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Fiber Reinforced Composite in Endodontically Treated Tooth: Case Report

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ABSTRACT

Background(s): Restoration of endodontically treated tooth has always been a matter of restorative practice in dentistry. Endodontically treated tooth has a tendency to fracture because of pulp is removed and significant loss of dental structure. Biomimetic restoration using fiber reinforced composite (FRC) as post-obturation material has the ability to resist fracture and good aesthetic.

Case report(s): A 21-year-old male presented with discomfort in eating and has no symptoms. The patient has no history of systemic disease. The intraoral clinical examination showed deep caries on the right mandibular first molar, negative on vitality, percussion, and bite test. A radiographic examination was done and showed the image of chronic apical periodontitis.

Case Management(s): The access cavity was prepared under rubber dam isolation. Root canal preparation was done by crown-down technique followed by irrigation using 5.25% sodium chloride and intracanal medicament with calcium hydroxide. The obturation procedure was conducted after seven days, using a warm vertical compaction technique and calcium hydroxide-based sealer. Considering the remaining hard tissue, a direct composite using FRC as dentine-replacing material was done.

Conclusion(s): Direct restoration using FRC can be an option for restoration of the mandibular right second molar tooth with endodontically treated.

Keywords: fiber reinforced composite, endodontically treated tooth, biomimetic restoration

BACKGROUND(s)

Root canal treatment aims to treat pulp necrosis and damaged teeth so that the teeth can still function.¹ Root canal treatment significantly reduces the tooth's strength.² Caries lesion, cavity preparation for access opening, trauma, and root canal preparation frequently cause structural loss, such as loss of tooth structure, including cusps, ridges, and pulp chamber's arched roof.^{3,4} Endodontically treated tooth may also fracture for a variety of reasons, including the use of chemicals and intracanal medications, as well as non-iatrogenic factors such as the occurrence of repeated pathology, teeth position, and the impact of aging on the dentine tissues.^{3,4} Teeth are prone to occlusal loading because of normal oral functions like chewing, biting, and some parafunctional habits.² Therefore, in order to avoid tooth fractures, it is crucial to equip them with sufficient and acceptable restorative materials after endodontic treatment.³

In order to allow for a reliable restoration, the tooth must still have enough good tooth structure after root canal therapy.⁴ Obturated teeth can be fixed directly by putting a restorative material within the tooth, or indirectly by producing a composite resin, cast metal, or ceramic restoration.⁵ Dental restorations are created to restore the teeth's aesthetic functionality and serve as a gauge of the procedure's success.^{1,6} Not every tooth that has had a root canal needs to be restored with a complete crown.⁴ The tooth can be promptly repaired with a composite resin to get good results if there is still a lot of hard tissue present.⁴ The study of the structure and operation of dental tissues as models for the design and production of materials, as well as procedures for the restoration of teeth, is known as biomimetic restorative dentistry.⁷ The goal of restorative treatment is not able to distinguish between the natural tooth and artificial tooth because of its perfection, such as composite.⁸ Composite resin has several advantages, such as aesthetic properties because it can be customized to match the color of a patient's teeth and is more conservative to the tooth structure due to its adhesive system without needing extensive tooth preparation.⁹

Since posterior teeth are subjected to severe masticatory loads, the composite resin used for restorations on them needs to be wear- and fracture-resistant as well as have a good radiopaque effect on the radiography picture.¹⁰ As previously stated, endodontically treated teeth are prone to breakage, which can be minimized by utilizing fiber-reinforced composite (FRC) materials.³ The combination of composite resin with FRC is performed on posterior teeth because the fiber will

increase the strength of the composite resin restoration.¹¹ In comparison to other materials, using FRC in combination with composite resin can lead to a smaller micro gap.⁷

CASE REPORT(s)

A 21-year-old male patient who came to RSGM-P Universitas Trisakti presented with chief complaint of discomfort in eating and has no other symptoms. The patient has no history of systemic disease. The intraoral clinical examination showed deep caries on the right mandibular first molar, negative on vitality, percussion, and bite test (Figure 1A). A radiographic examination was done and showed the image of chronic apical periodontitis (Figure 1B). Tooth #46 was diagnosed with pulp necrosis with asymptomatic apical periodontitis. Root canal treatment was planned and informed consent was achieved.

On the first visit, tooth #46 was isolated using a rubber dam (Rubber dam, Duradam) for moisture control and better access. The carious tooth was removed using round high-speed bur and carbide bur (Mani, Japan). Access cavity was prepared using endo access bur and refined using Endo Z bur (Mani, Japan). Canals were negotiated using pre-curved k-file #6 (Dentsply, Switzerland) until apical foramen and working length were determined using the apex locator (Tri Auto ZX II, Morita). Periapical radiographs were then performed to confirm the measured working length. The preparation was then continued with k-file #8, #10, #15, and NiTi rotary (M3 Pro Gold, Hympari) up to #25/.06 according to the root canal. K-file #8 was used to check apical patency while switching between shaping files and irrigation processes. The canals were thoroughly irrigated with 5,25% sodium hypochlorite (NaOCl) (NaOCl, Onemed) and 17% Ethylenediaminetetraacetic acid (EDTA), using a closed-ended tip of 30G (Endo Needle, OneMed) and were dried with paper points. Gutta-percha master cone #25/.06 (UDG, Hympari) fitting was done in accordance with the working length and was confirmed with a periapical radiograph. Intracanal medicament was then applied using calcium hydroxide (Ca(OH)₂) (UltraCal, Ultradent) for 1 week.

On the second visit, the canals were extensively rinsed with 5,25% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA), and 2% chlorhexidine gluconate (NaOCl, Onemed). An active irrigation system was used (Endoactivator, Dentsply). The canals then being

dried with paper points. Obturation was carried out using a gutta percha master cone and a calcium hydroxide-based sealer (Sealapex, Kerr) utilizing a warm vertical condensation approach and confirmed with a periapical radiograph (Figure 2A,B).

Restoration using Class I composite resin and fiber reinforced composite follows. 37% phosphoric acid was used to etch the cavities on the enamel for 15 seconds and the prepared dentin for 10 seconds (Figure 2C). After that, the area was washed with water. The entire cavity was lightly coated with the seventh generation of the bonding material (Kerr, Ivoclar) (Figure 2D). The cavity was exposed to the wind for 10 seconds, followed by 20 seconds of light curing. Application of orifice barrier using bulk fill flow composite (Tetric Ceram, Ivoclar Vivadent) and filled with about 2 mm then polymerized using a light cure for 20 seconds (Figure 2E).. The cavity was coated with fiber-reinforced composite (EverX, GC), which was allowed to cure for 20 seconds (Figure 2F). Bulk fill shade A3 with a low shrinkage flowable base (Xtra base, VOCO) was applied, smoothed with a composite carving tool, and polymerized with a light cure for 20 seconds (Figure 2G). Composite resin filling with an incremental layering technique with shade A2 (Filtek TM Z250, 3M), and shaped according to tooth anatomy #46 cusps per cusp and polymerization one by one with light cure 20 seconds (Figure 2H). Application of glycerin gel on the tooth surface and polymerization with a light cure for 20 seconds (Figure 2I). Occlusion and articulation were checked using articulating paper. Finishing and polishing with a fine-finishing burr with a flame (Mani, Japan) and a twist composite polisher (Eve Diacomp, Fondaco) (Figure 3J).

DISCUSSION(s)

Endodontically treated teeth have decreased coronal and radicular tissue due to dental cavities, operational procedures, root canal preparation, and prior restoration and restorative operations that necessitate considerable reduction of the tooth, resulting in further tissue loss.⁵ Access cavity preparation during endodontic therapy affects the structural viability of the dental tissues and further weakens the tooth, making it more brittle and susceptible to fracture.^{3,4} The amount of dental tissue still present is crucial because fracture resistance is impacted by disrupted marginal integrity or significant cavities.² If the tooth has dentin walls surrounding the access cavity, the structure will weaken minimally.⁴ This discovery highlights the need of preserving as

much healthy tissue as practicable during endodontic and restorative operations, as the structural stability of a tooth is strongly dependent on its anatomical form and quantity.¹² The majority of molars will not require posts for restoration since they have relatively big pulp chambers that provide retention and resistance.⁴ In this case, the cavity of the right mandibular first molar was Class I, and the remaining dentin was adequate so direct restoration was chosen for the final restoration using a combination of composite and fiber-reinforced composite (FRC).

The use of composite as a biomimetic restoration in the treatment of posterior teeth has proven to be very effective.¹³ Due to their excellent aesthetics, minimally invasive tooth preparations, and acceptable durability, composite resins are commonly used in dental practices.⁸ However, an important consideration during post-endodontic restoration is needed, using of the proper material that can resist fracture to restore teeth that have completed endodontic treatment.¹¹ FRC materials are used to help protect endodontically treated teeth that are prone to breakage.³ Composites reinforced with polyethylene fibers assist in altering the stress pattern and transferring stresses. Glass fibers provide adequate aesthetics and reinforcement capabilities.² FRC offers strong flexure strength and fatigue strength, a modulus of elasticity similar to dentin, good aesthetic characteristics, is not corrosive, is biocompatible, and can distribute pressure more uniformly under pressure to prevent fracture.¹⁴ When compared to composite alone, FRC has better fracture toughness (2.9 MPa m^{1/2}), flexural strength (124 MPa), and modulus (9.5 GPa).⁷ EverX posterior is a novel material with irregular and discontinuous fibers that improve the capacity to support a load, act as a replacement for dentin, minimize crack initiation and strengthen the structure.² Higher crack resistance is achieved when flowable composites are combined with fiber than when flowable composites are used alone.¹⁵ Based on prior research, in this case is using the combination of flowable composite, FRC, and packable composite. A substructure of continuous two-direction or short random FRC inserted beneath the particle filler composite resin can increase its capacity to support a load.⁵ It is composed of a resin matrix, random orientation E-glass fibers, and inorganic particle fillers.⁷ These fibers control stress by absorbing and distributing stresses to the tooth when a heavy load is applied to the dental tissue. Due to the monoblock produced between dentin and restorative material, this is achievable.³ It was also mentioned that fibers impact the reduction of the C-factor and the improvement of micro tensile bond strength.¹¹ On the other hand, the bulk-fill material that was used in this case has the ability to accelerate the application and

reduce chairside time and polymerization shrinkage, hence reducing the micro gap risk on the margins and enhancing the material's adaptability.⁷ The inclusion of glass fibers within the resin composite may vary the material's elastic modulus, hence altering the stress distribution and transmission to residual hollow walls.¹² In addition, as the tensile properties of the restorative material at the restoration contact increase, the deformation of dental structures reduces.¹²

CONCLUSION(s)

Composite resin restoration with fiber-reinforced composite may be a choice for the biomimetic restoration of the right mandibular first molar tooth that has been endodontically treated in order to improve the mastication strength of posterior teeth.

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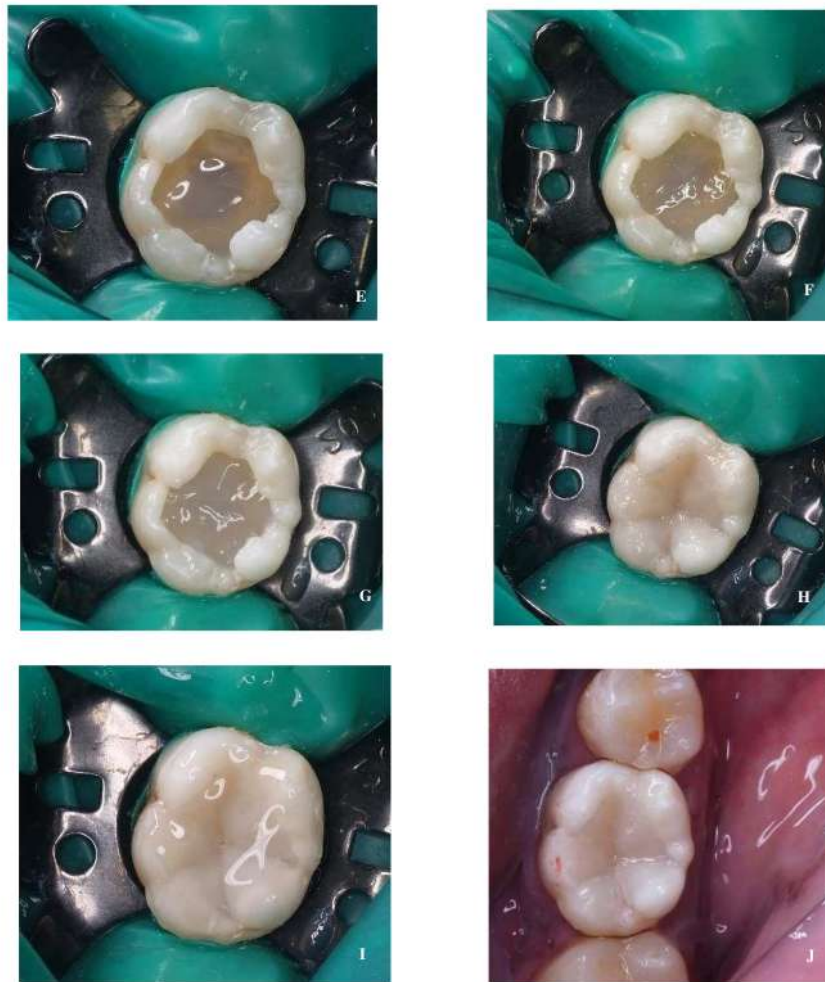
FIGURES



Figure 1A. Preoperative Intraoral (occlusal view), **B.** Preoperative radiograph



Gambar 2A. Obturation, **B.** Obturation radiograph, **C.** Etching, **D.** Bonding,



Gambar 3E. Coronal seal, **F.** Fiber-reinforced composite **G.** Low shrinkage flowable base composite bulk fill, **H.** Composite restoration using packable composite

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