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DENTAL TECHNIQUE

A CAD-CAM device for preparing guide planes for removable partial dentures: A dental technique

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ABSTRACT

To ensure stability and prevent harmful forces, proximal guide planes and those for reciprocation arms should be accurately prepared during mouth preparation for removable partial dentures. A device to guide accurate proximal and reciprocal guide planes was designed and fabricated by using computer-aided design and computer-aided manufacture (CAD-CAM). (J Prosthet Dent 2019;122:10-3)

Mouth preparation for removable partial dentures includes proximal and reciprocal guide planes. When appropriately prepared, reciprocal guide planes control harmful forces from the retentive arm on the abutment during placement and removal, and the proximal guide planes ensure stability of the prosthesis.[1-3] The design of the planes can be determined on a diagnostic cast with conventional surveying; however, it is not straightforward to replicate the parallel guide plane from the cast in the mouth without the aid of a specific device.

A guide plane–preparation device can be fabricated with conventional laboratory procedures.[4] However, digital technology[5] allows a more accurate and straightforward process with computer-aided design (CAD) software. A 3D analysis of the diagnostic cast and the design and fabrication of a device for accurate proximal and reciprocal guide plane preparation is presented.

TECHNIQUE

1. Scan the diagnostic cast using a laboratory scanner (rainbow scanner; Dentium) and import the scan into a software program (3-matic; Materialise) as a standard tessellation language (STL) file (Fig. 1).
2. Evaluate the STL file for appropriate undercuts at various axes and select a 3D axis as the path of placement (Fig. 2).
3. Determine the appropriate proximal and reciprocal planes facing the path of placement (Fig. 3).
4. Build a rectangular 3D object for each tooth and align them on the teeth according to the selected proximal and reciprocal planes (Fig. 4).
5. Build a 3-mm-thick offset structure, such as that for an occlusal device, for the maxillary STL file (Fig. 5).
6. Extract the overlapped area between the rectangular objects and the occlusal device–shaped object (Fig. 6).

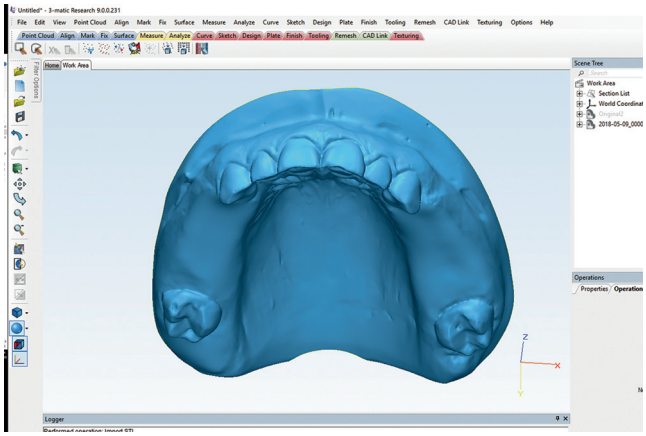

Figure 1. Imported standard tessellation language (STL) file of maxillary partially edentulous diagnostic cast.

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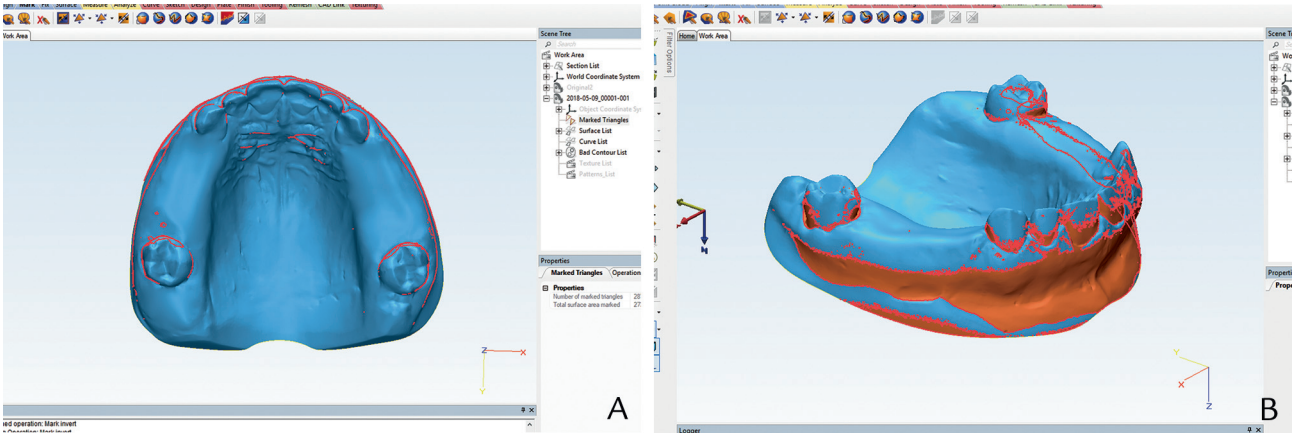

Figure 2. A, Path of placement determined based on 3D analysis. B, Undercut area shown in path of placement.

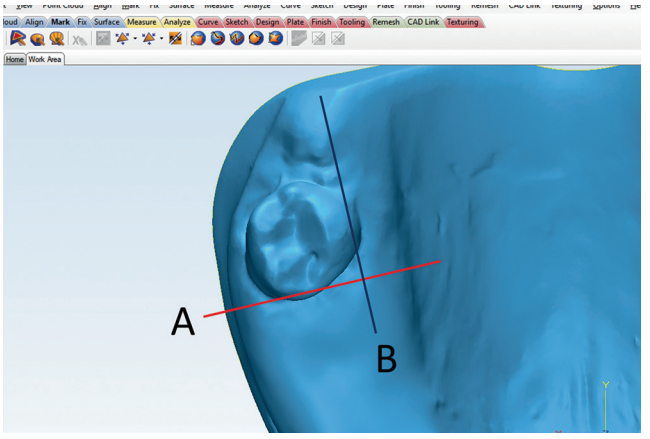

Figure 3. Proximal guide plane (A) and reciprocal guide plane (B) decided according to path of placement.

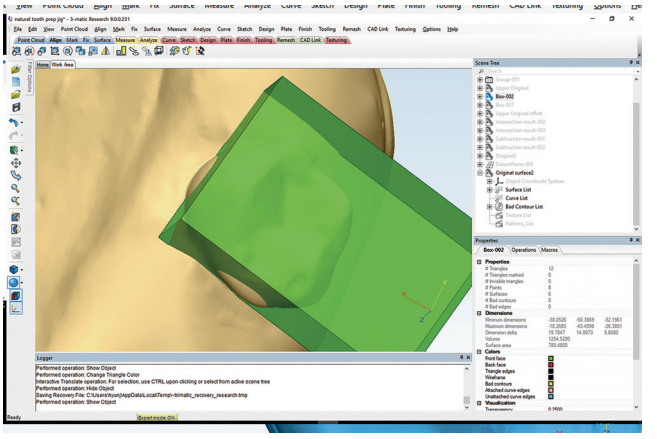

Figure 4. Rectangular 3D object built and aligned according to analyzed plane.

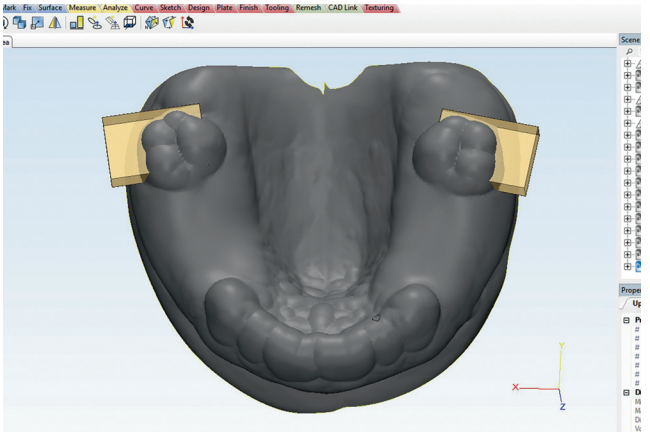

Figure 5. Occlusal device–shaped object of 3-mm thickness built on surface of diagnostic cast.

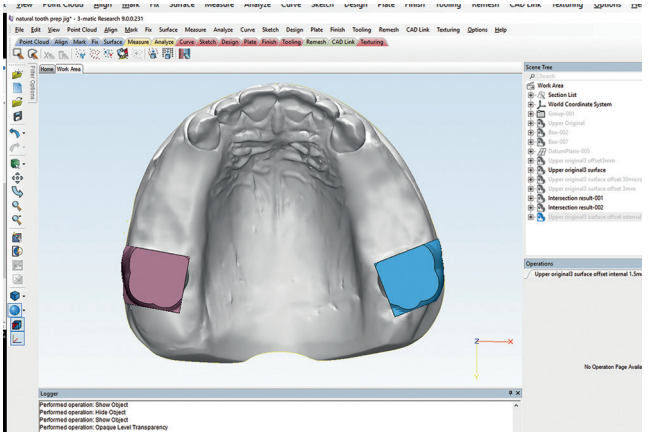

Figure 6. Extraction of overlapped area between rectangular and occlusal device–shaped objects.

7. Export the STL files of the devices (Fig. 7) and fabricate by computer-aided manufacturing (CAM) (Connex3 Objet260; Stratasys).

8. Set the device on the tooth, adjust if necessary, and prepare according to the proximal and palatal reference planes of the device (Fig. 8).

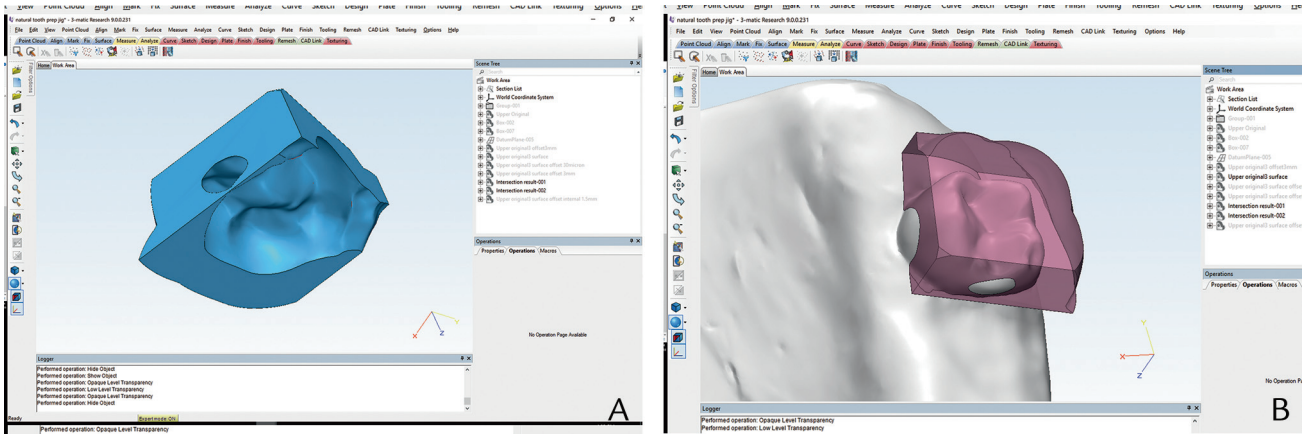

Figure 7. A, Designed device for mouth preparation based on 3D analysis. B, Mesial and palatal surfaces of device reference guide for proximal and reciprocal planes.

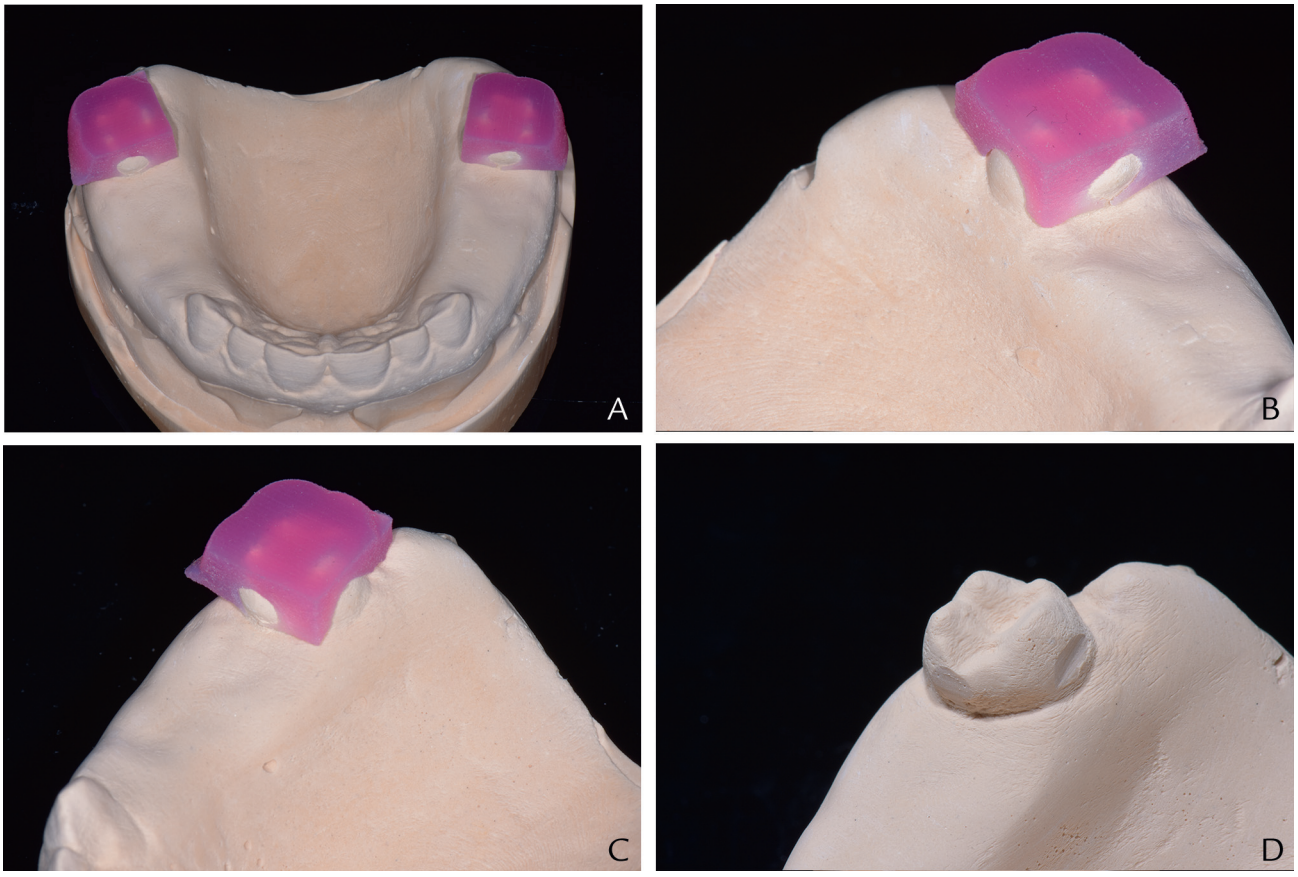

Figure 8. A, Devices positioned on cast. B, Maxillary right device. C, Maxillary left device. D, Prepared tooth using proximal and palatal reference planes of device.

DISCUSSION

Obtaining parallelism of 2 distant surfaces is challenging without any reference plane. When fabricating a surveyed crown, the parallelism is acquired using a surveyor. However, because the palatal surfaces of the right and left molars are approximately 35 mm apart, it is difficult to compare them accurately in a single field of view. Establishing parallelism between distant teeth without the help of a device is challenging.

In the era of digital dentistry, many types of scanners are available, and an STL file of the diagnostic cast can easily be acquired. The path of placement can be easily evaluated without surveyors using a 3D software program, and the 3D position of the diagnostic cast after

determining the path of placement can be recorded digitally. The proximal guide plane and the reciprocal plane are determined using the 3D software.

The design of the device is straightforward. The palatal surface of the device was used as the reciprocal plane, and the mesial surface of the device represented the proximal guide plane (Fig. 7). The occlusal plane of the device was also an important reference path of placement, and the top of the handpiece aligned with the occlusal plane of the device. After finishing the design, the STL file of the device was fabricated using a 3D printing material (VeroMagenta RGD851; Stratasys) and 3D printer (Connex3 Objet260; Stratasys). Undercuts in the device were simply adjusted before seating. The seating of the device on the tooth was confirmed by the fit of the mesial and palatal sections. The fabricated devices were positioned on the tooth, which was prepared according to the proximal and lingual reference planes of the device (Fig. 8).

This method facilitates the fabrication of devices compared with conventional methods, and the digital analysis delivers a precise product.

SUMMARY

A guide for preparing proximal and reciprocal guide planes can be fabricated with a 3D software program and a 3D printer.

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