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Managing Esthetic Discrepancy Between Vital and Nonvital Central Incisors Using a Fiber-Reinforced Composite Post-Core and Lithium Disilicate Restorations: A Case Report

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Abstract

Achieving esthetic harmony between vital and endodontically treated maxillary central incisors remains a challenge due to substrate heterogeneity and optical discrepancies. A 32-year-old woman with a history of childhood trauma presented with dissatisfaction with her smile due to discrepancies in shade, shape, and translucency between the maxillary central incisors. Tooth 11 was vital with an existing defective resin composite restoration, whereas tooth 21 was endodontically treated, with a provisional crown and substantial loss of coronal tooth structure. This clinical report presents an individualized digital workflow combining a customized computer-aided design/computer-aided manufacturing (CAD/CAM) fiber-reinforced composite post-core with high-translucency lithium disilicate (E-max) restorations. A pattern for the post and core of the nonvital incisor was fabricated intraorally using pattern resin and then digitally scanned to fabricate the definitive post-core, which was intended to provide retention and support for the definitive crown and a tooth-colored foundation. For the vital central incisor, minimally invasive veneer preparation was performed using a guided, controlled preparation technique, preserving as much enamel as possible. The approach demonstrates the versatility of lithium disilicate restorations in managing complex substrate interactions, allowing satisfactory masking and optical integration, as assessed visually. This case illustrates a substrate-oriented approach to anterior esthetic rehabilitation that warrants validation in further cases with longer follow-up.

Categories: Dentistry
Keywords: anterior esthetic rehabilitation, cad/cam, fiber-reinforced composite, lithium disilicate, maxillary central incisors

Introduction

Esthetic restoration of the anterior dentition remains one of the most demanding objectives in contemporary restorative dentistry. Ceramic materials such as laminate veneers and lithium disilicate crowns are widely used for their mechanical performance and superior optical properties, enabling clinicians to reproduce the appearance of natural teeth with high predictability [1]. Despite significant advancements in restorative materials and shade-matching technologies, achieving precise and biologically harmonious color integration remains a persistent clinical challenge, particularly in cases involving substrates with heterogeneous or unfavorable optical characteristics [2,3].

The final appearance of ceramic restorations is influenced by multiple interacting factors, including material translucency, restoration thickness, resin cement shade, surface texture, and, most critically, the underlying dental substrate. Substrate color significantly influences the final optical outcome, especially when highly translucent ceramic systems are used [2,3].

This effect becomes more pronounced when adjacent teeth exhibit significant discrepancies in biological status and structural integrity, particularly when a vital tooth is juxtaposed with an endodontically treated tooth, resulting in altered optical behavior and increased shade-matching complexity [1,2]. In this context, treatment choice depends on the degree of discoloration and tooth structure loss, with ceramic veneers offering a conservative option when sufficient enamel remains and full-coverage crowns being suitable for severely discolored or extensively damaged incisors.

Endodontically treated teeth often exhibit intrinsic discoloration and altered optical properties due to changes in dentin structure and light transmission [1]. Although fiber-reinforced posts and adhesive composite cores can help support the restoration and improve substrate uniformity, they do not reliably eliminate underlying discoloration, making complete masking unpredictable [2,4].

This limitation becomes particularly problematic when using lithium disilicate and other high-translucency ceramics, which are designed to mimic the optical qualities of natural enamel but are, as a consequence,

more sensitive to variations in underlying substrate color [2,3]. In such situations, a post is indicated primarily to retain the core when the remaining coronal structure is insufficient; it does not, in itself, reinforce the endodontically treated tooth. Fiber-reinforced composite post-cores also avoid the grayish discoloration associated with cast metal post-and-core restorations and may provide a more uniform underlying foundation for translucent ceramics.

Additionally, differences in restoration design, such as the use of partial-coverage veneers versus full-coverage crowns, introduce further variability in how light interacts with the tooth-restoration complex, affecting both perceived color and depth-of-shade integration [1,3]. As a result, attaining optimal esthetic integration in the maxillary central incisors, where subtle but clinically relevant color and translucency discrepancies are most noticeable, remains a principal clinical challenge, even when employing meticulous shade-selection protocols and advanced ceramic systems [2,3].

The aim of this case report is to describe the management of discrepant substrates between adjacent maxillary central incisors, in which the underlying conditions dictated two different restoration designs: a lithium disilicate crown supported by a customized computer-aided design/computer-aided manufacturing (CAD/CAM) fiber-reinforced composite post-core on the endodontically treated incisor and a conservative lithium disilicate veneer on the vital incisor. The report focuses on how substrate characteristics guided post-core design, preparation design, and ceramic selection to achieve optical harmony between the two teeth.

Case Presentation

A 32-year-old female patient presented to the Fixed Prosthodontics Department of the Dental Clinic of Monastir with esthetic concerns, primarily reporting dissatisfaction with her smile. She reported a noticeable color discrepancy between the two maxillary central incisors (teeth 11 and 21) and a loss of harmony with the adjacent natural dentition, which had progressively affected her self-confidence. The patient had no relevant medical history.

Past dental history revealed that the patient had received conventional root canal therapy for tooth 21 and a resin composite restoration on tooth 11 following previous dental trauma.

Clinical examination revealed a significant esthetic discrepancy between the two maxillary central incisors, including differences in shape, shade, translucency, and surface texture. Smile analysis revealed a low upper lip line. The gingival margins of the maxillary central incisors showed slight asymmetry, with a corresponding discrepancy in gingival zenith levels between teeth 11 and 21. No periodontal surgery was performed, as the patient declined surgical intervention. Nevertheless, the low upper lip line limited the visibility of this asymmetry during smiling. An intraoral examination revealed that tooth 11 had a defective and discolored resin composite restoration and responded positively to cold pulp sensibility testing. It exhibited minor shape and shade discrepancies, reinforcing the need for a bilateral, substrate-driven esthetic approach rather than an isolated restoration. Tooth 21 presented an old, non-retentive temporary crown and exhibited an opaque, nonvital appearance, contrasting with the vital contralateral tooth 11 (Figure *1*).



FIGURE 1: Preoperative view highlighting morphological and esthetic asymmetry between the maxillary central incisors

Lateral assessment further highlighted unfavorable light reflection associated with the existing restoration (Figure 2).



FIGURE 2: Lateral view of the initial clinical situation showing discrepancies in shade and position

Periodontal examination revealed acceptable oral hygiene, localized gingival swelling, and grayish discoloration around tooth 21, with probing depths of 2-3 mm circumferentially and no localized periodontal pocketing or bleeding on probing. Preoperative periapical radiographic examination demonstrated a previously endodontically treated maxillary left central incisor (tooth 21), with an adequate canal filling and a short metallic post incorporated within the obturation material. No evident periapical radiolucency was observed in either tooth 11 or 21, and the periradicular tissues appeared healthy, with no signs of disease or periodontal ligament (PDL) widening. There was no tenderness on percussion in either tooth. Occlusal examination revealed a 2 mm overbite and overjet. Functional analysis revealed canine guidance on the working side, disocclusion on the nonworking side, and dysfunctional anterior guidance. No parafunctional habits were reported.

Upon removal of the provisional crown retained by a metal post, substantial loss of coronal tooth structure was observed in tooth 21. The underlying dentin was discolored, corresponding to shade ND7 (IPS Natural Die Material, Ivoclar Vivadent), with supragingival margins on the buccal, palatal, and proximal surfaces. Following tooth preparation and careful removal of softened dentin, a circumferential ferrule of approximately 1.5 mm was obtained without the need for additional periodontal procedures.

The prognosis of tooth 11 was considered favorable, whereas that of tooth 21 was guarded due to extensive tooth structure loss. Accordingly, a conservative lithium disilicate veneer was planned for tooth 11 and a lithium disilicate crown for tooth 21, with a customized CAD/CAM fiber-reinforced composite post-core selected for the structurally compromised tooth 21 to provide adequate core retention and improve esthetic integration.

A key challenge in this case was the use of lithium disilicate (IPS e.max) restorations, which are highly esthetic but are strongly influenced by the color of the underlying tooth and the thickness of the restoration. Thin restorations on a discolored nonvital tooth may not fully mask the underlying color. Thicker restorations can provide better masking but may compromise tooth conservation and affect harmony with adjacent teeth.

We began by fabricating the customized CAD/CAM fiber-reinforced composite post-core for tooth 21. Radiographic assessment revealed that the previously prepared post space was insufficiently deep. The existing preparation was therefore extended apically using Peeso reamers #1 through #3 (D-PERFECT, Shenzhen, China) to a depth of 9 mm, while 4 mm of apical gutta-percha was retained to maintain the apical seal. To preserve the remaining radicular dentin, preparation was limited to increasing the depth of the post

space while minimizing additional enlargement of the canal walls. A 0.9% saline solution was then used to irrigate the canal and remove debris.

The post-core pattern was fabricated directly using pattern resin (DuraCryl Flow; New Stetic, Colombia). The resin was first applied around a prefabricated plastic post (ITENA, France) after confirming its proper seating to reproduce the anatomy of the prepared post space. Successive increments of resin were then added to build up and reshape the core. After complete polymerization, the one-piece pattern was carefully removed. It reproduced both the intraradicular post and the coronal core, providing an accurate fit and precise adaptation to the existing tooth morphology.

This resin pattern was then digitally scanned using a laboratory scanner (E3; 3Shape, Copenhagen, Denmark). After processing the 3D scan data and completing the CAD design with exocad software (exocad GmbH, Darmstadt, Germany), a custom glass fiber-reinforced composite post-core was milled from a prefabricated CAD/CAM disc (Zantex; Biofunctional Materials, Boca Raton, FL, USA) using a five-axis milling machine (CORiTEC 350i; imes-icore GmbH, Eiterfeld, Germany). The milled post-core had a tapered shape adapted to the anatomy of the prepared root canal. It was then tried in to verify its fit and adaptation, with no adjustments required. The post-core was subsequently sandblasted with 110 µm aluminum oxide (Al_2O_3) particles at 2 bar for 10 seconds (Figure *3*).

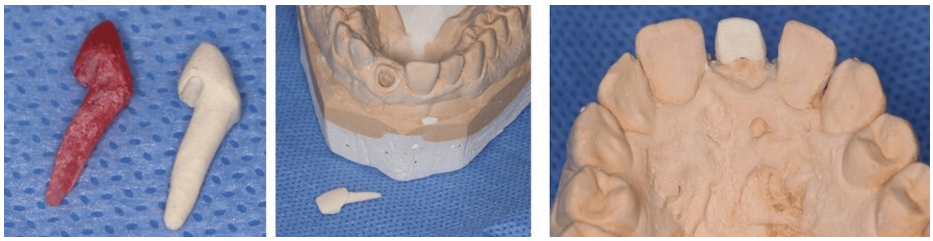


FIGURE 3: Indirect fabrication of a fiber-reinforced composite post-core for restoration of the nonvital central incisor (tooth 21)

An intraoral resin pattern reproducing both the intraradicular and coronal components was digitized using a laboratory scanner (E3; 3Shape) and converted into a virtual model using exocad software. The final restoration was milled from a fiber-reinforced composite CAD/CAM disc (Zantex; Biofunctional Materials, Boca Raton, FL, USA) using a five-axis milling unit (CORiTEC 350i; imes-icore GmbH). The figure also shows the restoration's fit on the working cast.

The bonding surfaces of the custom post-core were cleaned with alcohol, treated with a primer containing silane and 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP, G-Multi PRIMER; GC Corporation, Tokyo, Japan), and air-dried. Rubber dam isolation was maintained throughout adhesive cementation. The post space was irrigated with 17% ethylenediaminetetraacetic acid (EDTA), rinsed, and dried with paper points. A universal adhesive (G-Premio BOND; GC) was mixed with Dual Cure Activator (DCA; GC) in a 1:1 ratio and applied in self-etch mode to the intraradicular and intracoronal dentin surfaces using a microbrush for 20 seconds, followed by air-drying for 5 seconds. Excess adhesive was removed with paper points without separate light-curing, according to the manufacturer's instructions.

A dual-cure resin cement (G-CEM LinkForce; GC) was injected into the post space using an automix tip, and the post-core was immediately seated under gentle finger pressure. After excess cement was removed, light-curing was performed for 80 seconds (20 seconds per accessible surface), and the restoration was left undisturbed for 4 minutes to allow chemical polymerization. Full-coverage crown preparation was then completed for tooth 21 (Figure *4*).



FIGURE 4: Adhesive bonding of the fiber-reinforced composite post-core to the compromised central incisor (tooth 21)

The figure illustrates the placement of the restoration within the prepared post space using a dual-cure resin cement (G-CEM LinkForce; GC), followed by light-curing before refinement of the crown preparation.

Subsequently, minimally invasive veneer preparation of tooth 11 was performed, guided by the available enamel and the condition of the existing resin restoration. Depth-orientation grooves were created on the facial surface using a depth-cutting diamond bur, followed by approximately 0.5-0.7 mm of facial reduction with a tapered diamond bur. Unsupported composite was completely removed, and the preparation was extended palatally according to the boundaries of the previous restoration to achieve margins on sound enamel wherever possible. An incisal overlap design with 1 mm of reduction was adopted to position the margins away from functional occlusal contacts. The mesial and distal limits were placed just short of the interproximal contacts, and a 0.5 mm cervical chamfer was established at the gingival margin. The preparation remained predominantly within enamel (Figures *5*-*7*).



FIGURE 5: Depth-guided preparation of tooth 11 using orientation grooves created with a depth-cutting bur to ensure controlled reduction



FIGURE 6: Substrate-driven preparation design dictated by the extent of the unsupported composite restoration



FIGURE 7: Enamel-preserving preparation limits with incisal overlap, proximal extension terminating short of the contact point to preserve enamel, and an equigingival cervical chamfer

Precision finishing of the preparation margins ensured uniform adhesive layer thickness and improved bonding predictability (Figure *8*).



FIGURE 8: Finishing of the preparation using a flame-shaped diamond bur to refine the margins and surface geometry

Following tooth preparation, gingival retraction was achieved with retraction cords (Ultrapak Retraction Cord #00, Ultradent Products Inc., South Jordan, UT, USA), and a final intraoral digital impression (Aoralscan 3, Shining 3D Dental, Hangzhou, China) was taken for both arches, including an occlusal record in maximum intercuspation. Final shade selection was performed using the VITA 3D-MASTER shade guide (VITA, Yorba Linda, CA, USA) under natural daylight conditions, with shade 2M2 selected.

The definitive crown (tooth 21) and veneer (tooth 11) were manufactured using the heat-pressing technique with lithium disilicate ingots (IPS e.max Press, Ivoclar Vivadent, Schaan, Liechtenstein). For tooth 21, a 1.2 mm thick high-opacity (HO) lithium disilicate coping was fabricated, followed by the application of a layering ceramic (IPS e.max Ceram, Ivoclar Vivadent) to achieve a balance between esthetic integration and substrate masking. The veneer was pressed from medium-translucency (MT) ingots, with a ceramic thickness ranging from approximately 0.7 mm facially to 1 mm at the incisal edge.

The restorations were evaluated before cementation for fit, marginal integrity, symmetry, proximal contacts, contours, and color matching. After selecting the appropriate cement shade using a water-soluble try-in paste, the internal surfaces were cleaned with 95% alcohol under ultrasonic agitation and etched with 4% hydrofluoric acid (Porcelain Etchant; BISCO, Schaumburg, IL, USA) for 25 seconds. The surfaces were then coated with a silane coupling agent (Bis-Silane Parts A and B; BISCO) for 30 seconds.

Complete isolation was achieved using a rubber dam (Easy-Dam, MDC Dental, Zapopan, Jalisco, Mexico) and

dental floss ligatures. The tooth surfaces were cleaned with nonfluoridated prophylaxis paste, etched with 32% phosphoric acid (Uni-Etch w/BAC; BISCO) for 30 seconds on enamel and 15 seconds on dentin, and rinsed. A bonding agent (All-Bond Universal, BISCO, Schaumburg, IL, USA) was applied and air-thinned.

The veneer on tooth 11 was bonded with a light-cured resin cement (CHOICE 2, translucent shade; BISCO), given its limited thickness and adequate light transmission, whereas a dual-cured resin cement (DUO-LINK Universal, universal shade; BISCO) was used for the crown on tooth 21 to ensure adequate polymerization despite reduced light penetration. Initial light-curing for 5 seconds facilitated excess cement removal, followed by final curing for 40 seconds per surface. The margins were finished and polished, and final occlusion was verified in maximum intercuspation, excursive movements, and protrusive contacts.

Immediately following adhesive cementation, the restorations showed satisfactory correction of the initial color discrepancy, with a natural and symmetrical appearance of the vital and nonvital central incisors, despite the challenges posed by substrate heterogeneity and limited lithium disilicate thickness (Figure *9*). The final color match was assessed visually only.



FIGURE 9: Final extraoral views after cementation of the restorations, showing esthetic integration between different dental substrates

At the six-month follow-up, the patient was highly satisfied with the esthetic and functional outcomes. Clinical examination showed stable soft tissues, harmonious gingival contours, and no signs of inflammation, with probing depths within normal limits (approximately 3 mm). Both the lithium disilicate crown on tooth 21 and the veneer on tooth 11 exhibited excellent marginal adaptation, color stability, and surface integrity, without evidence of chipping, debonding, or secondary caries. The restorations maintained a natural appearance in harmony with the adjacent teeth, while phonetic and functional parameters remained unaffected.

Discussion

Optimal esthetic integration of anterior restorations is particularly demanding when adjacent teeth present dissimilar substrates. In cases involving endodontically treated and structurally compromised teeth, the optical behavior of the substrate can substantially influence the final restoration color, often outweighing the effects of ceramic type, cement shade, or veneer design [2,3]. A recent in vitro analysis showed that substrate shade was the main factor influencing the final color of lithium disilicate veneers, surpassing ceramic translucency and resin cement shade, and that even low-translucency ceramics could not completely mask severely discolored substrates [2]. These findings were obtained with veneers and should be extrapolated to crowns with caution.

This case highlights the importance of substrate modification and strategic restorative planning, a concept increasingly supported by contemporary evidence, as selecting high-translucency ceramics, such as lithium disilicate, without addressing the underlying substrate may compromise esthetic integration [2,3]. Evaluations of ceramic veneers report that ceramic thickness and preparation steps significantly influence color change, underscoring that optical integration cannot be reliably achieved through ceramic selection alone without modifying the foundation onto which the restoration is bonded [5].

Preserving enamel and limiting preparation to areas truly requiring reduction have dual benefits: they not only enhance adhesive potential (given enamel's superior bonding characteristics) but also minimize alterations to optical pathways important for shade integration [5,6]. Preparation design guided by substrate boundaries, as applied in this case, aligns with literature supporting substrate-driven approaches rather than uniform geometric reduction, which may improve clinical and esthetic outcomes [5,7]. However, biomechanical performance was not directly evaluated in the present case.

The clinical relevance of enamel preservation is corroborated by evidence from studies on ceramic veneers. In a recent systematic review, veneers bonded predominantly to enamel demonstrated favorable survival and success rates, whereas increased dentin exposure was consistently associated with a higher incidence of

complications and reduced longevity [6]. Similarly, a long-term retrospective analysis showed that survival outcomes were negatively influenced by extensive dentin involvement [7]. Collectively, these findings support the preparation approach adopted in the present case, which was adapted to the distinct structural conditions of the two maxillary central incisors. A conservative veneer preparation was performed on tooth 11 to preserve enamel for adhesive bonding, whereas tooth 21 required a full-coverage crown preparation due to extensive structural compromise, with the aim of preserving the remaining coronal dentin to maintain a ferrule effect while providing sufficient space for the lithium disilicate crown.

Adhesive cementation also contributes to the final optical outcome and long-term restoration performance. Resin cement shade selection should account for substrate color, restoration thickness, and the optical properties of lithium disilicate. Light-curing cements are generally preferred for thin, highly translucent restorations with adequate light transmission, whereas dual-curing cements may be indicated for thicker or more opaque restorations with limited light penetration [2,3,8].

In the present case, both maxillary central incisors were conservatively prepared and restored with lithium disilicate: a veneer for the vital incisor and a crown for the endodontically treated incisor. The principal challenge was the endodontically treated tooth, which presented substantial coronal tissue loss and an unfavorable substrate, requiring structural rehabilitation, retention of the definitive restoration, and substrate modification to achieve an optimal esthetic result.

The customized CAD/CAM fiber-reinforced composite post-core used in this case addressed this challenge by combining structural rehabilitation with optical optimization. Two main fabrication workflows have been described: a direct (fully digital) technique based on intraoral scanning of the post space and an indirect (semi-digital) technique involving the scanning of a resin or wax pattern or a post-space impression. The indirect technique may be preferable when direct scanning of deep post spaces is unreliable [9]. In the present case, the indirect technique was selected, whereby a resin pattern of the post space and core was fabricated intraorally, scanned, and used to design and mill the fiber-reinforced composite post-core.

This approach was intended to benefit from the potential advantages of digital accuracy and patient-specific customization. Available evidence suggests that CAD/CAM workflows can reproduce post-space geometry. Digital customization may facilitate adaptation to the patient's root canal anatomy, although this depends on the scanning technique and canal geometry [9]. However, adaptation was not quantitatively assessed in the present case.

The reconstruction offers retention while conserving tooth structure through individualized adaptation to canal anatomy, particularly in flared or anatomically complex canals [9,10]. Further advantages reported in the literature include the fabrication of a monolithic post-core, which reduces the number of interfaces between the post and core, and a controlled cement space that may limit excessive cement volume, polymerization stress, and interfacial defects [10]. Nonetheless, adequate residual structure and ferrule remain key determinants of mechanical prognosis [4,11], while final bonding performance depends on the cementation protocol and post-dentin interface quality [12].

Fiber-reinforced composite post-core systems have been shown to offer favorable mechanical properties and stress distribution compared with conventional metal or rigid posts, with elastic moduli closer to that of dentin and favorable failure patterns [11,13,14]. These properties derive from a resin matrix reinforced with glass fibers, whose behavior is influenced by fiber orientation [13].

CAD/CAM fabrication, however, does not necessarily improve fracture resistance, as studies have reported comparable fracture resistance for prefabricated fiber and cast metal posts [12]. The main benefit of a customized fiber-reinforced composite post-core may therefore lie in combining individualized adaptation with favorable mechanical properties rather than in increasing fracture resistance [10,11,14].

The digital workflow also has technical limitations. Direct intraoral scanning is sensitive to post-space depth and geometry, and indirect techniques may be preferable when the post space exceeds 10 mm [9]. Accurate scanning does not guarantee clinical success, which also depends on CAD design, manufacturing, and cementation [9,15], while retention remains contingent on an effective adhesive protocol [10,12].

From a material perspective, the success of this approach relies on the synergy between lithium disilicate and fiber-reinforced post-core systems. Lithium disilicate combines high strength with enamel-like translucency, while fiber posts exhibit dentin-like elasticity and favorable optical properties, providing a stable and optically favorable foundation for anterior esthetic rehabilitation [1,4].

Finally, the satisfactory esthetic integration observed reflects a multifactorial strategy in which mechanical reinforcement, enamel preservation, digital precision, and ceramic thickness control are applied synergistically. This case illustrates a clinical approach combining digital and biomimetic principles to address a complex esthetic challenge involving heterogeneous substrates. However, as a single case with short-term follow-up, it demonstrates technical feasibility but cannot establish reproducibility or predictability. Additional clinical cases with long-term follow-up are needed to validate these findings.

Conclusions

Achieving esthetic harmony between vital and nonvital teeth in the anterior region requires careful management of differing substrates. This case highlights the value of a substrate-oriented approach combining fiber-reinforced composite post-core rehabilitation with lithium disilicate restorations, which achieved a favorable esthetic outcome while preserving tooth structure whenever possible.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Nadia Ben Younes, Nissaf Daouahi

Acquisition, analysis, or interpretation of data: Nadia Ben Younes, Nissaf Daouahi, Yosra Gassara, Sarra Nasri, Jilani Saafi

Drafting of the manuscript: Nadia Ben Younes, Nissaf Daouahi

Critical review of the manuscript for important intellectual content: Yosra Gassara, Sarra Nasri, Jilani Saafi

Supervision: Jilani Saafi

Disclosures

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