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TIPS FROM OUR READERS

Radiographic template used to facilitate the alignment of digital scans to computed tomography scans with extensive beam hardening artifacts

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Endosteal dental implants have shown to be an excellent long-term resource for the treatment of edentulism.[1] For decades, restorative-driven implant placement has been considered the norm for patient care,[2,3] and careful presurgical planning by using accurate diagnostic elements is widely recognized as a requirement for predictable, esthetic, and functional implant placement.[3]

Computer-generated surgical guides generated from computed tomography (CT) scans are widely used and have been shown to be a resource that improves the outcomes of implant surgery.[4,5] The accurate reproduction and stability of the tissues that will support the guide is essential, and rigid references such as teeth or dental implants have been used successfully to support surgical guides.[4,6] However, in patients with multiple metal restorations, radiographic artifacts such as beam hardening or scatter can obscure the areas of interest,[7] thus complicating the accurate 3-dimensional recreation of the intraoral tissues in the planning software program.[8] An approach used to overcome this problem is the triple-scan technique.[8] In this technique, 3 independent scans are aligned in an implant planning software program to allow the accurate reproduction and visualization of the intraoral tissues. Usually, the 3 scans consist of a high-resolution intraoral scan, a CT scan made with an impression tray loaded with elastomeric impression material, and a CT scan of the same impression tray out of the mouth.[8] Although this technique is effective, the patient may find it unpleasant because of the bulk of the impression material and the difficult removal when undercuts are present. In addition, this approach can result

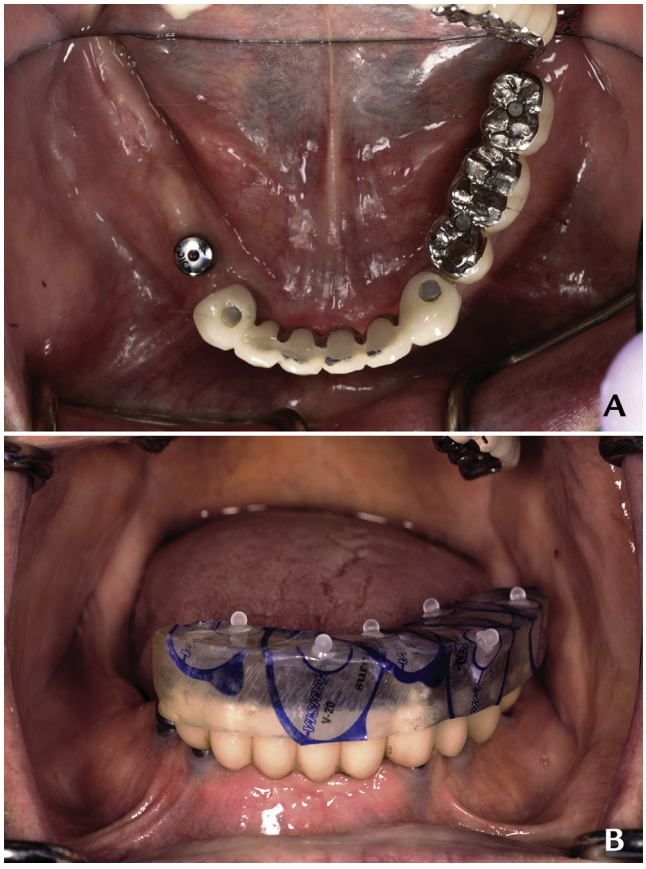

Figure 1. A, Intraoral image of mandibular arch restored with metal-ceramic restorations which caused extensive beam hardening artifacts. B, Device in place. Note adequate adaptation and widely spread fiducial markers on occlusal surface of device.

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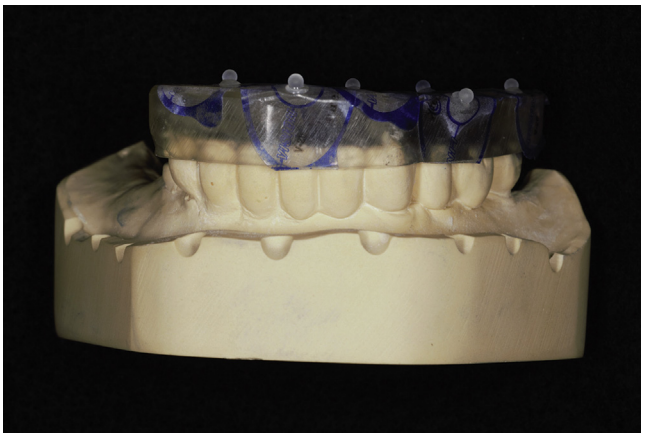

Figure 2. Diagnostic cast with device used to create scan to align with scan of diagnostic cast alone to computed tomography scan.

in inaccuracies because of difficulty in visualizing the separation of the tray from the intraoral tissues.

The purpose of this article was to introduce a straightforward but effective alternative to the triple-scan technique. In this approach, an acrylic resin radiographic stent with fiducial markers was used to relate high-resolution digital scans to the CT scan of a patient with multiple implant-supported restorations and abundant radiographic beam hardening artifacts. This approach allowed the accurate reproduction of the surface of the existing prostheses, thus allowing its use as the foundation for the computer-generated surgical template. An additional advantage of the described technique is that the guide is made from a clear material to allow the visual inspection of complete seating. For this reason, it is placed more easily and reliably than a tray filled with elastomeric impression material. Unlike techniques where fiducial markers are placed directly on the prostheses, this technique does not require the use of an intraoral scanner. The added distance between the fiducial markers and the restorations with this technique also reduces the possibility of interfering artifacts.

TECHNIQUE

1. Make an impression (Silginat; Kettenbach USA) that reproduces the anticipated areas that will support the surgical template. Pour the preliminary impressions conventionally with dental stone (Buff Stone; Whip Mix Corp) and fabricate a diagnostic cast and a definitive cast. With a tungsten carbide laboratory cutter (H251SA.11.060 HP SGE-Cutter Carbide; Brasseler USA), create multiple notches in the edges of the land area of the diagnostic cast. Subsequently, scan the diagnostic cast with a benchtop laboratory scanner (E3; 3Shape A/S). Make sure the areas that will support the future surgical template are well defined in the scan.
2. By using the definitive cast, fabricate a 3-mm device with a thermoplastic polymer (Clear Splint Biocryl 3mm/125mm; Great Lakes Dental Technologies) via pressure molding (Biostar Scan with LCD Display; Great Lakes Dental Technologies).

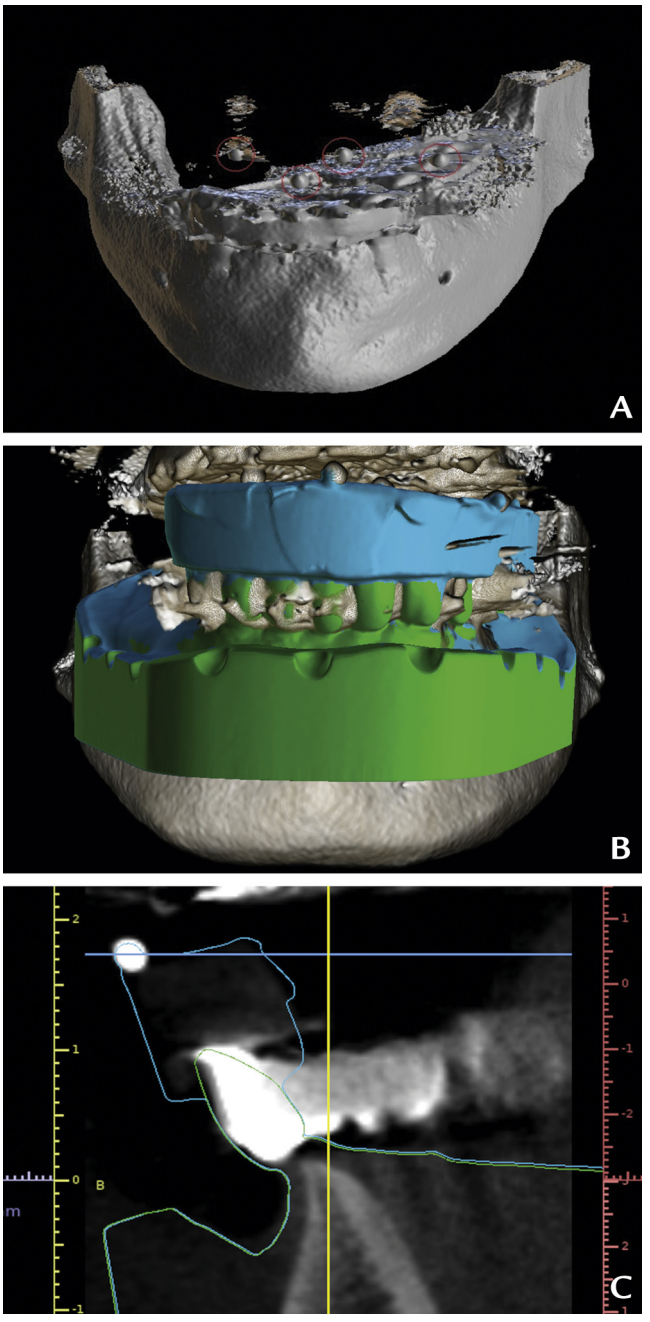

Figure 3. A, Volumetric cast generated from computed tomography scan. Note radiopaque fiducial markers above beam hardening artifacts. B, Digital scans of diagnostic cast with radiographic stent and diagnostic cast alone aligned to volumetric model. C, Alignment.

3. Prepare the surface of the device by applying acrylic monomer (Ortho-Jet Liquid; Lang Dental Manufacturing, Co) and add polymethyl methacrylate resin (Ortho-Jet Powder; Lang Dental Manufacturing, Co) to the occlusal surface of the clear device. Carefully trim the added resin to an approximate height of 10 mm above the occlusal plane. Remove the device from the definitive cast and verify that it fits accurately on the diagnostic cast.
4. Evaluate the device intraorally and verify its stability. Subsequently, adjust the height of the device while maintaining parallelism to the occlusal plane as much as possible. Apply fiducial markers (V-20; The SureMark Co) to the device, with maximum spread across the dental arch (Fig. 1). Make a CT scan with the device in position.
5. Scan the diagnostic cast with the device in place (Fig. 2). Align the CT scan and digital cast with the device by using corresponding fiducial marker points (Fig. 3A). Align the digital cast with the device and digital cast without the device by using the corresponding notches made in the land area (Fig. 3B, 3C).

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