

Case Report

Direct Fiber-Reinforced Composite Onlay for Post-Endodontic Restoration of the Maxillary First Premolar

¹Regina Meilin Syahputri, ²Noor Hafida Widyastuti, ²Cahyani

¹Undergraduate Student, Faculty of Dentistry, Universitas Muhammadiyah Surakarta, Indonesia

²Department of Conservative Dentistry, Faculty of Dentistry, Universitas Muhammadiyah Surakarta, Indonesia

Received date: October 1, 2025

Accepted date: April 15, 2026

Published date: April 30, 2026

KEYWORDS

Direct onlay, fiber-reinforced, root canal treatment



DOI: 10.46862/interdental.v22i1.12668

ABSTRACT

Introduction: Pulp necrosis is a pathological condition of the dental pulp that requires root canal treatment. Post-endodontic restoration is required to support the success of the root canal treatment, restore dental function, and improve aesthetics. In this case, the final restoration employed was a direct composite onlay with fiber reinforcement.

Case: A 30-year-old female patient presented to the Dental Hospital of Soelastri, Universitas Muhammadiyah Surakarta (UMS), with a chief complaint of a carious tooth on the upper right jaw, which had been present for the past year. The diagnosis was established based on subjective, objective, and supplementary examinations. The diagnosis was pulp necrosis with apical periodontitis in tooth 14.

Case Management: The patient underwent root canal treatment in accordance with the principles of the endodontic triad. Subsequently, the final restoration was placed as a direct composite onlay with fiber reinforcement. A direct composite onlay with fiber reinforcement is a restoration that can be utilized following root canal treatment. The advantages of this restoration include its resistance to masticatory forces, favorable aesthetics, and color resemblance to dentin.

Conclusion: Restoration after root canal treatment is crucial to ensure the success of endodontic therapy. The use of a direct composite onlay with fiber reinforcement represents one of the options for the final restoration following root canal treatment.

Corresponding Author:

Regina Meilin Syahputri
Undergraduate Student, Faculty of Dentistry
Universitas Muhammadiyah Surakarta, Indonesia
Email: j530235109@student.ums.ac.id

How to cite this article: Syahputri RM, Widyastuti NH, Cahyani. Direct Fiber-Reinforced Composite Onlay for Post-Endodontic Restoration of the Maxillary First Pre-molar. *Interdental Jurnal Kedokteran Gigi*. 2022;22(1):181-188. doi: 10.46862/interdental.v22i1.12668

Copyright: ©2026 [Regina Meilin Syahputri](#) This is an open access article distributed under the terms of the Creative Commons Attribution-ShareAlike 4.0 International License. Authors hold the copyright without restrictions and retain publishing rights without restrictions.

INTRODUCTION

The prevalence of pulp and periapical diseases in Indonesia is relatively high, as reported by Riskesdas 2018, which indicated a sharp increase from 23.2% in 2007 to 57.6% in 2018.¹ Pulpal diseases can be caused by various irritant factors that lead to damage of the dental pulp tissue, which may progress from inflammation to necrosis and tissue degeneration, and even damage to healthy tissue.²

Inflammation of the pulp progressing to pulp necrosis necessitates root canal treatment (RCT).³ Root canal treatment aims to cleanse the root canal of debris, necrotic tissue, and microorganisms, rendering the tooth functional and asymptomatic.⁴ The endodontic triad represents the main principles of root canal treatment, encompassing biomechanical preparation, sterilization, and hermetic root canal filling.⁵

Teeth after root canal treatment tend to become more brittle and susceptible to fracture due to low internal moisture resulting from reduced water content. Furthermore, the removal of dentin tissue during RCT renders the remaining hard tissue more fragile.⁶ Consequently, post-root canal treatment restorations must be meticulously planned and evaluated based on the remaining tooth structure, tooth position, functional requirements, and aesthetic considerations.⁷

Alongside technological advancements in the field of conservative dentistry, there is an integration of composite resin with fiber reinforcement in posterior teeth using a direct technique. Direct composite onlay restorations are selected taking into account the number of visits, laboratory costs, and superior aesthetics, as they can replicate the color and translucency of natural teeth.⁸ The fiber reinforcement utilized is Ever-X posterior, manufactured by GC, which contains e-glass fibers (9%) with a length of approximately 1.4 mm. This

material exhibits mechanical properties such as high wear resistance, fracture resistance, a color closely resembling dentin, and favorable aesthetics.⁹ Moreover, fiber-reinforced composites offer the advantage of reducing masticatory stress and transmitting it to other tooth-supporting structures, thereby enhancing the retention and strength of the dental restoration.¹⁰

CASE

A 30-year-old female patient presented to the Soelastrri Dental and Oral Hospital, Universitas Muhammadiyah Surakarta, with a chief complaint of dental caries. Subjective examination revealed a decayed tooth in the upper right jaw for one year, and no prior treatment had been performed on the affected tooth. The patient had a history of gastritis, with no known drug or food allergies.

Objective examination included both extraoral and intraoral assessments. Extraoral findings were within normal limits, with no abnormalities detected. Intraoral examination revealed a cavity on the disto-occlusal aspect extending to the pulp chamber of tooth 14, with the following test results: probing (-), palpation (-), percussion (-). Pulp vitality testing using ethyl chloride yielded a negative (-) response, and the electric pulp test showed a value of 40.

Supporting examination involved periapical radiography, which demonstrated a radiolucent area on the disto-occlusal aspect extending to the pulp chamber of tooth 14, along with widening of the periodontal ligament at the apical third of tooth 14. Based on the subjective, objective, and supporting examinations, including periapical radiography, it was concluded that the patient had pulp necrosis accompanied by apical periodontitis in tooth 14. The cavity had not extended below the cervical line and remained confined to the crown.



Figure 1. Clinical photograph of tooth 14



Figure 2. Periapical radiograph of tooth 14

CASE MANAGEMENT

First Visit: Following subjective, objective, and supporting examinations, the patient was provided with Communication, Information, and Education (KIE) regarding their dental condition, including the state of the tooth, diagnosis, treatment plan, treatment procedures, and potential complications. The patient agreed to and understood the information conveyed and was subsequently requested to sign the informed consent form. Subsequently, an estimated working length measurement was performed using radiography, subtracting 1 mm, yielding an estimated working length of 22 mm for the palatal root and 22.5 mm for the buccal root.

The subsequent procedure was an open access preparation, commencing with the preparation of

the required instruments and materials, including a mouth mirror, explorer, cotton pliers, excavator, metal round bur, endo access bur, diamendo bur, rubber dam kit, and endodontic files (K-files size #8, #10, and #15). Isolation of the operating field was achieved using a rubber dam to prevent bacterial and salivary contamination and to enhance clinician visibility. Carious tissue removal was performed using an excavator for soft carious tissue and a metal round bur for hard carious tissue. Access opening was performed using an endo access bur with an "ovoid" outline form in a buccopalatal direction until the root canals were located, followed by access enlargement using a diamendo bur.

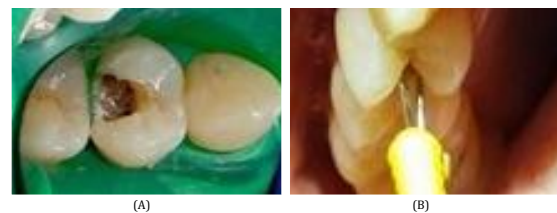


Figure 3. (A) Isolation of the operating field with rubber dam placement, (B) Tooth 14 following open access procedure

The orifices of the buccal and palatal root canals were located using a smooth broach. Pulp debridement was then performed using a barbed broach inserted to two-thirds of the estimated working length until the root canals were free from debris and necrotic tissue. Root canal irrigation was carried out using an irrigation syringe with 2.5% sodium hypochlorite (NaOCl), 2 mL, until the canal was free of necrotic tissue, and the root canal was subsequently dried using paper points. Determination of the actual working length was performed using the direct observation method by inserting a file to the estimated working length, fixing it with a stopper, and taking a radiograph. The results indicated the actual working length to be

22.5 mm for the buccal root and 22 mm for the palatal root.

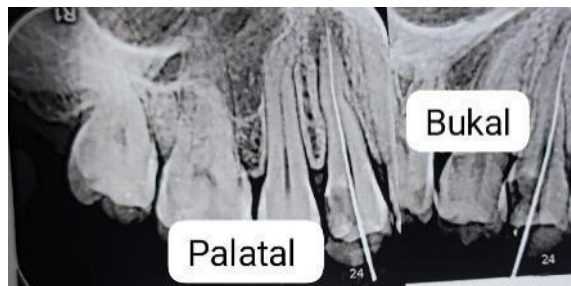


Figure 4. Measurement of actual working length using periapical radiography

Root canal dressing was performed by applying calcium hydroxide powder ($\text{Ca}(\text{OH})_2$) mixed with iodine glycerin on a glass plate using a stainless-steel spatula until a paste consistency was achieved. This combination is used because it provides potent antimicrobial activity and promotes the healing of periapical tissues. Calcium hydroxide ($\text{Ca}(\text{OH})_2$) is widely used as an intracanal medicament due to its multiple biological properties, including its role as an antimicrobial agent, its ability to dissolve organic tissue, promote healing in the presence of periapical lesions, inhibit inflammatory root resorption, and stimulate hard tissue formation. Its high pH (approximately 12.5) creates a strongly alkaline environment that is detrimental to most endodontic microorganisms, contributes to the inactivation of bacterial endotoxins, and facilitates the breakdown of necrotic tissue remnants. The addition of iodine glycerin further enhances the antimicrobial efficacy through the broad-spectrum antiseptic properties of iodine, while glycerin functions as a viscous vehicle that improves handling characteristics and enables sustained release and deeper diffusion of the medicament into the dentinal tubules. Therefore, this combination ensures effective intracanal disinfection and provides a favorable environment for periapical tissue healing between treatment visits.

This was inserted into the buccal and palatal root canals using a low-speed handpiece and lentulo spiral until the canals were thoroughly coated. The patient then received a temporary restoration (Cavition®, GC). The patient was scheduled for a follow-up visit after one week.

Second Visit: The second visit commenced with a subjective examination, revealing no complaints from the patient. Objective examination findings were negative for probing, percussion, and palpation. Subsequently, rubber dam isolation was placed, followed by root canal preparation using the crown-down technique with ProTaper Hand Use instruments (Dentsply). This began with coronal preparation using Sx and S1 ProTaper Hand Use instruments (Dentsply) at two-thirds of the working length in both the buccal and palatal roots. The subsequent stage involved apical preparation using ProTaper Hand Use instruments (Dentsply) of sizes SX, S1, S2, F1, and F2. Root canal irrigation was performed after each file change using 2.5% NaOCl (2 mL) and 17% EDTA solution, interspersed with saline solution. Upon completion of the preparation stages for the buccal and palatal root canals, the canals were cleaned with irrigation using 2% chlorhexidine solution. Root canal dressing was then performed by applying calcium hydroxide powder ($\text{Ca}(\text{OH})_2$) mixed with iodine glycerin to a paste consistency, inserted using a lentulo spiral mounted on a low-speed handpiece. The patient received a temporary restoration (Cavition®, GC) and was scheduled to return for treatment after one week.

Third Visit: At the third visit, subjective examination results indicated no complaints from the patient. Objective examination findings were negative for probing, percussion, and palpation. A bacterial test was conducted, specifically the perhydrol test using hydrogen peroxide (H_2O_2) solution, yielding a

negative result (no air bubbles), thereby permitting root canal obturation.

Root canal obturation was performed using the single cone technique with gutta-percha and endomethasone sealer. A gutta-percha try-in was performed according to the working lengths of the buccal and palatal roots, corresponding to the final ProTaper file used (F2): for the buccal root, gutta-percha F2 with a working length of 22.5 mm; for the palatal root, gutta-percha F2 with a working length of 22 mm. The try-in was evaluated radiographically to ensure the obturation material was precisely positioned at the apical constriction. Subsequently, the gutta-percha was sectioned 2 mm below the orifice, and vertical condensation was performed using a hand plugger. A lining material, type I glass ionomer cement (GIC), was applied, and a temporary restoration was placed using Cavit.



Figure 5. Periapical radiograph image of the obturation result



Figure 6. Result of gutta-percha cutting after obturation



Figure 7. Result of GIC lining application after gutta-percha cutting

Fourth Visit: One week following obturation, a follow-up visit was conducted. Subjective examination revealed no complaints from the patient. Objective examination findings were negative for probing, percussion, and palpation, and no tooth mobility was observed. Subsequently, the final restoration was performed using a direct composite restoration with fiber-reinforced reinforcement.

The final restoration involved removing enamel not supported by dentin, preparing the cavity floor to be flat, creating a bevel on the cavosurface line angle, and smoothing all sharp axial wall angles. The entire prepared cavity was then cleaned using a cavity cleanser. A sectional matrix was placed to adapt the contour on the proximal aspect. 37% phosphoric acid (acid etchant) was applied to the cavity for 20 seconds on enamel and 15 seconds on dentin, followed by rinsing and drying. Next, a fifth-generation bonding agent was applied to the cavity area using a microbrush and light-cured for 20 seconds. Short fiber-reinforced resin-based composite (everX Posterior) was applied to the cavity floor to a thickness of half the cavity depth and light-cured for 20 seconds. The subsequent stage involved applying packable composite into the cavity using a plastic instrument with an incremental oblique technique until shaped

according to the tooth anatomy, followed by light curing for 20 seconds.



Figure 8. Application of short fiber-reinforced resin-based composite (everX Posterior)

The restoration result was finished using a yellow-band bur and polished using silicone rubber points. Occlusion was then checked by asking the patient to bite on articulating paper; thickened colored areas indicating interference were addressed by further finishing and polishing using a yellow-band bur and silicone rubber points.



Figure 9. Result of direct restoration of tooth 14

DISCUSSION

Pulp necrosis is a pathological condition characterized by the death of the dental pulp tissue, characterized by the death of the pulp, while apical periodontitis is a periapical lesion caused by infection from pulp necrosis.¹¹

The treatment for pulp necrosis is root canal treatment. In this case, root canal treatment employs the crown-down technique. This technique commences from the coronal portion of the root

canal and proceeds toward the apex, aiming to eliminate coronal constriction and reduce root canal curvature, thereby allowing the apical third to be accessed more freely. The preparation creates a larger taper, enabling irrigation solutions to penetrate deeper, thus removing pulp debris and necrotic tissue before reaching the apical third, which reduces the risk of debris extrusion into the apical area and minimizes the potential for working length changes.¹²

Irrigation serves to cleanse the root canal of dentin and necrotic tissue.¹³ In this case, irrigation utilizes saline, NaOCl, 17% EDTA, and 2% chlorhexidine. Saline mainly functions to flush out debris generated during instrumentation and acts as an intermittent irrigant. NaOCl has advantages as an irrigating solution; it dissolves organic tissue, acts as an antibacterial agent by eliminating *Enterococcus*, *Actinomyces*, *C. albicans*, and other microorganisms that are difficult to eradicate from the root canal, and exhibits bleaching action, lubricates the canal, is readily available, and is economical.¹⁴

Dressing in this case involves the application of calcium hydroxide powder ($\text{Ca}(\text{OH})_2$) with iodine glycerin, which is inserted and evenly distributed across all root canal walls to ensure diffusion into the dentinal tubules and root canal. Calcium hydroxide ($\text{Ca}(\text{OH})_2$) has multiple uses as an antimicrobial agent, dissolving organic tissue, promoting healing if periapical tissue lesions are present, inhibiting inflammatory resorption, and stimulating hard tissue formation.¹⁵

Before obturation, a bacterial test in the root canal is necessary to determine if there are signs of active infection within the root canal.³ Obturation is a critical stage and a cause of failure in some cases due to non-hermetic obturation. In this case, obturation uses the single cone technique, employing the last gutta-percha cone corresponding to the

last preparation file. The single cone technique is chosen because it exhibits microleakage and good apical penetration, similar to other techniques. Furthermore, filling can be conducted more quickly and easily, saving time and being more comfortable for both the patient and the operator.¹⁶

Root canal treatment is successful, but teeth that have lost a substantial amount of enamel and dentin structure require final restoration. In this case, the final restoration uses a direct onlay with fiber reinforcement.

This has the advantage of withstanding masticatory pressure in posterior teeth; composite resin with a fiber base is increasingly used in conservative dentistry due to its good strength and aesthetic properties, as it has a translucent color resembling natural tooth.¹⁷

Fiber-reinforced material consists of fibers with a diameter of 7–10 μm , composed of fiber components mixed with a resin polymer matrix. These two materials have interrelated functions: the fiber acts as reinforcement against pressure, while the matrix distributes pressure/load between fibers, thereby absorbing pressure. Therefore, fibers used as a lining material in cavities are believed to enhance fracture resistance and strengthen restorations after root canal treatment.¹⁸

Based on various studies, short fiber-reinforced resin-based composites can strengthen tooth structure, particularly in teeth after root canal treatment with significant loss of enamel and dentin.¹⁹ Fibers exhibit better strength and lower shrinkage compared to other composites.²⁰ The fibers they contain can inhibit fractures and provide higher flexural strength, and pressure can be distributed to other tissues.²¹ Furthermore, it can be used to replace dentin because it is "similar" in

terms of elastic modulus, load-bearing capacity, and crack resistance.¹⁰

CONCLUSION AND SUGGESTIONS

Root canal treatment aims to eliminate infection and microorganisms within the root canal system. An appropriate final restoration following root canal treatment is necessary to restore tooth function and aesthetics. A direct onlay with fiber-reinforced reinforcement is used as the final restoration due to its ability to withstand masticatory forces and distribute them to the supporting dental tissues, thereby enhancing the retention and strength of the dental restoration. Direct composite onlay restorations are selected taking into account the number of visits, laboratory costs, and superior aesthetics, as they can replicate the color and translucency of natural teeth.⁸ The fiber reinforcement utilized is Ever-X posterior, manufactured by GC, which contains e-glass fibers (9%) with a length of approximately 1.4 mm. Fiber-reinforced material consists of fibers with a diameter of 7–10 μm , composed of fiber components mixed with a resin polymer matrix. These two materials have interrelated functions: the fiber acts as reinforcement against pressure, while the matrix distributes pressure/load between fibers, thereby absorbing pressure. This approach improves the long-term prognosis and overall success of the treatment.

ACKNOWLEDGMENTS

We would like to express our gratitude to the supervising dentist and colleagues who have provided guidance and assistance in completing this case.

REFERENCES

1. Arvetona AV, Pratama IWAW. Prevalensi pulpitis reversible di poliklinik gigi Puskesmas. *JPP (Jurnal Kesehatan Poltekkes Palembang)*. 2024; 19(2): 154–9. Doi: 10.36086/jpp.v19i2.2416
2. Widyastuti NH. *Penyakit Pulpa dan Periapikal beserta Penatalaksanaannya*. Surakarta: Muhammadiyah University Press; 2017.p. 270.
3. Widyastuti NH, Ningsih JR, Faza MA. Restorasi Mahkota Jacket Dengan Pasak Fiber Pasca Perawatan Saluran Akar Pada Kasus Nekrosis Pulpa Gigi Insisivus Lateral Maksila. *Prosiding Dental Seminar Universitas Muhammadiyah Surakarta Collaborative Dentistry*. 2025 Jul 3, Surakarta: Indonesia.
4. Bintang QA, Fatmawati DWA, Rakhmadian RD, Lestari S. Tingkat keberhasilan perawatan saluran akar pada gigi nonvital di RSGM Universitas Jember Tahun 2016. *ARTERI: Jurnal Ilmu Kesehatan* 2022; 3(3): 95–102. Doi: 10.37148/arteri.v3i3.224
5. Kartinawanti AT, Khoiruzza Asy'ari A. Penyakit pulpa dan perawatan saluran akar satu kali kunjungan: Literature review. *Jurnal Ilmu Kedokteran Gigi* 2021; 4(2): 64–72. Doi: 10.23917/jikg.v4i2.15872
6. Sidiartha IFN, Wiswananta PP. Penatalaksanaan fraktur Ellis kelas III 11 dengan pulpektomi dan restorasi mahkota pasak. *Interdental Jurnal Kedokteran Gigi (IJKG)* 2020; 16(2): 28–33. Doi: 10.46862/interdental.v16i2.910
7. Wiratama IP, Yolanda Y. Perawatan saluran akar satu kali kunjungan dengan restorasi full coverage pada gigi premolar kedua kiri rahang bawah: Laporan kasus. *SONDE (Sound of Dentistry)* 2021; 6(1): 34–44. Doi: 10.28932/sod.v6i1.3794
8. Alam MD, Ningsih JR. Restorasi Resin Komposit Pada Gigi-Gigi Anterior Maksila. *Prosiding Dental seminar 7 Universitas Muhammadiyah Surakarta Collaborative Dentistry*. 2025, July 3.
9. Ranka S, Rao AS, Shah U, Solanki D, Pawar AM, Reda R, et al. Comparative evaluation of two different fiber-reinforced composite materials in class 1 post-endodontic restorations in molars—A randomized clinical study. *Materials* 2022; 15(21): 7858. Doi: 10.3390/ma15217858
10. Alshabib A, Jurado CA, Tsujimoto A. Short fiber-reinforced resin-based composites (SFRCs); Current status and future perspectives. *Dental Materials Journal* 2022; 41(5): 647–54. Doi: 10.4012/dmj.2022-080
11. Pasril Y, Rustam A. Endodontic Treatment of pulp necrosis with apical periodontitis: A case report. *IMUNITY*. 2025; 2(1): 2025. Doi: 10.18196/imunity.v2i1.65
12. Giovanni A, Nahzi MYI, Adhani R. Perbandingan efektivitas penggunaan teknik preparasi saluran akar konvensional dan crown down terhadap ekstrusi debris apikal. *Dentin Jurnal Kedokteran Gigi* 2022; 2022(2): 71–5. Doi: 10.20527/dentin.v6i2.6389
13. Mohammadi Z, Shalavi S, Kinoshita JI, Giardino L, Gutmann JL, Banihashem Rad S, et al. A review on root canal irrigation solutions in endodontics. *Journal of Dental Materials and Techniques* 2021; 10(3): 121–32. Doi: 10.22038/jdmt.2021.56003.1431
14. Hafida Widyastuti N, Difa Y. Perawatan saluran akar dan restorasi porcelain fusi metal pada gigi fraktur mahkota nekrosis pulpa. *Jurnal Ilmu Kedokteran Gigi* 2021; 4(1): 1–5. Doi: 10.23917/jikg.v4i1.15849
15. Adisetyani Y, Mulyawati E. Perawatan saluran akar pada gigi parulis dengan restorasi resin komposit diperkuat pita fiber. *MKGK* 2016; 3(2): 156–62. Doi: 10.22146/mkgk.33760.
16. Putri Lesmana RA, Fatriadi F. Endodontic treatment on fracture mandibular anterior tooth with crown down. *Dentino: Jurnal Kedokteran Gigi* 2024; 9(1): 110. Doi: 10.20527/dentino.v9i1.18872
17. Dhamayanti I, Nugraheni T. Restorasi fiber reinforced composite pada gigi premolar pertama kanan mandibula pasca perawatan saluran akar. *Majalah Kedokteran Gigi Indonesia* 2013; 20(1): 65. Doi: 10.22146/majkedgiind.8382
18. Mahardika C, Hernawatiningsih H, Kristanti Y, Mulyawati E. Restorasi onlay komposit pasca perawatan endodontik pada gigi molar pertama kanan atas : laporan kasus. *E-Prodenta Journal of Dentistry* 2022; 6(1): 611–6. Doi: 10.21776/ub.eprodenta.2022.006.01.9
19. Aljarboua R, Alshihry R, Alkhaldi H, Al Marar F, Aljaffary M, Almana M, et al. Effect of fiber-reinforced composite placement site on fracture resistance of premolar teeth: an in vitro study. *Clin Cosmet Investig Dent* 2024; 16: 255–66. Doi: 10.2147/CCIDE.S461134
20. Kınıkoğlu İ, Kayacı ŞT, Arslan H. Short fiber reinforced composite on fracture strength of immature permanent anterior teeth with simulated regenerative endodontic procedures: an in vitro study. *Journal of Clinical Pediatric Dentistry*. 2023; 47(6): 171–77. Doi: 10.22514/jocpd.2023.074
21. Hazar E, Hazar A. Effect of long glass fiber orientations or a short-fiber-reinforced composite on the fracture resistance of endodontically treated premolars. *Polymers (Basel)* 2024; 16(9): 1289. Doi: 10.3390/polym16091289