QUALITY IMPROVEMENT IN DENTAL AND MEDICAL KNOWLEDGE, RESEARCH, SKILLS AND ETHICS FACING GLOBAL CHALLENGES

Edited by
Armelia Sari Widyarman, Muhammad Ihsan Rizal,
Moehammad Orliando Roeslan & Carolina Damayanti Marpaung

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The management of post-endodontic treatment using fiber-reinforced composite: A case report

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ABSTRACT: Post-endodontic treatment restoration with appropriate material is an essential factor. In this case, we choose a biomimetic approach. The dentin was then replaced with a biobased material, and the enamel was replaced with a composite restoration. In order to minimize the stress created in the hybrid layer, the biobased was additionally strengthened with polyethylene fiber at its base. A short fiber-reinforced composite resin that exhibits mechanical qualities similar to dentin was used to repair the dentin core. A 55-year-old female patient complained about a spontaneous throbbing pain in the upper left tooth. Upon completion of clinical assessment and test, tooth #24 was diagnosed with irreversible pulpitis. A non-surgical root canal procedure was carried out using an aseptic technique. Crown-down preparation and copious irrigation of 5.25% sodium hypochlorite were followed by root canal disinfection. The obturation was done using the warm vertical compaction technique. Due to the amount of remaining dental hard tissue, the direct restoration using fiber-reinforced composite was chosen as the optimum treatment for the final restoration of tooth #24. Short fiber reinforced composite can be used as a treatment of choice for direct posterior restoration in post-endodontic treatment.

1 INTRODUCTION

Due to the tremendous loss of coronal tooth structure, such as loss of tooth structure, including cusps, ridges, and the arched pulp chamber roof, endodontically treated teeth are structurally compromised. The most frequent causes of this structural loss are caries, trauma, access cavity preparation, and radicular preparation. The long-term survival of root canal-treated teeth was determined by the endodontic procedure's success, the amount of surviving dentinal thickness, and post-endodontic restoration.

Restoring the endodontically treated teeth with adequate material that can resist fracture is a crucial aspect to be considered during post-endodontic restoration. These chemically and structurally compromised teeth could be strengthened as a result of dentin bonding methods, which are stronger than earlier fiber-reinforced composite materials (Garlapati *et al.* 2017).

The development of non-restorable fractures in the coronal regions of the teeth is one of the leading causes of the extraction of endodontically treated teeth (ETT). This can be explained by the different biomechanical characteristics between ETT and vital teeth. Thus, coronal restoration of ETT is crucial in increasing the survival rate of these teeth. The use of

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posterior resin composites in coronal restorations has increased due to their desirable qualities, such as the ability to be applied in a single clinical visit and their acceptable aesthetic and mechanical attributes (Lukarcanin *et al.* 2022).

On the other hand, the capacity of the tooth to resist fracture following endodontic treatment is affected by large cavity designs and access cavities. Therefore, it is essential to choose a suitable material that can resist fracture. The ability to endure fracture has been demonstrated for the impact of post-obturation fiber-reinforced composite (FRC) on ETT (Shah *et al.* 2021).

Direct applications of resin composite materials have many benefits but minor drawbacks, namely, polymerization shrinkage properties. Additionally, they might not have adequate mechanical properties, particularly in high-stress locations like posterior teeth that are subject to chewing forces (Lukarcanin *et al.* 2022).

2 CASE REPORT

A 55-year-old lady visited RSGM-P Universitas Trisakti with a chief complaint of spontaneous throbbing pain in the upper left tooth. Tooth 24 was diagnosed with irreversible pulpitis with symptomatic apical periodontitis (Figure 1). Preoperative radiograph showed the presence of radiolucent at the distal of tooth 24, extending up to the pulp horn (Figure 4a). Clinical examination on tooth 24 revealed a deep carious lesion with pulp involvement on the occlusal and distal tooth surface with tenderness on percussion. Endodontic treatment is indicated, and patient consent was obtained.

Figure 1. Clinical image tooth #24.

3 CASE MANAGEMENT

During the first visit, tooth 24 was isolated with a rubber dam, and the carious lesion was removed using high-speed round bur (Mani, Japan) (Figure 2A). The orifice location was located. The distal wall was constructed to provide a coronal seal and the easiest tooth isolation inter-appointment. Root canal preparation started with k-file #8 as the initial file, and the working length was determined for all canals using the electrical apex locator and confirmed by radiograph. Preparation continues with k-file #10 and #15 and finishes with NiTi rotary up #25/.06 (M3-Pro Gold, United Dental, Shanghai, China) follows the canal curvature. Apical patency was checked with k-file #8 in an alternating manner between shaping files and irrigation steps. The canal was copiously irrigated with 5.25% sodium

hypochlorite (NaOCL) (Fibryanto *et al.* 2018) (NaOCL, Onemed, Surayaba) and 17% ethylenediaminetetraacetic acid (EDTA) (EDTA, Onemed, Surabaya) with closed-ended tip 30G syringe, and the canals are dried using paper point (Ali *et al.* 2022). Intracanal medicament with calcium hydroxide (Ca(OH)2) (UltraCal, Ultradent, USA) was placed.

During the second visit, the canal was copiously irrigated with 5.25% sodium hypochlorite (NaOCL) (NaOCL, Onemed, Surayaba), 17% ethylenediaminetetraacetic acid (EDTA) (EDTA, Onemed, Surabaya), and a final rinse with sodium hypochlorite 5.25% (NaOCL) (NaOCL, Onemed, Surabaya) was performed before drying the canals with a paper point. Irrigation was activated by an activator (Endoactivator, Dentsply Maillefer, Switzerland). Try-in Gutta Percha #25/.06 master cone was confirmed by radiograph. Obturation was done using a resin-based sealer (AH Plus, Dentsply Maillefer, Switzerland) with a warm vertical condensation technique (Figure 2b) and a final intra-oral periapical radiograph was taken to assess the quality of obturation (Figure 4b).

Intracanal retention was obtained using flowable bulk-fill (3M, USA) (Figure 3a), and application of short fiber-reinforced composite (EverX Posterior; GC; Tokyo, Japan) until dentinal area (Figure 3b, c), followed by the placement of packable composite (Garoushi *et al.* 2018) (Figure 3d). The occlusion was checked using articulating paper and shim stock articulating paper prior to finishing and polishing (Figure 3e). The final intra-oral periapical radiograph was taken to assess the quality of coronal restoration (Figure 4c).

Figure 2. a. Clinical image removing caries, b. Obturation.

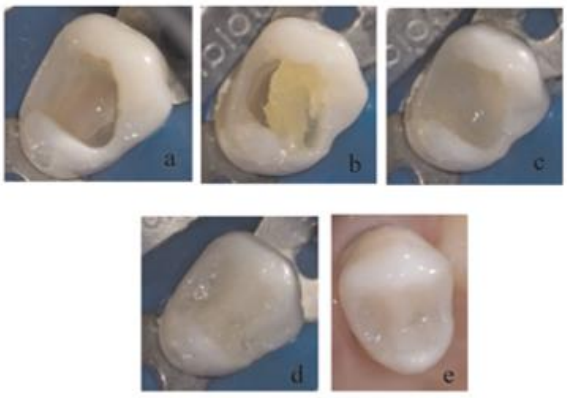

Figure 3. a. Intracanal retention, b,c. Short-fiber reinforced composite placement, d. Finishing, e. Polishing.

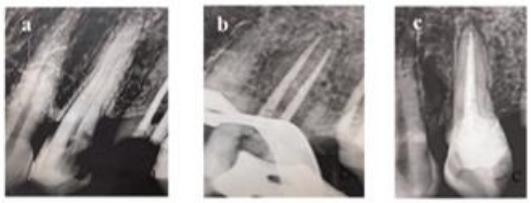

Figure 4. a. Radiograph image preoperative, b. Radiograph image obturation, c. Radiograph image postoperative.

4 DISCUSSION

The restoration of endodontically treated teeth (ETT) requires the knowledge of the tooth has decreased flexibility and loss of tooth morphology. When selecting the material of choice for the restoration, these factors should be considered (Shah *et al.* 2021). It is well known that ETT is weak and more prone to fracture than vital teeth because of altered dentinal mechanical characteristics, moisture content, and loss of proprioception. However, there are also studies advocating that ETT is not different from vital teeth in terms of fracture strength (Of & Sciences 2020).

In this case, the restoration of ETT was not using post and was restored with direct composite. It is usually possible to restore premolars without using posts when it still has both buccal and palatal walls. It is not always necessary to insert a post during the treatment when one or two cavity walls have been lost. Instead, a core buildup would serve as the foundation restoration (Baba *et al.* 2017).

A post-endodontic restoration should have an adequate coronal seal and be able to transmit and distribute functional stresses. Significant effects on tooth fracture resistance are caused by the qualities of the restorative materials and the dimensions of the cavity (Garlapati *et al.* 2017a). Since they can be applied in a single appointment and are relatively affordable, direct composite restorations are highly preferred (Garlapati *et al.* 2017b), specifically fiber-reinforced composites (Of & Sciences 2020).

Fiber-reinforced composite is used for this case to strengthen restoration on premolar tooth with structural weaknesses. The kind of fibers utilized, how they are oriented, how much resin is used, and how well the fibers and resin adhere to one another, all have a significant impact onto reinforce materials (Mangoush *et al.* 2021).

One of the important drawbacks of composite restorations is microleakage. The stresses produced at the restoration-tooth contact as a result of various factors, including polymerization shrinkage, repeated fatigue cycles brought on by masticatory pressures, and temperature changes in the oral cavity, led to this condition. Consequently, FRCs could successfully decrease microleakage during the restoration (Mangoush *et al.* 2021).

The success of coronal restorations is substantially impacted by polymerization shrinkage. The use of low-viscosity composite resins is advised to overcome this issue and decrease or buffer the stress brought by occlusal pressure (Anatavara *et al.* 2016; Pedram et al. n.d.; Ziskind *et al.* 2005). The interfacial integrity of the bulk-fill composite to the cavity floor was improved by adding a fiber-reinforced increment at the base of the deep preparation. The fiber-reinforced increment will protect the bonded contact and act as a shrinkage stress breaker in deep dentin. (Sadr *et al.* 2020).

For endodontically treated teeth, a basic classification system for determining how much tooth structure still exists is known as teeth with an occlusal cavity or a Mesio Occlusal (MO)/Disto Occlusal (DO) cavity with thick remaining axial walls ($\geq$ 2 mm). Moderately destructed teeth were characterized as teeth with a MO/DO cavity with thin remaining axial

walls (<2mm), and severely destructed teeth were characterized as teeth with tooth structure loss beyond a Mesial Occlusal Distal (MOD) cavity (Abu-Awwad 2019).

Fractures occur more commonly in restorations made of materials with poor flexural strength. However, fiber-reinforced composites have enough flexural strength and modulus of elasticity against functional forces in the mouth (Lukarcanin *et al.* 2022). Endodontically treated teeth's fracture resistance is increased when a core material made of fiber-reinforced composite is used, but not to the same extent as an intact tooth's fracture resistance (Shah *et al.* 2021). It appears to be a good option for restoring teeth that have undergone endodontic treatment (Divyasree *et al.* 2022).

Lukarcanin *et al.* (2022) found that the difference between the indirect and direct composite resin groups in fracture strength values was insignificant (Lukarcanin *et al.* 2022). According to a study, there is no difference comparing direct composite resin and indirect restoration in terms of the survival or success of teeth that have undergone endodontic treatment during the short term, 2.5–3 years (de Kuijper *et al.* 2021).

The benefit of fiber-reinforced composite is that it is thought of as a material that has such an impact on polymerization shrinkage, while also improving the composite's physical qualities and possibly serving as a method to prevent cracks. The mechanical characteristics and reinforced capability of FRC used in dentistry rely on the type of fiber, its orientation in relation to the load, its location within the restoration, its volume, and how well it has been impregnated with the resin matrix (Sadr *et al.* 2020).

Because of the distinctive fiber and polymer variety in short fiber reinforced composite (SFRC) materials, these materials have a wide range of improved mechanical and physical properties. For the coronal restorations of teeth with substantial cavities in high-stress bearing sites, the biomimetic restorative technique is used and is indicated as an alternative to direct restoration. This approach combines SFRC as a substructure with particle filler composite (PFC) on top. However, emphasizing the material's proper application is important to reap the benefits of reinforcement and durability (Garoushi *et al.* 2018).

5 CONCLUSION

Fiber-reinforced composite can be an option for posterior direct restoration after endodontic treatment. In addition, fiber-reinforced composite can be used to increase fracture resistance and minimize microleakage of endodontically treated teeth.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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