

Fiber-reinforced direct restoration of an endodontically treated molar using polyethylene ribbon and short fiber-reinforced composite: a case report

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Cite this article as: Aydın Hoş C. Fiber-reinforced direct restoration of an endodontically treated molar using polyethylene ribbon and short fiber-reinforced composite: a case report. *J Dent Sci Educ.* 2026;4(4):168-171. doi:10.51271/JDSE-0094

Received: 31.08.2026

Accepted: 15.10.2026

Published: 28.10.2026

ABSTRACT

Restoring endodontically treated posterior teeth with extensive tissue loss is challenging because of reduced structure and shrinkage stress. This report describes a residual-wall-thickness-guided fiber-reinforced direct restoration. A maxillary left first molar in a 45-year-old male, root-canal treated and restored nine years earlier without fiber reinforcement or cuspal coverage, showed cavitated secondary caries at both proximal margins. Caries removal left a wide mesio-occluso-distal cavity with a 1.5-mm residual palatal wall. Under rubber dam, the canal orifices were sealed and a polyethylene ribbon with a short fiber-reinforced composite base placed. The thinned palatal cusps were covered, the enamel-intact buccal cusps preserved, and the surface finished with supra-nano composite. At 1 month all World Dental Federation (FDI) parameters were clinically excellent; at 6 months only surface staining changed, without fracture or retention loss. These findings document early clinical behavior only; longer follow-up is needed before recommending this approach over indirect restorations.

Keywords: Root canal therapy, composite resins, dental restoration failure, polyethylene, short-fiber-reinforced composites

INTRODUCTION

Endodontically treated posterior teeth are biomechanically weakened by cumulative tissue loss from access preparation and from the caries or restorations that necessitated it; under occlusal load, cuspal deformation and the risk of unrestorable vertical fracture rise.¹ Mesio-occluso-distal (MOD) cavities are particularly detrimental, removing both marginal ridges and leaving tall, unsupported cusps. MOD preparation alone has been reported to reduce relative cuspal stiffness by 63% in extracted premolars,² so this configuration is among the most biomechanically compromised in the posterior dentition.

Secondary caries is a leading reason for replacing posterior direct restorations,³ and each replacement cycle removes more tooth structure, leaving the tooth weaker than before.^{4,5} The conventional alternative, indirect cuspal-coverage restoration, sacrifices further sound tissue and adds cost and visits.⁶

Direct composites are threatened by polymerization shrinkage stress at the adhesive interface, greatest in cavities with a high configuration factor (C-factor), and by functional stress in the remaining tissue. An ultra-high-molecular-weight polyethylene ribbon bridges the cavity, redistributing load and arresting crack propagation.⁷ Short fiber-reinforced composites (SFRCs) with randomly oriented E-glass fibers deflect cracks and provide a dentin-replacing core of intermediate elastic modulus.⁸ This report describes a fiber-reinforced direct restoration of such a molar; its contribution is a residual-wall-thickness-driven decision to cover only the

thinned palatal cusps while preserving the enamel-intact buccal ones, documented with standardized criteria.

CASE REPORT

This report follows the CARE guidelines.⁹ A 45-year-old male (American Society of Anesthesiologists class I), taking no regular medication and reporting no parafunctional habit, presented for a routine check-up. The maxillary left first molar (tooth 26) had been root-canal treated about nine years earlier and restored with direct composite, without fiber reinforcement or cuspal coverage.

The tooth was asymptomatic, with normal percussion and palpation, physiological mobility, and probing depths ≤ 3 mm. The antagonist tooth 36 was restored and in stable occlusal contact, excursions were canine-guided, and no wear facets were present. Cavitated secondary caries was present at both proximal margins with loss of the mesial marginal ridge (**Figure 1a**); preoperative panoramic radiography (**Figure 1b**) showed a root canal filling extending to the radiographic apex, with no periapical radiolucency and no evident interproximal bone loss. No preoperative periapical radiograph of this tooth was available, and panoramic imaging does not permit a reliable assessment of interproximal bone levels or of the density of the root canal filling; the preoperative radiographic status is therefore presented as a cropped detail of the panoramic image in the region of tooth 26, and both points are acknowledged among the limitations. Caries risk was

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high because of the active proximal lesions and interproximal plaque retention; fluoride varnish, interdental cleaning, and six-monthly recall were prescribed.

Because both proximal lesions extended beneath the restoration, replacement rather than repair was indicated. Indirect cuspal-coverage options and a fiber post were discussed; owing to cost and time constraints the patient chose the single-visit fiber-supported approach, including possible cuspal coverage, and consented in writing after being told the long-term prognosis is not established. The timeline is given in [Table 1](#).

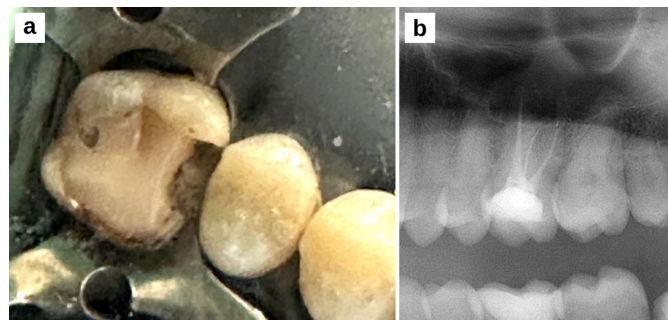


Figure 1. Preoperative documentation of tooth 26. (a) Clinical view after rubber-dam isolation, showing cavitated secondary caries at both proximal margins and loss of the mesial marginal ridge. (b) Cropped detail of the preoperative panoramic radiograph in the region of tooth 26, showing the root canal filling extending to the radiographic apex with no periapical radiolucency

The palatal cusps were therefore reduced 2 mm, the buccal cusps were left intact, and a sectional matrix with a separating ring (Quickmat Deluxe) was used sequentially for the mesial and distal walls. Enamel was selectively etched with 35% phosphoric acid (Promida Proetch Etching Gel) for 30 s, and a self-etch adhesive (Tokuyama Bond Force II) was applied and light-cured per manufacturer instructions. The canal orifices were sealed with a flowable composite (Polofil NHT Flow), creating a flat base for the ribbon. A 3-mm-wide polyethylene ribbon (InFibra) was cut into two pieces, wetted with the same adhesive uncured, and adapted mesio-distally (one onto the pulpal floor and one against the reduced palatal wall) then light-cured ([Figure 2b](#)). A 4-mm short fiber-reinforced composite (everX Posterior) was applied in two 2-mm increments to limit shrinkage stress and light-cured for 20 s each, serving as a dentin-replacing base extending beneath the covered palatal cusps ([Figure 2c](#)). The occlusal and external surfaces were completed with a 2-mm layer of shade A2 supra-nano spherical composite (Estelite Posterior), each increment cured for 20 s with an LED unit delivering 1400 mW/cm² (Vega). The restoration was finished and polished, and occlusion verified in centric and excursive movements ([Figure 2d](#)).

Evaluations used FDI World Dental Federation (FDI) criteria¹⁰ and were performed by the treating dentist. The tooth was asymptomatic at both recalls; at 1 month, all FDI criteria

Table 1. Case timeline

Time	Event
2017 (per patient dental records)	Root canal treatment of tooth 26 and direct composite restoration without fiber reinforcement or cuspal coverage
2 February 2026	Routine examination: cavitated secondary caries detected at both proximal margins; caries risk assessed as high, preventive measures prescribed
2 February 2026 (same visit)	Fiber-reinforced direct restoration: selective enamel etching, orifice sealing, two 3-mm polyethylene ribbon strips, 4-mm short fiber-reinforced composite base, palatal cuspal coverage, 2-mm covering composite
2 March 2026	One-month recall: all FDI parameters scored 1 (clinically excellent)
3 August 2026	Six-month recall: surface staining scored 2 (clinically good), all other parameters 1, restoration repolished

FDI: World Dental Federation

All procedures were completed in one visit (materials, manufacturers, and locations in [Table 2](#)). After infiltration anesthesia, the field was isolated with a rubber dam. Removal of the old restoration and caries produced a wide MOD cavity with loss of both marginal ridges, interruption of the oblique ridge, and supragingival margins. Caliper measurement at the cavity floor gave residual wall thicknesses of 1.5 mm palatally and 2.5 mm buccally, the latter enamel-intact ([Figure 2a](#)).

(esthetic: surface luster, staining, form; functional: fracture, marginal adaptation, wear; biological: post-op sensitivity, caries recurrence) were scored 1. At 6 months, only surface staining scored 2; all others remained 1, and the restoration was repolished. Proximal and occlusal contacts were maintained ([Figure 3a](#)), with no periapical or sub-restoration radiolucency ([Figure 3b](#)). The patient reported satisfaction with appearance and function.

Table 2. Materials used

Purpose	Trade name	Manufacturer
Rubber-dam clamp	Carl Martin Clamp (No. 8)	Carl Martin, Solingen, Germany
Sectional matrix	Quickmat Deluxe sectional matrix systems	Polidentia, Lugano, Switzerland
Selective enamel etching (35% phosphoric acid)	Promida Proetch Etching Gel	Promida Dental Materials, Eskişehir, Türkiye
Self-etch adhesive	Tokuyama Bond Force II	Tokuyama Dental, Tokyo, Japan
Flowable composite (orifice barrier)	Polofil NHT Flow	Voco, Cuxhaven, Germany
Polyethylene ribbon (3 mm, two strips)	InFibra	Bioloren, Saronno, Italy
Short fiber-reinforced composite	everX Posterior	GC Corporation, Tokyo, Japan
Covering composite (shade A2)	Estelite Posterior	Tokuyama Dental, Tokyo, Japan
LED curing unit (1400 mW/cm ²)	Vega	Dentac, İstanbul, Türkiye
Finishing discs	Sof-Lex	3M Oral Care, St. Paul, MN, USA
Polishing wheels	Twist Dia	Kuraray Noritake Dental, Tokyo, Japan

NHT: Nanohybrid technology, mm: Millimeter, GC: General Chemical, LED: Light-emitting diode, mW/cm²: Milliwatts per square centimeter, 3M: Minnesota Mining and Manufacturing, MN: Minnesota, USA: United States of America

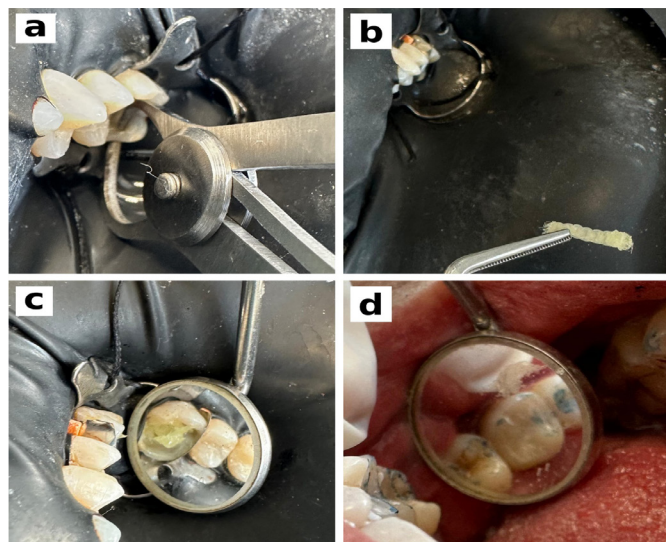


Figure 2. Stages of the fiber-reinforced direct composite restoration. (a) Caliper used to measure the residual palatal wall thickness at the cavity floor after removal of the old restoration and caries; (b) the two 3-mm-wide polyethylene ribbon strips wetted with uncured adhesive resin before placement on the pulpal floor and against the reduced palatal wall; (c) mirror view of the short fiber-reinforced composite base over the ribbons, extending beneath the reduced palatal cusps; (d) mirror view of the completed restoration after finishing and polishing; the blue articulating-paper marks show the centric occlusal contacts recorded after occlusal adjustment

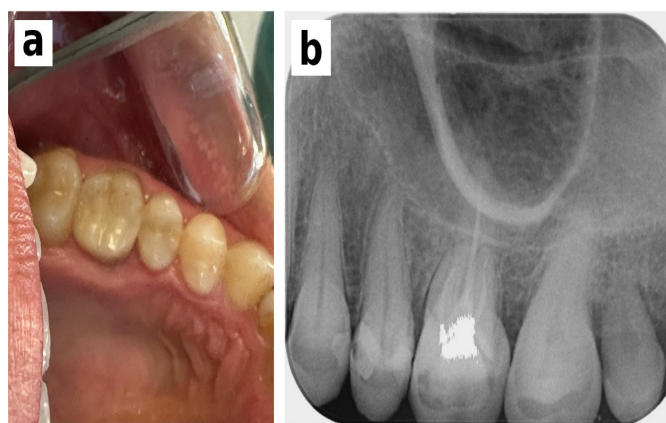


Figure 3. Six-month follow-up (3 August 2026) of the restored maxillary left first molar. (a) Occlusal view before repolishing, showing maintained proximal and occlusal contacts and superficial surface staining (FDI score 2); (b) periapical radiograph showing no periapical or sub-restoration radiolucency

FDI: World Dental Federation

DISCUSSION

Three design elements (an SFRC base, a ribbon, and selective cuspal coverage) plausibly contributed to the intact six-month outcome. In a high C-factor MOD cavity, an SFRC base reduces the volume of conventional composite polymerized against confined walls and, through its crack-arresting fiber network, helps absorb shrinkage stress;^{8,11} in vitro, such restorations match composite inlays in fatigue survival.¹² The ribbon, adapted mesio-distally over the pulpal floor and against the reduced palatal wall, is intended to redistribute load across the residual walls and to deflect cracks running from the cavity floor toward the cusps; in vitro, polyethylene fibre reinforcement of endodontically treated premolars and molars has been shown to reduce cuspal deflection, to increase fracture strength and to produce more favourable, repairable fracture patterns.^{7,13} These biomechanical effects were not measured in the present case; they are inferred from the cited laboratory evidence and are presented as the design rationale rather than as a demonstrated effect.

Cuspal coverage was decided on residual wall thickness: 2 mm is recommended for non-functional cusps and enamel cracking increases when walls thin to 1 mm;¹⁴ in vitro premolar data support the same 2-mm threshold.¹⁵ Because the palatal cusps of a maxillary molar are centric-holding, a more cautious threshold than the one reported for non-functional cusps was adopted in this case; finite element analysis indicates that the preservation of functional cusps affects stress distribution in onlay-restored molars differently from the preservation of non-functional cusps.¹⁶ No threshold specific to centric-holding cusps was identified in the literature, so this decision is presented as a case-specific clinical judgement rather than as an evidence-based cut-off. The measured palatal thickness of 1.5 mm was in any event below the 2-mm threshold cited above, and the rigidity-lending oblique ridge had also been interrupted. Coverage may therefore convert tensile loading of the thin cusps into more distributed compressive loading; preserving the buccal cusps kept the preparation conservative. A randomized trial found direct SFRC restorations comparable to composite onlays in complex molar cavities at one year.¹⁷ A fiber post was not indicated, since post-space preparation removes dentin without enhancing cuspal fracture resistance.⁶

The six-month outcome is consistent with short-term data reporting high survival for SFRC restorations in large posterior cavities, although that review found no clear clinical advantage over conventional composites despite in vitro superiority.¹⁸ Six months, however, tests the adhesive interface more than fatigue resistance, so these findings document early clinical behavior rather than durability. The previous restoration survived nine years and failed by caries rather than fracture, a presentation consistent with marginal-adhesive failure, although the mechanism cannot be established from a single case; nine years therefore represents a realistic benchmark against which the present restoration should be judged. The only deviation is surface discoloration. This is probably due to surface abrasion of the covering composite. Opening the E-glass fibers to the oral environment increases water absorption. For this reason, the surface was covered with an overlying composite.¹⁹ Ribbon placement is technique sensitive. An air bubble or inadequate adaptation to the walls reduces load transfer.

A single case does not permit any inference about long term survival. Because the contributions of the ribbon and of the SFRC cannot be separated from each other, fiber reinforcement is presented as a design rationale rather than as a measured effect. Because the orifice barrier, the polyethylene ribbon, the SFRC base and the selective cuspal coverage were all applied at the same visit, the design is methodologically inseparable. The contribution of any single component to the six-month outcome cannot be quantified. No conclusion can be reached about the mechanical benefit of the ribbon compared with that of the SFRC base. Separating these effects requires a controlled in vitro or randomized design in which each element is varied independently. For this reason, the present report should be read as a documented clinical application of the combined technique rather than as evidence regarding any one of its components. The evaluation was unblinded and was performed by a single examiner without a comparison group. For this reason, the possibility of bias in the FDI scores cannot be excluded.



Because periapical rather than bitewing radiography was used for follow up imaging, proximal changes beneath the restoration may have been underestimated. Periapical radiography is inadequate for the endpoints that matter most in a restoration placed because of proximal secondary caries (interproximal marginal adaptation, micro gap formation and recurrent proximal caries). Therefore, bitewing radiography will be used at the subsequent recalls. Documentation is a further limitation: the clinical photograph in Figure 1a is the only preoperative clinical image of this tooth and was obtained under routine clinical conditions. Consequently, its resolution and illumination limit detailed assessment of the preoperative cavity margins. No preoperative periapical radiograph was available, and the preoperative panoramic image presented in Figure 1b is inherently limited by superimposition, low spatial resolution and geometric distortion. For this reason, neither the interproximal bone level nor the density of the root canal filling could be assessed preoperatively with the accuracy that a periapical film would provide.

CONCLUSION

In an endodontically treated maxillary first molar with a residual palatal wall thickness of 1.5 mm, a fiber-reinforced direct restoration combining a polyethylene ribbon, an SFRC base, and selective palatal cuspal coverage was clinically acceptable at six months. These findings document early clinical behavior only; longer-term evidence is required before it can be recommended as an alternative to indirect restorations.

ETHICAL DECLARATIONS

Informed Consent

Written informed consent was obtained from the patient included in this report. Signed consent forms are retained by the authors and are available upon request.

Peer Review Process

This report underwent external peer review.

Conflict of Interest

The author declares no conflicts of interest.

Financial Disclosure

This case report did not receive any financial support.

Author Contributions

The author is solely responsible for the entirety of conception, execution, analysis, and writing of the manuscript.

Editor Note

Candan Aydın Hoş is a member of the Editorial Board of this journal. She was not involved in the editor assignment, reviewer selection, peer review process, or editorial decision for this manuscript. The peer review process was managed independently by another editor.

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