



CASE REPORT

Cervical pulpotomy in mature permanent molars with irreversible pulpitis: a clinical case series using Biodentine

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ABSTRACT

Cervical pulpotomy is a vital pulp therapy procedure that may be considered in selected mature permanent molars clinically diagnosed with irreversible pulpitis. Biodentine, a calcium-silicate material, has been proposed for pulp capping because of its sealing ability, biocompatibility and bioactivity. This case series describes the short-term clinical and radiographic outcomes of cervical pulpotomy using Biodentine in mature permanent molars presenting signs compatible with symptomatic irreversible pulpitis. Four mature permanent molars were treated by cervical pulpotomy under rubber dam isolation. After caries removal, coronal pulp amputation, control of bleeding and placement of Biodentine, the teeth were restored with composite resin. Clinical and radiographic controls were performed at 6 and 12 months. At 12 months, all treated teeth were functional and showed no radiographic evidence of new periapical pathology. These outcomes were considered clinically and radiographically favorable according to predefined criteria. However, postoperative pulp sensibility testing was not performed systematically; therefore, the term "preservation of pulp vitality" should be interpreted cautiously. Within the limits of this small descriptive case series and the 12-month follow-up period, cervical pulpotomy with Biodentine showed favorable short-term outcomes in selected mature permanent molars. Larger studies with standardized diagnostic tools, postoperative sensibility testing and follow-up of at least 24 months are required.

Keywords: Cervical pulpotomy, Biodentine, Irreversible pulpitis, Mature permanent molars, Vital pulp therapy, Conservative endodontics.

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1. INTRODUCTION

Cervical pulpotomy is a conservative vital pulp therapy procedure in which the inflamed coronal pulp tissue is removed while the radicular pulp is preserved. In selected mature permanent molars, this approach may reduce the need for conventional root canal treatment, while preserving dental hard tissue and maintaining tooth function (1-4).

The biological rationale for this procedure is supported by the contemporary shift from purely extirpative endodontic approaches toward minimally invasive management of inflamed but still potentially healing pulp tissue. Current position statements and reviews emphasize that the diagnosis of pulpal inflammation should combine subjective symptoms, clinical examination, pulp sensibility tests, radiographic findings and intraoperative findings such as the ability to achieve stable hemostasis (3,7,13,14).

Biodentine is a tricalcium-silicate-based material used in vital pulp therapy because of its sealing capacity, biocompatibility and potential to promote mineralized tissue formation (5,6). Clinical studies and reviews have reported favorable outcomes for Biodentine in pulpotomy procedures; however, the interpretation of success in mature permanent teeth requires standardized diagnostic criteria, clearly defined outcome measures and sufficiently long follow-up (1,4,11,12).

The aim of this clinical case series was to present four mature permanent molars treated with cervical pulpotomy using Biodentine and followed clinically and radiographically for 12 months. The report also explicitly defines the diagnostic approach, outcome criteria and limitations of the follow-up protocol.

2. MATERIALS AND METHODS

Study design and ethical considerations

This manuscript is a descriptive clinical case series of four mature permanent molars managed by cervical pulpotomy with Biodentine. The treatments were performed as part of clinical dental care. Written informed consent for treatment and for anonymized publication of clinical and radiographic images was obtained from the patients. No facial images, names, initials, file numbers or other patient-identifying information are reported. The manuscript was prepared in accordance with confidentiality requirements and anonymized case reporting principles.

Diagnostic criteria

The diagnosis of symptomatic irreversible pulpitis was based on standardized clinical and radiographic criteria: history of spontaneous or provoked pain, lingering pain after thermal stimulation, nocturnal pain when present, response to percussion, presence of deep carious involvement or carious pulp exposure, and absence of radiographic signs indicating established periapical disease. The diagnostic approach was therefore clinical and radiographic. Pulse oximetry and quantitative thermal testing were not used; this point is acknowledged as a methodological limitation.

Clinical protocol

All procedures were performed under local anesthesia and rubber dam isolation. After caries removal and access to the pulp chamber, the coronal pulp was amputated. The pulp chamber was irrigated and hemostasis was obtained within 10-15 minutes. Biodentine was then placed directly over the radicular pulp stump according to the manufacturer's instructions, and the teeth were restored in the same session using composite resin. The same clinical sequence is illustrated in Figure 1.

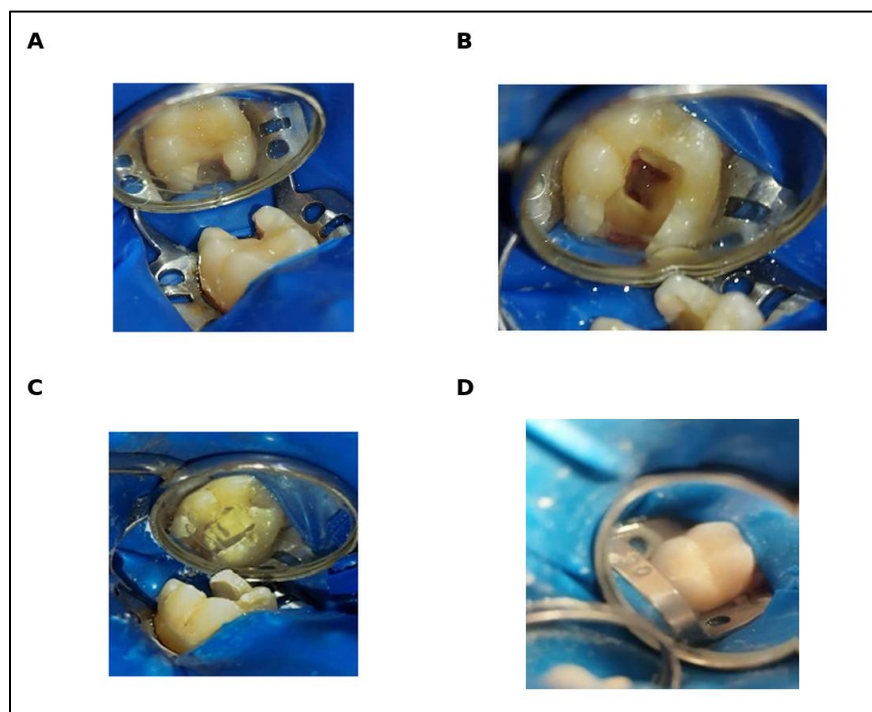


Figure 1. Representative clinical sequence of cervical pulpotomy with Biodentine. A: rubber dam isolation; B: coronal pulp removal and hemostasis; C: Biodentine placement; D: composite resin restoration.

Follow-up and outcome assessment

Patients were reviewed clinically and radiographically at 6 and 12 months. Clinical success was defined as absence of spontaneous pain, swelling, sinus tract, abnormal mobility, persistent percussion pain or functional discomfort. Radiographic success was defined as absence of new or progressive periapical radiolucency, absence of pathological root resorption and absence of radiographic signs suggestive of pulpal necrosis or apical periodontitis. Because postoperative pulp sensibility tests were not performed systematically, the outcome was reported as favorable clinical and radiographic healing rather than definitive proof of residual pulp vitality.

3. CASE PRESENTATIONS AND OUTCOMES

Four mature permanent molars were included. Tooth numbering was checked according to the FDI notation system. The tooth was described as tooth 37, corresponding to a mandibular left second molar, rather than tooth 27 (Table 1).

Table 1. Clinical summary of the four cervical pulpotomy cases.

Case	Age/sex	Tooth (FDI)	Clinical diagnosis	Hemostasis	Restoration	12-month outcome
1	24/F	46	Symptomatic irreversible pulpitis; no preoperative periapical radiolucency	Controlled	Biodentine + composite	Favorable clinical and radiographic outcome
2	42/F	47	Symptomatic irreversible pulpitis; deep carious lesion; no periapical involvement	10-15 min	Biodentine + composite	Favorable clinical and radiographic outcome
3	23/M	46	Severe symptomatic irreversible pulpitis; deep carious lesion; no periapical lesion	12 min	Biodentine + composite	Favorable clinical and radiographic outcome
4	36/M	37	Severe symptomatic irreversible pulpitis; deep carious lesion; no periapical lesion	10 min	Biodentine + composite	Favorable clinical and radiographic outcome

Case 1

A 24-year-old female patient presented with spontaneous and provoked pain associated with tooth 46. The tooth showed clinical signs compatible with symptomatic irreversible pulpitis and no radiographic evidence of periapical pathology. Cervical pulpotomy was performed under rubber dam isolation, Biodentine was placed over the radicular pulp stump, and the tooth was restored with composite resin. The radiographic sequence is presented in Figure 2.

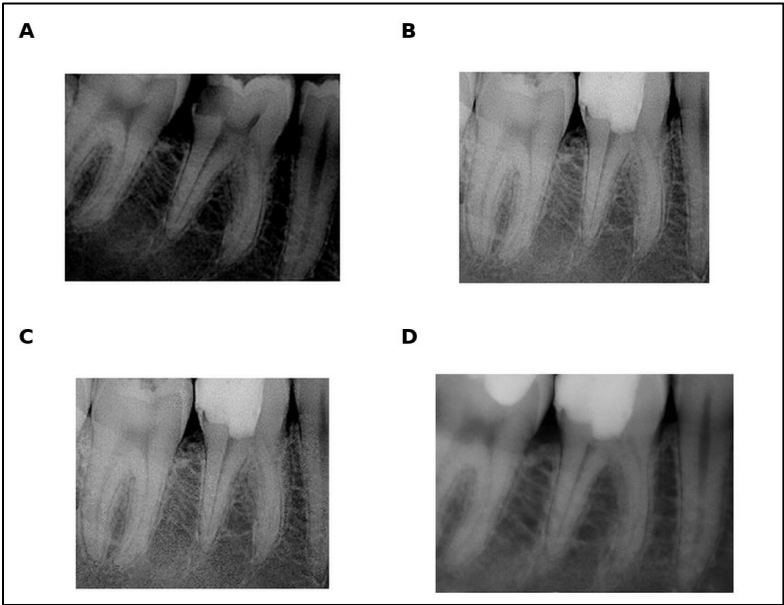


Figure 2. Case 1 radiographic sequence for tooth 46. A: preoperative radiograph; B: immediate postoperative radiograph; C: 6-month follow-up; D: 12-month follow-up.

Case 2

A 42-year-old female patient presented with persistent spontaneous and provoked pain associated with tooth 47. A deep carious lesion was present, with clinical findings compatible with symptomatic irreversible pulpitis and without radiographic periapical involvement. Hemostasis was obtained within 10-15 minutes, followed by Biodentine placement and composite restoration. The radiographic sequence is presented in Figure 3.

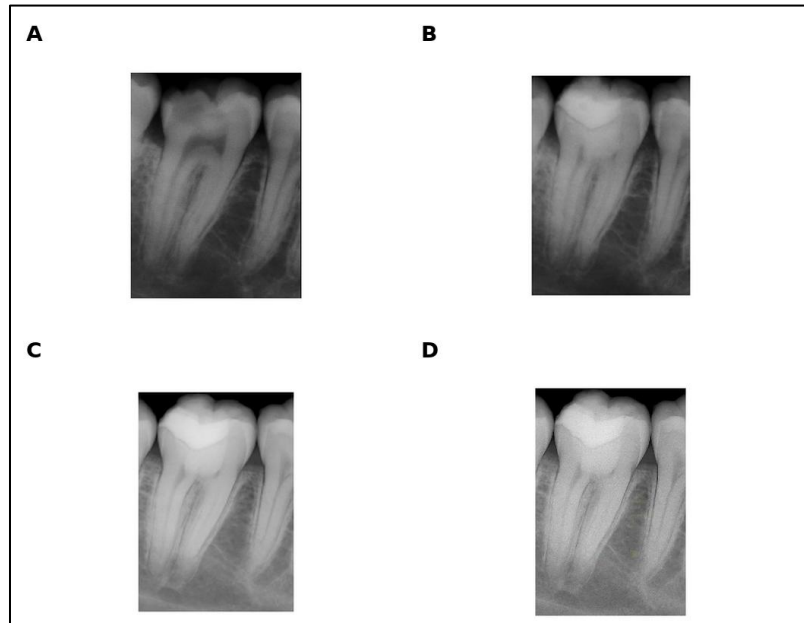


Figure 3. Case 2 radiographic sequence for tooth 47. A: preoperative radiograph; B: immediate postoperative radiograph; C: 6-month follow-up; D: 12-month follow-up.

Case 3

A 23-year-old male patient sought treatment for severe spontaneous and provoked pain associated with tooth 46. The pain was particularly marked at night. Clinical and radiographic findings were compatible with severe symptomatic irreversible pulpitis without periapical pathology. Hemostasis was achieved within 12 minutes. Biodentine was placed and the tooth was restored with composite resin. The radiographic sequence is presented in Figure 4.

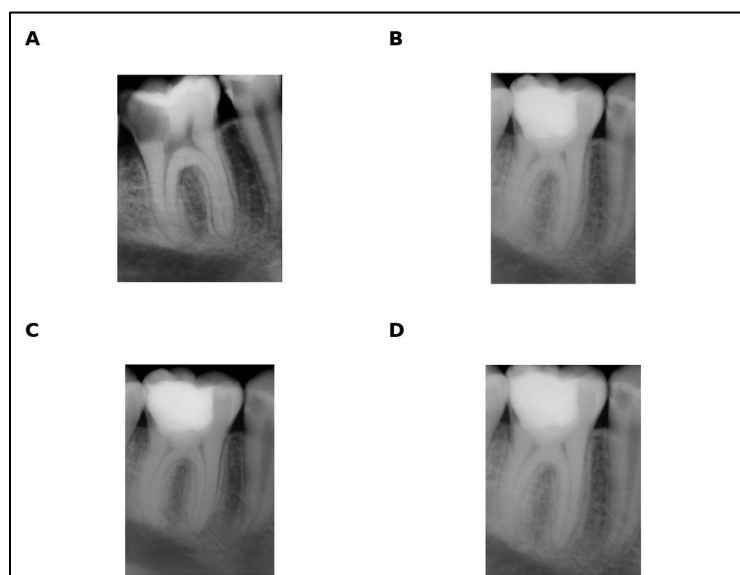


Figure 4. Case 3 radiographic sequence for tooth 46. A: preoperative radiograph; B: immediate postoperative radiograph; C: 6-month follow-up; D: 12-month follow-up.

Case 4

A 36-year-old male patient presented with severe spontaneous pain, nocturnal exacerbation and clinical signs compatible with symptomatic irreversible pulpitis in tooth 37. The tooth number was corrected according to FDI notation. Radiographic examination showed deep carious involvement without periapical lesion. After rubber dam isolation and caries excavation, hemostasis was obtained within 10 minutes, Biodentine was placed and the tooth was restored. The radiographic sequence is presented in Figure 5.

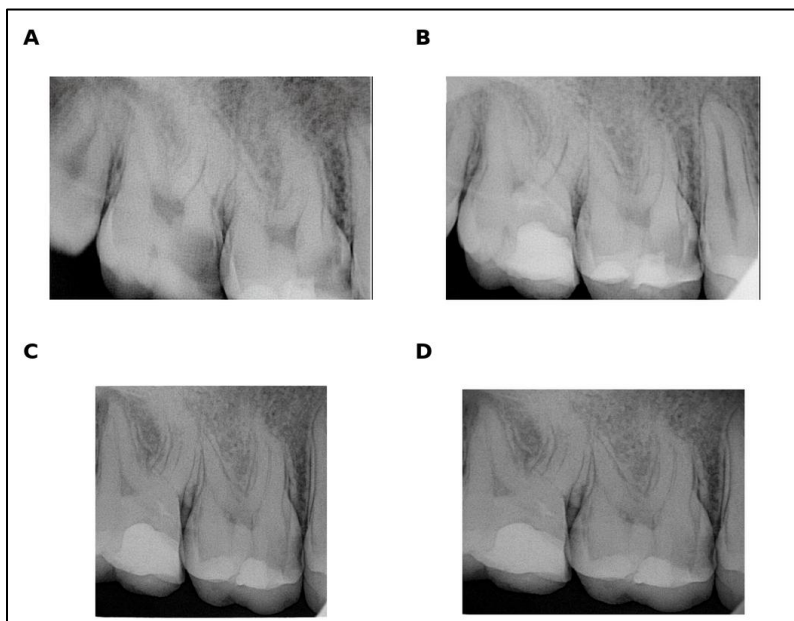


Figure 5. Case 4 radiographic sequence for corrected tooth 37. A: preoperative radiograph; B: immediate postoperative radiograph; C: 6-month follow-up; D: 12-month follow-up.

4. DISCUSSION

This case series reports favorable short-term clinical and radiographic outcomes after cervical pulpotomy with Biodentine in four selected mature permanent molars diagnosed with symptomatic irreversible pulpitis. At the 12-month follow-up, all treated teeth remained functional and no new periapical radiolucency, swelling, sinus tract or functional discomfort was observed. These findings support the potential value of cervical pulpotomy as a conservative vital pulp therapy option in carefully selected mature permanent molars. However, the interpretation of these outcomes must remain cautious because this report is descriptive, includes only four cases and relies on clinical and radiographic follow-up rather than systematic postoperative assessment of residual pulp sensibility (1-4,11,12).

The diagnostic issue is central when interpreting the present cases. Symptomatic irreversible pulpitis remains a clinical diagnosis based on the association of spontaneous pain, lingering pain after thermal stimulation, nocturnal exacerbation when present, percussion findings, deep carious involvement and radiographic exclusion of established periapical disease. These criteria are routinely used in clinical practice, but they do not provide direct histological confirmation of the pulp status. Consequently, the distinction between severe irreversible pulpitis, partial necrosis and early apical involvement may sometimes be difficult. In the present series, pulse oximetry, quantitative thermal testing and histological examination were not used. This limitation was acknowledged because objective vascular or quantitative tests would have strengthened the diagnostic rigor and reduced the risk of misclassification (13,14).

The biological rationale of cervical pulpotomy is based on the concept that inflammation may be more severe in the coronal pulp while the radicular pulp can remain capable of repair when bacterial contamination is controlled. By removing the inflamed coronal pulp, achieving hemostasis and sealing the radicular pulp with a bioactive material, the clinician attempts to maintain the remaining pulp in a condition compatible with healing. This philosophy is consistent with the contemporary evolution of endodontics toward minimally invasive vital pulp therapy, especially when tooth structure can be preserved and conventional root canal treatment may be avoided or postponed in selected cases (3,7,13,14).

Hemostasis was obtained within 10-15 minutes in all four cases. This finding was considered favorable for continuing the pulpotomy procedure because uncontrolled or prolonged bleeding may suggest a more extensive inflammatory condition or inadequate control of the operative field. Nevertheless, hemostasis should not be interpreted as an isolated proof of long-term radicular pulp vitality. It is better understood as one intraoperative decision-making parameter that must be interpreted together with preoperative symptoms, radiographic findings, aseptic protocol, quality of caries removal and quality of the final coronal seal. In this revised manuscript, hemostasis is therefore presented as a favorable clinical criterion, not as definitive biological evidence of preserved pulp vitality.

Biodentine was selected as the pulp capping material because calcium-silicate-based materials have properties that are clinically relevant for vital pulp therapy. These include biocompatibility, alkaline pH, sealing capacity, bioactivity and the potential to promote mineralized tissue formation. The sealing quality is particularly important because failure of vital pulp therapy is often related not only to the pulp capping material itself, but also to bacterial microleakage and inadequate coronal restoration. In the present cases, Biodentine placement was followed by composite resin restoration during the same session, with the objective of reducing early contamination and ensuring an immediate functional coronal seal (5,6,11).

The favorable outcomes observed in this series are broadly consistent with reviews and clinical studies reporting positive results for pulpotomy in permanent teeth with symptoms compatible with irreversible pulpitis. However, comparison with the literature must be made carefully. Some published studies include young permanent teeth, immature teeth or mixed populations, whereas the present report focuses on mature permanent molars in adult patients. For example, Taha and Abdulkhader reported outcomes for symptomatic young permanent teeth with carious exposure; their results support the biological potential of Biodentine in vital pulp therapy, but they cannot be considered directly equivalent to adult mature molars. This distinction was clarified in the revised discussion to avoid overgeneralization (8).

The outcome criteria were deliberately defined as clinical and radiographic rather than histological or biological. Clinical success was based on the absence of spontaneous pain, swelling, sinus tract, abnormal mobility, persistent percussion pain and functional discomfort. Radiographic success was based on the absence of new or progressive periapical radiolucency, pathological root resorption or radiographic signs suggestive of apical periodontitis. These criteria are clinically relevant for short-term assessment, but they do not prove residual pulp vitality. Because postoperative thermal or electric pulp sensibility tests were not systematically performed at 6 and 12 months, the statement that the radicular pulp remained vital cannot be asserted with certainty. For this reason, the wording was changed to "favorable clinical and radiographic outcomes" rather than definitive "preservation of pulp vitality."

From a clinical perspective, the present cases suggest that cervical pulpotomy with Biodentine may be considered when strict selection criteria are respected: mature permanent molars with symptoms compatible with symptomatic irreversible pulpitis, absence of radiographic periapical pathology, possibility of rubber dam isolation, controllable bleeding after coronal pulp removal and ability to obtain an immediate coronal restoration. Conversely, the procedure should not be generalized to teeth with necrotic pulp, purulent discharge, uncontrolled bleeding, advanced periodontal compromise, extensive periapical lesions, vertical root fracture or poor restorability. These selection criteria are essential because inappropriate case selection may lead to failure and delayed root canal treatment.

Overall, this case series should be interpreted as a preliminary clinical observation rather than definitive evidence of superiority. Its main contribution is to document, in a concise and structured manner, the management and 12-month follow-up of four mature permanent molars treated by cervical pulpotomy using Biodentine, while explicitly addressing the diagnostic and follow-up limitations raised by the reviewers. Future prospective studies should include larger sample sizes, standardized diagnostic protocols, quantitative or objective pulp vitality assessment, systematic postoperative sensibility testing, direct comparison with conventional root canal treatment or other vital pulp therapy materials, and follow-up periods of at least 24 months. Such studies are necessary before broad clinical recommendations can be made (1-4,12-14).

Limitations

This report has several limitations. First, it is a small descriptive case series without a control group. Second, the diagnosis of irreversible pulpitis was based on clinical and conventional radiographic criteria without pulse oximetry, quantitative thermal testing or histological confirmation. Third, postoperative pulp sensibility tests were not systematically recorded at 6 and 12 months. Fourth, the follow-up period was limited to 12 months, whereas longer follow-up, preferably at least 24 months, is necessary to better assess the durability of cervical pulpotomy in mature permanent molars. Finally, the clinical cases were selected and therefore cannot be generalized to teeth with necrotic pulp, uncontrolled bleeding, extensive periapical pathology or poor restorability.

5. CONCLUSION

Cervical pulpotomy with Biodentine showed favorable short-term clinical and radiographic outcomes in four selected mature permanent molars presenting signs compatible with symptomatic irreversible pulpitis. The revised interpretation is deliberately cautious: the findings support the potential usefulness of Biodentine as a conservative treatment option, but they do not establish definitive proof of preserved pulp vitality because postoperative sensibility testing was not systematically performed. Larger prospective studies with standardized diagnostic tests, validated success criteria and follow-up of at least 24 months are required before broad clinical recommendations can be made.

Declarations

Ethics approval and consent to participate: Written informed consent for treatment and for anonymized publication of clinical and radiographic images was obtained from the patients. The manuscript does not include patient names, initials, file numbers, facial photographs or other identifying information. Confidentiality and anonymity were respected throughout manuscript preparation.

Conflict of interest: The authors declare that they have no conflicts of interest related to this work.

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Data availability: The clinical and radiographic data supporting this case series are available from the corresponding author upon reasonable request, while respecting patient confidentiality.

Author contribution: All authors contributed to the clinical management, conception, interpretation, drafting or critical revision of the manuscript and approved the final version for submission.

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