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CLINICAL REPORT

A completely digital workflow for a maxillary tooth-supported complete overdenture and mandibular telescopic denture to manage the treatment of a patient with hypohidrotic ectodermal dysplasia

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ABSTRACT

This clinical report provides a complete digital workflow for the rehabilitation of a 17-year-old male patient who had been diagnosed with hypohidrotic ectodermal dysplasia. A maxillary tooth-supported overdenture was used with a mandibular computer-aided design and a computer-aided manufacturing telescopic denture with occlusal modifications. This digital workflow significantly reduced chairside time and enhanced the precision of the fit. (J Prosthet Dent 2025;134:17-23)

Hypohidrotic ectodermal dysplasia (HED) is a rare genetic disorder characterized by the abnormal development of tissues and structures derived from the ectoderm.[1] The prevalence of HED is estimated to range from 1 in 10 000 to 1 in 100 000 live male births[2] and is characterized by a triad of symptoms, including hypodontia, hypotrichosis, and hypohidrosis.[3,4]

Oral abnormalities not only affect mastication and speech but also negatively affect facial and alveolar process development, leading to a decrease in the occlusal vertical dimension (OVD) and giving an appearance similar to that of a patient with complete edentulism.[5] Therefore, it is essential to reconstruct both functionality and facial esthetics for individuals with HED.

In the last 5 years, computer-aided complete denture fabrication has seen significant advancements in materials and technology, resulting in reduced chairside time, enhanced accuracy, and improved retention.[6,7] A digital technique involving 3-dimensional (3D) scanning and printing has been integrated into the treatment protocol for denture replication.[8] However, the authors are unaware of a clinical report on the digital replication of existing dentures via a jaw motion analyzer to transfer jaw relations to a virtual articulator and fabricate a mandibular telescopic denture for a patient with HED.

This clinical report presents a completely digital workflow for duplicating existing complete dentures using a 3D scanner, a jaw motion analyzer, and computer-aided design and computer-aided manufacturing (CAD-CAM) to achieve digital jaw relation transfer and dynamic occlusal adjustment. Mandibular telescopic copings and crowns were defined virtually without requiring a second impression. A maxillary tooth-supported complete overdenture and a mandibular telescopic denture were fabricated in 2 visits.

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A 17-year-old male patient visited the Faculty of Prosthodontics at Xiamen Medical College regarding the compromised retention of his overdentures and difficulties in mastication. He requested enhanced masticatory function and retention while maintaining his current smile. The clinical examination indicated a decrease in lower facial height and the presence of a saddle nose, nail dysplasia, and thick protuberant lips (Fig. 1A, B). He presented with mixed dentition, having only 5 teeth remaining (Fig. 1C-E). The radiographs indicated the presence of thin alveolar ridges and the absence of most of his permanent dentition (Fig. 1F). His mandibular right deciduous second molar had been endodontically treated. His family history was notable, and he had dental characteristics similar to those of his father. The patient's medical history included a diagnosis of HED.

Implant-supported prostheses were not offered because of his inadequate bone volume, so a tooth-supported overdenture and a mandibular CAD-CAM telescopic denture was provided to restore esthetics, phonetics, and function. The treatment plan was established following a comprehensive discussion of the potential risks, benefits, and alternatives with his parents.

For his remaining mandibular teeth, minimal trimming was limited to lingual surfaces, with polishing. Then, definitive impressions were made using medium- and light-body silicone impression materials (Virtual Light Body; Ivoclar AG) for the existing completed overdenture (Fig. 2A, B). A digital facebow system (Jaw Motion Analyzer; Zebris Medical GmbH) was affixed to the patient's existing maxillary denture, and the mandibular tracing was recorded (Fig. 2C). Data were exported in the "jaw motion" and extensible markup

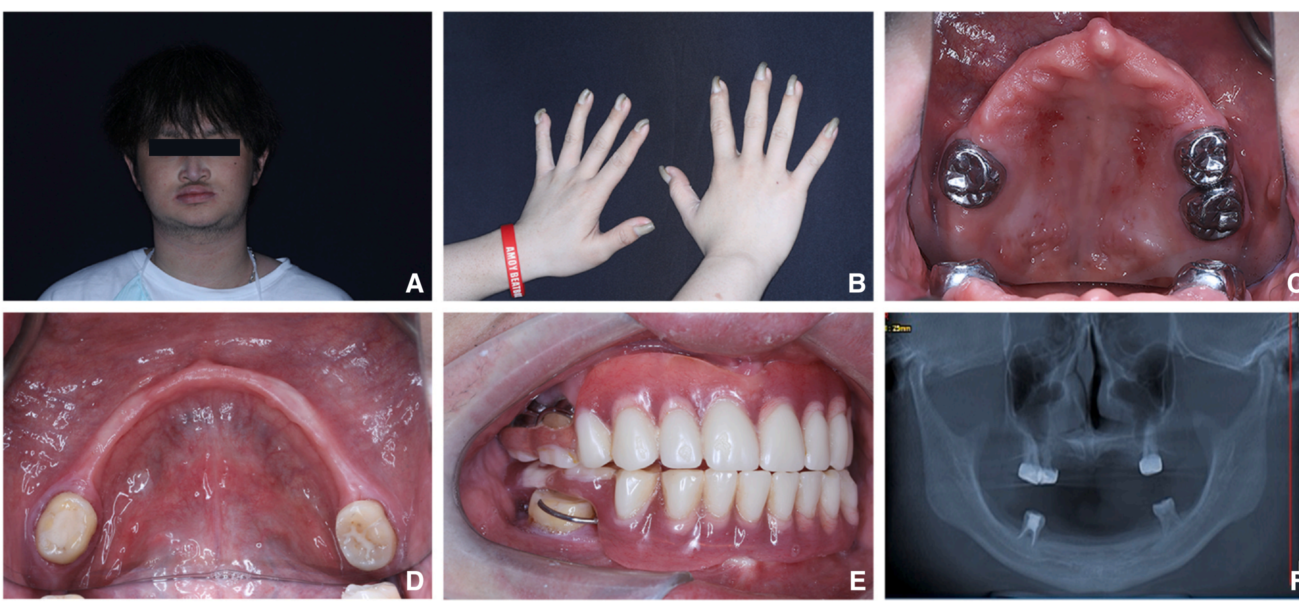

Figure 1. Initial condition. A, Frontal facial view. B, Nails view. C, Maxillary occlusal view. D, Mandibular occlusal view. E, Existing overdentures. F, Panoramic radiograph.

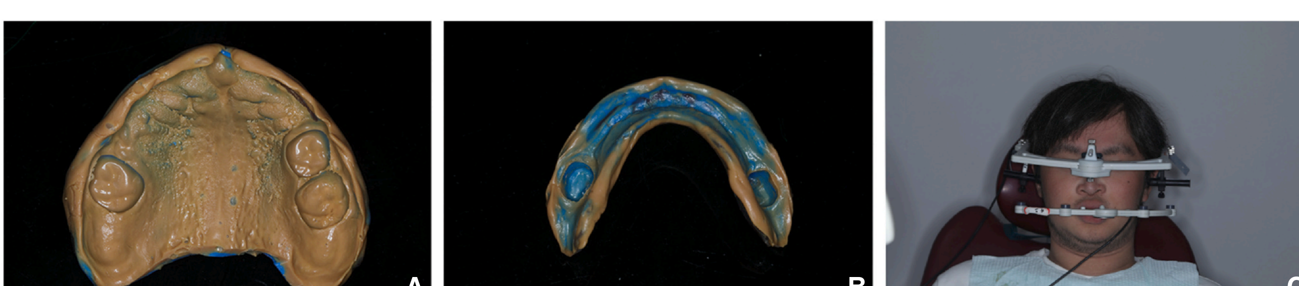

Figure 2. A, Maxillary definitive impression. B, Mandibular definitive impression. C, Jaw relation and motion tracks recorded by digital facebow system.

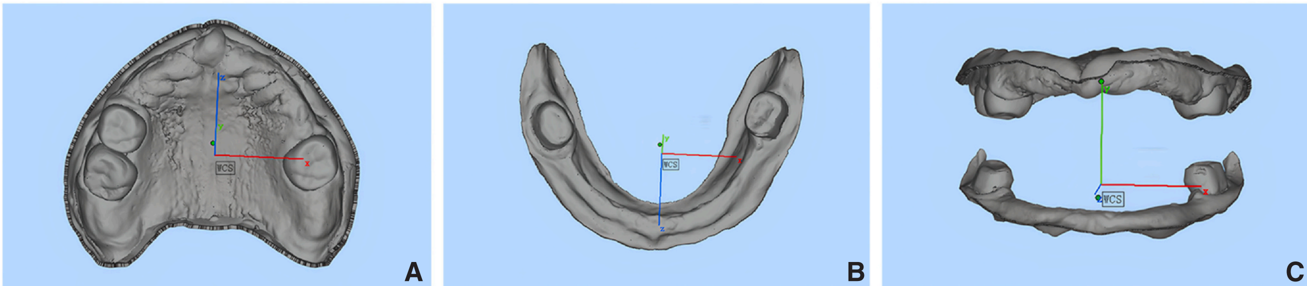

Figure 3. A, Maxillary primary virtual cast. B, Mandibular primary virtual cast. C, Digital articulator mounting.

language (XML) formats for virtual articulator integration (TypeA Adjustable; exocad GmbH).

The external and intaglio surfaces of the maxillary and mandibular dentures were scanned using an intraoral scanner (TRIOS 3; 3Shape A/S). A scannable registration material (Virtual CADbite Registration; Ivoclar AG) was also used to record centric occlusion at the reestablished occlusal vertical dimension (OVD). The data were exported as standard tessellation language (STL) files and processed in an engineering software program (Magics 24; Materialise) for the creation of a digital cast (Fig. 3A-C).

For the mandibular arch, copings for the mandibular right and left deciduous second molar were designed using the "primary telescopic crown" feature in the dental CAD software program (exocad3.0 DentalCAD; exocad GmbH) (Fig. 4A). These copings were designed with a 0.1-mm cement space and manufactured from zirconia (Multilayer 3D pro; Aidite). Subsequently, the cast with the newly designed copings was saved as a distinct cast via the "save the scene file as" option. Building upon this, the telescopic crowns and the supporting framework were created using the "secondary telescopic crown" and "partial denture" functionalities, respectively (Fig. 4B). Finally, a software program (Materialise Magics 24; Materialise) was used to integrate the telescopic crowns into the framework, culminating in a cohesive unit (Fig. 4C, D).

In the prosthetic design phase, the artificial teeth were arranged in "Full Denture" mode in the dental CAD software program (exocad3.0 DentalCAD; exocad GmbH). The jaw movement data were integrated into

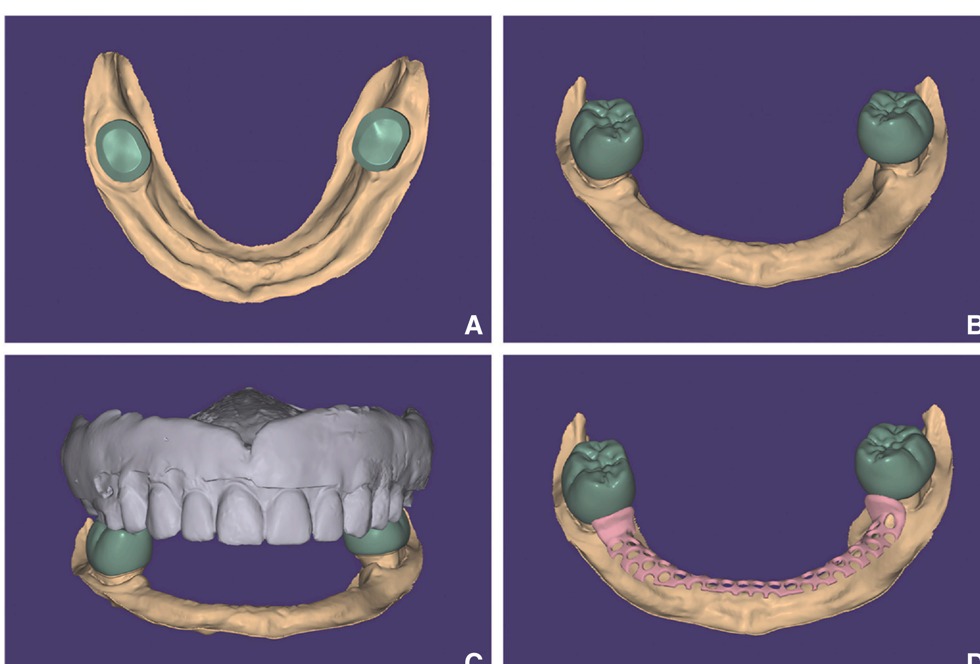

Figure 4. A, Design of telescopic copings. B, Design of telescopic crowns. C, Digital articulator mounting. D, Integration of telescopic crowns with framework.

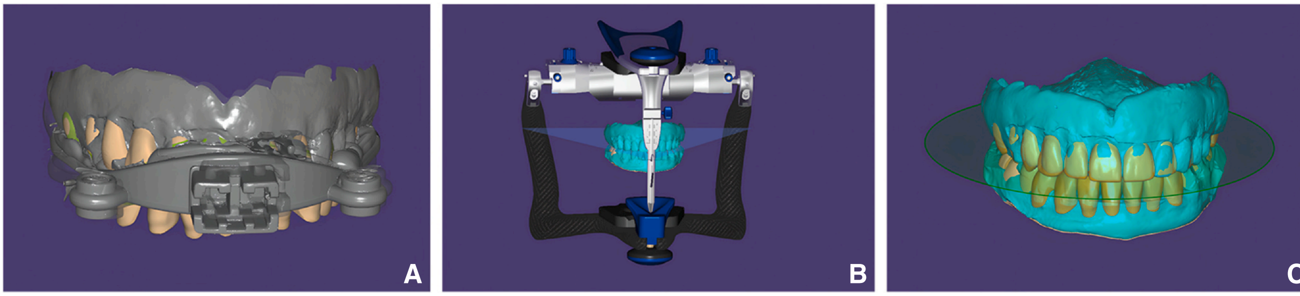

Figure 5. A, Digital facebow transfer with existing denture. B, Digital facebow transfer with new denture. C, Duplication of existing dentures.

the software program to accurately simulate the patient's mandibular motions and eliminate interferences. The maxillary arch was aligned to maintain the midline, smile line, and curve of Spee as per the specifications of the existing denture. The mandibular arch was subsequently arranged harmoniously with the maxillary dentition, ensuring a balanced occlusion and esthetic alignment (Fig. 5). Finally, the denture bases with scanned mucosal surfaces and borders from existing prostheses were integrated into the dental CAD software program (Fig. 6). Telescopic crowns and a framework (BioPAEK; Dentek), denture bases (Denture UV; HeyGears), and artificial teeth (Denture Teeth UV; HeyGears) were fabricated with a 3D printer (UltraCraft A2D; HeyGears). The printed artificial teeth were bonded to the denture bases using resin (Denture UV; HeyGears) (Fig. 7).

The copings were then cemented in the patient's mouth with a dual-polymerizing resin-based cement (RelyX U200; 3M ESPE). The overdentures exhibited excellent stability, retention, and adaptation (Fig. 8A-D). Both the patient and his parents expressed satisfaction with the treatment. The patient was scheduled for routine follow-up appointments to facilitate further adjustments (Fig. 8E, F), and the adaptation of the prostheses was evaluated.

DISCUSSION

Although the success rate of dental implant in patients with congenital tooth loss has been documented, the choice of treatment plan still needs to be based on the patient's wishes, financial resources, and intraoral bone

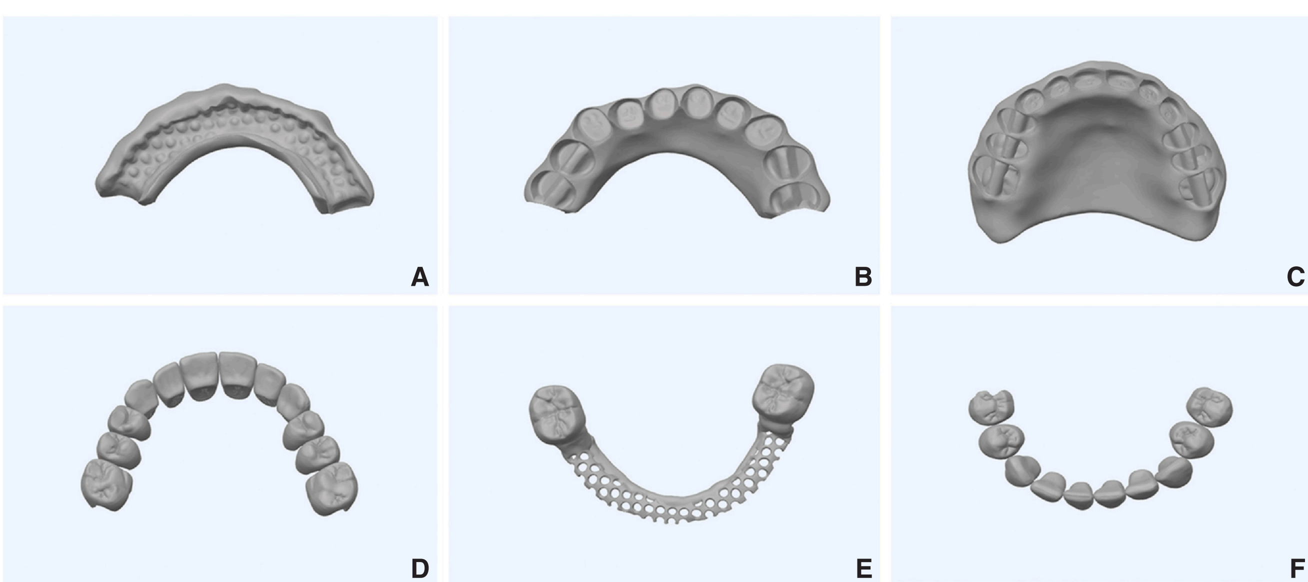

Figure 6. A, Mandibular tissue surface generated by dental CAD software program. B, Mandibular base generated by dental CAD software program. C, Maxillary base generated by dental CAD software program. D, Maxillary artificial teeth. E, Mandibular framework and telescopic crowns generated by dental CAD software program. F, Mandibular artificial teeth. CAD, computer-aided design.

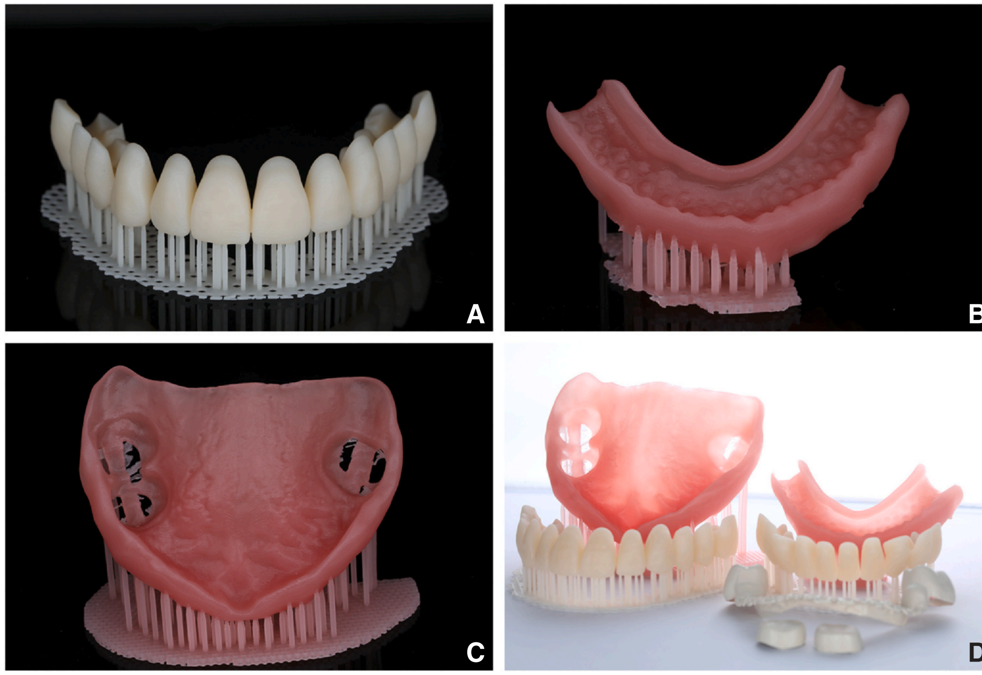

Figure 7. A, 3D printed artificial teeth. B, 3D printed mandibular denture. C, 3D printed maxillary denture. D, 3D printed denture. 3D. 3-dimensionally.

volume, among other factors.[9–11] Removable dentures are often the best treatment option for patients with poor bone.

In the prerestorative phase of the abutment teeth, using resin guide injection technology to establish a common insertion path is an efficacious strategy that ensures the precise placement and stability of the restorations.[12,13] Additionally, orthodontic treatment and ceramic crowns have been commonly used as restorative options.[14] Crown restorations emerged as an optimal solution for the current patient, given that the mandibular right deciduous second molar had been endodontically treated.

The traditional removable denture restoration process requires making impressions, pouring casts, fabricating copings, constructing removable denture frameworks, transferring jaw relations, and evaluating waxings.[15] Patients typically need 3 or 4 visits before the dentures can be delivered.[16] Moreover, the traditional method cannot replicate the polished surface morphology or track the patient's mandibular motion, requiring patients to adapt to the new dentures.[17]

Digital techniques were used in constructing the copings, streamlining the design process for the telescopic denture, and developing a digital cast. This cast established the foundational platform for the subsequent design of the telescopic crown and framework. Furthermore, poly-aryletherketone (PAEK) was selected as the material for the fabrication of both the framework and telescopic crown, as it offered straightforward direct 3D printing capability and allowed better esthetic outcomes than traditional metal alternatives.[18,19]

SUMMARY

This clinical report described a complete digital workflow for the rehabilitation of a 17-year-old boy diagnosed with HED that involved the fabrication of a maxillary tooth-supported complete overdenture and a mandibular telescopic denture. The definitive impression and jaw relationship were recorded simultaneously during the first visit. The maxillary existing denture was replicated, and the mandibular telescopic copings and crowns were virtually defined, eliminating the need for a second impression. This approach facilitated the transfer of a personalized jaw relationship and dynamic occlusal adjustments, culminating in a balanced occlusion.

PATIENT CONSENT

The clinical operation described in this clinical report was explained to the patient and his parents, who provided informed consent. The procedure was approved by the Ethics Committee of the Stomatological Hospital of Xiamen Medical College.

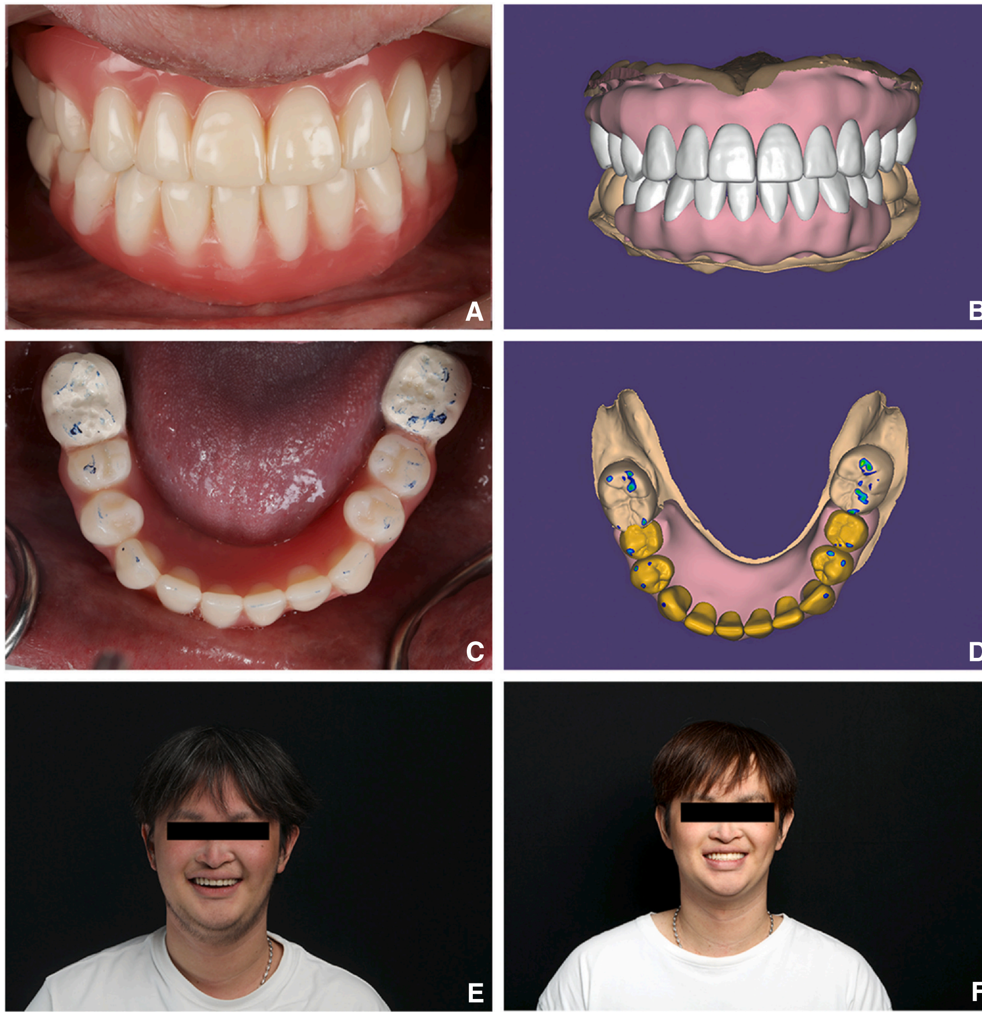

Figure 8. A, Intraoral centric occlusion of definitive prosthesis. B, Centric occlusion designed by dental CAD software program. C, Mandibular occlusal contact for definitive prosthesis. D, Mandibular occlusal contact designed by dental CAD software program after dynamic occlusion adjustment. E, Posttreatment smile. F, Posttreatment smile at 1-year follow-up. CAD, computer-aided design.

DISCLOSURE

The author reports no conflicts of interest in this work.

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