SYSTEMATIC REVIEW

Impact of pulpotomy versus root canal treatment on oral health-related quality of life in patients with pulpitis: a systematic review

Syeda Abeerah Tanveer[1], Itrat Batool[2], Robia Ghafoor[3]

Abstract

Objective: The aim of the review is to compare the pain outcome measures and oral health-related quality of life (OHRQOL) in pulpotomy versus root canal treatment.

Methodolgy: The systematic review was conducted from October 10 to November 21, 2024, and comprised literature search on electronic databases: PubMed (CENTRAL, MEDLINE) and Cochrane Central Register of Controlled Trials (CENTRAL) [Cochrane Library], Clarivate Analytics' Web of Science (including Web of Science Core Collection—WoS, Russian Science Citation Index—RSCI, SciELO Citation Index—SCIELO), and CINAHL using key words and Boolean operators, including “pulpotomy” OR “pulpotomies” OR “pulp capping” AND “root canal treatment” OR “root canal therapy” OR “pulpectomy” OR “pulpectomies” AND “pulpitis” AND “quality of life” OR “oral health” AND “permanent dentition” OR “secondary” in the electronic databases. The outcomes evaluated were postoperative pain after full pulpotomy compared to non-surgical root canal therapy as well as their quality of life at different time intervals.

Results: The initial search retrieved 729 articles from electronic databases of them 5 articles were included. Among the included studies, three (60%) demonstrated a low risk of bias, while two (40%) were assessed as having a high risk of bias.

Conclusion: Pulpotomy may be as effective as root canal treatment in managing postoperative pain, while quality of life assessment showed significant improvement over time in favour of pulpotomy.

Keywords: Pulpotomy, Root canal treatment, Pulpitis, Quality of life, Pulp capping.

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Introduction

In endodontics, dental caries often culminate in irreversible pulpitis — a condition characterised by severe, lingering pain and diminished quality of life (QOL) that necessitates definitive treatment, such as root canal therapy (RCT) or, alternatively, vital pulp therapy (VPT).[1] Despite high success rate of 96% in RCT cases, limitations, such as the complexity of the procedure, time investment, technical challenges and long-term susceptibility of the treated teeth to structural weakening, necessitate consideration of alternative approaches.[2]

In the era of advances in minimally invasive dentistry, VPT offers a least invasive alternative that preserves pulp vitality, supporting its defensive, proprioceptive and developmental functions.[3] Recent clinical trials have demonstrated successful clinical and radiographical outcomes, as well as reduced postoperative pain and improved cost-effectiveness for mature teeth with irreversible pulpitis (IP).[4,5] From a longitudinal perspective, advocating less aggressive dentistry reduces overtreatment, and limits the ‘restorative cycle’ concept, while also improving the cost-effectiveness of the treatment.[3] However, till recently it was considered a temporary treatment rather than definitive IP treatment.[6] A pulpotomy is a therapeutic approach aimed at removing partial or full coronal pulp, followed by the application of a biomaterial directly onto the remaining pulp tissue to maintain physiological functions.[7] Recent studies have documented the success of coronal pulpotomies in mature and immature teeth with carious pulp exposures, both with signs and symptoms of reversible pulpitis and IP.[8,9] This challenges the decision to perform RCT based on a diagnosis of pulpitis.

Research into the extent of postoperative pain and its impact on QOL is essential in any aspect of clinical practice, particularly when clinicians are faced with overlapping diagnosis and multiple treatment options.[3] The use of the oral health impact profile in endodontics has shown that pulpal disease may impact oral health-related quality of life (OHRQOL) and that orthograde endodontic treatment can improve QOL.[4] Although full pulpotomy is endorsed as a viable treatment by the American Association of Endodontists and the European Society of Endodontology[7,10], the current evidence base underscores the need for more robust decision to establish its position as a definitive treatment.

The current systematic review was planned to compare the pain outcome measures and QOL in pulpotomy versus RCT.

Materials and Methods

The systematic review was conducted from October 10 to November 21, 2024, in line with the 2021 guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[11] The review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) database (CRD42024622436).[12]

A literature search was conducted on electronic databases: PubMed (CENTRAL, MEDLINE) and Cochrane Central Register of Controlled Trials (CENTRAL) [Cochrane Library], Clarivate Analytics' Web of Science (including Web of Science Core Collection—WoS, Russian Science Citation Index—RSCI, SciELO Citation Index—SCIELO), and CINAHL were searched. Articles published in English language which fulfilled the objectives of PICOS criteria (Population, intervention, comparison, outcomes and study design) of the study were included.[13] The search was conducted through medical subject heading (MeSH_ terms and key words (all fields) using Boolean operators including "pulpotomy" OR "pulpotomies" OR "pulp capping" AND "root canal treatment" OR "root canal therapy" OR "pulpectomy" OR "pulpectomies" AND "pulpitis" AND "quality of life" OR "oral health" AND "permanent dentition" OR "secondary". Articles that met the Population-Intervention-Comparison-Outcomes-Study design (PICOS) criterion were included if they were randomised control trials, comparative clinical trials (CCTs), non-randomised retrospective and prospective comparative cohorts or case-control studies published in the English language. Case reports, case series, narrative, scoping or systematic reviews, letters, commentaries and editorials were excluded, and so were studies published in languages other than English, and registered clinical trials without results.

Screening and extraction process was carried out by two researchers in two phases. The screening and selection of articles began with an initial review of titles and abstracts, followed by a detailed screening of full-text publications. Articles featuring the specified key words in their titles or abstracts were first evaluated, and, subsequently, the full texts were reviewed. The authors encountered no disagreements during the screening.

The articles were further evaluated for duplication, language, relevance to the topic, outcome measures and full-text availability.

The main findings of studies evaluated were postoperative pain-related outcomes after full pulpotomy compared to non-surgical RCT as well as QOL of the patients at different intervals of time using validated questionnaire. Moreover, patients' characteristics, such as age, gender and tooth type were noted. Clinical protocols, including type (partial or coronal) and material for pulpotomy, were also assessed.

Risk of bias assessment was done by two independent reviewers, an any disagreement was resolved in consultation with the third reviewer. The Cochrane Risk of Bias tool for randomised trials (RoB 2.0) was used. Based on factors, such as randomisation, deviations from intended interventions, missing outcome data, outcome measurement, selection of reported results, and overall quality, the studies were classified as having a 'low', 'unclear', or 'high' risk of bias.

Results

The initial search retrieved 729 articles from electronic databases using MeSH terms and keywords. After screening, duplicates (n = 319), non-English articles (n = 79), studies irrelevant to the topic or not meeting eligibility criteria (n = 339), and articles without full-text availability (n = 4) were excluded. A total of 5 studies were included and summarized in the PRISMA flowchart (Figure 2; Table 1). Among the included studies, three (60%) demonstrated a low risk of bias, while two (40%)

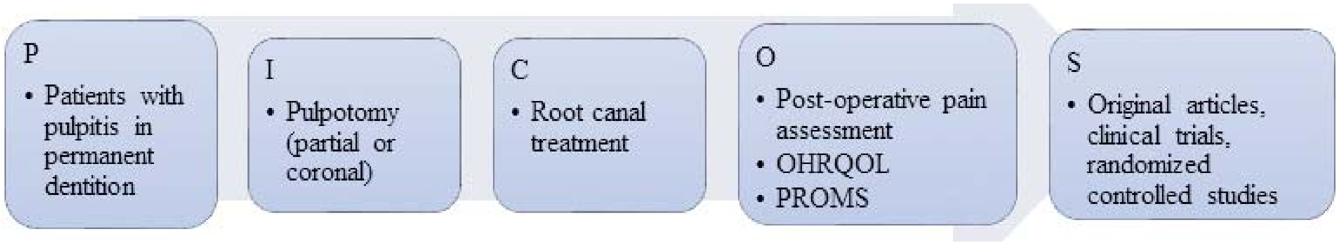

Figure-1: Population-Intervention-Comparison-Outcomes-Study design (PICOS) criteria.

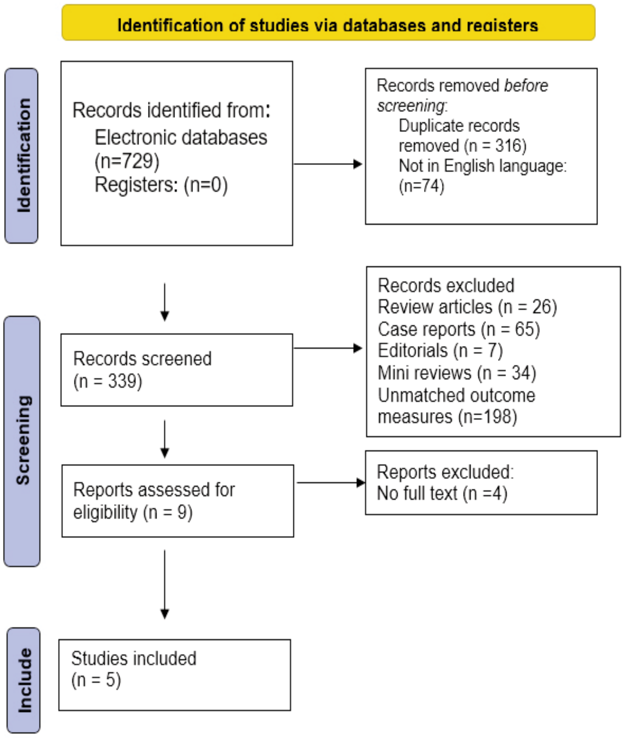

Figure-2: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA flowchart.

were assessed as having a high risk of bias (Figure 3).

Discussion

The findings indicated that pulpotomy may be as effective as RCT in managing postoperative pain by Day.[7] These results could significantly influence the future management of endodontic disease, particularly for patients presenting with pulpitis. Studies using visual analogue scale (VAS) 5 or the numeric rating scale (NRS)[4,8,14] reported low pain scores.

The QOL assessment showed significant improvements over time in both the groups, with significant differences in favour of pulpotomy concerning the patient's ability to resume usual activities post-treatment.[5] In relation to the effect of pulpotomy and RCT, EuroQOl 5 Dimensions 5 Levels (EQ-5D-5L), Oral Health Impact Profile-14 (OHIP-14) and OHIP-17 validated questionnaires were used.[4,5]

A key feature of EQ-5D-5L tool is its ability to convert health conditions obtained from the questionnaire into a single index value using country-specific value sets. This enables the calculation and comparison of quality-adjusted life years (QALYs) among treatments, such as pulpotomy, primary RCT and potential tooth extraction. These findings can support economic evaluations of

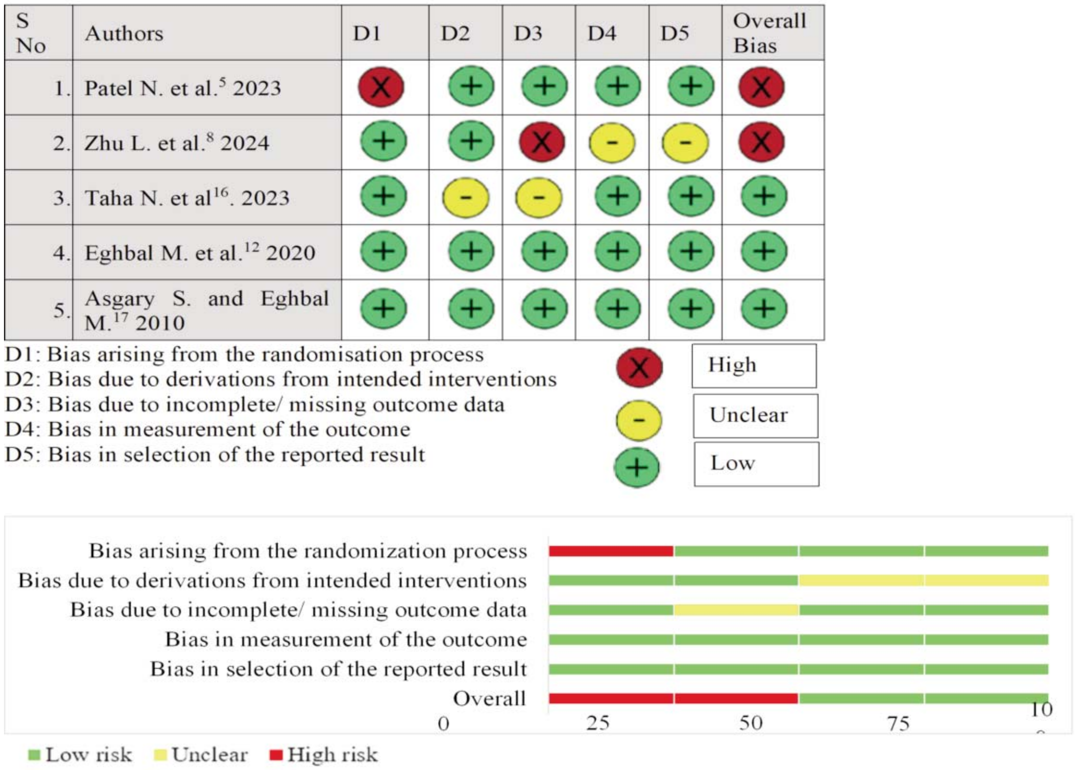

Figure-3: Risk of bias assessment.

Table-1: Characteristics and patient-reported outcomes.

Authors	year	Study design	Patient treated/ evaluated	Diagnosis	VPT material	VPT (partial or coronal/ full)	Study tools	Sample Characteristics			Outcome Measures	
								Type of teeth	Age (mean)	Gender (M/F)	Pain (P/RCT)(Mean)	QOL (P/RCT)(Mean)
Patel N. et al.[5]	2024	Randomized Control Trial	86	IP	Biodentine	full	VAS (0-100)EQ-5D-5LOHIP-14	Molars	-	84/87	Day 0: 50/57 Day 1: 37.3/37.2 Day 3: 33.3/34.1 Day 5: 27.4/28 Day 7: 19.2/31	EQ-5D-5L Day 0: 1.62/1.69 Day 1: 1.41/1.52 Day 3: 1.34/1.46 Day 5: 1.27/1.35 Day 7: 1.20/1.25 OHIP-14 Improved significantly over the 1st week ($p < .001$) magnitude was similar in groups ($p = .668$)
Zhu L. et al.[8]	2024	Randomized Control Trial	80	IP	iRoot BP Plus	full	NRS (0-10)	Molars	34.2/ 38.32	20/60	Day 1: 2.3/5.5 Day 2: 1.7/2.8 Day 3: 0.8/1.6 Day 4: 0.5/1 Day 5: 0.2/0.4 Day 6 & 7: 0.1/0.1	
Taha N. et al.[21]	2023	Randomized Control Trial	60	IPAAPSAP	Biodentine	full	NRS (0-10)OHIP-17	N/S	25.97/ 33.53	30/30	Day 1: 3.03/4.90 Day 2: 1.5/2.57 Day 3: 0.63/1.27 Day 5: 0.23/0.27 Day 7: 0.23/0.23	(% scores) 1 week: 58.63/62.55 1 year: 60.29/64.1
Eghbal M. et al.[14]	2020	Randomized Control Trial	356	IPAAPSAP	MTA	full	NRS (0-9)	Molars	28.89/ 29.59	131/225	6h: 3.3/2.9 12h: 2/2.3 18h: 1.3/1.4 24h: 1/1.2 36h: 0.7/0.9 Day 3: 0.6/0.7 Day 4: 0.4/0.5 Day 5: 0.4/0.4 Day 6: 0.3/0.2 Day 7: 0.2/0.1	-
Asgary S. and Eghbal M.[22]	2010	Randomized Control Trial	407	IP	CEM	N/S	NRS(None, Mild, Moderate, Severe)	Molars	27/ 26	154/253	(% scores) Day 1: 26.82/5.98 Day 2: 15.6/36.63 Day 3: 15.6/26.23 Day 4: 15.2/22.77 Day 5: 13.65/17.32 Day 6: 12.19/13.86 Day 7: 10.24/10.39	-

VPT: vital pulp therapy, VAS: Visual analogue scale, CEM: Calcium-enriched mixture, N/S: Not specified, NRS: Numeric rating scale, P: Pulpotomy, SAP: Symptomatic apical periodontitis, AAP: Asymptomatic apical periodontitis, RCT: Root canal treatment, IPL IP: Irreversible pulpitis, EQ-5D-5L: EuroQOl 5 Dimensions 5 Levels, OHIP: Oral Health Impact Profile.

healthcare interventions and assist in a more effective and efficient allocation of healthcare resources.

In a study, the EQ-5D scores showed a significant increase during the first week post-procedure, with similar improvements across groups and no overall differences observed on any specific day. Problems related to usual activities decreased significantly in both groups and to a comparable extent. Pain and discomfort improved markedly, but the RCT group experienced significantly higher overall pain levels compared to the pulpotomy group. Additionally, both groups reported significant reductions in anxiety and depression-related issues.[5]

The 49-item OHIP was originally developed by Slade and Spencer in Australia based on statements obtained through interviews with dental patients.[15] The items were distributed across seven dimensions: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. The theoretical model was proposed by Locker et al.[16] Shortened versions of this instrument were developed subsequently. Patel N. et al. utilised OHIP-14 and reported that the scores improved significantly over the first week after the procedure, and the magnitude was similar in RCT and pulpotomy groups.[5]

Taha N. et al. employed OHIP-17 questionnaire. The study observed that at 1 week, the patients' QOL improved in 10 of 17 items among subjects in the pulpotomy group, and in 11 of 17 for the RCT group. At 1 year, all patients in both groups who had some impact before treatment showed improvement in the OHIP scores without significant differences. The average improvement in the OHIP score was not significantly related to gender or age.[4] However, Compos L.et al.[17] concluded that the validity of data related to the impact of oral health problems on individuals' lives need to be confirmed through a unifactorial model. Also, OHIP-14 worked properly in dental patient samples and had limited utility among non-dental patient samples. Besides, it was also influenced by cultural context and age.[17]

The current review has limitations. Variability in study designs, diagnostic criteria and outcome measures among the studies analysed may have impacted the comparability and generalisability of the findings. Some of the studies reviewed had limited follow-up durations, restricting insights into long-term outcomes.[18,19] Differences in clinical protocols, including materials and techniques used for pulpotomy, could have influenced the results. Most studies were conducted in specific regions, limiting the applicability of results to global populations.[19,20] Furthermore, the meta-analysis could not be conducted due to lack of standardised tools and variations in the assessment of pain and QOL among the studies.

Accurate assessment of pulp vitality remains pivotal in selecting appropriate treatment modalities for pulpitis. Emerging diagnostic technologies, such as laser Doppler flowmetry and pulse oximetry, offer non-invasive and reliable methods for evaluating blood flow within the pulp, enhancing the differentiation between reversible pulpitis and IP. Advancements in biomaterials present significant opportunities for improving treatment outcomes. Research into bioactive glass and next-generation calcium silicate cements, with superior biocompatibility and regenerative properties, could revolutionise pulpotomy techniques.

Conclusion

Pulpotomy may be as effective as RCT in managing postoperative pain by Day 7. The QOL assessment showed significant improvement over time in favour of pulpotomy. However, the clinical data accumulated represented insufficient evidence to draw robust conclusions. There is a need for more well-designed trials to develop a stronger evidence base in this area.

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Abbreviations:

AAP: Asymptomatic apical periodontitis

CEM: Calcium enriched mixture

IP: Irreversible pulpitis

MTA: Mineral trioxide aggregate

N/S: Not specified

NRS: Numeric rating scale

P: Pulpotomy

RCt: Randomized clinical trial

RCT: Root canal treatment

VAS: Visual analogue scale

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