# Clinical management of a bifurcation perforation of previously treated teeth with symptomatic apical periodontitis using Biodentine: case report

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## ABSTRACT

**Introduction:** Bifurcation perforation is an iatrogenic or pathological communication between the pulp chamber floor and the surrounding alveolar bone. The success of perforation repair largely depends on the repair material's sealing ability, biocompatibility, and bioactivity. Biodentine, a calcium silicate-based bioceramic material, has shown excellent sealing ability and favorable biological properties for managing perforation defects. This case report presents the clinical management of a bifurcation perforation in a mandibular left first molar previously diagnosed with symptomatic apical periodontitis, treated with Biodentine. **Case Report:** A 22-year-old female presented to the Dental Conservation Clinic of RSGM Prof. Soedomo with a chief complaint of pain during mastication in the mandibular left first molar. A general dentist had previously treated the tooth endodontically. Clinical examination revealed a negative pulp vitality test and a positive percussion response. Radiographic examination demonstrated a radiolucent lesion in the furcation area, indicating a bifurcation perforation. The final diagnosis was symptomatic apical periodontitis associated with a bifurcation perforation in a previously treated tooth. Non-surgical root canal retreatment was performed using rotary instrumentation, followed by sealing of the perforation with Biodentine. Root canal obturation was completed using the single-cone technique. One month later, an endocrown was placed to restore function while preserving as much of the remaining tooth structure as possible. **Conclusion:** At the 18-month follow-up, the patient remained asymptomatic, and radiographic evaluation showed a marked reduction in the radiolucency within the bifurcation area. No clinical signs of inflammation, tenderness, or pain were observed. These findings indicate favorable long-term healing and a successful endodontic outcome, highlighting Biodentine's excellent sealing ability and clinical effectiveness in managing bifurcation perforations.

## Keywords

Bifurcation perforation, biodentine, endodontic treatment, sealability

# *Penatalaksanaan klinis perforasi furkasi pada gigi yang telah dirawat endodontik dengan periodontitis apikal simptomatik menggunakan Biodentine: laporan kasus*

## *ABSTRAK*

***Pendahuluan:*** *Perforasi bifurkasi merupakan komunikasi patologis atau iatrogenik antara tulang alveolar dan dasar kamar pulpa. Keberhasilan perawatan perforasi sangat bergantung pada kemampuan material dalam melakukan penyegelan, biokompatibilitas, serta bioaktivitasnya. Biodentine, material berbasis biokeramik, telah terbukti memiliki kemampuan penyegelan yang unggul dalam menangani kasus perforasi bifurkasi. Laporan kasus ini bertujuan untuk menyajikan penatalaksanaan klinis perforasi bifurkasi pada gigi molar pertama kiri rahang bawah yang sebelumnya telah dirawat karena periodontitis apikal simptomatik, dengan menggunakan Biodentine sebagai bahan reparasi.* ***Laporan Kasus:*** *Seorang perempuan berusia 22 tahun datang ke Klinik Konservasi Gigi RSGM Prof. Soedomo dengan keluhan nyeri saat mengunyah pada gigi molar pertama kiri rahang bawah. Pasien sebelumnya telah mendapatkan perawatan dari dokter gigi umum. Pemeriksaan klinis menunjukkan vitalitas pulpa negatif dan respon perkusi positif. Pemeriksaan radiograf memperlihatkan adanya radiolusensi pada area furkasi. Diagnosis ditegakkan sebagai previously treated disertai periodontitis apikalis simptomatik dengan perforasi bifurkasi. Perawatan ulang saluran akar dilakukan secara non-bedah dengan instrumen rotary, diikuti dengan aplikasi Biodentine untuk menutup area perforasi. Obturasi saluran akar dilakukan menggunakan teknik single cone. Setelah satu bulan, dipasang endocrown dengan tujuan mempertahankan sebanyak mungkin struktur gigi asli.* ***Simpulan:*** *Evaluasi pada kunjungan ke-18 bulan menunjukkan pasien tetap bebas gejala, dengan gambaran radiograf menunjukkan penurunan radiolusensi pada area bifurkasi. Tanda peradangan atau keluhan nyeri tidak ditemukan. Kasus ini menunjukkan bahwa Biodentine efektif dalam menutup perforasi bifurkasi dan berkontribusi terhadap keberhasilan terapi endodontik jangka panjang.*

## *Kata kunci*

*Perforasi bifurkasi, biodentine, perawatan endodontik, kemampuan penyegelan.*

## INTRODUCTION

One of the most common and challenging complications encountered during endodontic treatment is bifurcation perforation. A perforation is defined as an unintentional or pathological communication between the radicular pulp complex and the external surface of the tooth.[1] Perforations occurring at the pulp chamber floor of multirooted teeth, particularly within the furcation area, can lead to irreversible periodontal attachment loss and periodontal inflammation.[2]

Perforations may result from either non-iatrogenic or iatrogenic factors. Non-iatrogenic perforations may occur due to extensive carious lesions extending to the pulp chamber floor or as a consequence of internal or external root resorption. [2] Iatrogenic perforations, which clinicians cause, are frequently associated with insufficient clinical experience and inadequate knowledge of tooth morphology and root canal anatomy.[3] These procedural errors compromise treatment success and may ultimately result in endodontic failure.

An ideal material for perforation repair should promote bone and cementum regeneration, provide an effective seal, and be biocompatible, non-toxic, non-carcinogenic, dimensionally stable, and insoluble in biological fluids. Biodentine, a calcium silicate-based material, has emerged as an alternative to mineral trioxide aggregate (MTA) because it possesses comparable biological properties while offering improved handling characteristics and a shorter setting time.[4,5] Biodentine also exhibits enhanced bioactivity by promoting remineralization and sealing of the surrounding tissues through the formation of a mineral-rich interfacial layer and accelerated apatite deposition, supporting repair success.[6]

Compared with MTA, Biodentine has shown significantly higher cementum repair scores in previous studies, suggesting greater potential to promote cementum regeneration on the root surface in the furcation area. Biodentine also exhibits superior micromechanical adhesion to dentin, which contributes to its excellent adaptability in restorative and endodontic procedures.[7] Unlike MTA, Biodentine does not contain bismuth oxide, calcium sulfate, or calcium aluminate. Instead, it incorporates zirconium oxide as a radiopacifier. Zirconium oxide enhances the material's biocompatibility and mechanical properties while providing adequate radiopacity without causing the tooth discoloration commonly associated with bismuth oxide. The absence of bismuth oxide is particularly advantageous because this compound has been linked to compromised biocompatibility and tooth discoloration. These characteristics make Biodentine an excellent material for perforation repair and other restorative procedures, improving overall clinical outcomes.[8-12]

In contrast to materials containing bismuth oxide, Biodentine eliminates the disadvantages associated with this radiopacifier, including tooth discoloration and potential biocompatibility concerns. Instead, zirconium oxide provides sufficient radiopacity while maintaining diagnostic visibility and the esthetic appearance of the restored tooth, thereby supporting more favorable restorative outcomes.[13] Tricalcium silicate–based materials, such as Biodentine, are inorganic biomaterials that demonstrate excellent biocompatibility with the periapical tissues. They have significantly improved the management of various clinical endodontic conditions.[12] One of their major advantages is their ability to stimulate the formation of new alveolar bone, cementum, and periodontal tissues, thereby facilitating tissue attachment to the material's surface and improving healing outcomes.[10] Furthermore, these cements promote the deposition of hydroxyapatite within their pores and along the material-dentin interface, resulting in the formation of a dense and well-bonded monoblock structure.[14]

Root perforation is a serious complication that can compromise root canal treatment outcomes. Because any perforation weakens the tooth's structural integrity and may ultimately lead to tooth loss, prevention should always be the primary objective.[15] When a perforation does occur, it is essential for the clinician to recognize it promptly, determine the most appropriate treatment strategy for repair, and ensure adequate visualization for successful management.[16] Repairing a perforation can be technically challenging and often requires careful treatment planning and appropriate clinical techniques.[15] A favorable prognosis depends on a thorough understanding of the perforation's size, location, time of occurrence, and the properties of the available repair materials. Achieving an effective seal between the root canal system and the periodontal tissues also requires a high level of clinical skill. Therefore, successful healing of a perforation depends on accurate diagnosis, meticulous treatment planning, and appropriate clinical management.[17]

These defects usually require non-surgical periodontal therapy, although surgical intervention may be necessary in certain cases. Clinicians should carefully select treatment options based on the regenerative potential of the affected tissues, including non-surgical or combined approaches. The clinician's experience also influences treatment outcomes, as most clinical studies report that endodontic specialists or dental clinicians with advanced training in managing complex endodontic complications, including perforations, performed these procedures.[16,18] Long-standing perforations may not always be amenable to successful repair; therefore, informed consent should clearly explain the advantages and disadvantages of retaining the tooth, leaving it untreated, or proceeding with extraction followed by prosthetic replacement.[16]

This case report highlights the clinical decision-making process, technical procedures, and long-term outcomes of non-surgical retreatment followed by restoration with an endocrown. It emphasizes the importance of accurate diagnosis, conservative treatment, and appropriate material selection to achieve successful clinical outcomes in complex cases of bifurcation perforation. It describes a young adult with a previously treated mandibular first molar who presented with symptomatic apical periodontitis and a bifurcation perforation caused by iatrogenic overextension of gutta-percha into the alveolar bone.

CBCT-guided retreatment enabled accurate localization and stepwise removal of the extruded gutta-percha using rotary instrumentation. Biodentine was then precisely placed under magnification to seal the perforation, followed by restoration with a zirconia microceramic endocrown to preserve the remaining tooth structure while avoiding post placement. This minimally invasive, biologically favorable approach provides valuable clinical evidence supporting the use of Biodentine to manage bifurcation perforations. This case report presents the clinical management of a bifurcation perforation in a mandibular left first molar with symptomatic apical periodontitis, using Biodentine.

## CASE REPORT

A 22-year-old female patient presented to the Dental Conservation Clinic of RSGM Prof. Soedomo with pain and discomfort in the mandibular left first molar during mastication. About one week earlier, a general dentist had treated the tooth. Despite several treatment visits, the pain and discomfort progressively worsened. The patient reported that the tooth was particularly painful when chewing, especially on hard foods. She had no history of systemic disease or known allergies.

The patient was in good general health, with a symmetrical facial appearance and no regional lymphadenopathy. Vital signs were within normal limits. Intraoral

examination showed good oral hygiene (OHI-S = 0.5), Angle Class I molar relationships, normal overjet (2.2 mm), and normal overbite (2.6 mm). The gingiva appeared coral pink with normal stippling and firm consistency. Tooth 36 had a temporary occlusal restoration and exhibited no mobility. Clinical examination revealed a negative pulp vitality test and a negative palpation test, but a positive percussion test, consistent with symptomatic apical periodontitis (Figure 1).



**A** **B**

**Figure 1.** (A) intraoral occlusal view, (B) close-up intraoral view tooth 36

Preoperative periapical radiographs revealed a radiopaque mass of extruded gutta-percha extending into the bifurcation area (indicated by the red arrow). A radiolucent lesion was also observed in the bifurcation region, extending toward the root apex (indicated by the blue arrow). In addition, the obturation of both the mesial and distal root canals appeared inadequate and lacked a hermetic seal (Figures 2 and 3), consistent with the previous treatment history.

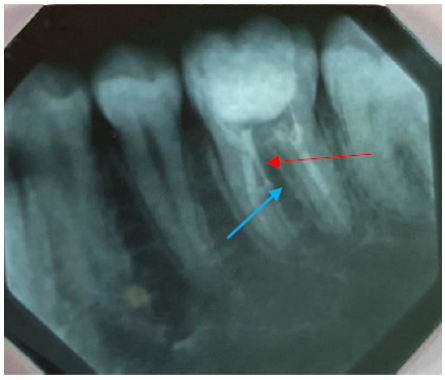
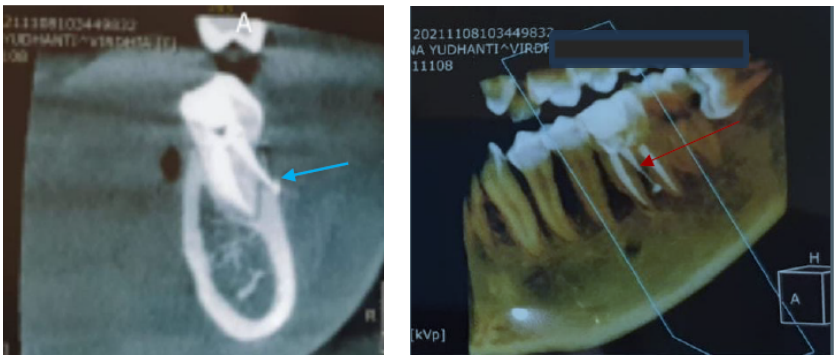


**Figure 2.** The preoperative radiographs showed a radiopaque (bright/dense) area on the images, indicating that gutta-percha had penetrated or extended towards the bifurcation.

Based on the clinical and radiographic findings, the diagnosis was a previously treated tooth with symptomatic apical periodontitis and root canal perforation. The treatment plan included managing the perforation with Biodentine, nonsurgical root canal retreatment of tooth 36, and restoration with an endocrown fabricated from zirconia microceramic composite (CERAMAGE). Endocrowns require less removal of healthy tooth structure than post-and-core crowns because they utilize the pulp chamber for retention without requiring additional post-space preparation, thereby reducing the risk of root fractures associated with post placement.



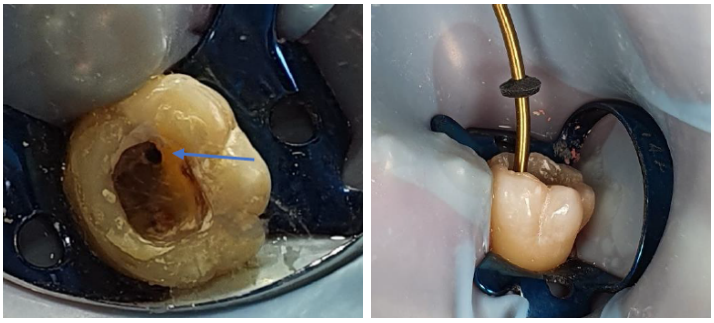
**A** **B**

**Figure 3.** The CBCT (Cone Beam Computed Tomography) examination on the coronal section (A) shows the presence of gutta-percha filling that has extended beyond the alveolar bone towards the buccal side (blue arrow). In the sagittal section (B), the gutta-percha filling can be seen extending from the mesial direction, reaching the alveolar bone between the mesial and distal roots (red arrow). (Source: personal documentation).

Biodentine was used to seal the perforation, and root canal retreatment was performed to thoroughly clean and disinfect the root canals. An endocrown restoration made of zirconia microceramic composite (CERAMAGE) was then placed to reinforce the remaining tooth structure and restore function and aesthetics.

The prognosis was considered doubtful to good (dubia ad bonam) based on several factors. The perforation was located in the middle portion of the root, with minimal coronal contamination. Although it extended to the alveolar bone, it remained clearly visible with a dental operating microscope. The remaining hard-tissue structure of tooth 36 was adequate for restoration, and the supporting alveolar bone and periodontal ligament were in good condition. The patient maintained good oral hygiene, the treatment area could be adequately isolated, and no history of systemic disease could interfere with healing. The patient was cooperative and compliant with the treatment protocol. Given these factors, the prognosis was favorable, with a reasonably good likelihood of successful treatment.

The initial procedure began with management of the perforation. The access cavity was enlarged to remove the dentinal shelf and establish straight-line access using a non-cutting-edge diamond fissure bur until the gutta-percha was visualized. The overextended gutta-percha was removed after determining the working length using CBCT measurements obtained at the coronal and middle thirds. Gutta-percha removal was performed using rotary retreatment files (M3 Retreatment Files, United), beginning with the RT3 file (30/09) for the coronal portion, followed by the RT2 file (25/08) for the middle portion and the RT1 file (20/07) for the apical portion. We used saline during the procedure, followed by irrigation with 2.5% NaOCl after each file change. A #15 K-file was used to confirm that no residual gutta-percha remained (Figure 4A).



A B

**Figure 4.** (A) Following the gutta-percha's extraction from the perforated canal, (B) Application of Biodentine using an MTA carrier.

The next phase involved sealing the perforation with Biodentine. The Biodentine powder and liquid were mixed using an amalgamator and then applied to the perforation site using an MTA carrier (Figure 4B). The material was subsequently condensed with a plugger until it reached the pulp chamber floor and was allowed to set for 12 minutes (Figure 5).

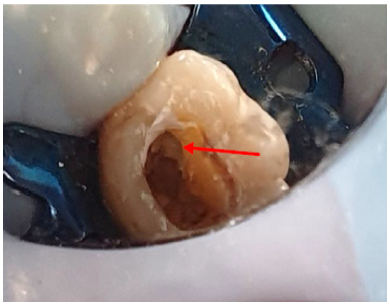


**Figure 5.** Biodentine is positioned until it touches the pulp chamber's floor.

Root canal retreatment was subsequently performed. Gutta-percha removal was carried out using the same rotary retreatment files (M3 Retreatment Files, United), beginning with the RT3 file for the coronal portion, followed by the RT2 file for the middle portion and the RT1 file for the apical portion. After each file change, we irrigated with saline and 2.5% NaOCl. CBCT examination confirmed complete removal of the extruded gutta-percha from the perforation area in the axial section (Figure 7A). In contrast, the coronal section demonstrated that the perforation site had been completely sealed with Biodentine (Figure 7B).

Coronal flaring was performed as the first step of the crown-down method of root canal preparation using M3 ProGold rotary files and an Opener File. The electronic apex locator was used to determine the working length. Preparation was then continued to the established working length using M3 ProGold rotary files, followed by ultrasonic activation of 2.5% NaOCl, 17% EDTA, and 2% chlorhexidine digluconate during root canal irrigation. The root canals were dressed with calcium hydroxide paste (Calcipex II) after being dried with paper points. At the subsequent visit, the calcium hydroxide dressing was removed, and the root canal was obturated using the single-cone technique. Periapical radiography was used to evaluate obturation quality and confirm adequate sealing of the root canal filling (Figure 6).



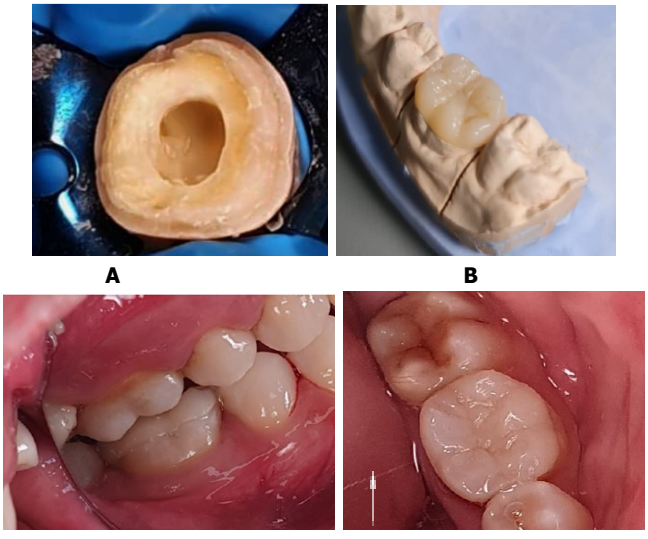
**Figure 6.** The radiography image displays tooth 36's root canal retreatment.




A B

**Figure 7.** CBCT radiographic images: (A) Axial section showing complete removal of gutta-percha from the perforation area; (B) Coronal section demonstrating that the perforation has been completely sealed with Biodentine.

An endocrown restoration was selected as the definitive restoration in this case because it's simple, minimally invasive preparation allowed maximum preservation of the remaining tooth structure. The stages of endocrown preparation, fabrication, cementation, and the immediate post-treatment appearance are presented in Figure 8.



A B C D

**Figure 8.** (A) Final preparation of the endocrown for tooth 36. (B) Endocrown for tooth 36. (C) Occlusal contact after cementation of the endocrown. (D) Tooth 36 after the treatment.

At the one-week follow-up, the patient reported no discomfort or pain. At the 18-month follow-up, direct clinical examination and radiographic evaluation showed that the tooth remained asymptomatic and functional. Radiographic examination demonstrated healing of the bifurcation region, with no evident periapical pathology (Figure 9), confirming a successful treatment outcome.

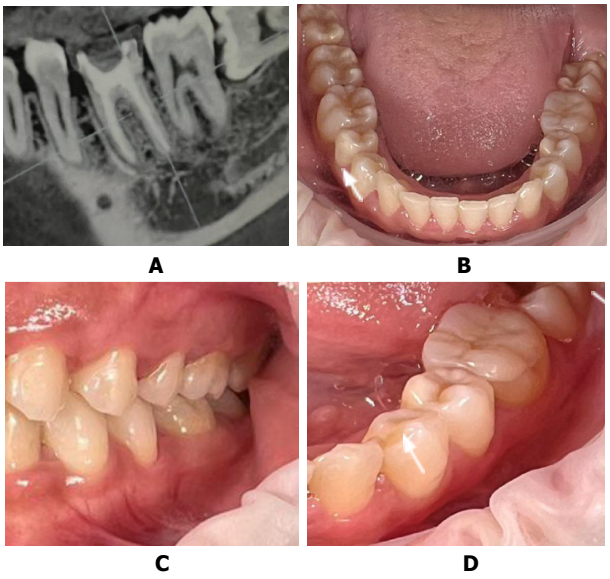



**Figure 9.** Follow-up after 18 months: A. CBCT photograph shows healing on bifurcation and hermetic obturation; B. Endocrown 36 form occlusal view; C. Occlusal contact after 18 months; D. Endocrown 36 after 18 months.

## DISCUSSION

This case demonstrates that a bifurcation perforation associated with a previously treated mandibular first molar can be successfully managed when diagnosis, localization, removal of extruded filling material, perforation repair, root canal retreatment, and definitive coronal restoration are integrated into a comprehensive treatment strategy. Clinical and radiographic findings showed symptomatic apical periodontitis with a perforation extending into the furcation region. Figure 2 shows radiographic evidence of extruded gutta-percha and the associated radiolucency, while Figure 3 provides three-dimensional information on the spatial relationship between the extruded material and the alveolar bone. This additional information was important because prognosis and treatment approach for perforations are influenced by their location, size, accessibility, contamination, and relationship with the periodontal tissues. Current literature emphasizes that successful repair requires not only an appropriate repair material but also accurate diagnosis, controlled removal of irritants, adequate isolation, and an effective coronal seal.[15–19]

The 18-month clinical and radiographic outcome in this case was encouraging and was consistent with the favorable healing potential reported for calcium-silicate-based repair materials. Biodentine is a hydraulic calcium silicate cement those hydrates and interacts with surrounding dentin and tissue fluids, which may support the formation of a mineralized interfacial layer. Its bioactivity, biocompatibility, sealing ability, and relatively short setting time are clinically relevant to perforation repair, in which maintaining a stable seal and preventing communication between the root canal system and periodontal tissues are essential.[19–24]

A systematic review reported comparable early clinical and radiographic outcomes between Biodentine and MTA, with Biodentine demonstrating more favorable outcomes at 12 months.[19] Although these findings do not establish the superiority of Biodentine in all clinical situations, they provide a rationale for its use in the present case. Therefore, the absence of symptoms and reduction in the radiographic lesion at 18 months should be interpreted as favorable clinical and radiographic outcomes, while recognizing that healing cannot be attributed solely to Biodentine.

Figures 4 and 5 illustrate the importance of the operative sequence. Removing the extruded gutta-percha before placing Biodentine allowed the repair material to be positioned directly at the perforation site and may have reduced a potential source of persistent irritation. Magnification and controlled condensation may also have contributed to adequate adaptation of the material to the defect. Calcium-silicate bioceramics are increasingly used in endodontic treatment because of their bioactivity and favorable interactions with dentin and periradicular tissues.[24] However, clinical outcome depends not only on the material but also on appropriate clinical management. Clauder emphasized that early recognition and appropriate management of perforations are important for improving prognosis, while contamination and accessibility may influence treatment outcomes.[15] In the present case, accurate localization and access to the perforation under magnification, followed by removal of the extruded material, provided favorable conditions for repair. Figure 7 demonstrates radiographic sealing of the perforation after treatment, supporting the favorable clinical outcome.

Root canal retreatment was an essential component of the overall treatment. The preoperative radiograph showed inadequate obturation of the mesial and distal canals, while CBCT demonstrated gutta-percha extending beyond the intended canal space. Therefore, treatment addressed both the perforation and the residual filling material to facilitate adequate canal disinfection. The retreatment protocol began with rotary instrumentation, followed by sodium hypochlorite irrigation, EDTA, chlorhexidine, ultrasonic activation, and calcium hydroxide medication. Figure 6 shows the radiographic appearance following retreatment, while Figure 7 demonstrates removal of the extruded gutta-percha and sealing of the perforation. The favorable 18-month outcome should therefore be considered the result of the combined treatment approach rather than solely attributed to the perforation-repair material.[25,26]

The definitive endocrown was selected because the tooth had undergone endodontic retreatment and required a restoration that could restore function while preserving the remaining coronal and radicular structure. Endocrowns preserve tooth structure by eliminating the need for post-space preparation, potentially reducing further weakening of the remaining tooth structure[27,28] Figures 8 and 9 document the immediate restoration and the 18-month clinical outcome, respectively. Contemporary evidence suggests that endocrowns can provide biomechanical performance comparable to, and in some studies superior to, conventional post-and-core restorations in endodontically treated teeth with substantial coronal destruction.[29] The conservative approach was particularly relevant in this case because additional dentin removal for post-space preparation could have further compromised the remaining tooth structure. However, the clinical performance of endocrowns may vary according to preparation design, remaining tooth structure, restorative material, occlusal loading, and cementation.[29,30] A two-year mixed-cohort study reported satisfactory clinical performance of CAD/CAM endocrowns fabricated from different ceramic systems. However, these findings should not be generalized to all materials or clinical conditions.[31,32] In the present case, the zirconia microceramic composite endocrown supported a favorable clinical and esthetic outcome at the 18-month follow-up (Figure 9).

The 18-month follow-up was clinically encouraging, as the patient remained asymptomatic and radiographic examination showed healing in the bifurcation region without evident periapical pathology. Figure 9 documents the clinical condition of the definitive restoration and the radiographic status of the treated area at follow-up. Recent evidence syntheses suggest that one-piece endodontic crowns may be a reliable restorative option for posterior endodontically treated teeth. However, the certainty of evidence remains limited by differences in preparation designs, restorative materials, follow-up periods, and study quality.[33] Therefore, the present finding should

be interpreted as supportive clinical evidence rather than definitive evidence of long-term treatment superiority. The favorable outcome likely reflects the combined effects of accurate diagnosis, controlled perforation repair, adequate retreatment, appropriate restoration, and follow-up care.

Several limitations should be considered when interpreting this case. As a single-case report without a control group, the findings cannot establish Biodentine's relative effectiveness compared with other repair materials. However, previous evidence has reported favorable outcomes for Biodentine and MTA in managing furcation perforations.[19,20] The 18-month follow-up provides evidence of intermediate-term stability but does not establish long-term tooth or endocrown survival. The assessment also relied primarily on clinical and radiographic findings, and the multiple interventions prevented determination of each treatment component's individual contribution. Future studies should include larger prospective studies with standardized treatment protocols, longer follow-up periods, and comparisons of calcium-silicate repair materials and endocrown designs.[29,30,33] Despite these limitations, this case supports the feasibility of a minimally invasive approach combining Biodentine perforation repair, endodontic retreatment, and endocrown restoration, with a favorable clinical and radiographic outcome at 18 months.[19,24,29,33]

## CONCLUSION

Managing bifurcation perforations presents several challenges, including potential periodontitis, the need for patient cooperation, and prolonged follow-up and evaluation. With appropriate treatment planning and selection of a suitable repair material, such as Biodentine, successful clinical outcomes and favorable healing can be achieved in cases of bifurcation perforation. A thorough understanding of the composition and properties of available bioceramic materials is crucial for informed case selection. This case report suggests that Biodentine can be a reliable material for managing bifurcation perforations because of its favorable sealing ability, biocompatibility, and ease of handling. The successful clinical and radiographic outcomes observed in this case strongly support the continued use and further investigation of Biodentine in complex endodontic cases involving perforations, particularly in anatomically challenging areas such as the furcation.

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Owing to ethical and privacy constraints, the information is not publicly accessible.

**Conflicts of Interest:** The authors have reported no conflicts of interest

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