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CASE REPORT

ENDODONTIC TREATMENT OF A MOLAR TOOTH RESTORED WITH A FIBER-REINFORCED POST AND PORCELAIN-FUSED-TO-METAL CROWN

Rosita Stefani,[1] Ellen Winarta,[2] Bernard Ongki Iskandar,[1] Dina Ratnasari,[1] Aryadi Aryadi,[3] Natalia Tjingson[4]

ABSTRACT

Introduction: *Endodontically treated teeth (ETT) are reported to have higher risk of fracture due to the loss of tooth structure and integrity following procedures such as canal preparation and obturation. Placement of a post followed by full-coverage crown is a recommended treatment option in such cases.****Aim:*** *This report aims to present the selection and design of a permanent restoration for a mandibular first molar following root canal treatment as a clinical reference.* ***Case and Management:*** *A 41-year-old patient who complained of pain in the lower left molar during mastication. Clinical examination revealed tooth 36 with temporary restoration, which had replaced precious permanent restoration due to patient's discomfort. The patient experienced tenderness on percussion, while palpation and mobility were within normal limits. Radiographic examination showed a radiolucent lesion on the mesial root. Based on the history, clinical, and radiographic findings, tooth 36 was diagnosed as previously initiated. The treatment plan consisted of root canal therapy followed by fiber post placement and porcelain-fused-to-metal (PFM) crown restoration.* ***Conclusion:*** *Placement of fiber post and PFM successfully reinforced remaining tooth structure and restored its functions. This case highlights the importance of adequate restorative management after endodontic procedure was given in order to enhance clinical outcome.*

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INTRODUCTION

The main purpose of root canal treatment is to eliminate infectious agents, manage pathological conditions, and preserve the tooth within the oral cavity.[1] This procedure includes diagnosis, anesthesia, access cavity preparation, canal location, irrigation, root canal preparation, and obturation, in which each step must be performed optimally to maintain the tooth's prognosis.[2] The success of endodontic treatment is also influenced by the choice of post-treatment restoration.[3]

Structural integrity of the tooth is compromised by access preparation and caries history, which in turn lowers resistance and retention for the final restoration.[4] Teeth with

more than 50% loss of their structure, or those with inadequate ferrule, require post-and-core restoration followed by full-coverage restoration.[5] Porcelain-fused-to-metal crowns are the most commonly used restorative option for restoring function in severely damaged teeth (63.8%), particularly in molars (58.1%).[6]

This report aims to present the selection and design of a permanent restoration for a mandibular first molar following root canal treatment as a clinical reference.

CASE MANAGEMENT

A 41-year-old male patient presented with a chief complaint of pain in the lower left tooth when chewing. The tooth had been treated 4 months prior and restored with a permanent filling; however, the patient later sought treatment to have the restoration removed and replaced with a temporary filling. The patient expressed a desire to undergo further treatment. No history of systemic disease was reported.

Clinical examination revealed a large temporary restoration on the occlusal surface, with a brownish-black discoloration apical to the restoration. The tooth was positioned slightly buccally (Figure 1A). Periodontal assessment showed tenderness to percussion, while palpation and mobility were within normal limits without complaints. A periapical radiograph was obtained to evaluate the condition of the tooth and surrounding periapical tissues. Radiographic findings demonstrated a radiopaque area extending from the occlusal surface to the floor of the pulp chamber, as well as within the coronal portion of the root canal. Additionally, radiolucent areas were observed at the apices of both the mesial and distal roots, along with bone loss in the coronal one-third of the root (Figure 1B).

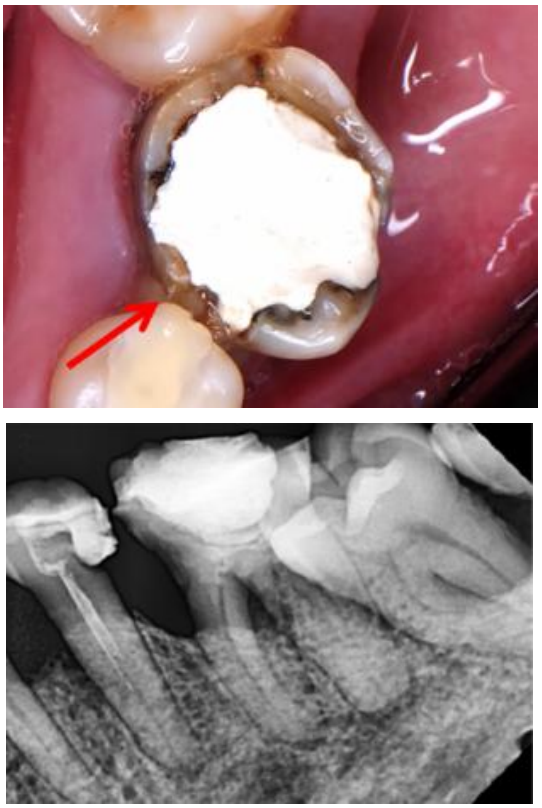

Figure 1. Temporary restoration of tooth 36 (A) and radiographic findings on tooth 36 (B)

Based on the anamnesis, clinical examination, and radiographic findings, the diagnosis for tooth 36 was previously initiated tooth with symptomatic apical periodontitis. The prognosis in this case was considered moderate due to the presence of periodontal disease with horizontal bone loss, as well as poor oral hygiene.

The treatment plan for this patient was root canal retreatment followed by a porcelain-fused-to-metal restoration reinforced with a fiber post on tooth 36. The retreatment procedure was initiated by removal of the temporary restoration and caries excavation (Figure 2A), followed by placement of an artificial wall using composite resin. Rubber dam isolation was then applied, and

root canal exploration was performed using K-files #8 and #10 to the estimated working length based on radiographic evaluation. The canals were irrigated with 5.25% sodium hypochlorite (NaOCl) at each instrument change.

Definitive working length was determined using an apex locator and confirmed radiographically with a #10 K-file, yielding lengths of 19 mm for the mesiobuccal and mesiolingual canals, and 20 mm for the distal canal (Figure 2B). Glide path preparation was performed using a ProGlider file (#16/.02), followed by irrigation with 5 mL of 5.25% NaOCl. Canal preparation was then carried out using a crown-down technique with ProTaper Next instruments (X1 #17/.04 for the mesiobuccal canal, X2 #25/.06 for the mesiolingual canal, and X3 #30/.06 for the distal canal). Apical patency was maintained and verified using a #10 K-file at each instrument change (Figure 2C), with continued irrigation using 5.25% NaOCl.

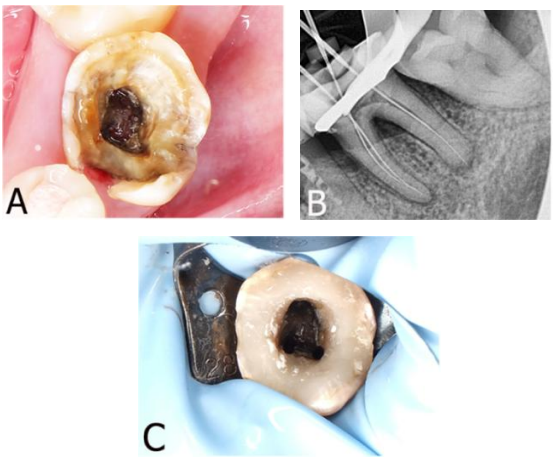

Figure 2. Removal of temporary restoration and infected tissue (A), radiographic confirmation of definitive working length (B), orifice of tooth 36 after preparation (C)

Upon completion of instrumentation, final irrigation with NaOCl was performed, followed by 17% EDTA and a rinse with distilled water. The canals were then dried with paper points, medicated with calcium hydroxide as an intracanal dressing, and temporarily sealed.

At the second visit, shade selection for the crown restoration was performed using a shade guide, and shade A3.5 was obtained (Vita Lumin Vacuum). Rubber dam isolation was applied, followed by removal of the temporary restoration, irrigation with 5.25% NaOCl, and drying of the root canals with paper points. ProTaper Next gutta-percha cones (X2 and X3) were disinfected by immersion in 5.25% NaOCl for 1 minute, dried with air from a three-way syringe, rinsed with alcohol, and dried again. Trial fitting of the gutta-percha cones was performed and confirmed radiographically (Figure 3A).

The procedure was continued with final irrigation using 5.25% NaOCl with agitation, followed by rinsing with distilled water, then irrigation with 17% EDTA with agitation, and a final rinse with distilled water. The canals were subsequently dried with paper points. The gutta-percha cones (X2 and X3) were again disinfected using 5.25% NaOCl, air-dried, rinsed with alcohol, and dried. The cones were then inserted, cut using a heat carrier to the apical one-third, and compacted. The canals were further obturated using injectable gutta-percha and compacted (Figure 3B). Excess gutta-percha was then removed to approximately 2 mm below the canal orifice.

Post space preparation was carried out in the distobuccal canal using a precision drill with

a diameter of 1.25 mm, measured and marked with a stopper according to the planned post length. The post position was confirmed radiographically (Figure 3C). Subsequently, 37% phosphoric acid etching was applied for 20 seconds to the prepared orifice areas (mesiobuccal, mesiolingual, distolingual, and distobuccal) and the pulpal floor, then rinsed with water, followed by application of a bonding agent using a microbrush.

A fiber post was cemented into the distobuccal canal using a self-adhesive resin cement applied to both the post and canal walls. The post was inserted with a gentle rotational motion to the predetermined length, held in position, and light-cured for 20 seconds, followed by additional curing for 20 seconds from the buccal, lingual, mesial, and distal aspects. Radiographic confirmation was performed prior to core build-up (Figure 3D). A composite resin core was subsequently fabricated to obtain a total preparation height of 4 mm. Due to the limited remaining coronal tooth structure, ferrule establishment was achieved through gingivectomy, as described below.

The residual coronal tooth structure was insufficient to provide an adequate ferrule effect for definitive restoration. Therefore, gingivectomy was performed using an electrocautery unit to expose additional supragingival tooth structure and facilitate margin deep elevation. This procedure enabled the establishment of an adequate ferrule while preserving the biological width.

The tooth was then prepared for a porcelain-fused-to-metal (PFM) crown. An occlusal reduction of 1.5 mm was performed using a round-end wheel diamond bur, followed by axial reduction of the buccal, lingual, mesial, and distal surfaces with a cylindrical diamond bur to create a circumferential butt-joint finish line (Figure 3E). Following gingivectomy, the definitive finish line was positioned at the gingival margin. Finally, a retraction cord was placed on tooth 36, followed by double impression technique for the prepared tooth and an impression of the opposing arch using irreversible hydrocolloid material.

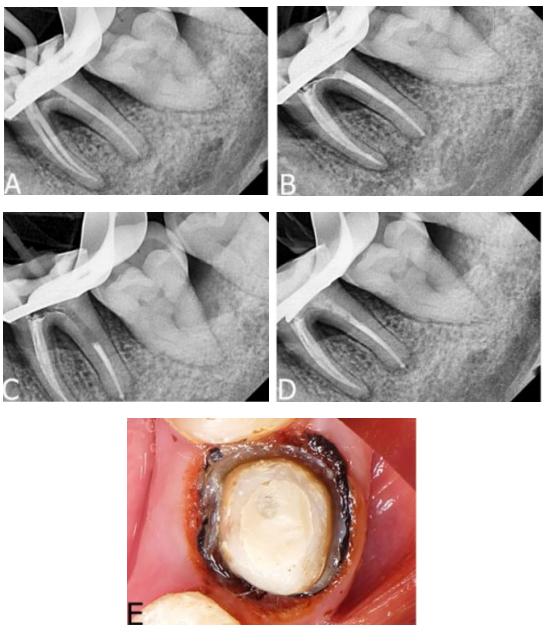

Figure 3. Trial fitting of gutta-percha in the mesiobuccal, mesiolingual, and distal canals (A), obturation using the warm vertical condensation technique (B), post space preparation in the distal canal (C), fiber post cementation (D), and crown preparation (E)

At the third visit, the procedure was initiated with subjective and objective examinations, which indicated an asymptomatic

condition. A crown try-in was then performed to evaluate marginal fit, proximal contacts, and occlusal contacts. Once deemed satisfactory, the crown was cemented using type I glass ionomer cement, and excess cement was removed (Figure 4A). The result was subsequently confirmed radiographically (Figure 4B). The final step included occlusal and articulation adjustment.

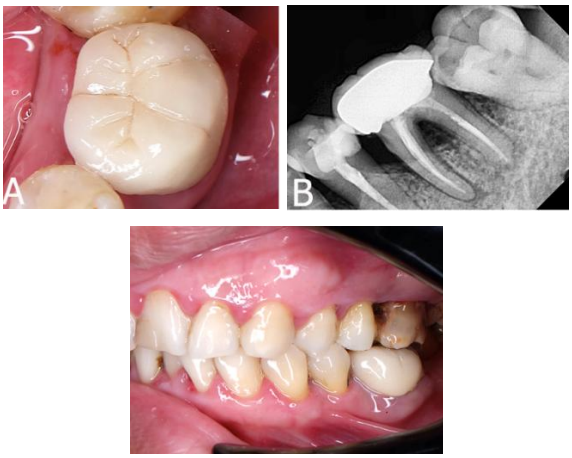

Figure 4. Cementation of the porcelain-fused-to-metal crown restoration (A), radiographic confirmation (B), and occlusion after restoration (C)

DISCUSSION

Teeth following root canal treatment have been reported to be more susceptible to fracture compared to vital teeth.[7] Such teeth often present with extensive structural loss, which compromises their long-term survival within the oral cavity.[8] Several factors contribute to improving fracture resistance in these cases, including masticatory forces, type of restoration, ferrule effect, and the quality and quantity of remaining tooth structure.[9]

Loss of the marginal ridge in teeth with Class II mesio-occluso-distal (MOD) cavities reduces coronal structural resistance by up to 63%.[10] Tooth type is also a critical determinant of fracture resistance, as posterior teeth are more prone to fracture due to their proximity to the fulcrum (temporomandibular joint), resulting in higher occlusal load during mastication.[11]

To guide the selection of an appropriate endodontically treated tooth, the Tooth Restorability Index (TRI) proposed by McDonald and Setchell was utilized.[12] The TRI evaluates the height, thickness, and distribution of the remaining axial dentine following the removal of existing restorations. Each axial wall is assigned a score ranging from 0 to 3, where a score of 0 indicates the absence of axial dentine coronal to the finish line; 1 indicates inadequate remaining dentine with a wall thickness of less than 1.5 mm; 2 indicates questionable restorability with dentine wall thickness between 1 and 3 mm; and 3 indicates adequate height, thickness, and circumferential distribution of the remaining axial dentine.[13]

All six axial walls—mesiobuccal, mesial, distobuccal, mesiolingual, distal, and distolingual—were evaluated individually. The cumulative score was subsequently calculated and interpreted according to the TRI criteria. Teeth with a total score of 12 or greater are generally considered suitable for direct restoration, whereas teeth with a score below 9 are recommended for restoration with a cast post-and-core system.[12]

In the present case, all axial walls were assigned a score of 1, except for the mesiolingual wall, which received a score of 0 due to the absence of remaining coronal dentine. This resulted in a total TRI score of 10. Based solely on the TRI, the tooth demonstrated questionable restorability and did not meet the threshold requiring a cast post-and-core restoration.

Nevertheless, considering the extensive structural loss and the compromised mesiolingual wall, a cast post-and-core restoration was selected to provide additional retention and support for the definitive prosthetic restoration.

To compensate for the loss of structural stability in endodontically treated teeth, post placement is recommended to enhance the ferrule effect.[10] The ferrule effect plays a crucial role in improving the mechanical properties of such teeth by minimizing crown bending under masticatory forces. Ferrule is defined as a vertical band of tooth structure at the gingival aspect of the crown preparation that provides resistance against root fracture. Therefore, preservation of adequate dentin above the cementoenamel junction is a significant factor in increasing fracture resistance in post-restored teeth.[14] The ferrule height should be adjusted according to the remaining tooth structure, with a minimum of 1.5–2 mm. Another study reported that a 2 mm ferrule provides more favorable stress distribution along the tooth structure.[15]

Metal posts have traditionally been used due to their good adaptation to the root canal and high fracture resistance. However, they present several drawbacks, including high rigidity, unfavorable stress distribution, and poor esthetics. To overcome these limitations, fiber posts have been developed as an alternative. Fiber posts offer improved esthetics and are easier to manipulate clinically.[16] Additionally, resin-based fiber posts can be removed relatively easily with minimal trauma by direct drilling.[17]

The conventional approach for restoring endodontically treated teeth after post placement is a full-coverage restoration using a porcelain-fused-to-metal (PFM) crown.[8] This recommendation is supported by Suksaphar et al., who reported that full-coverage crowns demonstrate better clinical outcomes compared to direct composite restorations.[18] Metal-based crowns have shown a survival rate of up to 73.3% after 25 years.[19] PFM crowns remain a primary choice for rehabilitating structurally compromised teeth, consisting of a metal substructure that provides mechanical strength and fracture resistance, veneered with porcelain to enhance esthetics.[20]

The definitive restorative material was selected based on the functional demands of the posterior dentition. As a mandibular first molar, the tooth is subjected to high occlusal loads and repetitive masticatory forces, necessitating a restoration with sufficient fracture resistance and wear durability. Porcelain-fused-to-metal (PFM) was therefore chosen because its metal substructure provides superior mechanical strength while minimizing the risk of catastrophic fracture associated with all-ceramic restorations, particularly in structurally compromised endodontically treated teeth. Furthermore, previous studies have demonstrated that PFM restorations exhibit favorable long-term clinical performance in posterior teeth owing to their high fracture resistance, wear resistance, and predictable survival under functional loading.[13,21]

This study is limited in its ability to substantiate the long-term effectiveness and durability of full-coverage porcelain-fused-to-metal restorations, as extended follow-up and longitudinal evaluation of the restoration have not yet been conducted. Consequently, the clinical performance, survival rate, and potential

complications associated with the restoration over time cannot be comprehensively assessed, highlighting the need for further long-term studies.

CONCLUSION

Endodontically treated teeth are more susceptible to fracture, particularly in cases of MOD cavities with extensive coronal structure loss. Therefore, to enhance the success of root canal treatment, an adequate definitive restoration is required. The selection of a porcelain-fused-to-metal crown is based on its ability to compensate for the loss of tooth structure and provide sufficient mechanical strength.

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