

Healing from within: Vital pulp therapy in deep carious lesions—A case series

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Abstract

Vital pulp therapy (VPT) aims to preserve the health and function of the dental pulp following pulpal exposure. Direct pulp capping (DPC) is a conservative treatment modality in which a biocompatible material is placed directly over an exposed pulp to promote healing and reparative dentin formation. The outcome of DPC depends on appropriate case selection, control of infection, management of the pulp exposure, and selection of a suitable capping material.

This case series presents the clinical management and follow-up of four permanent posterior teeth with deep carious lesions and pinpoint pulpal exposures treated using different pulp-capping materials. Following clinical examination, pulp sensibility testing, radiographic assessment, isolation, and management of the exposure, DPC was performed using Dycal, Biodentine, mineral trioxide aggregate (MTA), and platelet-rich fibrin (PRF) in four individual cases. The treated teeth were restored and followed clinically and radiographically for 12 months.

Follow-up assessment focused on symptoms, pulp sensibility, percussion and palpation, mobility, soft-tissue findings, periodontal ligament space, lamina dura, periapical status, root resorption, and evidence of dentin bridge formation where assessable. The cases illustrate the potential of conservative pulp therapy to maintain pulp vitality in appropriately selected permanent teeth.

Keywords: Direct pulp capping, vital pulp therapy, deep caries, Biodentine, mineral trioxide aggregate, platelet-rich fibrin

Introduction

Dental caries is a major cause of pulpal inflammation and loss of tooth vitality. Traditionally, deep carious lesions associated with pulpal exposure were frequently managed with root canal treatment. Contemporary minimally invasive dentistry, however, emphasizes preservation of natural tooth structure and maintenance of pulp vitality whenever biological conditions permit ^[1].

Vital pulp therapy encompasses treatment approaches designed to preserve the health and vitality of all or part of the dental pulp. These include indirect pulp capping, direct pulp capping, partial pulpotomy, full coronal pulpotomy, and apexogenesis. Among these procedures, direct pulp capping involves placement of a biocompatible material directly over an exposed pulp under an aseptic operative field ^[1, 3]

The rationale for DPC is to provide a favourable environment for pulpal healing and hard-tissue barrier formation. Successful treatment is influenced by accurate diagnosis, appropriate case selection, effective infection control, adequate management of the exposure, suitable pulp-capping material, and an effective definitive coronal restoration ^[1, 5]

Calcium hydroxide has historically been used as a pulp-capping material because of its antibacterial properties and ability to stimulate hard-tissue formation. However, limitations including material dissolution and inadequate long-term sealing have encouraged the development and use of bioactive calcium-silicate materials. MTA has

demonstrated favourable biocompatibility and sealing characteristics, while Biodentine was developed as a calcium-silicate-based bioactive material with favourable handling characteristics ^[2, 6, 8]

PRF is an autologous platelet concentrate containing a fibrin matrix and cellular components and has also been explored as a biologically based material in regenerative dental procedures.

The present case series describes the clinical management of four permanent posterior teeth with deep carious lesions and pinpoint pulpal exposures using four different pulp-capping materials: Dycal, Biodentine, MTA, and PRF.

Case Presentation

Case 1: Direct Pulp Capping with Dycal

A permanent maxillary left first molar (tooth 26) with a deep carious lesion was selected for conservative pulp therapy. Clinical and radiographic examinations were performed before treatment. The presentation documented a pinpoint pulpal exposure during caries removal.

Following isolation and management of the exposed pulp, caries-detecting dye was used during caries removal. Dycal, a calcium hydroxide-based pulp-capping material, was placed directly over the exposure. The tooth was subsequently restored with a definitive restoration.

Clinical and radiographic follow-up was performed at 12 months. The postoperative documentation included an immediate postoperative photograph and radiograph and a 12-month follow-up assessment.



Fig 1: Clinical and radiographic sequence for Case 1: preoperative assessment, caries detection, pinpoint pulp exposure, Dycal placement, immediate postoperative restoration, and 12-month follow-up.

Case 2: Direct Pulp Capping with Biodentine

A permanent mandibular left first molar (tooth 36) with a deep carious lesion was treated conservatively. Clinical and radiographic examinations were performed before treatment, and a pinpoint pulp exposure occurred during caries removal.

Caries-detecting dye was used during operative caries removal. Biodentine was subsequently placed directly over the exposed pulp. The tooth was restored with a definitive restoration.

The case was followed clinically and radiographically for 12 months. Immediate postoperative documentation and the 12-month follow-up assessment were recorded.



Fig 2: Clinical and radiographic sequence for Case 2: preoperative assessment, caries detection, pinpoint pulp exposure, Biodentine placement, immediate postoperative restoration, and 12-month follow-up.

Case 3: Direct Pulp Capping with MTA

A permanent mandibular right first molar (tooth 46) with a deep carious lesion was selected for conservative pulp therapy. A pinpoint pulp exposure was encountered during caries removal. Caries-detecting dye was used to assist in assessment of the

carious dentin. Mineral trioxide aggregate was placed directly over the exposed pulp following management of the exposure. A definitive restoration was subsequently provided.

The tooth was clinically and radiographically followed for 12 months.

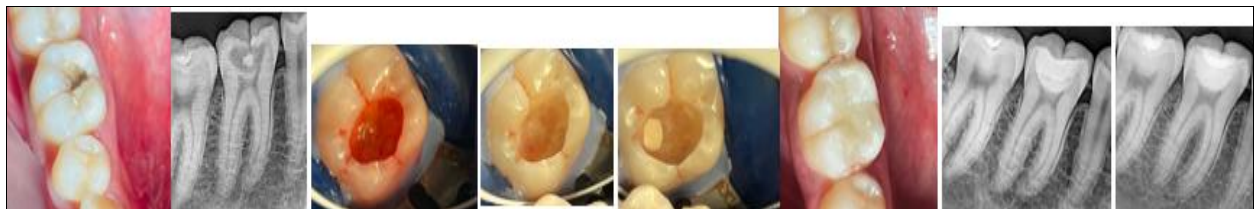


Fig 3: Clinical and radiographic sequence for Case 3: preoperative assessment, caries detection, pinpoint pulp exposure, MTA placement, immediate postoperative restoration, and 12-month follow-up.

Case 4: Direct Pulp Capping with PRF

A permanent mandibular left second molar (tooth 37) with a deep carious lesion was treated using PRF as the pulp-capping material. A pinpoint pulp exposure occurred during caries removal.

After clinical management of the exposure, PRF was prepared and placed over the exposed pulp. The tooth was subsequently restored with a definitive restoration.

Clinical and radiographic follow-up was conducted for 12 months.

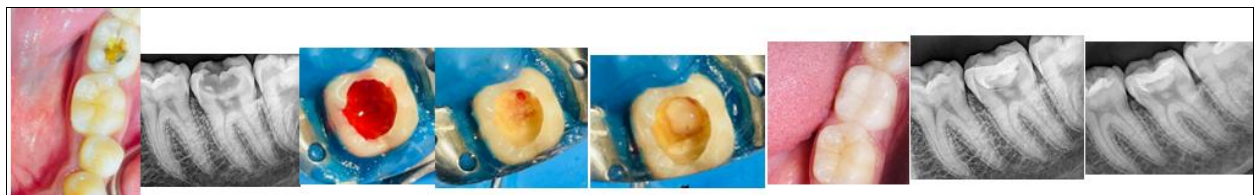


Fig 4: Clinical and radiographic sequence for Case 4: preoperative assessment, caries detection, pinpoint pulp exposure, PRF preparation and placement, immediate postoperative restoration, and 12-month follow-up.

Clinical and Radiographic Evaluation

The clinical and radiographic assessments were based on the parameters documented for successful vital pulp therapy.

Clinical assessment

Clinical success was assessed by:

- absence of spontaneous pain or persistent symptoms;

- appropriate response to pulp sensibility testing;
 - absence of tenderness to percussion or palpation;
 - absence of abnormal mobility; and
 - absence of swelling or sinus tract.
- Cold testing and electric pulp testing were used to assess pulp sensibility as documented in the treatment protocol.

Radiographic assessment

- Radiographic evaluation included:
- continuity of the lamina dura;
- assessment of the periodontal ligament space;
- presence or absence of periapical radiolucency;
- presence or absence of internal or external root resorption; and
- evidence of dentin bridge formation when assessable radiographically.

The European Society of Endodontology recommends clinical and radiographic monitoring after vital pulp treatment, with assessment at 6 months supplemented by a periapical radiograph at 1 year. Thermal and electric pulp sensibility tests may be used to monitor pulpal response.

Discussion

Preservation of pulp vitality has become an important objective in contemporary endodontic treatment. The present case series demonstrates four different approaches to DPC in permanent posterior teeth with deep carious lesions and pinpoint pulpal exposures [1].

The outcome of vital pulp therapy is strongly influenced by case selection and biological control of the operative field. The cases presented were managed using a conservative approach following clinical examination, pulp sensibility assessment, radiographic evaluation, isolation, and management of the pulpal exposure. These principles are consistent with contemporary recommendations for the management of deep caries and exposed pulp [1, 5].

Calcium hydroxide has a long history of use in vital pulp therapy. Its high pH provides antibacterial activity and promotes mineralized tissue formation. Nevertheless, dissolution and limitations in sealing have contributed to the development of alternative materials. The use of Dycal in the first case therefore represents the conventional calcium hydroxide-based approach to DPC [7, 8].

MTA is a hydraulic calcium-silicate material with established applications in vital pulp therapy. Its favourable biological response and sealing ability have contributed to its widespread clinical use. The literature supports the biocompatibility and clinical utility of MTA in pulp-related procedures [7, 8].

Biodentine is another calcium-silicate-based material used in vital pulp therapy. Comparative clinical research has evaluated Biodentine and MTA as direct pulp-capping materials, demonstrating the clinical relevance of both materials in appropriately selected teeth [2, 4, 6].

The present case series also included PRF as a biologically derived material. Unlike conventional calcium-silicate cements, PRF provides an autologous fibrin matrix containing platelets and leukocytes and has been investigated for its potential role in tissue healing and regeneration.

Radiographic assessment is particularly important during follow-up because clinical absence of symptoms alone does not completely establish the status of the pulp and periapical tissues. Maintenance of the lamina dura and periodontal ligament space, absence of periapical radiolucency and root resorption, and evidence of hard-tissue barrier formation can provide additional information regarding treatment response [1, 5].

The European Society of Endodontology position statement emphasizes preservation of pulp health and recommends follow-up based on clinical history, clinical examination, and radiographic assessment. The statement recommends evaluation at 6 months and a periapical radiograph at 1 year, with continued monitoring where symptoms persist or healing remains uncertain [5].

An important limitation of the present case series is its very small sample size, with only one tooth treated with each material. Consequently, the cases cannot be used to establish superiority of one material over another, calculate comparative success rates, or perform statistical analysis.

Similarly, dentin bridge formation should be reported only for cases in which it was demonstrably identified on follow-up imaging. The available case documentation does not provide sufficient quantitative information to calculate the proportion of cases showing dentin bridge formation.

The 12-month observation period provides short-term follow-up but does not establish long-term treatment predictability. Further prospective studies with larger sample sizes, standardized diagnostic criteria, clearly defined clinical and radiographic endpoints, and longer follow-up are required to compare different DPC materials [1, 4, 6].

Conclusion

Within the limitations of this four-case series, direct pulp capping provided a conservative approach for managing selected permanent teeth with deep carious lesions and pinpoint pulpal exposures. Dycal, Biodentine, MTA, and PRF were used as pulp-capping materials in individual cases, with clinical and radiographic follow-up extending to 12 months.

The cases emphasize that preservation of pulp vitality depends not only on the choice of capping material but also on appropriate case selection, accurate assessment of pulpal status, effective infection control, careful management of the exposure, and provision of an adequate definitive restoration.

Because of the small number of cases and absence of a comparative study design, no conclusion regarding superiority of one material over another can be drawn. Nevertheless, the cases illustrate the potential role of conservative vital pulp therapy in maintaining the biological function of the natural tooth.

Declarations

Patient Consent: Written informed consent for treatment and publication of clinical/radiographic images should be obtained from each patient before manuscript submission.

Ethical Approval:

The study protocol was reviewed and approved by the Institutional Ethics Committee, K.V.G. Dental College and Hospital (IEC, KVGDC), prior to commencement.

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Conflict of Interest: The authors declare that they have no competing interests related to this study, its findings, or the materials and techniques evaluated.

Authors' Contributions:

Dr. Manoj M. Dhavalagi: Conceptualization, study design, methodology, clinical case management, clinical and radiographic assessment, data collection, data interpretation, literature review, and manuscript preparation.

Dr. Moksha Nayak: Supervision, methodological guidance, clinical guidance, critical review of the manuscript, and final approval of the manuscript.

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References

1. Aguilar P, Linsuwanont P. Vital pulp therapy in vital permanent teeth with cariously exposed pulp: a systematic review. *J Endod*,2011;37(5):581-587. doi:10.1016/j.joen.2010.12.004
2. Nowicka A, Lipski M, Parafiniuk M, Sporniak-Tutak K, Lichota D, Kosierkiewicz A, *et al.* Response of human dental pulp capped with Biodentine and mineral trioxide aggregate. *J Endod*,2013;39(6):743-747.
3. Taha NA, Khazali MA. Partial pulpotomy in mature permanent teeth with clinical signs indicative of irreversible pulpitis: a randomized clinical trial. *J Endod*,2017;43(9):1417-1421.
4. Parinyaprom N, Nirunsittirat A, Chuveera P, Na Lampang S, Srisuwan T, Sastraruji T, *et al.* Outcomes of direct pulp capping by using either ProRoot mineral trioxide aggregate or Biodentine in permanent teeth with carious pulp exposure in 6- to 18-year-old patients: a randomized controlled trial. *J Endod*,2018;44(3):341-348. doi:10.1016/j.joen.2017.10.012
5. Duncan HF, Galler KM, Tomson PL, Simon S, El-Karim I, Kundzina R, *et al.* European Society of Endodontology position statement: management of deep caries and the exposed pulp. *Int Endod J*,2019;52(7):923-934. doi:10.1111/iej.13080
6. Katge FA, Patil DP. Comparative analysis of 2 calcium silicate-based cements (Biodentine and mineral trioxide aggregate) as direct pulp-capping agent in young permanent molars: a split-mouth study. *J Endod*,2017;43(4):507-513. doi:10.1016/j.joen.2016.11.026
7. Torabinejad M, Parirokh M. Mineral trioxide aggregate: a comprehensive literature review—Part II: leakage and biocompatibility investigations. *J Endod*,2010;36(2):190-202. doi:10.1016/j.joen.2009.09.010
8. Kaur M, Singh H, Dhillon JS, Batra M, Saini M. MTA versus Biodentine: review of literature with a comparative analysis. *J Clin Diagn Res*,2017;11(8):ZG01-ZG05. doi:10.7860/JCDR/2017/25840.10374