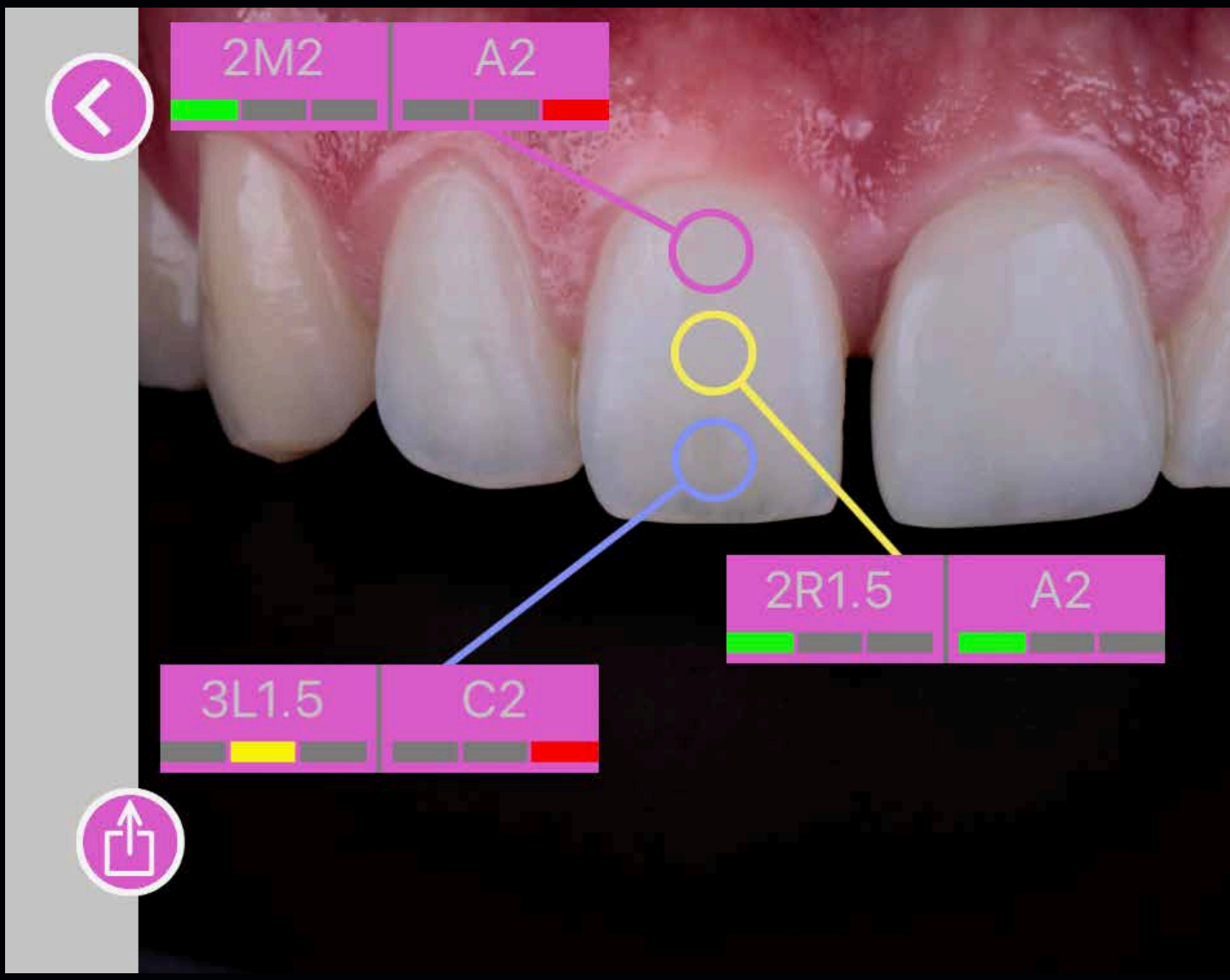


[1]Director, Chairside CAD/CAM Dentistry, Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania, USA.

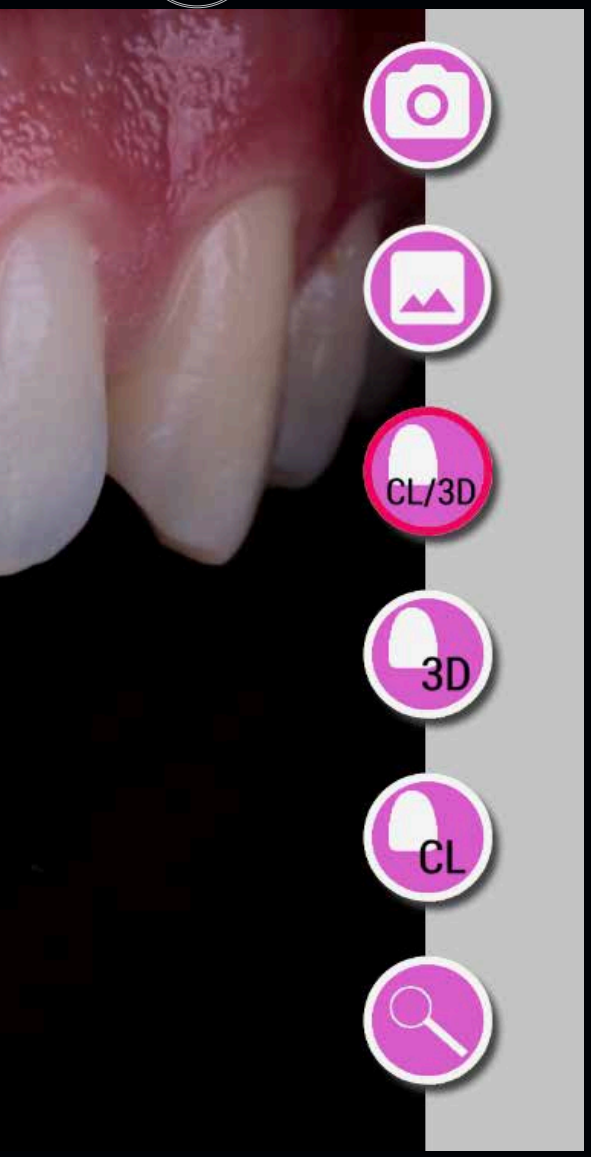
[2]Clinical Professor of Restorative Dentistry, Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania, USA.

[3]Chairside Dental Technology, Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania, USA.

[4]Director, CAD/CAM Ceramic Center, Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania, USA.

[5]Professor of Restorative Dentistry, Chairman, Department of Preventive and Restorative Sciences, Assistant Dean, Digital Innovation and Professional Development, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania, USA.

Correspondence to: Dr Julian Conejo, Department of Preventive and Restorative Sciences, University of Pennsylvania School of Dental Medicine, 240 South 40th Street, Philadelphia, PA 19104. Email: jconejo@upenn.edu



Veneer and Crown Shade Matching: A Digital Approach

Julián Conejo, DDS MSc[1]
Leslie Stone-Hirsch, DMD MSc[2]
Sooryung Ann, CDT[3]
Michael Bergler, CDT, MDT[4]
Markus B. Blatz, DMD, PhD[5]

Shade matching indirect restorations of central incisors with different types of ceramic has always been a challenge for clinicians and dental technicians.[1] A digital approach implementing the latest dental applications (apps) for mobile devices can simplify the treatment planning, accurate shade selection, and patient communication involved in this treatment. The combination of new CAD/CAM software technology with improved design features allows clinicians and dental technicians to successfully address demanding clinical challenges such as matching the appearance and shades of maxillary central incisors that require different types of indirect restorations.[2]

This article presents key details of the clinical and laboratory steps for chairside CAD/CAM restorations and a case that illustrates a technique to predictably match color and translucency of a laminate veneer and a full-coverage crown. The presented approach involves multilayer monolithic restorations with symmetric support structures and ceramic laminate veneers to achieve a good match and natural appearance.

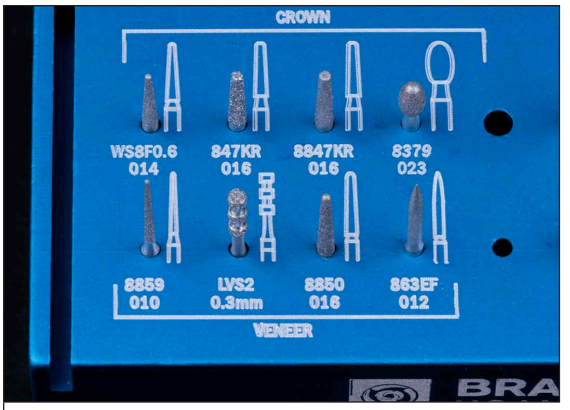


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Fig 1 Dr Markus Blatz/Dr Julian Conejo Preparation System for CAD/CAM Restorations #K0394, Brasseler).

Fig 2 Intraoral view of the maxillary central incisor preparations.

MOBILE APPLICATIONS

Mobile applications, commonly referred to as apps, are application software that run on mobile devices such as smart phones and tablets. Apps have become part of our daily lives, providing valuable information and facilitating common tasks. Their implementation in clinical and laboratory protocols provides opportunities to streamline workflows and surpass common communication challenges between clinicians, dental technicians, and the patient.

The Digital Smile Design (DSD) App is an advanced tool for 2D and 3D treatment planning and patient education on a mobile device, based on preoperative STL files from intraoral scans, specific intra- and extraoral photos, face scans, and videos.[3] Shade selection and communication are other key components of the workflow when restoring maxillary central incisors with indirect ceramic restorations. A small dental spectrophotometer (Easy Shade V, VITA Zahnfabrik), controlled through the VITA mobileAssist App and supported by intraoral photos, simplifies the shade-taking process and facilitates shade communication. Accurate shade taking and effective communication reduce the number of clinical appointments and possible remakes.[4]

TOOTH PREPARATION

When treating both maxillary central incisors with the same type of indirect ceramic restorations, clinical outcomes can be greatly improved by preparing the abutment teeth symmetrically with the same amount of 3D tooth reduction and finish line position.[5]

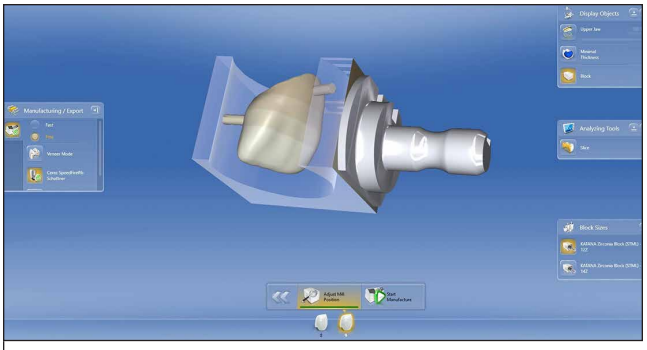
Preparation design features for full-coverage CAD/CAM restorations on maxillary central incisors include:

- Finish line with an internally rounded shoulder and symmetric zenith levels
- Smooth transitions from interproximal walls to the incisal edge while avoiding sharp angles, corners, and undercuts
- Same preparation design and amount of 3D tooth structure reduction for both abutment teeth

Fine diamond burs with specific dimensions and shapes (eg, Dr Markus Blatz/Dr Julian Conejo Preparation System for CAD/CAM Restorations #K0394, Brasseler; Fig 1) are necessary to carry out ideal tooth preparation designs (Fig 2) for chairside CAD/CAM restorations, which are typically fabricated without any models. An ideal tooth

3a

3b



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5a

5b

Figs 3a and b Design of CAD/CAM restorations.

Fig 4 Dry-milling preview.

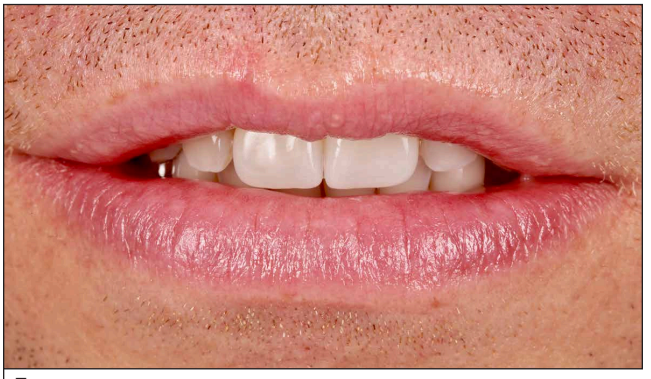
Figs 5a and 5b Fully sintered monolithic polychromatic preshaded zirconia crowns.

preparation also simplifies the digital restoration design process and provides better design proposals (Figs 3a and 3b), especially for endodontically treated teeth, which have less critical anatomical design considerations since they are not vital.[6]

When the abutment teeth reveal a noticeable color difference after tooth preparation, the design proposals for monolithic restorations should provide a minimum thickness of 1.0 mm on the labial surfaces to mask any discolorations and avoid discrepancies in the appearance of the final restorations.[7] A chairside digital workflow and high-translucent multilayer preshaded zirconia blocks (eg, Katana STML, Kuraray Noritake) provide viable options in such situations. The presintered zirconia blocks (Fig 4) are dry milled in a 4-axis milling machine (eg, MCXL, Dentsply Sirona) with carbide burs and are then fully sintered with a speed sintering cycle in a small-footprint furnace (eg, Speed Fire, Dentsply Sirona). In this manner, the entire fabrication process of a chairside full-contour monolithic zirconia crown takes only slightly more than half an hour (Figs 5a and 5b).[8] The restorations are tried in and delivered with the proper cementation materials and protocols (Figs 6a

6a

6b



7a

7b

Figs 6a and 6b Try-in and cementation of final restorations.

Figs 7a and 7b Postoperative extraoral views at rest and during a smile.

and 6b) with the goal to provide natural tooth morphologies and shapes (Figs 7a and 7b).

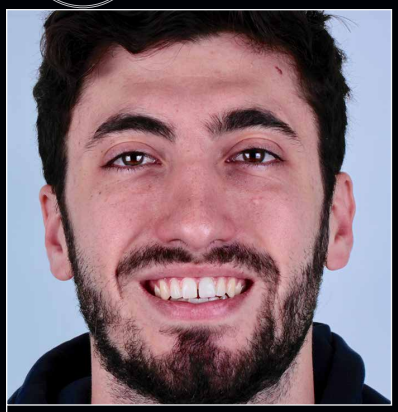
CASE PRESENTATION

A 23-year-old male patient presented with an overcontoured porcelain-fused-to-zirconia crown on the maxillary left central incisor and a diastema between the maxillary central incisors. Extraoral frontal, lateral, and anterior 12 o'clock views of the patient's smile as well as intraoral photographs were taken (Figs 8 and 9). These photographs and STL files of preoperative maxillary, mandibular, and buccal intraoral scans were uploaded to the DSD App on a tablet (iPad Pro, Apple).

The maxillary intraoral scan was calibrated and positioned to the extraoral images to calculate the smile frame. The width/length ratio of both maxillary central incisors was calculated for ideal restorative space distribution (Figs 10a to 10c). A 2D smile that included a proposal for the maxillary central incisors was designed and used to explain the treatment and possible esthetic outcomes to the patient for motivational purposes (Figs 11a and 11b). A spectrophotometer (Vita Easyshade V) and App (Vita mobileAssist) were used for shade communication with the patient and the laboratory technician (Fig 12).

After approval of the 2D design, a digital 3D wax-up and set-up were created with natural tooth shapes from the tooth and smile libraries in the DSD App. A resin model was 3D-printed based on the digital wax-up, and a silicone index was made to serve as a guide for the tooth preparations.

The maxillary right central incisor was prepared for a ceramic laminate veneer following common preparation guidelines. The endodontically treated maxillary left central incisor was prepared for a full-coverage crown (Fig 13). Digital and conventional impressions were made.



8a

8b

8c

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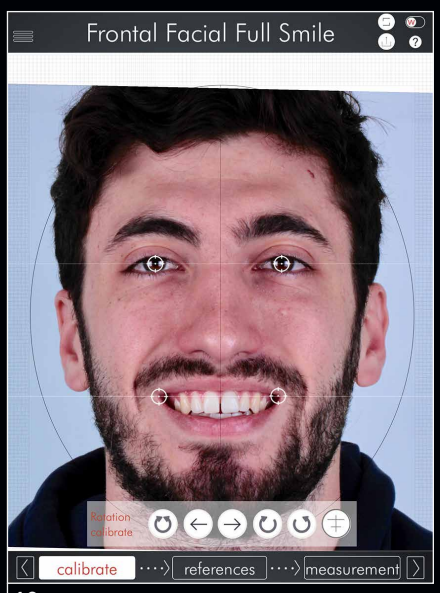

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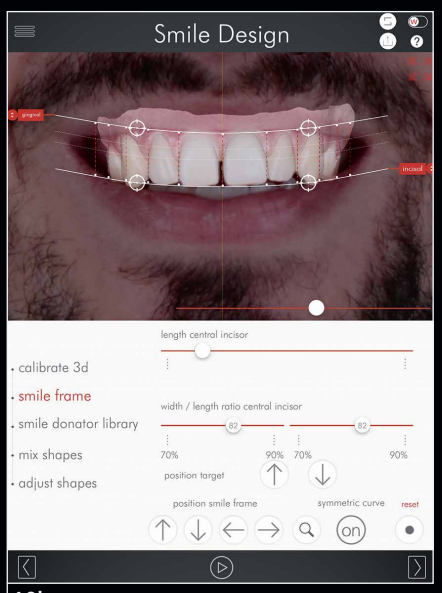

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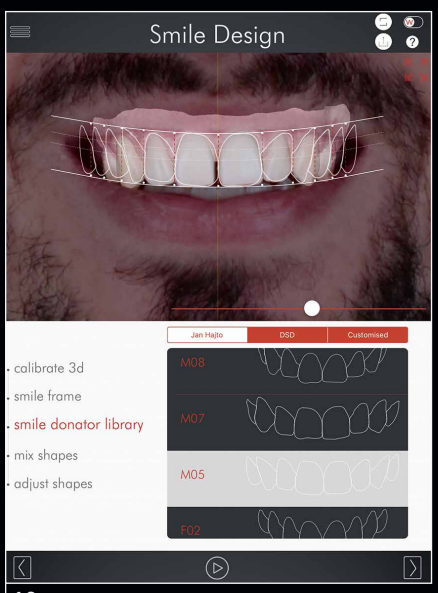
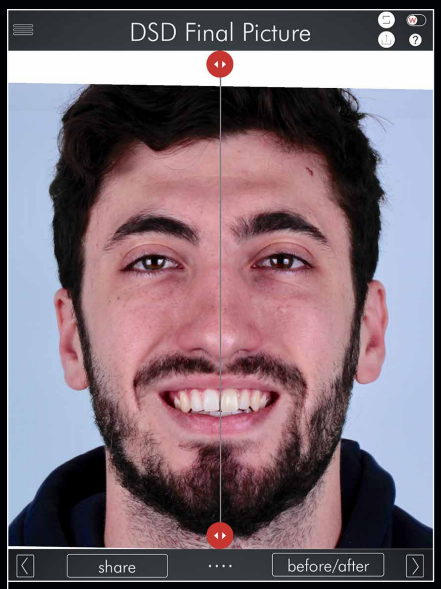


10c

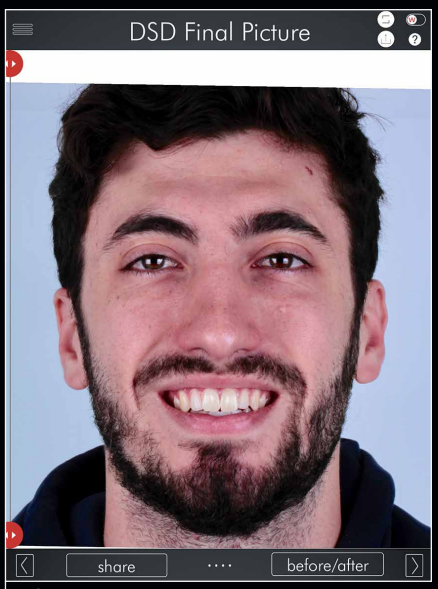
Figs 8a to 8c Preoperative extraoral views.

Fig 9 Preoperative intraoral view.

Figs 10a to 10c Smile frame calculation and width/length ratio of maxillary central incisors with the DSD App.



11a



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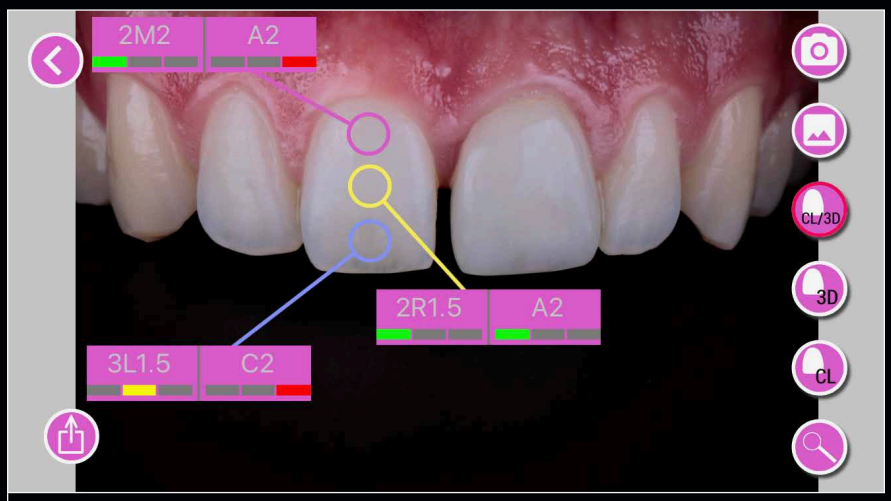

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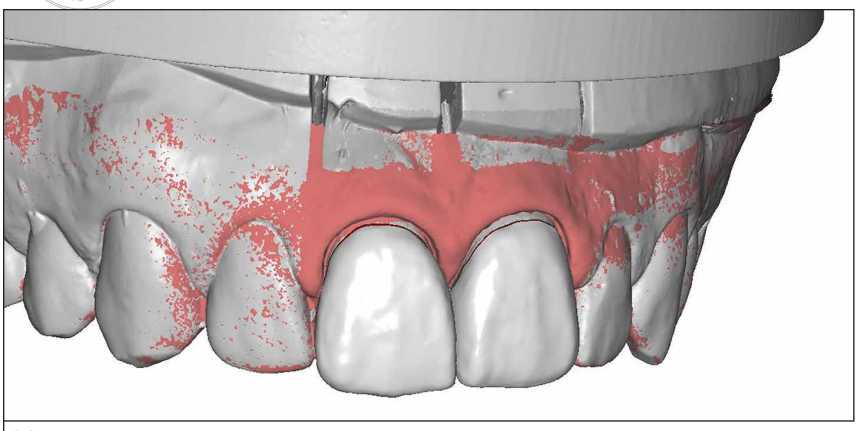
13

Figs 11a and 11b Visualization of the anticipated 2D smile design.

Fig 12 Shade values from the spectrophotometer are uploaded to the mobileAssist App through Bluetooth connectivity.

Fig 13 Tooth preparations for a veneer on the maxillary right central incisor and a crown on the maxillary left central incisor.



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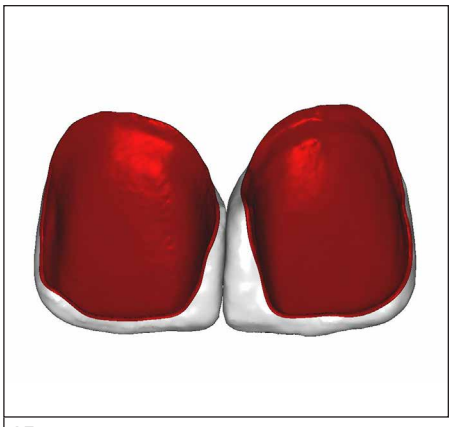

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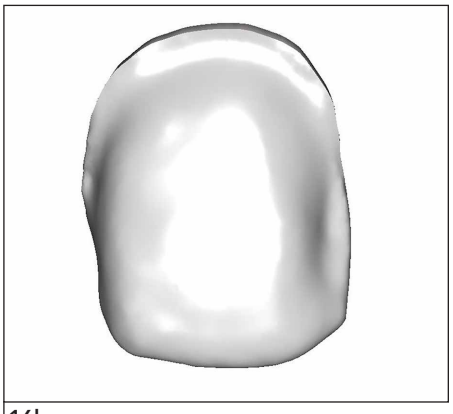
16a



16b

17a

17b

17c

Fig 14 Digital restoration design in full contour.

Fig 15 Design of two symmetric laminate veneers after split-file of the maxillary left central incisor.

Figs 16a and 16b Crown coping design on the maxillary left central incisor.

Figs 17a to 17c The crown coping was fabricated from a preshaded multilayer zirconia block, and laminate veneers were milled from a polychromatic feldspathic ceramic.

Two symmetric monolithic restorations were designed (Fig 14) and a split-file was created on the maxillary left central incisor to obtain symmetrically shaped veneers for both central incisors (Fig 15). In addition, a full-coverage coping was designed for the crown preparation (Figs 16a and 16b) in a shape that imitated a veneer preparation symmetrically to the prepared maxillary right central incisor.[9] The two veneers were milled from polychromatic feldspathic ceramic blocks (Vita Tri-lux Forte, VITA Zahnfabrik), shade A2, while the zirconia coping was milled from a multilayer preshaded zirconia block (Katana ML, Kuraray Noritake; Figs 17a to 17c).[10] The block was selected to mimic the shade of the contralateral prepared central incisor with the intent to achieve the best possible color match between the two most visible teeth.


18a


18b


18c


19a


19b


20a


20b

Figs 18a to 18c Intraoral views during try-in of the restorations.

Figs 19a and 19b A ceramic primer that contains both a silane and the zirconia-binding MDP monomer was applied to the bonding surfaces of the veneers and the zirconia coping after air-particle abrasion and to the feldspathic ceramic after hydrofluoric acid etching.

Figs 20a and 20b Extraoral cementation of the veneer to the coping ensures a simplified bonding procedure, excess cement removal, and polishing process. The same clear composite resin cement was used for the veneer.

After try-in and esthetic evaluation (Figs 18a to 18c), the feldspathic ceramic veneers were etched with 5% hydrofluoric acid for 60 seconds, followed by ultrasonic cleaning. Following the APC technique,[11–13] the zirconia coping was air-particle abraded with 50-micron aluminum oxide particles for 10 seconds. A ceramic primer that contains both a silane and the zirconia-binding MDP monomer (Clearfil Ceramic Primer Plus, Kuraray Noritake) was applied to the bonding surfaces of the veneers and the zirconia coping (Figs 19a and 19b).[11] The zirconia coping and ceramic veneer were cemented extraorally with an adhesive resin system (Panavia V5 Clear, Kuraray Noritake; Figs 20a and 20b). Extraoral cementation of the veneer to the coping ensures a simplified bonding procedure, easy excess cement removal, and ideal polishing process.[12] The ceramic laminate veneer for the maxillary right central incisor and the and bilayered crown on the maxillary left central incisor were inserted with the same resin cement (Figs 21 and 22) after proper pretreatment of the restoration and tooth bonding surfaces.[13]

CONCLUSION

Matching a veneer and a crown in the esthetic zone is one of the great clinical challenges, especially when the abutment teeth present variations in stump shades. The reported approach was applied in an attempt to match the restorations of the two central incisor teeth in a most ideal manner despite the variations. Matching the crown coping to the tooth prepared for a veneer in terms of both shade and 3D design allows for the fabrication of two symmetrically designed ceramic laminate veneers that offer the exact same material, shade, shape, thickness, and translucency.

A fully digital approach that includes all treatment steps from design to completion and even allows for chairside restoration fabrication is highly supportive of achieving the esthetic and functional goals in a variety of challenging clinical situations. Novel tools such as mobile smile design applications further simplify these processes and improve communication with the patient and between clinical and laboratory teams.

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Fig 21 Postoperative intraoral situation 4 weeks after insertion.

Fig 22 Postoperative extraoral view.

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