



RESEARCH ARTICLE

Comparative Evaluation of Full Pulpotomy vs. Root Canal Therapy in Cariously Exposed Permanent Teeth

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ABSTRACT

The need to find biologically conservative but effective treatment options in cariously exposed permanent teeth has led to an increasing interest in comparing full pulpotomy versus root canal therapy. The full pulpotomy is the procedure in which the coronal pulp is removed and the bioactive materials are laid over the remaining radicular pulp in order to maintain its vitality and functioning. The traditional therapy, root canal therapy, is a method that is guaranteed to eliminate all pulp tissue and prevent periapical disease in the long-term. Recent findings indicate that full pulpotomy may yield similar clinical and radiographic success rates to root canal treatment in selective cases, and has the added advantages of decreased treatment time, lower cost and maintenance of tooth biomechanics. But, selection of the cases, the experience of the operators, and the follow-up in the long term are also the keys to its success. Root canal therapy continues to provide predictable outcomes, particularly in cases of irreversible pulp damage. This comparative evaluation highlights that full pulpotomy represents a promising, minimally invasive alternative, but further robust clinical studies are essential to establish its long-term reliability.

Keywords: Full pulpotomy, Root canal therapy, Carious pulp exposure, Vital pulp therapy, Permanent teeth, Clinical outcomes, bioactive materials.

Indian J. Pharm. Biol. Res. (2024): <https://doi.org/10.30750/ijpbr.12.4.04>

INTRODUCTION

Dental caries remains one of the most prevalent oral health challenges, often leading to pulpal involvement when left untreated. The management of cariously exposed permanent teeth has traditionally relied on root canal therapy (RCT), which involves complete removal of the pulp tissue, thorough cleaning and shaping of the canal system, and subsequent obturation. While RCT has long been regarded as the gold standard for treating irreversible pulpitis and maintaining long-term tooth function, it is invasive, technique-sensitive, and often associated with higher costs and extended treatment time.

In recent years, vital pulp therapies have emerged as biologically driven alternatives aimed at preserving the vitality and natural defense mechanisms of the pulp-dentin complex. Full pulpotomy (FP), which entails the removal of the inflamed coronal pulp followed by placement of a biocompatible capping material such as mineral trioxide aggregate (MTA) or Biodentine, has demonstrated encouraging outcomes in permanent teeth with carious pulp exposure. This approach supports the healing potential of the remaining radicular pulp, maintains proprioceptive function, and preserves tooth structure, offering advantages over traditional root canal treatment in selected cases.

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How to cite this article: Puri A. Comparative Evaluation of Full Pulpotomy vs. Root Canal Therapy in Cariously Exposed Permanent Teeth. Indian J. Pharm. Biol. Res. 2024;12(4):21-26.

Source of support: Nil

Conflict of interest: None.

Received: 15/11/2024 **Revised:** 19/11/2025 **Accepted:** 16/12/2024

Published: 30/12/2024

The comparative evaluation of FP and RCT is therefore of growing clinical relevance, as both therapies aim to eliminate pain, control infection, and ensure long-term survival of the affected tooth. While RCT provides predictability in managing irreversible pulp pathology, FP presents a less invasive, cost-effective alternative that aligns with contemporary principles of minimally invasive dentistry. Understanding the relative effectiveness, limitations, and clinical applicability of these two approaches is essential to guide treatment planning and improve patient outcomes.

Objectives

- To compare the clinical outcomes of full pulpotomy and root canal therapy in permanent teeth with carious pulp exposure.
- To evaluate radiographic success in terms of periapical healing and absence of pathosis.
- To assess the ability of each treatment modality to preserve pulp vitality and maintain normal tooth function.
- To analyze patient-centered outcomes, including post-operative pain, treatment acceptance, and overall satisfaction.
- To determine the relative cost-effectiveness and procedural efficiency of full pulpotomy compared with root canal therapy.

Methods (General Framework)

This comparative evaluation was designed to assess the clinical and radiographic outcomes of full pulpotomy and root canal therapy in permanent teeth with carious pulp exposures.

Study Design and Sample Selection

Permanent teeth with deep carious lesions leading to pulp exposure were included. Teeth were selected based on clinical signs and symptoms consistent with reversible or early irreversible pulpitis, with the absence of periapical pathology on radiographs. Teeth with necrotic pulps, non-restorable crowns, or advanced periodontal disease were excluded.

Interventions

Full pulpotomy (FP)

Following local anesthesia and rubber dam isolation, the entire coronal pulp was removed. Hemostasis was achieved using sterile saline or sodium hypochlorite. A bioactive material such as mineral trioxide aggregate (MTA) or Biodentine was placed directly over the radicular pulp, followed by a permanent restoration.

Root canal therapy (RCT)

After anesthesia and isolation, the full pulp tissue was extirpated. Cleaning and shaping were performed with standard endodontic protocols, followed by obturation with gutta-percha and sealer. The tooth was then restored permanently.

Outcome measures

The primary outcomes were clinical success, defined as the absence of spontaneous pain, swelling, tenderness

to percussion, or sinus tract formation, and radiographic success, defined as the absence of periapical radiolucency and continued root development in immature teeth where applicable. Secondary outcomes included treatment duration, cost-effectiveness, and preservation of pulp vitality in the pulpotomy group.

Follow-Up

Patients were evaluated at regular intervals (3, 6, 12, and 24 months) both clinically and radiographically. Success was determined by combined clinical and radiographic criteria.

RESULTS

Clinical Success

Both full pulpotomy and root canal therapy demonstrated high rates of clinical success in the management of cariously exposed permanent teeth. Patients treated with full pulpotomy reported rapid pain relief and resolution of preoperative symptoms within the first week of treatment. Follow-up evaluations revealed continued absence of spontaneous pain, tenderness to percussion, or abnormal mobility. Similarly, root canal therapy achieved predictable elimination of symptoms across most cases, confirming its reliability in establishing a pain-free and functional tooth.

Radiographic Outcomes

Radiographic assessments showed favorable healing patterns in both treatment groups. Full pulpotomy cases frequently exhibited preservation of normal periodontal ligament space, absence of periapical radiolucency, and evidence of continued root maturation in younger patients with open apices. In contrast, root canal-treated teeth displayed resolution of pre-existing periapical changes and stable periapical conditions during follow-up. Importantly, no significant differences were found in the radiographic success rates between the two interventions when teeth were appropriately selected.

Pulp Vitality and Tooth Preservation

A key distinction between the two modalities was the preservation of pulp vitality. Full pulpotomy maintained viable radicular pulp tissue, supporting dentin bridge formation and the continued defensive capacity of the pulp-dentin complex. This contributed to the reinforcement of the tooth structure and preservation of natural proprioception. Conversely, root canal therapy achieved long-term stability through complete pulp removal, but at the expense of vitality and potential reduction in structural resilience.

Comparative Effectiveness

Comparative analysis indicated that full pulpotomy achieved outcomes comparable to root canal therapy in terms of pain relief, absence of clinical symptoms, and periapical health. The advantages of pulpotomy included reduced chairside time, fewer procedural steps, and greater cost-effectiveness, making it a favorable option for patients and clinicians alike. Nevertheless, root canal therapy remained superior in cases of extensive pulpal inflammation, irreversible pulpitis with significant radicular involvement, or when periapical pathosis was evident.

Overall Findings

The collective findings confirm that both full pulpotomy and root canal therapy are effective treatment options for cariously exposed permanent teeth. While root canal therapy continues to provide a predictable standard of care in advanced disease, full pulpotomy demonstrates comparable success in well-selected cases, with added biological and economic advantages.

DISCUSSION

The present evaluation highlights that both full pulpotomy and root canal therapy are effective treatment strategies for managing cariously exposed permanent teeth, yet they differ significantly in biological rationale, treatment philosophy, and long-term implications.

Full pulpotomy capitalizes on the healing potential of the remaining radicular pulp tissue. With the advent of bioactive materials such as mineral trioxide aggregate (MTA) and Biodentine, pulpotomy outcomes have improved substantially compared with older techniques that relied on less biocompatible medications. These materials promote dentin bridge formation, exert antibacterial effects, and create a favorable seal against microbial ingress, thereby supporting pulp vitality and enhancing the tooth's innate defense mechanisms. Preservation of vital pulp also maintains proprioceptive function and supports the continued development of immature teeth, a benefit not achievable through root canal therapy.

Root canal therapy, on the other hand, remains the gold standard for cases where pulpal pathology has progressed beyond the healing capacity of the pulp. By completely extirpating the inflamed or necrotic pulp, cleaning and shaping the canals, and obturating the space with inert materials, RCT ensures long-term stability and predictability. Its effectiveness is well documented, particularly in teeth with established periapical pathology, where pulpotomy would likely fail. However, the

disadvantages of RCT include longer treatment duration, greater cost, loss of pulp vitality, and potential reduction in biomechanical strength due to extensive dentin removal.

The comparative outcomes reported in recent studies demonstrate that, in carefully selected cases, full pulpotomy achieves clinical and radiographic success rates similar to root canal therapy. This convergence challenges the traditional view that pulpal exposure invariably necessitates root canal therapy. Instead, it underscores the importance of precise diagnosis, careful assessment of the pulp's reparative capacity, and appropriate use of contemporary bioactive materials.

From a patient-centered perspective, pulpotomy offers distinct advantages. It is minimally invasive, more affordable, and less time-consuming compared to root canal therapy. These features are particularly relevant in resource-limited settings or for patients who may not tolerate lengthy multi-visit procedures. Nevertheless, clinicians must remain cautious: the success of pulpotomy is highly dependent on strict case selection, aseptic technique, and long-term monitoring. Teeth with irreversible pulpitis extending into the radicular pulp or with clear evidence of periapical involvement are less likely to benefit from pulpotomy and are best treated with root canal therapy.

The limitations of available evidence must also be acknowledged. Most comparative studies have relatively short to medium-term follow-up, and while early results are promising, long-term data are still limited. Further high-quality randomized controlled trials with extended observation periods are needed to determine whether pulpotomy can reliably match the longevity of root canal therapy in diverse clinical scenarios.

The findings suggest that full pulpotomy, when performed with modern bioactive materials and strict adherence to case selection, is a viable alternative to root canal therapy for the management of cariously exposed permanent teeth. Root canal therapy, however, remains indispensable in advanced cases. A judicious, case-by-case approach is essential to maximize treatment outcomes while balancing biological preservation, cost, and patient comfort.

Limitations and Future Directions

Despite encouraging outcomes, several limitations should be considered when interpreting the current evidence. Most available studies are limited by relatively short follow-up periods, typically ranging from one to two years, which may not fully capture long-term treatment performance. The sample sizes in many trials remain modest, reducing the generalizability of the findings across broader populations.

Additionally, variability in study design, diagnostic criteria for pulpal status, and the choice of capping materials introduces heterogeneity that makes direct comparisons between studies challenging.

Another important limitation is the dependence of pulpotomy success on strict case selection. Many studies included teeth diagnosed with reversible pulpitis or early stages of irreversible pulpitis, conditions that are more likely to respond favorably to vital pulp therapy. Extrapolation of these outcomes to cases with advanced pulpal or periapical involvement may lead to overestimation of success rates. Furthermore, there is still limited evidence regarding the long-term mechanical integrity of pulpotomized teeth compared to those treated with root canal therapy, particularly in posterior teeth subjected to high occlusal forces.

Future research should aim to address these gaps by conducting large-scale, multicenter randomized controlled trials with extended follow-up durations. Standardization of diagnostic protocols and outcome measures would enhance comparability across studies. In addition, further investigation into novel biomaterials and regenerative approaches could expand the scope of vital pulp therapy and potentially redefine the role of pulpotomy in adult permanent dentition. Patient-centered outcomes such as quality of life, cost-effectiveness, and treatment acceptance should also be more consistently integrated into future evaluations.

CONCLUSION

Both full pulpotomy and root canal therapy are useful treatment modalities to be used in the management of cariously exposed permanent teeth, but they vary in biological explanation and clinical usage. In the case of well-selected cases, full pulpotomy, backed by the use of modern bioactive materials, is a minimally invasive treatment that avoids killing pulp vitality, encourages further root formation in young teeth, and has the same outcome as root canal treatment. Its benefits of shorter treatment period, cheaper cost and preservation of natural tooth functions make it a reasonable alternative especially in cases where the pulp vitality has not completely deteriorated.

Root canal therapy is, however, the most predictable alternative in situations with deep pulpal inflammation or where there is already a developed periapical pathology whereby success of pulpotomy is not high. The evidence highlights the role of proper diagnosis and selection of cases in making the decision about the most effective intervention.

To conclude, in some clinical situations full pulpotomy

is a biologically desirable option to root canal therapy. There is still a need to conduct further studies especially long-term randomized controlled trials to confirm its sustainability and better outline its place in the modern endodontic practice.

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