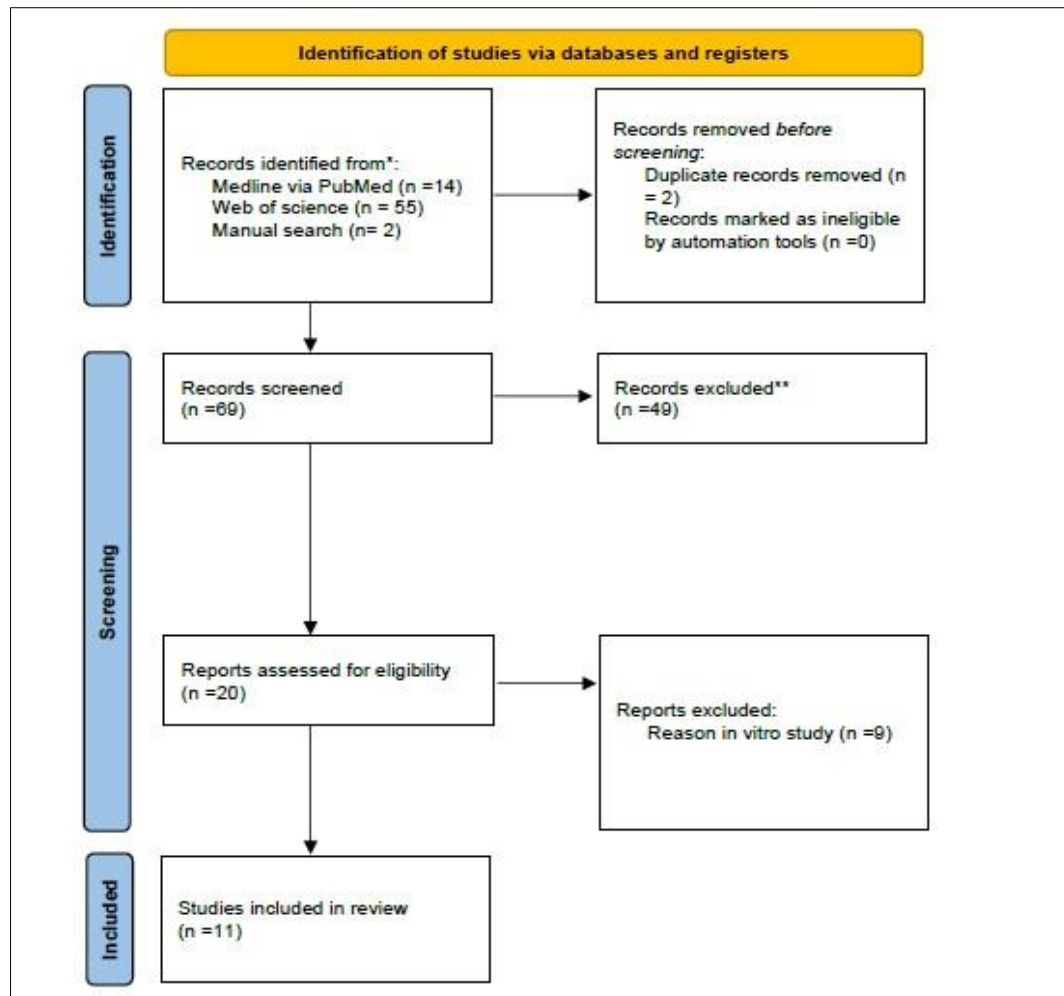


Figure 1: PRISMA 2020 flow diagram

		Risk of bias domains				
		D1	D2	D3	D4	D5
Study	A. Al-Haddad et al.	+	+	+	+	+
	A. Koçer et al.	+	+	+	+	+
	S Kurnaz et al.	+	+	+	+	+
	P.S. Oliveira et al.	+	+	+	+	+
	F.E.D. de-Figueiredo et al.	+	+	+	+	+
	H.S.Topçuoğlu et al.	+	+	+	+	+
	M.S. Coelho et al	+	+	+	+	+
	J. Dagher et al.	+	-	+	+	+
	N. Verma et al.	+	+	+	+	+
	L.S. Demenech et al.	+	+	+	+	+
	N de S. Ferreira et al	+	+	+	+	+
		Domains:				
		D1: Bias arising from the randomization process.				
		D2: Bias due to deviations from intended intervention.				
		D3: Bias due to missing outcome data.				
		D4: Bias in measurement of the outcome.				
		D5: Bias in selection of the reported result.				
		Judgement				
		- Some concerns				
		+ Low				

Figure 2: Robvis traffic light plots of the risk of bias assessment for the included studies, according to the RoB 2.0 tool

Table 1: The Characteristics of the Included clinical Trials Based on the Postoperative pain related to instrumental dynamics

Title	Authors	Number of patients/teeth	Pulpal or periapical diagnosis	Shaping Instrument	Instrumental dynamics	Results
The Effect of Root Canal Preparation Using Single Versus Multiple Endodontic Rotary Files on Post-operative Pain, a Randomised Clinical Trial [4]	M. Aminsobhani, <i>et al.</i> ,	105 patients	Asymptomatic irreversible Pulpitis	-Neoniti single file -Race single file -Mtwo single file -Easy race up -Mtwomulti-file up	Continuous rotation	There were no significant differences in postoperative pain intensity between the different shaping systems.
Comparison of Postoperative Pain after Foraminal Enlargement of Necrotic Teeth Using Continuous Rotary System and Reciprocating Instrument: A Randomized Clinical Trial [12]	S. Kurnaz	79 patients	Asymptomatic apical periodontitis	Protaper Next WaveOne	Continuous rotation Reciprocity	During the first two days after treatment, postoperative pain was significantly higher in the WaveOne group than in the ProTaperNext group. However, in the following days, no significant difference was found between the two groups.
Impact of root canal preparation performed by ProTaper Next or Reciproc on the quality of life of patients: a randomized clinical trial [13]	P. S. Oliveira <i>et al.</i> ,	62 patients	Asymptomatic irreversible Pulpitis.	Reciproc Protaper Next	Continuous rotation Reciprocity	No significant differences in postoperative pain were observed between the ProTaper Next and Reciproc systems.
Apical periodontitis healing and postoperative pain following endodontic treatment with a reciprocating single-file, single-cone approach: A randomized controlled pragmatic clinical trial [14]	F.E.D. de-Figueiredo <i>et al.</i> ,	120 teeth	- Symptomatic and asymptomatic apical periodontitis, - Chronic apical abscess	-Reciproc - Manual files	- Reciprocity - Crown down technique	The results showed no significant difference in postoperative pain between crown-down and reciprocal movement.

Table 2: The Characteristics of the included clinical Trials Based on the Postoperative pain related to irrigation dynamics

Title	Authors	Number of patients/teeth	Pulpal or periapical diagnosis	Irrigation Solutions	Irrigation Dynamics	Results
The Effect of Apical Positive and Negative Pressure Irrigation Methods on Postoperative Pain in Mandibular Molar Teeth with Symptomatic Irreversible Pulpitis: A Randomized Clinical Trial [15]	H.S.Topçuoğlu <i>et al.</i> ,	116 patients	Symptomatic irreversible pulpitis	Sodium hypochlorite 2.5 % EDTA 17% Distilled water	-Positive pressure irrigation -Negative pressure irrigation	At 6h, 24h et 48h, The group that received passive irrigation had more severe postoperative pain than those that received negative pressure irrigation. At 72 hours and 7 days, no significant difference was noted between the two groups.
The effects of photodynamic therapy on postoperative pain in teeth with necrotic pulps [16]	M. S.Coelho <i>et al.</i> ,	60 patients	Necrosis	Sodium hypochlorite 2.5 % EDTA 17 % Methylene blue 1.56 µM/mL	- Passive irrigation -Photodynamic therapy	From 24 to 72 hours, patients who received photodynamic therapy experienced significantly less pain than those without this therapy. It is only after a week that there is no longer any difference between the 2 groups.
Postoperative Quality of Life Following Conventional Endodontic Intracanal Irrigation Compared with Laser-Activated Irrigation: A	J. Dagher <i>et al.</i> ,	56 patients	- Symptomatic irreversible pulpitis - Necrosis with or	Sodium hypochlorite 5.25% EDTA 17%	- Passive irrigation -Active irrigation by laser Er:YAG PIPS technique	No significant difference in postoperative pain was observed between the two protocols: laser-activated irrigation and passive irrigation.

Randomized Clinical Study [17]			without complications			
Effect of Different Concentrations of Sodium Hypochlorite on Outcome of Primary Root Canal Treatment: A Randomized Controlled Trial [18]	<u>N. Verma et al.,</u>	100 teeth	Asymptomatic apical periodontitis	- Sodium hypochlorite 1% and 5% -EDTA 17%	Passive irrigation	There is no difference in terms of postoperative pain between the high-concentration group (5% NaOCl) and the low-concentration group (1% NaOCl)
Postoperative Pain after Endodontic Treatment under Irrigation with 8.25% Sodium Hypochlorite and Other Solutions: A Randomized Clinical Trial [19]	<u>L.S. Demenech, et al.,</u>	180 patients	Not specified	-Sodium hypochlorite : 2.5%, 5.25%, 8.25% - Chlorhexidine 2% -EDTA 17% -Salina 0.9%	Passive irrigation	No significant differences were recorded in postoperative pain for the different irrigation solutions (NaOCl at 2.5%, 5.25%, 8.25% and chlorhexidine: 2%)

Table 3: The Characteristics of the Included clinical Trials Based on the Postoperative pain related to the filling

Article	Authors	Number of patients/teeth	Pulpal or periapical Diagnosis	Obturation technique	Endodontic sealer	Results
Apical periodontitis healing and postoperative pain following endodontic treatment with a reciprocating single-file, single-cone approach: A randomized controlled pragmatic clinical trial [14]	F.Diniz de-Figueiredo <i>et al.,</i>	120 Teeth	- Symptomatic and asymptomatic apical periodontitis, - Chronic apical abscess	-Cold lateral compaction -mono cone technique	AH plus: Epoxy resin-based sealer	The results showed no significant difference in terms of postoperative pain between the 2 filling techniques : lateral compaction and mono cone.
Postoperative pain after root canal filling with different endodontic sealers: a randomized clinical trial [20]	N.S. Ferreira <i>et al.,</i>	60 patients	Necrosis	- Monocone technique - Vertical compaction	AH plus EndoFill MTA Fillapex	The results revealed no significant difference in postoperative pain between the three groups at 24, 48 hours and 7 days post-treatment.

technique

Table 3: Risk of Bias Assessment Based on Cochrane RoB-2

Study	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall risk of bias
The Effect of Root Canal Preparation Using Single Versus Multiple Endodontic Rotary Files on Post-operative Pain, a Randomised Clinical Trial [4]	Low	Low	Low	Low	Low	Low
Postoperative pain intensity and incidence following single visit root canal treatment with different obturation techniques: a randomized clinical trial [7]	Low	Low	Low	Low	Low	Low
Comparison of Postoperative Pain after Foraminal Enlargement of Necrotic Teeth Using Continuous Rotary System and Reciprocating Instrument: A Randomized Clinical Trial [12]	Low	Low	Low	Low	Low	Low
Impact of root canal preparation performed by ProTaper Next or Reciproc on the quality of life of patients: a randomized clinical trial [13]	Low	Low	Low	Low	Low	Low
Apical periodontitis healing and postoperative pain following endodontic treatment with a reciprocating single-file, single-cone approach: A randomized controlled pragmatic clinical trial [14]	Low	Low	Low	Low	Low	Low
The Effect of Apical Positive and Negative Pressure Irrigation Methods on Postoperative Pain in Mandibular Molar Teeth with Symptomatic	Low	Low	Low	Low	Low	Low

Irreversible Pulpitis: A Randomized Clinical Trial [15]						
The effects of photodynamic therapy on postoperative pain in teeth with necrotic pulps [16]	Low	Low	Low	Low	Low	Low
Postoperative Quality of Life Following Conventional Endodontic Intracanal Irrigation Compared with Laser-Activated Irrigation: A Randomized Clinical Study [17]	Low	Some concerns	Low	Low	Some concerns	Some concerns
Effect of Different Concentrations of Sodium Hypochlorite on Outcome of Primary Root Canal Treatment: A Randomized Controlled Trial [18]	Low	Low	Low	Low	Low	Low
Postoperative Pain after Endodontic Treatment under Irrigation with 8.25% Sodium Hypochlorite and Other Solutions: A Randomized Clinical Trial [19]	Low	Low	Low	Low	Low	Low
Postoperative pain after root canal filling with different endodontic sealers: a randomized clinical trial [20]	Low	Low	Low	Low	Low	Low

DISCUSSION

This systematic review aimed to provide a critical and up-to-date evaluation of treatment-related parameters associated with postoperative pain following conventional endodontic treatment. In fact, this postoperative pain is a multifactorial phenomenon primarily related to periapical inflammation triggered by mechanical, chemical, and microbial aggression during root canal shaping and obturation procedures. Given the lack of recent systematic reviews providing an updated overview of this topic, a comprehensive evaluation of the available data is warranted to better understand the influence of treatment-related factors.

Postoperative Pain and Instrumentation Kinematics

Instrumentation dynamics during canal preparation significantly contribute to postoperative pain by promoting extrusion of debris, pulp remnants, microorganisms, and irrigants beyond the apex [17]. Therefore, evaluating the intensity, timing, triggering factors, and incidence of postoperative pain is essential to better prevent and manage this undesirable outcome.

In this context, technical differences in instrumentation kinematics may have important clinical implications, as the choice of shaping system can influence the amount of debris extruded into the periapical tissues, potentially exacerbating postoperative pain [4]. Several studies, including those by Oliveira *et al.*, [17], and Fabricio *et al.*, [18], reported no significant differences in postoperative pain between continuous rotation systems and reciprocating crown-down techniques. Conversely, other investigations demonstrated a significantly higher pain intensity during the first two postoperative days in teeth prepared using reciprocating systems compared with continuous rotation systems [20-34]. These findings are consistent with the conclusions of a meta-analysis conducted by Caviedes-Bucheli *et al.*, [32].

This difference may be explained by the tendency of reciprocating motion to compact debris

within the canal space and push it apically beyond the foramen. In contrast, continuous rotation tends to direct debris coronally toward the canal orifice, functioning like a screw conveyor, thereby reducing debris compaction and apical extrusion, and consequently lowering postoperative pain levels [33]. Additionally, instrument geometric parameters, such as helix angle, pitch, and cross-sectional design, have also been shown to influence debris extrusion and postoperative pain. While enhanced cutting efficiency improves canal cleaning, it may simultaneously increase apical debris transportation [33].

On the other hand, when comparing single-file systems with conventional multi-instrument sequences, the latter provides a more gradual and controlled mechanical enlargement, theoretically reducing debris extrusion and postoperative pain. However, a randomized clinical trial by Aminsobhani *et al.*, [7], reported no significant difference in postoperative pain between single-file instrumentation and multi-file sequences, with pain intensity remaining low in both groups. These findings suggest that both instrumentation strategies can be considered safe and effective in endodontic treatment.

Postoperative Pain and Endodontic Irrigation

Beyond instrumentation, irrigation dynamics further influence the risk of periapical irritation and postoperative discomfort. In fact, numerous studies have demonstrated that dentinal debris, microorganisms, and irrigating solutions can be extruded into periapical tissues, potentially causing postoperative pain [19].

Sodium hypochlorite is the most commonly used endodontic irrigant due to its antibacterial properties and ability to dissolve organic tissue. Its concentrations range from 2.5% to 5.25% [20]. High-concentration solutions enhance tissue dissolution but may increase apical extrusion, as shown by Parirokh *et al.*, [21]. Even minimal extrusion of highly cytotoxic solutions can irritate periapical tissues [22]. Nevertheless, included studies indicate that irrigant

concentration does not significantly impact the incidence of postoperative pain after endodontic treatment [16]. Overall, irrigation dynamics and solution renewal are more critical factors than concentration in reducing bacterial load, minimizing microbial extrusion, and preventing flare-ups [21-23].

Irrigation dynamics encompass flow patterns, penetration, and solution renewal. Understanding these dynamics is essential for optimizing techniques that limit periapical extrusion, enhance disinfection, and reduce postoperative pain [21-24]. Clinical studies have evaluated the effects of various irrigation methods on pain. Topçuoğlu *et al.*, [13], reported that passive irrigation resulted in higher pain scores at 6, 24, and 48 hours compared with negative-pressure irrigation, although no differences were observed at 72 hours and 7 days. Negative-pressure systems, such as EndoVac, aspirate irrigant at the apex, maintaining constant flow throughout the canal, enabling effective cleaning with minimal apical extrusion [25]. Yost *et al.*, [26], confirmed that negative-pressure irrigation reduces apical extrusion of NaOCl compared with positive-pressure systems.

Adjunctive techniques such as laser-activated irrigation and photodynamic therapy may reduce bacterial load and inflammation, potentially decreasing postoperative pain, although evidence remains limited. Jessica *et al.*, [22], showed that PIPS laser activation does not reduce postoperative pain more than passive irrigation alone. In contrast, Marcelo *et al.*, [14], demonstrated that combining photodynamic therapy with laser activation significantly reduces postoperative pain by decreasing bacterial load and debris extrusion. Low-power lasers also exhibit anti-inflammatory effects, lowering prostaglandin concentrations, which may further reduce edema and pain [27].

In conclusion, while passive irrigation is simple, cost-effective, and easy to implement, it has limitations in controlling apical extrusion. Negative-pressure irrigation, particularly with the EndoVac system, improves patient comfort postoperatively. Laser-activated irrigation, especially photodynamic therapy, is most effective as a complementary method to optimize canal disinfection and reduce postoperative pain through multiple biological mechanisms.

Postoperative Pain and Root Canal Obturation

Root canal obturation, as the final step of root canal treatment carries a risk of material extrusion, as well as pressure exerted during lateral or vertical compaction, which can often be associated with postoperative discomfort.²⁸ Therefore, it is crucial to evaluate these factors to identify techniques that minimize patient discomfort while ensuring optimal clinical success.

In the comparison of obturation techniques, GuttaFlow2 was associated with a higher proportion of pain-free patients, whereas the thermoplasticized solid-core carrier technique (GuttaCore) showed a higher incidence of overfilling. This tendency toward overextension was in turn associated with increased postoperative pain during the early healing phase, particularly on days 1 and 2, suggesting a potential relationship between obturation technique, apical extrusion, and short-term postoperative discomfort [5].

In the other hand, Fabricio *et al.*, [12], compared the single-cone and lateral compaction techniques and conclude that there are no significant differences between the two methods regarding postoperative pain, with low pain levels. These findings suggest that the obturation technique itself may not significantly influence postoperative pain. This may be explained by the practitioner's adherence to the necessary precautions during canal obturation, thus minimizing the risk of gutta-percha or sealer extrusion. However, in cases of apical extrusion, sealers may come into direct or close contact with periapical tissues, triggering a local inflammatory response manifested as pain.¹⁸ Consequently, sealer biocompatibility is an important criterion when selecting a material that does not exacerbate postoperative discomfort.

In this context, Ferreira *et al.*, [18], compared postoperative pain when using different endodontic sealers and found no differences in the incidence of flare-ups among the groups. The authors noted that, even in cases of accidental sealer extrusion, postoperative pain was not affected, likely reflecting the high biocompatibility of the materials.

CONCLUSION

Postoperative pain following conventional endodontic treatment is multifactorial, and this review indicates that instrumentation kinematic approaches do not significantly influence pain outcomes. Continuous rotation, however, is consistently associated with lower postoperative discomfort. Evidence further shows that higher-concentration irrigants offer no additional benefit, whereas negative-pressure irrigation provides a meaningful reduction in postoperative pain, particularly compared with passive irrigation. Although PIPS laser activation shows limited effect, combining initial irrigation with photodynamic therapy appears to enhance symptom reduction.

Overall, careful adherence to clinical protocols, use of biocompatible materials, and optimization of irrigation and instrumentation appear key to minimizing patient discomfort.

Clinical Significance

Postoperative pain remains a major determinant of patient satisfaction following conventional endodontic treatment. The findings of this systematic review

highlight the multifactorial nature of postoperative endodontic pain and emphasize the role of procedural factors, particularly canal preparation, irrigation, and obturation techniques, in its occurrence. A better understanding of these determinants may help clinicians adopt evidence-based strategies aimed at minimizing periapical irritation, reducing apical extrusion of debris and materials, and improving postoperative comfort. Ultimately, optimizing clinical protocols based on current evidence may contribute to enhanced patient-centered care and improved clinical outcomes in endodontic practice.

DISCLOSURES

Funding: The authors received no specific funding for this work.

Conflicts of Interest: The authors declare that they have no conflicts of interest related to this study.

Ethical Approval: Not applicable. This study is a systematic review of previously published studies and did not involve human participants or animals directly.

Author Contributions

All authors contributed substantially to the conception and design of the study. The first and the second authors performed the literature search and data extraction and conducted the data analysis. All authors contributed to manuscript drafting, critically revised the manuscript for important intellectual content, and approved the final version for publication.

Data Availability Statement

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Source(s) of Support: none.

Organisation: none

Conflicting Interest: The authors deny any conflicts of interest related to this study. The authors report no funding for the present study.

Acknowledgements

The authors declare that no funding, grants, institutional, technical, administrative, or language support was received for the conduct of this study. No contributions were made by individuals who do not meet the criteria for authorship.

Author's Contributions

1. Conceptualization:<Kawther Belhajsalah>
2. Protocol:<Kawther Belhajsalah – Mariem Elarem>

3. Search:< Kawther Belhajsalah – Mariem Elarem >
4. Screening:< Kawther Belhajsalah – Mariem Elarem >
5. Risk of bias:< Kawther Belhajsalah – Mariem Elarem >
6. Meta-analysis: no meta-analysis
7. Writing–original draft: Kawther Belhajsalah – Mariem Elarem >
8. Writing–review & editing: kawther Belhajsalah>
9. Visualization/Figures:< Mariem Elarem>
10. Supervision:< Imen Gnaba – Souha Benyoussef>

REFERENCES

1. Di Spirito F, Scelza G, Fornara R, Giordano F, Rosa D, Amato A. Post-Operative Endodontic Pain Management : An Overview of Systematic Reviews on Post-Operatively Administered Oral Medications and Integrated Evidence-Based Clinical Recommendations. *Healthcare*. 19 avr 2022;10(5):760.
2. Ahmed YE, Ahmed GM, Ghoneim AG. Evaluation of postoperative pain and healing following regenerative endodontics using platelet-rich plasma versus conventional endodontic treatment in necrotic mature mandibular molars with chronic periapical periodontitis. A randomized clinical trial. *Int Endod J*. avr 2023;56(4):404-18.
3. Albertini R, Villaverde AB, Aimbire F, Salgado M a. C, Bjordal JM, Alves LP, et al. Anti-inflammatory effects of low-level laser therapy (LLLT) with two different red wavelengths (660 nm and 684 nm) in carrageenan-induced rat paw edema. *J Photochem Photobiol B*. 12 nov 2007;89(1):50-5.
4. Al-Haddad A, Che Ab Aziz ZA. Bioceramic-Based Root Canal Sealers: A Review. *Int J Biomater*. 2016;2016:9753210.
5. Koçer A, Özkan HD, Turk T. Postoperative pain intensity and incidence following single visit root canal treatment with different obturation techniques: a randomized clinical trial. *PeerJ*. 27 juill 2022;10:e13756.
6. Aminsobhani M, Meraji N, Khoshdel A, Ghorbanzadeh A. The Effect of Root Canal Preparation Using Single Versus Multiple Endodontic Rotary Files on Post-operative Pain, a Randomised Clinical Trial. *Eur Endod J*. 22 sept 2017;2(1):1-5.
7. Alonso-Ezpeleta LO, Gasco-Garcia C, Castellanos-Cosano L, Martín-González J, López-Frías FJ, Segura-Egea JJ. Postoperative pain after one-visit root-canal treatment on teeth with vital pulps: comparison of three different obturation techniques.

- Med Oral Patol Oral Cirurgia Bucal. 1 juill 2012;17(4):e721-727.
8. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 29 mars 2021;372:n71.
9. Higgins JP, Altman DG. Assessing Risk of Bias in Included Studies. In: *Cochrane Handbook for Systematic Reviews of Interventions* [Internet]. John Wiley & Sons, Ltd; 2008 [cité 6 août 2025]. p. 187-241. Disponible sur: <https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470712184.ch8>
10. Kurnaz S. Comparison of postoperative pain after foraminal enlargement of necrotic teeth using continuous rotary system and reciprocating instrument : a randomized clinical trial. *Niger J Clin Pract*. 2020 Feb ;23(2):212–218.
11. Oliveira PS, da Costa KNB, Carvalho CN, Ferreira MC. Impact of root canal preparation performed by ProTaper Next or Reciproc on the quality of life of patients: a randomized clinical trial. *Int Endod J*. févr 2019;52(2):139-48.
12. de-Figueiredo FED, Lima LF, Lima GS, Oliveira LS, Ribeiro MA, Brito-Junior M, et al. Apical periodontitis healing and postoperative pain following endodontic treatment with a reciprocating single-file, single-cone approach: A randomized controlled pragmatic clinical trial. *PloS One*. 2020;15(2):e0227347.
13. Topçuoğlu HS, Topçuoğlu G, Arslan H. The Effect of Apical Positive and Negative Pressure Irrigation Methods on Postoperative Pain in Mandibular Molar Teeth with Symptomatic Irreversible Pulpitis: A Randomized Clinical Trial. *J Endod*. août 2018;44(8):1210-5.
14. Coelho MS, Vilas-Boas L, Tawil PZ. The effects of photodynamic therapy on postoperative pain in teeth with necrotic pulps. *Photodiagnosis Photodyn Ther*. sept 2019;27:396-401.
15. Dagher J, El Feghali R, Parker S, Benedicenti S, Zogheib C. Postoperative Quality of Life Following Conventional Endodontic Intracanal Irrigation Compared with Laser-Activated Irrigation: A Randomized Clinical Study. *Photobiomodulation Photomed Laser Surg*. avr 2019;37(4):248-53.
16. Verma N, Sangwan P, Tewari S, Duhan J. Effect of Different Concentrations of Sodium Hypochlorite on Outcome of Primary Root Canal Treatment: A Randomized Controlled Trial. *J Endod*. avr 2019;45(4):357-63.
17. Demenech LS, de Freitas JV, Tomazinho FSF, Baratto-Filho F, Gabardo MCL. Postoperative Pain after Endodontic Treatment under Irrigation with 8.25% Sodium Hypochlorite and Other Solutions: A Randomized Clinical Trial. *J Endod*. mai 2021;47(5):696-704.
18. Ferreira N de S, Gollo EKF, Boscato N, Arias A, Silva EJNL da. Postoperative pain after root canal filling with different endodontic sealers: a randomized clinical trial. *Braz Oral Res*. 2020;34:e069.
19. Al-Saffar FB, Al-Gharrawi HA. A Comparative Evaluation of the Apically Extruded Debris from Root Canals Prepared by R-Motion NiTi File System. *Int J Dent*. 2023;2023:5731248.
20. De-Deus G, Brandão MC, Barino B, Di Giorgi K, Fidel RAS, Luna AS. Assessment of apically extruded debris produced by the single-file ProTaper F2 technique under reciprocating movement. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. sept 2010;110(3):390-4.
21. Parirokh M, Jalali S, Haghdoust AA, Abbott PV. Comparison of the effect of various irrigants on apically extruded debris after root canal preparation. *J Endod*. févr 2012;38(2):196-9.
22. Pasqualini D, Corbella S, Alovisei M, Taschieri S, Del Fabbro M, Migliaretti G, et al. Postoperative quality of life following single-visit root canal treatment performed by rotary or reciprocating instrumentation: a randomized clinical trial. *Int Endod J*. nov 2016;49(11):1030-9.
23. Hockett JL, Dommisch JK, Johnson JD, Cohenca N. Antimicrobial efficacy of two irrigation techniques in tapered and nontapered canal preparations: an in vitro study. *J Endod*. nov 2008;34(11):1374-7.
24. Bystrom A, Sundqvist G. The antibacterial action of sodium hypochlorite and EDTA in 60 cases of endodontic therapy. *Int Endod J*. janv 1985;18(1):35-40.
25. Desai P, Himel V. Comparative Safety of Various Intracanal Irrigation Systems. *J Endod*. 1 avr 2009;35(4):545-9.
26. Yost RA, Bergeron BE, Kirkpatrick TC, Roberts MD, Roberts HW, Himel VT, et al. Evaluation of 4 Different Irrigating Systems for Apical Extrusion of Sodium Hypochlorite. *J Endod*. sept 2015;41(9):1530-4.
27. Silveira CMM, Pimpão MV, Fernandes LA, Westphalen VPD, Cavenago BC, Carneiro E. Influence of Different Irrigation Solutions and Instrumentation Techniques on the Amount of Apically Extruded Debris. *Eur Endod J*. 19 nov 2019;4(3):122-6.
28. Teixeira JMS, Cunha FM, Jesus RO, Silva EJNL, Fidel SR, Sassone LM. Influence of working length and apical preparation size on apical bacterial extrusion during reciprocating instrumentation. *Int Endod J*. juill 2015;48(7):648-53.

Cite This Article: Belhaj Salah, K., ElArem, M., Gnaba, I., & Ben Youssef, S. (2026). Postoperative Pain in Endodontics: A Systematic Review of Randomized Controlled Trials. *EAS J Dent Oral Med*, 8(5), 180-189. <https://doi.org/10.36349/easjdom.2026.v08i05.005>