Definitive Endocrown Restoration in First Molar Right Mandibular After Multiple-Visit Endodontic Treatment: A Case Report

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Received 30 December 2025; 1st revision 3 Februari 2026;2nd revision 9 Februari 2026; Accepted 20 Februari 2026; Published online 29 April 2026

Keywords:

Endocrown, Endodontic Treatment, Restoration

ABSTRACT

Background: *Root canal treatment is a dental procedure aimed at preserving teeth and roots that have been infected by bacteria, with the expectation of restoring the tooth's normal function and aesthetics. The selection of an appropriate final restoration plays a significant role in supporting the success of root canal therapy.*
Method: *A 22-year-old male patient presented to the conservative dentistry clinic with a chief complaint of a cavity in the lower right molar that had been present for the past two years. The patient reported experiencing pain one year ago when the tooth was used for chewing or exposed to sweet and cold stimuli, accompanied by swelling, but no treatment was sought at that time. Currently, the patient no longer experiences pain but feels discomfort due to food impaction in the cavity. The ICD-10 diagnosis for tooth 46 was necrosis of the pulp.*
Result: *The patient reported comfort during mastication and expressed satisfaction with the final restoration. These findings indicate the clinical success of the endocrown restoration, achieving optimal retention, occlusal function, and esthetic outcome.*
Conclusion: *Endocrowns preserve more remaining tooth structure and provide good marginal adaptation. One week after placement, the evaluation showed satisfactory marginal adaptation with no post-treatment complaints. Therefore, endocrowns can be considered a conservative, functional, and esthetic restorative option for endodontically treated posterior teeth.*

doi: http://dx.doi.org/10.30659/odj.13.1.79-86.
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How to Cite: Mahardika, *et all*. Definitive Endocrown Restoration in First Molar Right Mandibular After Multiple-Visit Endodontic Treatment: A Case Report. Odonto: Dental Journal, v.13, n.1, p.79-86, April 2026.

INTRODUCTION

Root Canal Treatment (RCT) is a dental procedure performed to preserve the normal function of the tooth and to eliminate infection within the root canal system. Successful endodontic therapy aims to restore both the masticatory and esthetic functions of the affected tooth[1]. The treatment is guided by the endodontic triad principles, which include access opening, cleaning and shaping, and obturation[2,3].

The access opening stage is intended to remove infected and necrotic tissues within the pulp chamber and canal system to eliminate residual microorganisms[4]. The cleaning and shaping stage involves thorough disinfection of the infected canal and preparation of the canal space to facilitate optimal obturation[5]. Irrigation procedures performed during the cleaning and shaping stage aim to remove debris and microorganisms from the root canal system. Irrigation also helps eliminate the smear layer from the root canal, reduces the risk of microleakage, and enhances the adhesion and sealing ability of the sealer to the dentin[6]. The obturation stage aims to achieve a hermetic seal of the canal using biocompatible materials, thereby preventing reinfection. All three stages must be performed systematically and comprehensively to ensure both biological and functional success of the treatment[7].

Multiple-visit endodontic treatment offers several benefits, particularly in teeth with necrotic pulp conditions. The placement of intracanal medicaments prior to obturation can reduce the microbial load, thereby promoting optimal healing[8]. Furthermore, the interval between visits allows for stepwise evaluation of the periapical tissue response as well as the condition of the root canal system. This approach supports effective disinfection and consequently increases the likelihood of treatment success. The success of endodontic therapy is determined not only by infection control but also by the clinician's ability to preserve the remaining tooth structure through appropriate selection of the definitive restoration[9]. Teeth with extensive carious lesions often require substantial removal of tooth structure, leading to a higher risk of fracture due to reduced dentin thickness[10]. Among the available restorative options, the endocrown has emerged as a conservative and reliable choice for restoring endodontically treated posterior teeth with significant loss of coronal structure. It offers optimal retention and efficient distribution of masticatory forces, thereby enhancing the functional and esthetic outcomes of post-endodontic restorations[11].

CASE REPORT

A 22-year-old male patient presented to the Conservative Dentistry Clinic of the Dental and Oral Hospital, Muhammadiyah University of Semarang (RSGM UNIMUS), with a chief complaint of a cavity in the lower right molar that had been present for approximately two years. The patient reported a history of pain one year ago, which occurred during mastication and upon exposure to sweet and cold stimuli, accompanied by swelling in the surrounding area. However, no treatment was sought at that time. Currently, the patient reported no pain but expressed discomfort due to food impaction in the cavity. Extraoral examination revealed a symmetrical facial profile, normal lips, and no palpable enlargement of the right or left submandibular glands. Intraoral examination of tooth #46 showed a cavity on the occlusal surface extending to the mesiolingual wall, with a depth reaching the pulp chamber. The tooth showed a positive response to probing, negative percussion and palpation responses, negative cold test (vitality test), and grade 0 mobility according to Miller's classification (1950). Radiographic examination revealed a radiolucent area on the occlusal crown extending to the mesial aspect, with an open pulp chamber, two roots, and four convergent root canals. The periapical area appeared

within normal limits. Based on clinical and radiographic findings, the diagnosis for tooth 46 was necrosis of pulp according to ICD-10, and pulpal necrosis with asymptomatic apical periodontitis according to the American Association of Endodontists (AAE) classification. The treatment plan included multiple-visit root canal therapy followed by endocrown restoration as the definitive treatment (figure 1).

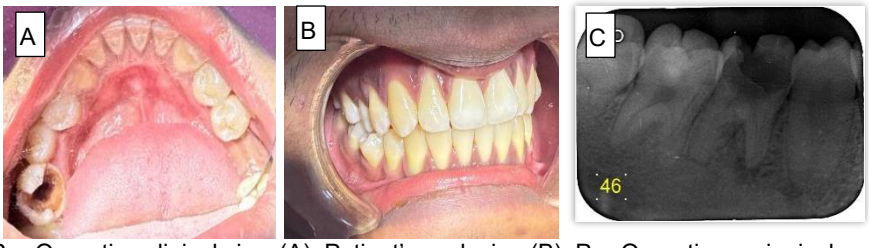

Figure 1. Pre-Operative clinical view (A); Patient's occlusion (B); Pre-Operative periapical radiograph (C)

The treatment was carried out over multiple visits to ensure the success of the endodontic procedure and to achieve an optimal final restorative outcome. During the first visit, subjective and objective examinations were performed, along with clinical photographs and radiographic imaging. After receiving a thorough explanation regarding the tooth condition and treatment procedures, the patient signed an informed consent form.

At the second visit, infected tissue was removed, and the roof of the pulp chamber was opened using an endo access bur until the canal orifices were located. Extirpation of the root canals—mesiobuccal (MB), mesiolingual (ML), distobuccal (DB), and distolingual (DL)—was performed using a #15 barbed broach to approximately two-thirds of the working length. The canals were then irrigated with 2.5% sodium hypochlorite (NaOCl), followed by canal negotiation using K-files of different sizes for each canal: MB with K-file #20, ML with K-file #15, DB with K-file #15, and DL with K-file #20. Working length (WL) was determined using an Electric Apex Locator (EAL), with the following measurements: MB 17.5 mm, ML 17.5 mm, DB 18.5 mm, and DL 19 mm. The working lengths were then confirmed radiographically to obtain the actual canal lengths. The canals were subsequently irrigated again using 0.9% normal saline (NaCl). The access cavity was temporarily sealed with a cotton pellet moistened with eugenol and a temporary restorative material (figure 2).

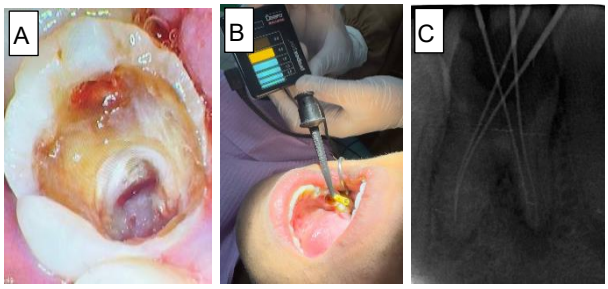

Figure 2. Access Opening (A); Working length determination using EAL (B); Periapical radiograph confirming actual working length with K-file (C)

At the third visit, the temporary restoration was removed, followed by an objective examination. Clinically, tooth #46 presented with a temporary filling on the occlusal surface, and showed negative responses to probing, percussion, and palpation tests. The diagnosis at this stage was previously initiated therapy with normal apical tissues. Biomechanical preparation was performed using ProTaper hand files (Dentsply) with the crown-down technique. The initial preparation was carried out up to two-thirds of the working length, measured

as 11.5 mm for the MB and ML canals, 12 mm for the DB canal, and 12.5 mm for the DL canal, using the ProTaper S1 file, and subsequently continued with S2. The preparation was then completed using files S1 through F3 up to the actual working length. Irrigation was performed between each file change using 17% EDTA Endo Solution, 0.9% NaCl, and 2.5% NaOCl, followed by rechecking the working length using K-files corresponding to the confirmed measurements. After completing the preparation, intracanal medication was applied using pure calcium hydroxide (CaOH) mixed with glycerin, delivered into the canals with a lentulo spiral. The access cavity was then sealed with a temporary restorative material (Cavitron) (figure 3).

Figure 3. Clinical view after biomechanical preparation

At the fourth visit, two weeks later, an objective examination was performed. Clinically, tooth #46 presented with a temporary restoration on the occlusal surface and showed negative responses to probing, percussion, and palpation tests. The diagnosis at this stage remained previously initiated therapy with normal apical tissues. Root canal obturation was performed using Pearl Dent gutta-percha with the single-cone technique. Prior to obturation, gutta-percha cones were fitted according to the working length of each canal and confirmed radiographically. The canals were obturated using ProTaper gutta-percha points and Tiedent sealer (Vladmiva). The master cone sizes and working lengths were as follows: F3 (17.5 mm) for the MB and ML canals, F3 (18.5 mm) for the DB canal, and F3 (19 mm) for the DL canal. After obturation, the gutta-percha was vertically sectioned 2 mm below the canal orifices using a heated plugger. A Type III Glass Ionomer Cement (GIC, GC) was then applied as a lining material at the base of the cavity, and the access cavity was sealed with a temporary restorative material (figure 4).

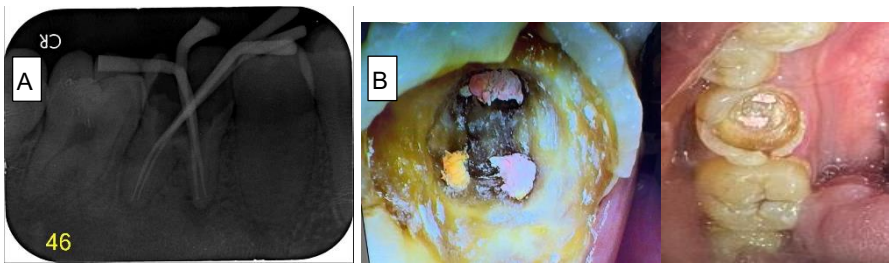

Figure 4. Try in of gutta percha (A); Root canal obturation (B)

At the fifth visit, one week later, the patient returned for follow-up after root canal treatment. Intraoral examination of tooth #46 revealed a temporary restoration on the occlusal surface with negative responses to probing, percussion, and palpation tests. The diagnosis at this stage remained previously initiated therapy with normal apical tissues. Radiographic evaluation showed a hermetic obturation with satisfactory canal filling. Tooth shade selection was performed using a Vita shade guide, and the selected shade was A3. An occlusal record was obtained using red wax. Occlusal reduction of approximately 2 mm was performed, adjusted according to the height of the buccal cusp. A circumferential margin with a width of 1–2 mm was prepared using

a flat-end tapered bur. The preparation was refined to ensure the absence of undercuts, rounded cavosurface angles, and a flat cavity floor. Rewalling of the mesial and lingual walls was performed using Palfique LX5 (Tokuyama Dental Corp) packable composite resin shade A3, following standard restorative procedures, and finished with a superfine bur. A double-impression technique was used for the working model fabrication, employing putty and elastomer materials. The cavity was then temporarily sealed with a temporary restorative material (figure 5).

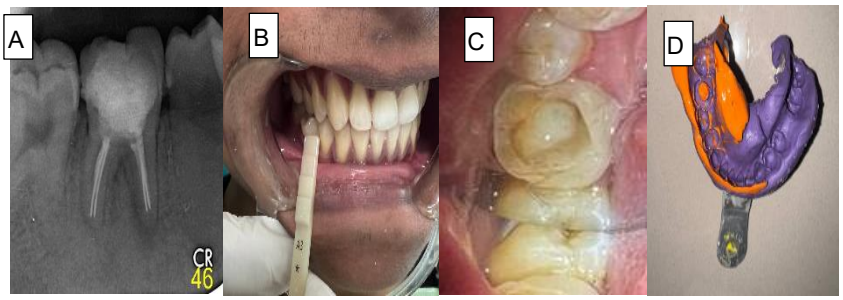

Figure 5. Post obturation control (A); Shade selection (B); Re-walling (C); Double Impression technique (D);

At the sixth visit, cementation of the endocrown was performed using a dual-cure resin cement. The temporary restoration was removed using a scaler, followed by a try-in of the endocrown within the cavity to ensure proper fit. The marginal integrity, color match, and occlusal relationship with the opposing tooth were carefully evaluated. For cementation, the operative field was isolated. 37% phosphoric acid (Any-Etch, MD-Clus) was applied to the cavity walls with a microbrush for 15 seconds, then thoroughly rinsed and gently air-dried to maintain a moist surface. Hexa Bond adhesive was applied to the cavity using a microbrush, air-thinned for 2 seconds, and light-cured for 15 seconds. The same bonding agent was also applied to the internal surface of the endocrown and air-dried. Allcem dual-cure resin cement (FGM Dental Group) was then applied to the fitting surface, and the endocrown was inserted into the cavity. Excess cement was removed using a plastic filling instrument at the cervical area and dental floss at the interproximal contacts. Light-curing was performed for 20 seconds on each surface. The occlusion was checked using articulating paper, followed by finishing and polishing with a superfine bur. The patient received oral hygiene and post-treatment instructions (KIE) and was advised to return for a follow-up evaluation after one week (figure 6).

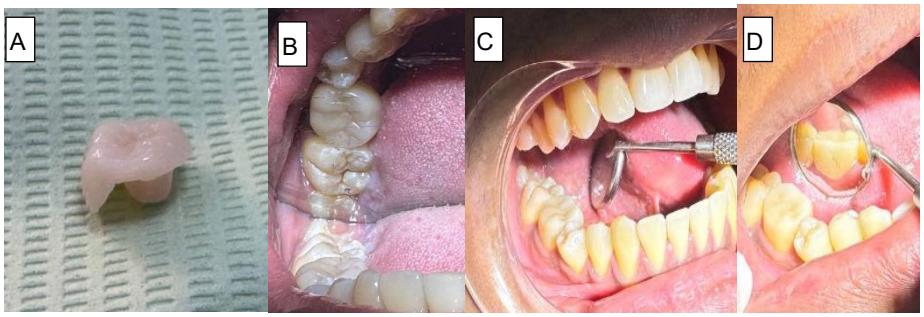

Figure 6. Endocrown (A); Cementation of endocrown showing occlusal (B); buccal (C); and lingual (D) views

At the seventh visit, a follow-up evaluation was conducted. Clinical examination of tooth #46 showed negative responses to probing, percussion, and palpation tests, with grade 0 mobility according to Miller's classification (1950). The restoration demonstrated good marginal adaptation, and no redness or inflammation

was observed in the surrounding mucosal area. The patient reported comfort during mastication and expressed satisfaction with the final restoration. These findings indicate the clinical success of the endocrown restoration, achieving optimal retention, occlusal function, and esthetic outcome (figure 7).

Figure 7. Post cementation control of endocrown

DISCUSSION

The success of root canal treatment is greatly influenced by thorough cleaning, shaping, and obturation of the root canal system, as well as by the selection of an appropriate final restoration. Effective canal shaping facilitates the elimination of most pulp tissue, debris, and microorganisms from the coronal and middle thirds before apical shaping, minimizes debris extrusion, provides better access and control over apical enlarging instruments, and allows improved penetration of irrigants[12]. Therefore, the selection of the crown-down technique is considered highly appropriate for biomechanical preparation, especially in cases with four root canals[13]. Adequate biomechanical preparation plays an important role in achieving optimal root canal obturation. In this case, working length determination and the obturation procedure were performed according to standard endodontic principles. Based on endodontic literature and textbooks, adequate obturation is ideally terminated 0.5–1 mm short of the apical foramen. Clinical and radiographic evaluations showed that the obturation result corresponded to the established working length and that the root canals were well filled without voids[14,15]. Optimal obturation indicates that the objectives of endodontic treatment have been achieved. However, teeth that have undergone endodontic treatment, particularly non-vital teeth, still experience a reduction in structural strength and therefore require special consideration at the restorative stage. In non-vital teeth, the loss of dentin structure and moisture results in increased brittleness, thereby elevating the risk of tooth fracture. Therefore, post-endodontic restorations should not only aim to restore the anatomical form and function of the tooth but also to reinforce the remaining tooth structure and enhance its resistance to fracture[16].

Post-endodontic restoration of posterior teeth can be accomplished using several indirect restorative options, such as inlays, onlays, overlays, post-core crowns, and endocrowns[17]. The selection of the appropriate restorative type depends on the extent of coronal tooth structure loss, esthetic requirements, and the occlusal load received by the tooth. Inlays and onlays are indicated when the loss of hard tissue is minimal and the remaining cavity walls are sufficiently strong to support the restoration. Overlays provide broader protection by covering the cusps of posterior teeth, whereas post-core crowns are commonly used in cases of extensive structural loss involving the pulp chamber and root canal. However, in cases of extensive coronal tissue loss where intraradicular post placement is not required, an endocrown serves as an effective and conservative restorative alternative[11].

The endocrown is an effective and appropriate restorative alternative for posterior teeth that have undergone root canal treatment and exhibit extensive loss of coronal hard tissue. The endocrown concept utilizes the pulp chamber space as a source of mechanical retention, while the adhesive system provides the

primary bond between the restorative material and the tooth structure[18]. This design eliminates the need for additional intraradicular post preparation and allows for the preservation of the remaining dentin structure, making it a conservative and minimally invasive restorative option[19].

The selection of restorative material for an endocrown is crucial, as it significantly influences the long-term success of the restoration. Indirect resin composite or lithium disilicate ceramic materials are commonly used due to their superior mechanical strength, esthetic properties, and adhesive capability to both dentin and enamel following proper etching and bonding procedures. In this case, a dual-cure resin cement was used for the cementation process. This material provides a strong micromechanical bond between the cavity walls and the internal surface of the endocrown, thereby optimizing the marginal integrity and enhancing the overall durability of the restoration[20].

Several studies have demonstrated that endocrowns exhibit higher fracture resistance compared to conventional post-and-core crown restorations. Abo-Elmagd et al. (2020) reported that modifications in endocrown design could significantly improve stress distribution and fracture strength in posterior teeth[21]. Similarly, a study by Ahmad et al. (2021) showed that the clinical success rate of endocrowns reached 90% after two years of function, with no significant difference among various restorative materials. However, clinical success is also influenced by factors such as the quality of tooth preparation, cleanliness of the cavity, appropriate adhesive selection, and occlusal adjustment after cementation[22].

CONCLUSION

One-week post-cementation evaluation revealed good marginal adaptation, with no complaints of pain or sensitivity, and proper occlusal function was maintained. These findings indicate that the endocrown can serve as an effective definitive restoration for mandibular molars following multiple-visit root canal treatment, provided that all clinical procedures are performed accurately and precisely.

Thus, it can be concluded that the endocrown represents a conservative, functional, and aesthetic restorative alternative for posterior teeth following endodontic treatment, particularly in cases with extensive loss of coronal structure but without root involvement. This restoration not only restores morphological integrity and masticatory function, but also provides a favorable long-term prognosis when supported by optimal isolation and bonding techniques.

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to the patient for their kind cooperation during the treatment. The author further thanks the Department of Conservative Dentistry for providing assistance and facilities that contributed to the success of this treatment.

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