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DENTAL TECHNIQUE

Esthetic integration area concept in digitally guided veneer rehabilitation: A dental technique

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ABSTRACT

Computer-aided design and computer-aided manufacturing (CAD-CAM) technologies have been integrated into the dental digital workflow. However, pretreatment virtual veneer preparations and the digital design and manufacturing of guided preparation and cementation templates has not yet been incorporated into the clinical routine. This article presents a novel protocol for digitally guided veneer rehabilitation by following the esthetic integration area concept, facilitating precise control over tooth structure removal and obviating the need for interim restorations. (J Prosthet Dent xxxx;xxx:xxx-xxx)

Adequate treatment planning from a diagnostic waxing is essential for successful esthetic restorations.[1–6] Through the advancement of intraoral scanners (IOSs), computer-aided design (CAD) software programs, and computer-aided manufacturing (CAM), an accurate digital workflow for diagnostic treatment planning has become available.[7–26] Despite advances in the digital workflow, the most widespread guided treatments have been surgical,[27–29] with fewer solutions for guided preparations to receive tooth-supported prostheses. In a conventional approach for veneer preparations, tooth preparations have been controlled by the use of silicone indices.[30] However, the conventional method has constraints, depending on the technical ability of the clinician, resulting in an unregulated determination of the restorative space, potentially leading to overcontoured restorations as specified by the esthetic integration area (EIA) concept.[31] The EIA concept is based on restorations that do not exceed the maximum buccal volume of the soft tissues nor the maximum volume of the papillae interproximally.[31] The present article describes a step-by-step digital protocol to plan, design, and additively manufacture 3 dimensional (3D) templates for fully guided maxillary ceramic veneers from dental preparation to cementation in the same clinical appointment.

TECHNIQUE

A 25-year-old woman was referred to a private practice for prosthodontic treatment. Her chief complaint was poor esthetics.

Step 1. Clinical Procedure. First Appointment

1. Make 2 digital photographs of the patient's face with a digital single-lens reflex camera (EOS 750D; Canon), 1 smiling and 1 with cheek retractors (Fig. 1).
2. Make an intraoral digital scan of the patient´s dentition with an IOS (Itero Element 5D; Align Technology) under 1000 lux ambient lighting measured by using a luxometer (LXB1033B; Dr. Meter). Once the digital

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Figure 1. Pretreatment planning data set. A, Smiling. B, With cheek retractors. C, Maxillary STL file. STL, standard tessellation language.

scans are completed and processed, export them as a standard tessellation language (STL) file: STL_1 (maxillary) and STL_2 (mandibular).

Step 2. Computer-aided Design

3. Import STL_1 and STL_2 into a dental CAD software program (exocad DentalCAD; exocad GmbH) to perform a virtual diagnostic waxing of the teeth (Fig. 2A, B). Export the waxed STL file (STL_3) and 3D print it from a cast material (Nextdent Model 2.0; Nextdent) using an SLA-DLP 3D printer (Nextdent 5100; Nextdent) with a 50-μm-layer thickness.
4. Make a silicone index using polyvinyl siloxane putty and light-body materials (Virtual Putty, Virtual Light Body; Ivoclar AG).

Step 3. Clinical Procedure. Second Appointment

5. Use an autopolymerizing bis-acryl interim resin (Voco Structur 2 SC, Bleach; Voco GmbH) to evaluate trial restorations. After polymerization, remove the silicone index (Fig. 2C).
6. Reshape the interproximal and cervical areas if needed to obtain a natural emergence profile before definitive preparation.[31] Make a scan of the reshaped teeth by following the same protocol described in step 1.2. Export the STL file as STL_4 and send it to the dental laboratory technician.

Step 4. Laboratory Procedures

7. Import STL_3 and STL_4 into a specific CAD software program (FirstFit; Viax Dental Technologies) to

Figure 2. A, Superimposition of smile position photograph with initial maxillary STL file. B, Digital diagnostic waxing facially driven. C, Trial restorations made from bis-acrylic resin. STL, standard tessellation language.

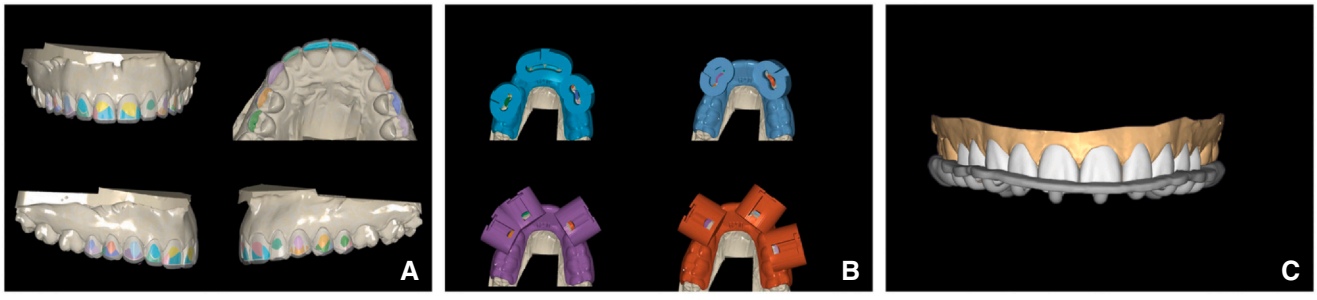

Figure 3. Digital data set. A, Virtual simulation of veneers preparation based on diagnostic waxing. B, Digital design of preparation guides. C, Digital design cementation guide.

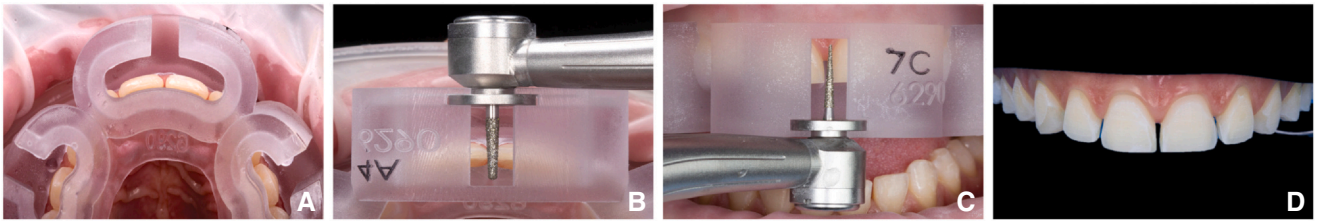

Figure 4. Veneer preparation phase. A, 3D printed guide placed in mouth. B, Specific dental handpiece and calibrated diamond rotary instrument for incisal reduction. C, Guided facial preparations on maxillary central incisors. D, Teeth prepared for ceramic veneers.

perform digital veneer preparations (Fig. 3A). Export the STL file as STL_5.

8. Design the 3D rigid tooth preparation guides based on STL_5 (FirstFit; Viax Dental Technologies) (Fig. 3B). Export them in an STL file and use a material jetting polymer 3D printer (ProJet MJP 2500 IC; 3D Systems) and polymer material (Visijet M2R-CL; 3D Systems).
9. Import STL_5 into a dental CAD software program (exocad DentalCAD; exocad GmbH) to digitally design the veneers. Combine the designed restorations and the cast and export it as STL_6. Manufacture the ceramic veneers in lithium disilicate monolithic material (e.max; Ivoclar AG).
10. Import STL_6 into a CAD software program (exocad DentalCAD; exocad GmbH) and design and 3D print the maxillary tray (Max 2; ASIGA) using a specific polymer resin (Imprimo LC IBT; Scheu-Group) (Fig. 3C).

Step 5. Clinical Procedure. Third Appointment

11. Place the rigid 3D preparation guides and prepare the teeth using a special handpiece (FirstFit; Viax Dental Technologies) and specific diamond rotary instruments (Shape A B; Hager-Meisinger GmbH) (Fig. 4).
12. Evaluate each veneer individually for marginal fit and proximal contacts. Seat the veneers in the 3D printed cast and bond them provisionally into a semirigid 3D printed positioning tray (Fig. 5A).
13. Prepare the ceramic restorations by following the manufacturer´s recommendations. Then, etch the tooth surfaces with phosphoric acid (Total Etch; Ivoclar AG) for 30 seconds. Rinse, dry, and apply a universal adhesive (Adhese Univeral Vivapen; Ivoclar AG) followed by a light-polymerization resin cement (Variolink Esthetic LC; Ivoclar AG) placed in the veneers. Seat all veneers at the same time (Fig. 5B). Spot-polymerize each veneer for 3

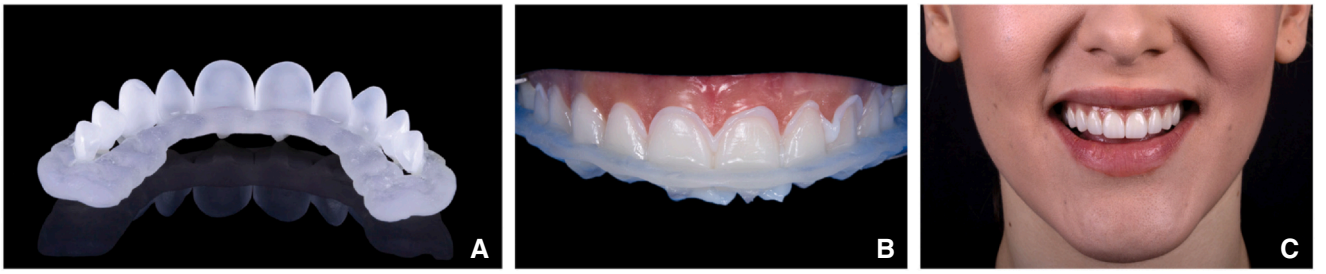

Figure 5. Veneer cementation. A, Veneers placed in cementation guide. B, Veneers delivered. C, Frontal view.

Figure 6. Three months after treatment. A, Frontal view. B, Emergence profile view. C, Evaluation of esthetic integration area.

seconds (Bluephase G4 pin-point 2 mm; Ivoclar AG). Remove the semirigid cementation guide and remove excess cement. Polish the margins (Optra Fine; Ivoclar AG). Evaluate function.

14. After 3 months, re-evaluate the veneers and soft tissues by following the EIA concept (Fig. 6).

DISCUSSION

The incorporation of a 3D CAD software program enables the superimposition of the digital scans on 2-dimensional facial smile photographs to determine the functional and esthetic parameters of the oral rehabilitation. This approach improves communication between dental laboratory technicians and clinicians. If modifications to the diagnostic waxing are needed, the clinicians should modify it intraorally during the trial restoration step and make a new digital scan for the dental laboratory technician to consider in the definitive restorations. The technique presented in this article enables the required tooth reduction to be determined to assess the adequate available space for guided veneer preparations. This is achieved through the EIA concept, avoiding overcontoured restorations or excessive tooth preparation.

The technique described has advantages that include the accuracy of the tooth preparation, enabling the digital calculation of an ideal insertion path for the veneers and ensuring uniform tooth preparations. Additionally, interim restorations are not required with the presented technique. Furthermore, fewer and shorter clinical appointments are possible, as the methodology enables tooth preparation and cementation of the definitive restorations at the same clinical appointment. Once the learning curve is overcome, the total time needed to prepare and cement 10 veneers is about 1 hour.

The preparation and cementation guides are made with a multijet printing additive manufacturing technology that allows for 3D printing without support structures. The technology minimizes deformation of the guided surfaces,[32] ensuring accuracy in the dental procedures presented.

Limitations of the presented technique include the need for the patented handpiece with the use of specific calibrated diamond rotary instruments and the need for interproximal preparations in the reshape phase before the design of the guided preparation templates. When comparing digital guided and free-hand tooth preparations, there is a notable increase in direct costs attributed to the fabrication of preparation guides. However, these costs are mitigated by a reduction in the number of required clinical appointments and the accuracy obtained. However, in vitro and in vivo studies are necessary to assess the accuracy of the digital workflow for the veneer preparations provided in the presented technique.

SUMMARY

The application of a specialized digital workflow for digital veneer preparation enables precise control over tooth structure removal, ensuring uniform teeth preparations. This approach also results in a cost-effective workflow as the need for interim restorations can be eliminated.

PATIENT CONSENT

Informed patient consent has been obtained.

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