# Replacing mandibular central incisors with a direct resin-bonded fixed dental prosthesis by using a bilayering composite resin injection technique with a digital workflow: A dental technique

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DENTAL TECHNIQUE

# Replacing mandibular central incisors with a direct resin-bonded fixed dental prosthesis by using a bilayering composite resin injection technique with a digital workflow: A dental technique

## ABSTRACT

A straightforward technique is presented for an interim or short-term definitive esthetic replacement of missing anterior teeth requiring no tooth preparation. Composite resins are injected into transparent silicone indices fabricated from 3D-printed casts of a digital waxing. The dentin core is formed of a durable short fiber-reinforced injectable composite resin and veneered with an enamel-shade composite resin for enhanced esthetics. Besides being noninvasive, this technique is more straightforward than traditional options, reducing chair time while providing an accurate outcome.

## INTRODUCTION

Treatment options for replacing missing anterior teeth include removable partial dentures and conventional or implant-supported fixed prostheses. Recently less invasive restorative options have been increasingly used, including ceramic cantilever resin-bonded fixed dental prostheses (RBFDPs) which require minimal tooth preparation while providing excellent clinical longevity.[1-3] Direct or indirect fiber-reinforced RBFDPs are another widely accepted alternative for the replacement of 1 or 2 missing teeth. A recent systematic review reported a 93% 5-year survival rate of direct and indirect glass fiber or polyethylene fiber-reinforced composite fixed dental prostheses and concluded that they are a reliable, predictable, minimally invasive, esthetic,

and cost-effective option for restoring a single missing tooth.[4] Another study reported no negative effects on periodontal health (probing depth, clinical attachment, bleeding index, and plaque index) with these restorations.[5]

Most of these indirect prostheses require 2 appointments and at least lingual coverage to provide an adequate bonded area and provide a stable pontic. The bond strength of indirect restorations has been reported to be lower than for direct bonding.[6,7] However, direct fiber-reinforced composite resin restorations can be performed free-hand within a single appointment, but they are challenging, technique-sensitive, and dependent on the skill of the clinician. The recently introduced composite resin injection technique could simplify and expedite the process while providing a more predictable outcome,[8-11] especially when combined with a digital workflow.[12,13] For the present patient, 2 missing mandibular incisors were replaced with a direct bilayered RBFDP fabricated by using injectable composite resins applied to transparent silicone indices made from 3D-printed casts of a digital diagnostic waxing.

## TECHNIQUE

1. Record the preoperative situation (Fig. 1) and jaw relation by using a digital scanner (TRIOS 3; 3Shape A/S). Design a virtual smile to visualize the definitive prosthesis and to evaluate its relation to the esthetic frame of the face. Prepare a diagnostic waxing on a digital articulator (3Shape Dental System; 3Shape A/S). Use the cut-back technique labially and incisally to obtain the ideal dentinal shape and to provide sufficient space (0.5 mm) for a veneering enamel-shade composite resin. 3D-print casts (VarseoWax Model; BEGO GmbH) of the cut-back and anatomic waxing of the designed restoration (Fig. 2).

2. Fabricate transparent silicone indices of the dentin core (dentin index, Fig. 3A) and the definitive anatomic form (enamel index, Fig. 3B) by using a clear polyvinyl siloxane (EXACLEAR; GC Corp). Polymerize the indices at 0.2 MPa for 10 minutes in a dental polymerizer (Polymax 5; Dreve Dentamid GmbH) to prevent bubble formation in the silicone. Prepare small openings at the incisal areas of both indices and at the center of the labial surfaces of the enamel index (Fig. 3). Clean the openings with a microbrush.
3. Isolate the operative field with a dental dam. Clean the mesial enamel surfaces of both abutment teeth with a sodium bicarbonate air-polishing powder (AIR-FLOW CLASSIC COMFORT; EMS S/A) and etch them with 37% phosphoric acid (K-ETCHANT Syringe; Kuraray Noritake Dental Inc) for 15 seconds. Rinse off the etchant with water, air dry the enamel surfaces, apply a 2-step self-etch adhesive system (CLEARFIL SE BOND 2; Kuraray Noritake Dental Inc) with a microbrush, and polymerize the bonding agent for 10 seconds (G-Light Prima-II Plus; GC Corp) according to the manufacturer's instruction.
4. Position the dentin index and inject a flowable short fiber-reinforced composite resin (everX Flow; GC Corp) of dentin shade through the incisal openings (Fig. 4A). Polymerize the composite resin for 60 seconds from the labial and lingual direction, remove the index, and cut off excess material at the incisal edge. Position the second index (enamel index) and inject an enamel-shade flowable composite resin (G-ænial Universal Injectable, E1 shade; GC Corp) through the labial and incisal openings of the index (Fig. 4B). Polymerize it for 60 seconds, remove the index, cut off any excess material with a #12 scalpel, and polymerize the restoration for an additional 60 seconds from each side. If the digital waxing is accurately translated into the restoration, minimal occlusal adjustments will be necessary, and the chair time required for polishing to a high gloss will be substantially reduced (Fig. 5).

5. Deliver a protective occlusal device to increase the clinical life of the prosthesis.

## DISCUSSION

Fixed dental prostheses require tooth preparation or surgery; even minimally invasive RBFDPs need at least lingual coverage. In contrast, the presented restoration was bonded only to etched mesial surfaces of the adjacent teeth, requiring no preparation and avoiding occlusal interferences. In the absence of lingual coverage, the reduced bonded area could have a negative impact on pontic stability, but that could be compensated by the higher bond strength of direct restorations compared with indirect bonding.[6,7] The short-term outcome was excellent, suggesting that this technique could be useful for interim or short-term definitive restorations. However, longer follow-up is necessary to evaluate long-term durability.

In the past, such direct restorations could only be placed by using laborious and time-consuming additive techniques, but highly filled flowable composite resins and clear silicone matrices have enabled the composite resin injection technique.[8-11] This approach substantially reduces the technique-sensitivity and chair time while providing precise and predictable results, especially when combined with a digital workflow.[12,13] The mechanical properties of injectable composite resins are inferior to those of indirect restorative materials, but the incorporation of short fibers leads to improved fracture toughness and flexural strength.[14] Although these composite resins might still be more susceptible to wear or fracture, they can be repaired more efficiently than indirect restorative materials, thus extending restoration longevity.[15] It is recommended to cover the short fiber-reinforced composite resin with a layer of a universal restorative material, which was enabled by the implementation of the cut-back technique. The veneering enamel-shade composite resin also contributed to the esthetic outcome.

**SUMMARY**

Missing anterior teeth were esthetically replaced with a direct no-preparation RBFDP by using a straightforward bilayering composite resin injection technique. Because of the silicone indices fabricated from 3D-printed casts of a digital waxing and injectable composite resins, the restoration placement was straightforward and predictable. The digital workflow expedited laboratory procedures and contributed to the accuracy of the technique.

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**FIGURES**

Figure 1. Preoperative views. 

Figure 2. A, Digital waxing of dentinal core cut-back by 0.5 mm labially and incisally. B, Anatomic-contour digital waxing. 

Figure 3. Clear polyvinyl siloxane indices on 3D-printed plastic casts. A, Dentin index. B, Enamel index. *Red arrows* indicate small openings prepared for composite resin injection.

Figure 4. A, Dentin-shade short fiber-reinforced composite resin injected through incisal openings of dentin index to form restoration core. B, Core veneered with enamel-shade injectable composite resin applied through labial and incisal openings of enamel index. 

Figure 5. Finished restoration. Cut-back and veneering with enamel-shade composite resin led to esthetic color matching. 

Figure1



Figure2



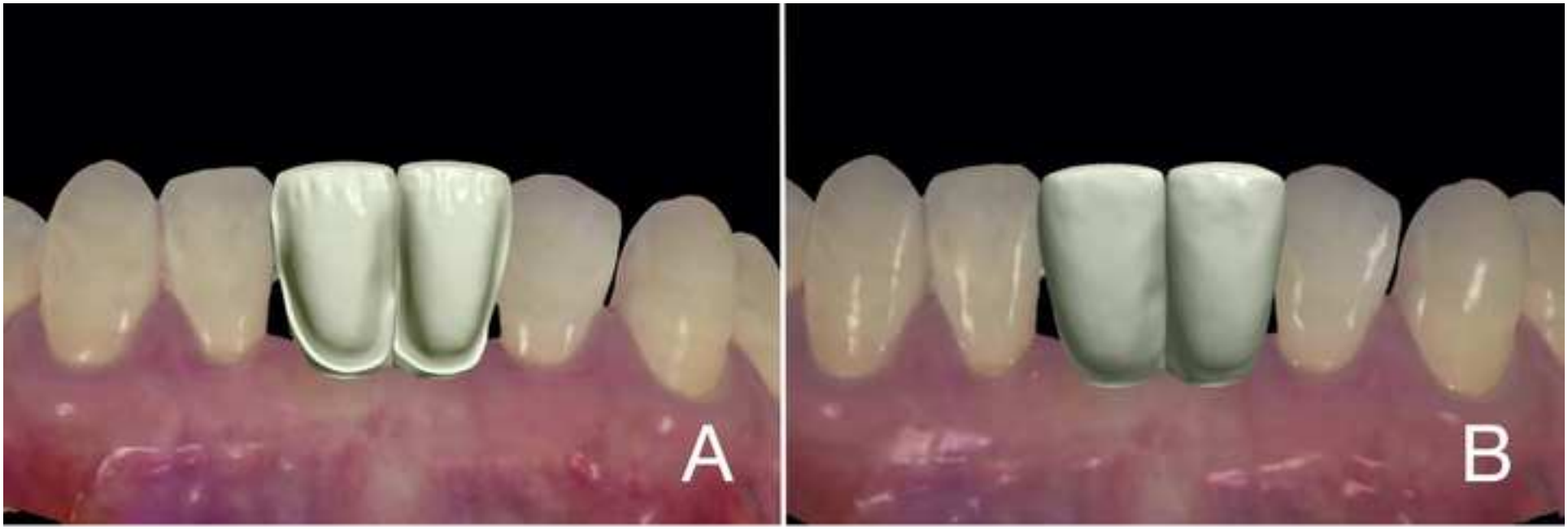

Figure3

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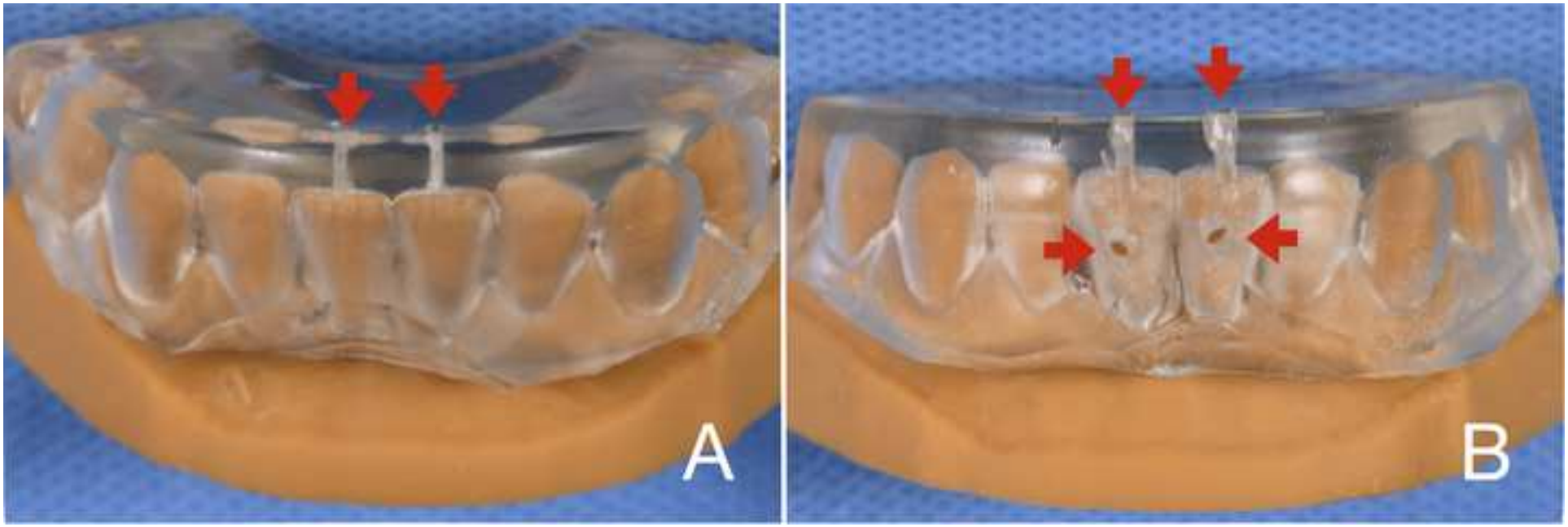

Figure4

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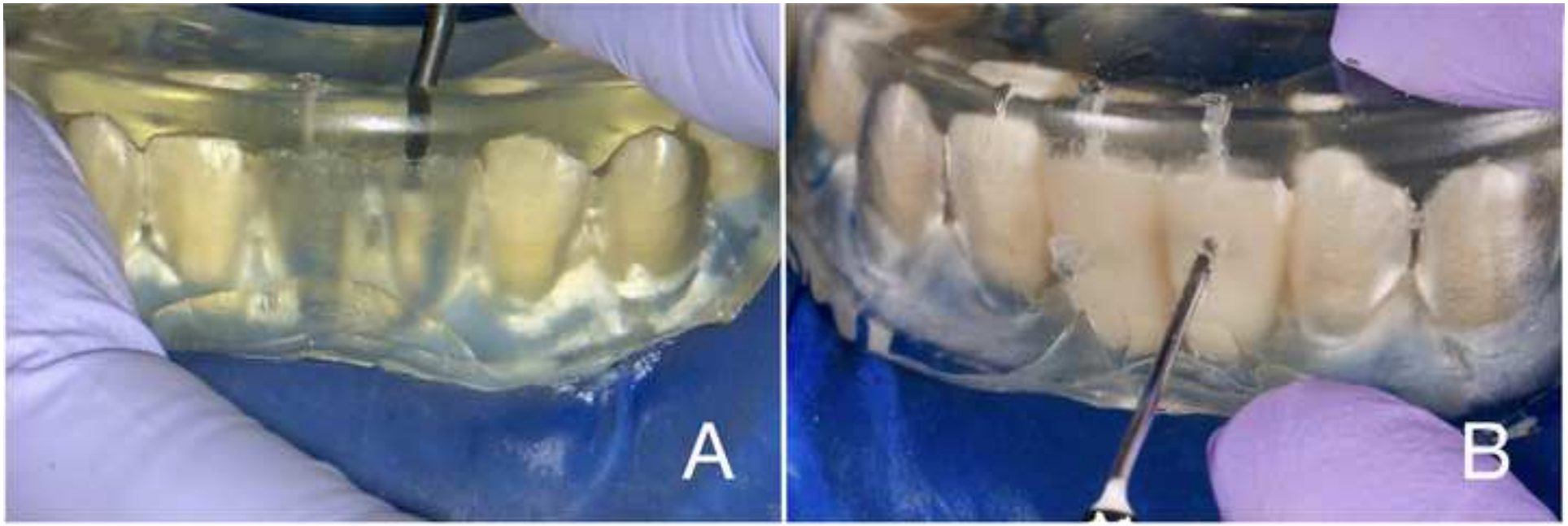

Figure5

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