

DENTAL TECHNIQUE

Integration of intraoral digital scans with a 3D facial scan for anterior tooth rehabilitation



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Development and application of digital technologies in dentistry have enabled a significant conceptual shift and suggested novel treatment options in prosthodontics.^{1,2} Initial intraoral digital scans can easily be stored in standard tessellation language (STL) format and can be imported at any time, using dental computer-aided designing (CAD) software.^{3,4} The morphology of the teeth or interim restorations can be transferred to the design of definitive prostheses by using CAD software.⁵

Restoring anterior teeth is challenging as it requires both esthetic and functional outcomes.⁶ The color and

ABSTRACT

This article describes a digital technique that combines intraoral digital scans with a 3-dimensional facial scan to predict the outcome of prosthodontic treatment of anterior teeth at the treatment planning phase. This approach may increase patient acceptance of the definitive treatment, as the altered facial appearance is visualized with definitive prosthodontic restorations, thereby improving communication before treatment begins. (*J Prosthet Dent* 2019;121:394-7)

morphology of the prostheses should be in harmony with adjacent teeth and should coincide with patient preferences. In addition, the prostheses should provide appropriate anterior guidance.⁷

Efforts have been made to predict and visualize the outcomes of definitive treatments at the treatment planning phase.⁸⁻¹² These efforts include conventional diagnostic



Figure 1. Intraoral digital scans and interocclusal record.

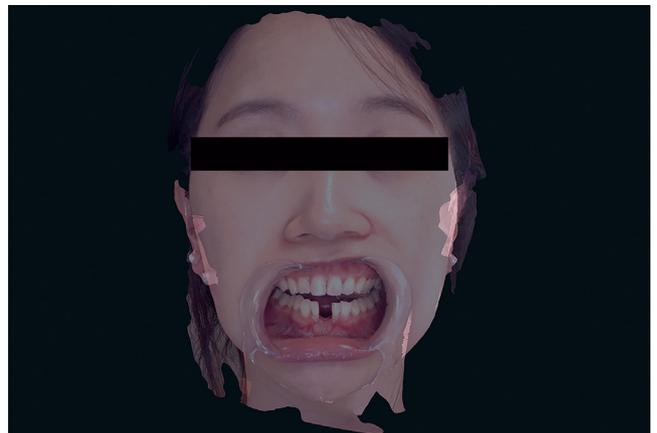


Figure 2. Facial scan data obtained with cheek retractors to expose teeth.

Technical support provided by Morpheus Corp, Ltd, Republic of Korea. J-M.P. and K.C.O. contributed equally to this work.

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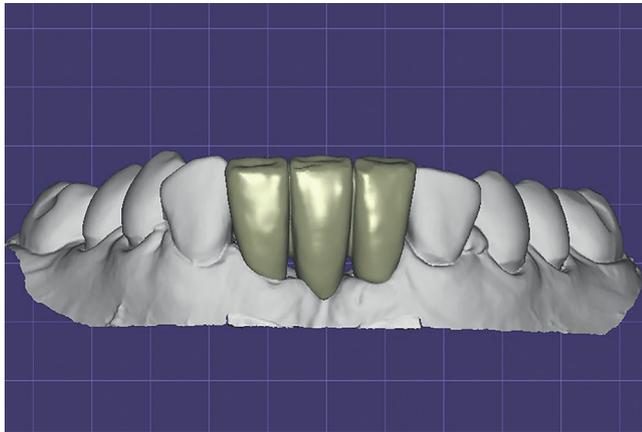


Figure 3. Trial restorations in CAD software. CAD, computer-aided design.

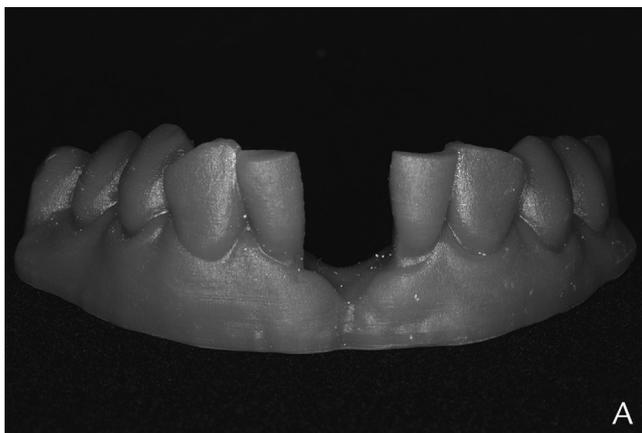


Figure 4. 3D-printed casts provided accessory information. A, Initial state. B, Trial restoration state.

waxing, manipulation of extraoral photographs, dynamic video evaluations, cephalometrically guided method, and matching with cone beam computed tomography. Positioning digitized dental casts in 3-dimensional (3D) facial scan data has been suggested for orthodontic treatment planning.^{13,14} Facial scans obtained at the occluded state, both with and without cheek retractors, and digitized dental

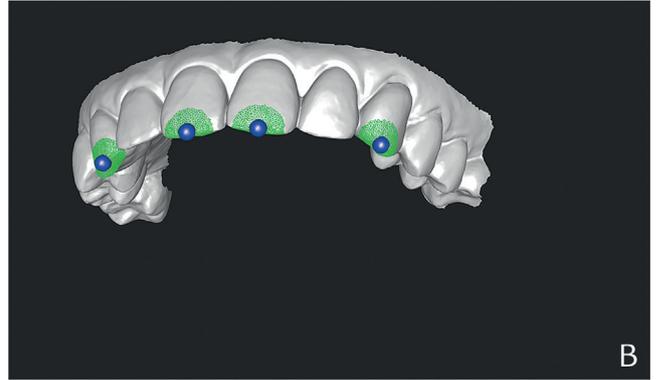


Figure 5. Procedures for superimposition. A, Marking points on teeth for 3D facial scan data. B, Marking corresponding points of either intraoral digital scans or trial restoration data. C, Outcome of superimposition.

casts are superimposed by applying the iterative closest point algorithm.¹⁵ This algorithm is used to match the surfaces of chosen pairs by iteratively computing the closest point pairs.¹⁶ Recently, integrating extraoral photographs with intraoral digital scans by using CAD software (3Shape Dental System; 3Shape) has been suggested. However, a limitation of this method has been that the integrated data do not enable 3D evaluation and cannot provide information about the soft tissue profile.¹⁷

The purpose of this article was to introduce a virtual trial restoration technique for anterior tooth rehabilitation

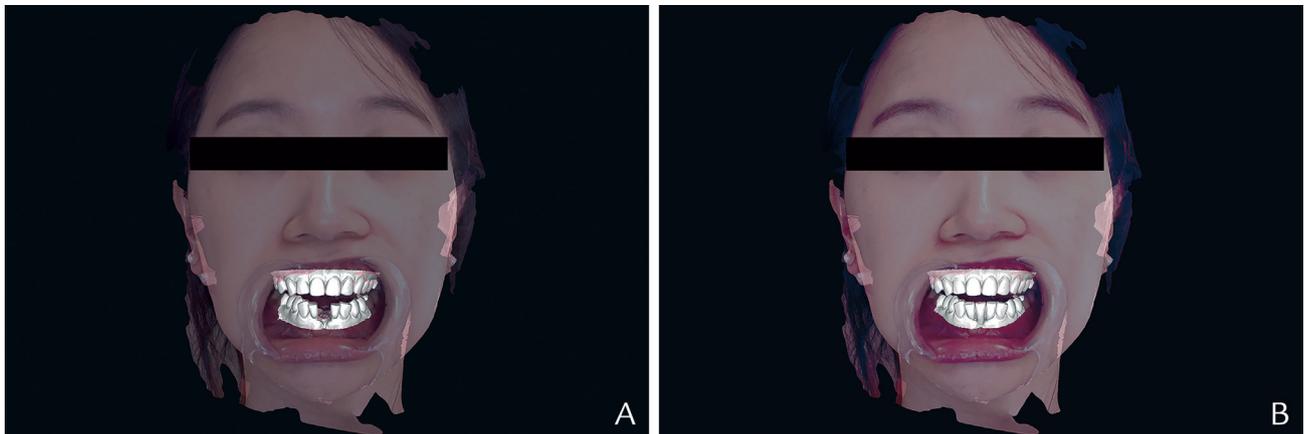


Figure 6. A, Integration of initial intraoral digital scanning with facial scan data. B, Integration of trial restoration data with facial scan data.

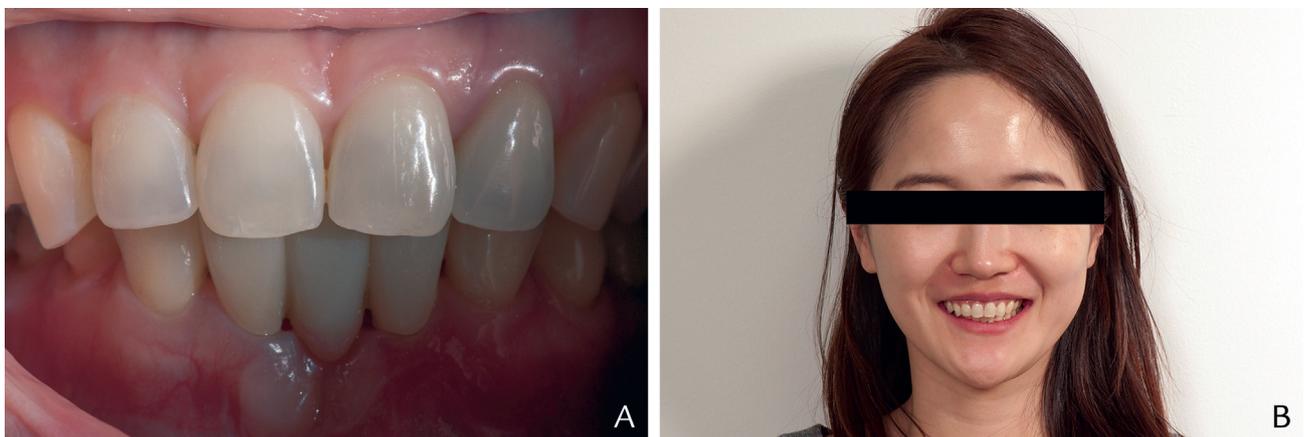


Figure 7. Placement of definitive restorations. A, Intraoral view. B, Facial view.



Figure 8. Facial scan data in smile view after placement of definitive restorations. A, Frontal view. B, Lateral view.

by combining intraoral digital scans with 3D facial scan data.

TECHNIQUE

1. Make intraoral digital scans of maxillary and mandibular anterior teeth, using an intraoral

- scanner (TRIOS 3; 3Shape). Obtain an interocclusal record with the same device (Fig. 1).
2. Obtain a facial scan using cheek retractors to expose the teeth by using a 3D facial scanner (Morpheus 3D scanner; Morpheus Corp) (Fig. 2).
3. Make diagnostic trial restorations by using CAD software (Exocad DentalCAD; Exocad

GmbH) and save the design in STL format (Fig. 3).

4. Fabricate maxillary and mandibular casts by using a 3D printer (Form2; FormLabs) (Fig. 4). These 3D-printed casts can serve as supplementary tools to communicate the predicted outcome.
5. Mark 4 points on the teeth of 3D facial scan data and on the corresponding points of either the intraoral digital scans or the trial restoration data in STL format (Fig. 5).
6. Integrate each STL file with the 3D facial scan data to produce 2 sets of superimposed data: initial state and trial restoration state (Fig. 6).
7. Communicate with the patient regarding the predicted treatment outcome by using the integrated virtual data and the 3D-printed casts.
8. Proceed to the definitive treatment procedures if the patient accepts the predicted treatment outcomes (Fig. 7).
9. Obtain a 3D facial scan in smile view after placing the definitive prosthesis to evaluate esthetics and harmony with facial profile (Fig. 8).

DISCUSSION

Considering the importance of esthetics for the restoration of anterior teeth, the integration of intraoral digital scanning with facial scan data enables extended evaluation of the definitive prosthesis beyond the oral cavity. The prosthesis can be further assessed for parallelism with the interpupillary line, and the relationship between dental and facial midline can be evaluated. The long axis of each tooth can also be examined for restoration by rotating the facial scan and the designed prostheses data altogether (Supplemental Video 1).

This technique could be further incorporated into a 3D virtual smile design. Additional facial scan data in the smile position obtained without cheek retractors can be superimposed with facial scan data obtained with cheek retractors, enabling a virtual evaluation of facial appearance during smiling in the 3D aspect at the treatment planning phase. However, the workflow should be simplified or automated for more widespread use. In addition, interference may exist because of the reflective effects of tooth surfaces from a 3D facial scan dataset.¹⁵

SUMMARY

The digital technique described in this article provides virtual treatment planning for rehabilitating anterior

teeth by combining digital intraoral scan with 3D facial scan data.

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<https://doi.org/10.1016/j.prosdent.2018.03.018>