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DENTAL TECHNIQUE

Computer-engineered complete denture fabrication with conventional clinical steps: A technique to overcome protocol limitations

Hatem Alqarni, BDS,[a] Abdulaziz AlHelal, BDS, MS,[b] and Mathew T. Kattadiyil, BDS, MDS, MS[c]

ABSTRACT

Treating patients with complete edentulism presents unique clinical challenges. With advancements in digital dentistry and computer-engineered complete denture fabrication, new clinical challenges occur. This report describes a modification to a computer-engineered complete denture maxillomandibular relation–recording protocol to manage a patient with an increased interarch distance. (J Prosthet Dent 2019;122:430-4)

Rehabilitation of completely edentulous patients with conventional complete dentures has been a predictable treatment approach.[1,2] Advancements in digital technology have led to the use of computer-aided design and computer-aided manufacturing (CAD-CAM) technology in the design and fabrication of complete dentures.[2-4] With computer-engineered complete dentures (CECDs) and despite numerous advantages, including fewer appointments and reduced chair time,[2-8] situations occur that might not be manageable using the recommended CECD manufacturer's protocol.

CECD protocols typically require the use of a central bearing tracing device that includes a horizontal recording plate and a vertical stylus to capture the occlusal vertical dimension (OVD) and centric relation.[3,4,8,9] However, excessive loss of alveolar ridge height results in significant interarch space—sometimes beyond the adjustment range of the tracing device provided by the manufacturer—which complicates the capture of maxillomandibular records.[10] Such a clinical situation cannot be managed with the available CECD protocol. This technique describes management of 1 such limitation in a patient with severely resorbed completely edentulous arches (Fig. 1A).[8,9] The tracing stylus and plate could not be adjusted to the correct OVD because of the increased interarch distance as seen in Figure 1B. This complication was managed by combining features of computer-engineered and conventional complete denture protocols to capture the maxillomandibular relation record.

A 68-year-old man sought treatment to replace his unstable and worn mandibular and maxillary complete dentures (Fig. 1C). The panoramic radiograph and clinical examination revealed severe resorption of the mandible, which was classified according to the prosthodontics diagnostic index as class IV.[10] Although the panoramic radiograph (Fig. 1D) revealed a potential dehiscence of the inferior alveolar nerves bilaterally, no symptoms corroborated this observation clinically. Frictional hyperkeratosis was seen on the center of the anterior mandibular alveolar ridge. The maxillary alveolar ridge revealed moderate resorption and hyperplasia of the anterior maxillary ridge. Treatment options were discussed, and milled CECDs were selected for their excellent retention[7] and adaptation.[11]

TECHNIQUE

1. Determine the arch where excessive resorption has occurred. For this patient, the mandibular arch had

[a]Prosthetic Dental Science Department, College of Dentistry, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia; and Graduate student, Advanced Specialty Education Program in Prosthodontics, School of Dentistry, Loma Linda University School of Dentistry, Loma Linda, Calif.
[b]Assistant Professor, Department of Prosthetic Dental Sciences, College of Dentistry, King Saud University, Riyadh, Saudi Arabia.
[c]Professor and Director, Advanced Specialty Education Program in Prosthodontics, Loma Linda University School of Dentistry, Loma Linda, Calif.

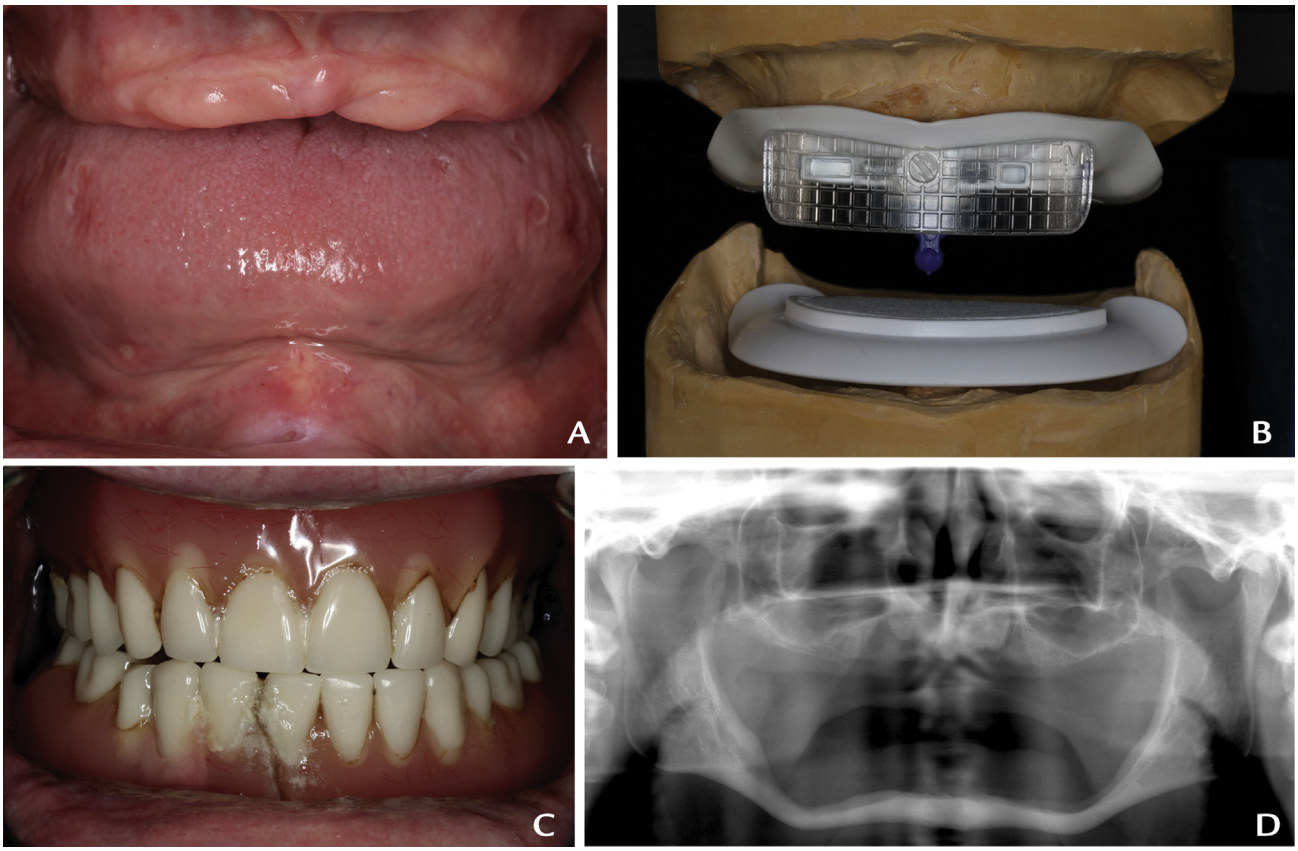

Figure 1. A, Pretreatment intraoral view at approximate OVD showing severely resorbed edentulous mandible leading to excessive interarch distance. B, Diagnostic cast mounting with AMD revealed that stylus, at maximum extension, and tracing plate could not be adjusted to accommodate large interarch distance. C, Existing maxillary and mandibular complete dentures. D, Panoramic radiograph. AMD, anatomic measuring device; OVD, occlusal vertical dimension.

undergone severe resorption. Make preliminary impressions using irreversible hydrocolloid (Jeltrate Alginate Fast Set; Dentsply Sirona) impression material. Pour the impression in Type III stone (Microstone; Whip Mix Corp) to fabricate diagnostic casts.

2. Fabricate a mandibular record base (Triad; Dentsply Sirona) and occlusion rim (Hygienic medium-soft no. 3 pink wax; Coltène) on the mandibular diagnostic cast. Modify the mandibular occlusion rim (MOR) to provide appropriate visibility (height) and labial fullness.
3. Adjust the record base of the MOR for appropriate extensions, border mold the record base using heavy-body polyvinyl siloxane (PVS) (Aquasil Heavy body; Dentsply Sirona), and make a definitive mandibular impression using light-body PVS (Aquasil Light body; Dentsply Sirona). The MOR serves also as a custom tray.
4. Select an appropriately sized anatomic measuring device (AMD) (AvaDent; Global Dental Science [GDS]) (1 of 3 available sizes) for the maxillary arch by using the caliper provided by the manufacturer and adapt the AMD to the diagnostic cast. Apply PVS impression adhesive (VPS Tray Adhesive; 3M ESPE) before relining the maxillary AMD with PVS impression material (Fig. 2) as recommended by the manufacturer. After relining with PVS,

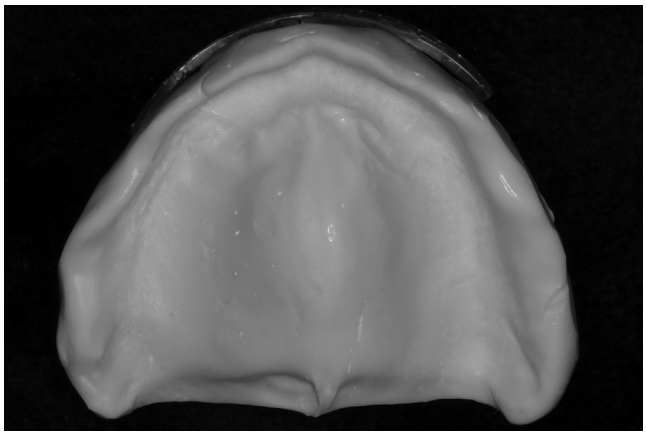

Figure 2. Polyvinyl siloxane material used to stabilize maxillary AMD. AMD, anatomic measuring device.

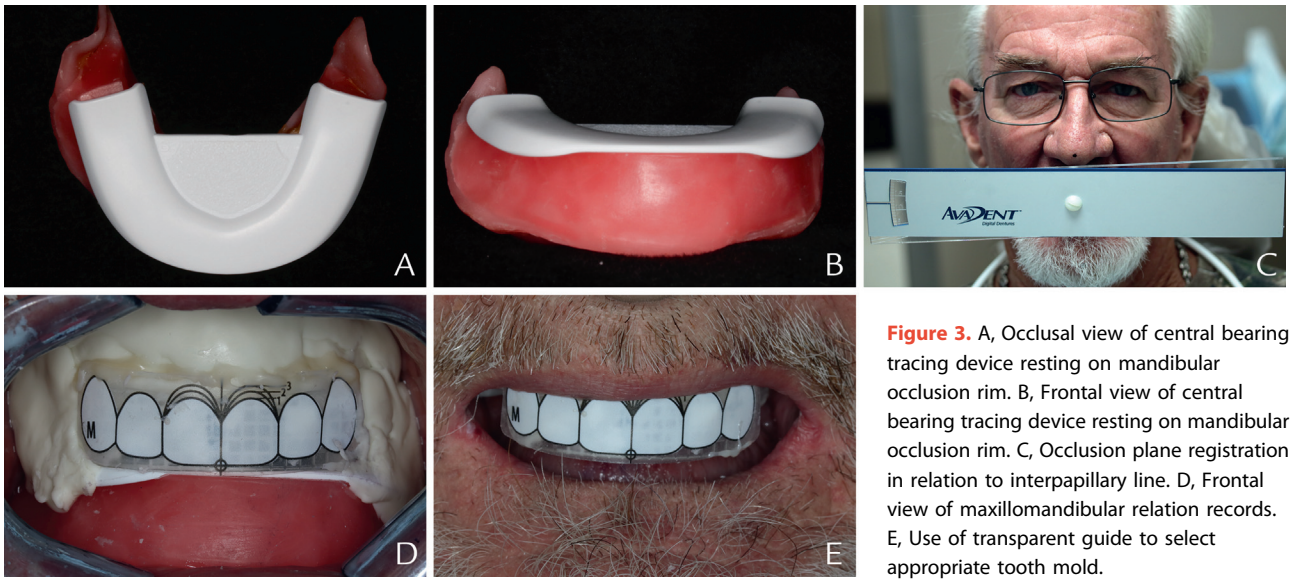

Figure 3. A, Occlusal view of central bearing tracing device resting on mandibular occlusion rim. B, Frontal view of central bearing tracing device resting on mandibular occlusion rim. C, Occlusion plane registration in relation to interpapillary line. D, Frontal view of maxillomandibular relation records. E, Use of transparent guide to select appropriate tooth mold.

determine the correct OVD using a preferred assessment technique.[12] Place dots on the tip of the nose and chin and capture the distance with a caliper.[13] The PVS impression relining procedure will help stabilize the AMD while capturing the centric relation record.

5. Select the customizable maxillary tray manufactured by GDS as explained with the AMD, adjust extensions as needed, and make the definitive maxillary impression with PVS impression material by following the clinical steps mentioned earlier.
6. Attach the horizontal plate of the maxillary AMD to the MOR on the occlusal surface as seen in Figure 3A, B.
7. Place the maxillary AMD and attach the AvaDent ruler and adjust to establish the occlusal plane as seen in Figure 3C. Place the MOR with the horizontal plate and adjust the OVD by turning the stylus on the side of the maxillary AMD to achieve the previously established OVD. Determine centric relation with a gothic arch tracing by coating the tip of the bearing pin with a marking agent. Guide the patient's mandible to centric relation and capture the lateral and protrusive movements on the mandibular tray with the bearing pin to achieve an arrow point tracing.[14]
8. Remove the MOR and drill a divot into the horizontal plate at the arrow point of the tracing. Replace the MOR intraorally and guide the patient to retrude the mandible until the stylus on the maxillary AMD slots into the divot. Capture the vertical and horizontal relationship by injecting PVS occlusal registration material (Vanilla Bite; DenMat Holdings, LLC) into the space between the maxillary AMD and MOR as seen in Figure 3D. The MOR provides adequate support for the PVS material, which would not have been possible at the correct OVD if the manufacturer's mandibular AMD had been used.
9. Advance the labial flange of the maxillary AMD by turning the anterior screw to achieve appropriate lip support. Select the denture tooth mold by overlaying the esthetic transparent guide (1 of 3 sizes) onto the AMD tray. Record the desired gingival height once the appropriate transparent guide is chosen. Provide this information in the laboratory authorization form. Delineate the midline and incisal edges for maxillary anterior teeth on the labial flange of the maxillary AMD. Place composite resin (Tetric EvoFlow; Ivoclar Vivadent AG) onto the transparent guide and cure so that it adheres to the labial flange. Place the maxillary AMD and MOR and verify the esthetics and OVD (Fig. 3E).
10. Send the maxillomandibular relation records and laboratory authorization form indicating the type of occlusal scheme, tooth shade, and size to the laboratory (GDS) for fabrication of milled trial dentures. The laboratory provides a digital file to preview the denture tooth arrangement.
11. Review the digital design images carefully and suggest modifications if needed before obtaining final approval and requesting trial dentures.[8]
12. Place the milled poly(methyl methacrylate) trial dentures (Functional BTI; GDS), perform

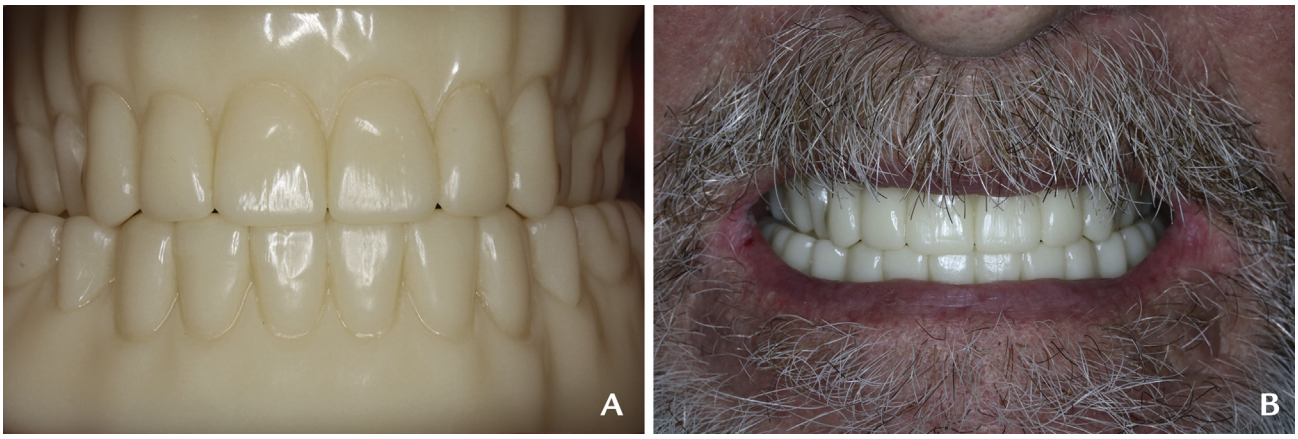

Figure 4. Functional trial dentures for verification A. Intraoral view. B. Frontal view.

adjustments as needed, and obtain patient approval (Fig. 4).[15] Approve fabrication of monolithic definitive CECDs by GDS.

13. Deliver the definitive prostheses (Fig. 5) and adjust as needed. Provide home care and hygiene instructions to the patient. Schedule recall appointments.

DISCUSSION

This modified technique provides a predictable outcome for the CECD protocol in patients with complete edentulism associated with severe dental-arch resorption. This technique provides a significant advantage in such situations by using a conventional MOR to compensate for the lost alveolar height and achieves adequate visibility; this would not be possible with the dimensions of the mandibular AMD provided by the manufacturer. Management of severe mandible resorption using conventional technique methods has been reported.[16-18] However, this protocol allows the capture of the maxillomandibular relation record using a conventional approach and still allows transition to digital fabrication.[19] This technique retains all the advantages of CECD fabrication.

A limitation caused by the increased interarch distance was managed by using a conventional MOR with a horizontal plate of the AMD and the maxillary AMD with the stylus. Alternately, conventional maxillary occlusion rims and MORs could have been fabricated, and a conventional protocol could have been followed without using gothic arch tracing, followed by a digital fabrication process. This would be a good option for those unfamiliar with the gothic arch recording protocol for CECDs.

Another concern with this technique was the possible distortion during transportation of the MOR from temperature changes. The trial dentures helped to overcome this concern. Also, modification to the described AMD is not unique to one manufacturer as other manufacturers recommend similar techniques.[20,21]

Figure 5. Frontal view of maxillary and mandibular definitive computer-engineered complete dentures.

The described technique added a fourth visit to the CECD protocol, which increased chair time. However, an additional visit is usually unavoidable in this or similar clinical situations.

SUMMARY

CECD systems offer the facility for rapid fabrication of dentures in fewer visits compared with conventional denture-fabrication procedures. However, these systems come with some clinical and design limitations that make it unsuitable for all patient situations. A technique is described that combines a conventional mandibular record base and occlusion rim along with the maxillary AMD to record the maxillomandibular relationship with an arrow point recording. This resulted in an additional appointment and modifications to the CECD fabrication protocol proposed by the manufacturer to overcome a complication associated with CECD systems.

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Corresponding author:
Dr Hatem Alqarni
Loma Linda University, School of Dentistry
11092 Anderson St
Loma Linda, CA 92350
Email: halqarni@llu.edu

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