DENTAL TECHNIQUE

Digital custom implant impression technique for capturing the acquired emergence profile

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Implant restorations, especially those in the anterior esthetic zone, can benefit greatly from well-contoured interim restorations. By modifying the contours of the interim restoration, the clinician has control of shaping the peri-implant soft tissue before the definitive restoration. The direct and indirect custom implant impression coping techniques are commonly used to record this essential information so that accurate details on casts reflecting the clinical situation can be communicated to the dental laboratory technician.[1-3] Dentists who have adopted digital dentistry are finding improved workflow efficiency and ease of collaboration with dental laboratories. The current digital method is similar to the direct analog method because the peri-implant soft tissue and emergence profile are scanned directly after removal of the interim restoration or custom healing abutment. Although the soft tissue architecture can be captured by digital scans, time is an important factor because the gingiva around implants has been shown to change within the first 20 to 40 seconds after removal of the healing abutment.[4] For patients who require more scan time or when the accuracy of the soft tissue scan is suspected, Liu et al[5] have proposed a sequence for capturing the acquired emergence profile by using a different digital method. However, the authors did not specify which software was used or how to actually perform the Boolean operation. The present article describes a similar technique performed by using a free software (Meshmixer; Autodesk).

ABSTRACT

A digital method for capturing the acquired emergence profile from contoured implant interim restorations is described. Three separate digital scans were made by using an intraoral scanner and aligned by using a design software program capable of merging and alignment. The Boolean Difference function was then performed by using a free software program to obtain the emergence profile. This technique may be less time-consuming than analog methods and may be more accurate than existing digital methods. (J Prosthet Dent 2019;122:348-50)

TECHNIQUE

Chairside:

1. Before removing the interim implant restoration, perform a complete-arch digital scan (scan 1) by using an intraoral scanner (TRIOS; 3Shape) (Fig. 1). This scan will serve as the reference for alignment with the other scans.

2. Remove the interim implant restoration and attach an intraoral scan body to the implant. Perform a second intraoral scan (scan 2), capturing 2 or more adjacent teeth on each side of the scan body (Fig. 2).

3. Attach an analog, which acts as a handle, to the interim restoration. Scan the entirety of the interim restoration by using the intraoral scanner (scan 3) (Fig. 3). Replace the interim restoration in the patient's mouth. Export the scans as standard tessellation language (STL) files.

Laboratory:

1. Using a dental CAD software program (exocad GmbH), import and align the STL file containing the scan body (scan 2) to the complete-arch STL file

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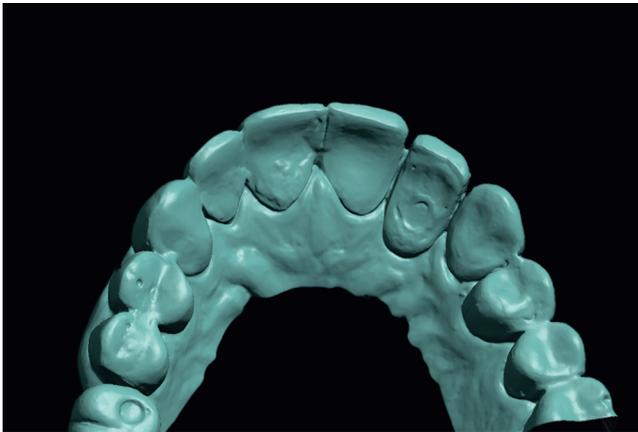
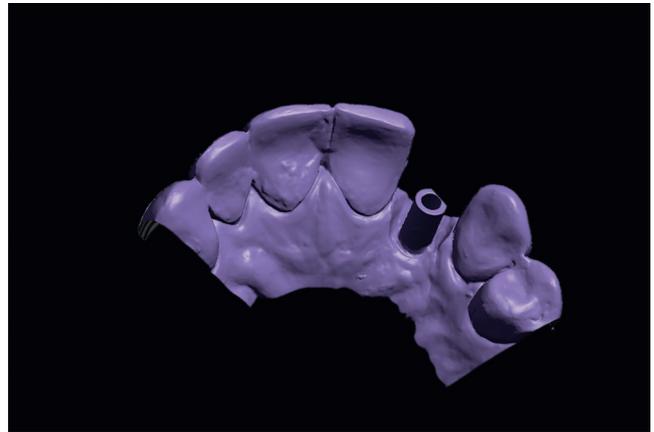**Figure 1.** Scan 1: Complete-arch scan with interim restoration in place.

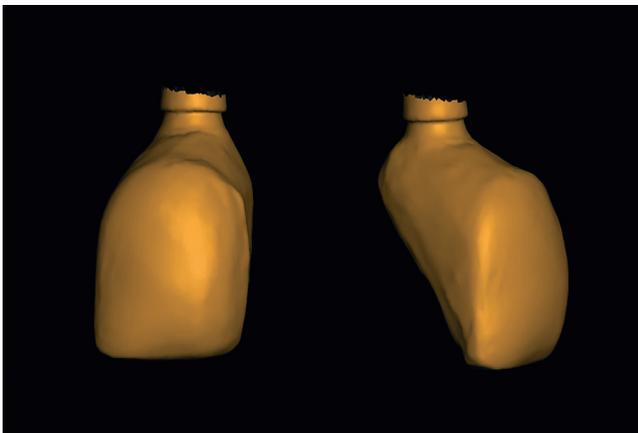**Figure 2.** Scan 2: Scan body and surrounding dentition captured.

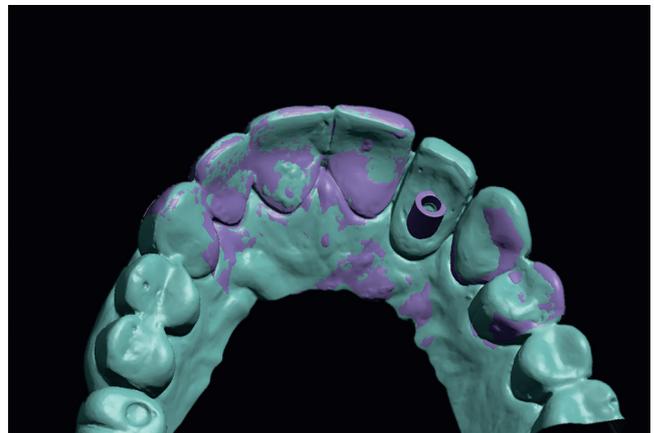**Figure 3.** Scan 3: Records of contours of interim restoration.

Figure 4. Scan 1 and 2 aligned using identical points.

(scan 1) with 3-point registration, followed by the best-fit alignment feature (Fig. 4).

2. Align the interim STL file (scan 3) to the complete-arch STL file (scan 1) in the same fashion as seen in Figure 5. Export the 3 scans in the same 3D coordinate system to preserve their aligned positions.

3. Using Meshmixer, start a new project and import and append scans 2 and 3. Ignore any prompts attempting to shift the positions of the scans.

4. Optional: Make the scans into solids by selecting each scan individually and choosing the Make Solid command under the Edit menu. To preserve the accuracy of the scans, Solid Type needs to be switched to Accurate. Solid Accuracy and Mesh Density should be maximized as well. By turning the scans into solid objects, the likelihood of errors is reduced with the next operation.

5. Perform the Boolean Difference function by highlighting scan 2, followed by scan 3, and selecting Boolean Difference. This command trims the shared areas between 2 polysurfaces, leaving behind the object that was selected first. In the described scenario, scan 3 is trimmed or subtracted from scan 2, and as a result, the negative likeness of the interim restoration contours is left behind (Fig. 6). This modified scan can be saved and exported as file A.

6. Scan 1 can then be imported into a dental CAD software program of choice as the prepreparation scan; scan 2 can be imported as the scan body scan to generate the implant position, and file A can be imported as the tissue scan to communicate the peri-implant soft tissue architecture.

DISCUSSION

Performing intraoral tissue scans for implant restorations can often be carried out with adequate precision. However, reflective tissue that is undergoing rapid changes almost immediately after the removal of the interim restorations can be hard to record accurately, especially for multiple implants. This technique can be used in most situations that include soft tissue molding by interim restorations, including multiunit restorations and pontic sites. In terms of accuracy, digital intraoral scans rival that
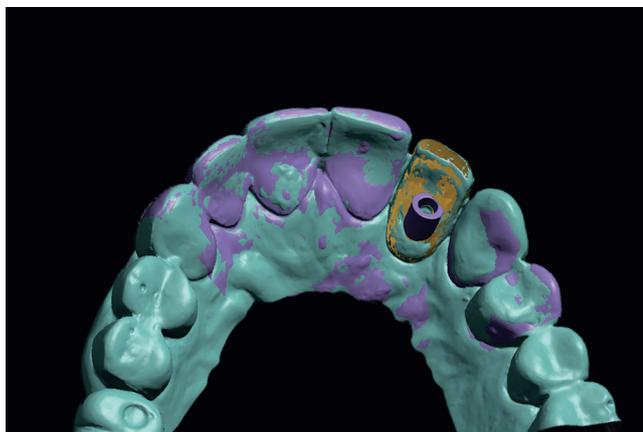
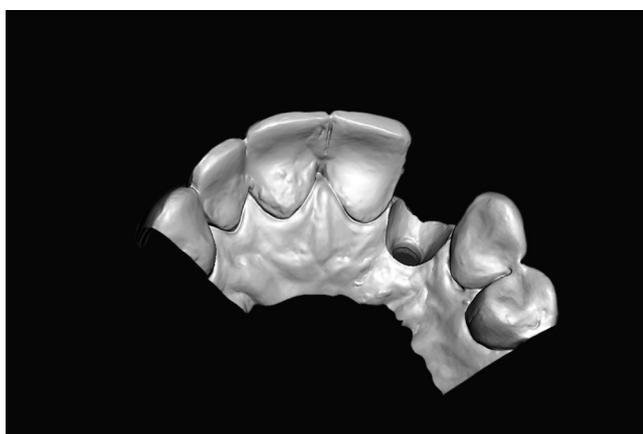**Figure 5.** Scan 3 aligned in preparation for Boolean Difference.

Figure 6. After Boolean Difference, emergence profile molded by interim restoration obtained.

of conventional impressions.[6,7] When compared with the indirect analog custom impression coping technique, the digital method may be less time-consuming because no laboratory work is required while the patient is in the chair. Furthermore, when compared with the direct analog custom impression coping technique, this digital technique may be more accurate because the clinician is making an exact copy of the interim restoration and is not forced to work under a time limit before soft tissue collapse; again, this can occur soon after interim removal.[4] However, research is required to validate the accuracy of the technique. Finally, for clinicians and commercial dental laboratories using digital technology, this technique can be easily integrated as there is no monetary cost to using Meshmixer.

SUMMARY

The described digital custom impression technique may be more accurate than performing the tissue scan immediately after removal of the interim restoration and could be less time-consuming than conventional methods. The Boolean Difference function, which is unavailable in most dental CAD software programs, can be easily performed with a free software program.

REFERENCES

1. Polack MA. Simple method of fabricating an impression coping to reproduce peri-implant gingiva on the master cast. J Prosthet Dent 2002;88:221-3.
2. Chee WW, Cho GC, Ha S. Replicating soft tissue contours on working casts for implant restorations. J Prosthodont 1997;6:218-20.
3. Schoenbaum TR, Han TJ. Direct custom implant impression copings for the preservation of the pontic receptor site architecture. J Prosthet Dent 2012;107:203-6.
4. Nissan J, Zenziper E, Rosner O, Kolerman R, Chaushu L, Chaushu G. The effect of mucosal cuff shrinkage around dental implants during healing abutment replacement. J Oral Rehabil 2015;42:774-8.
5. Liu X, Liu J, Mao H, Tan J. A digital technique for replicating peri-implant soft tissue contours and the emergence profile. J Prosthet Dent 2017;118:264-7.
6. Lee SJ, Betensky RA, Gianneschi GE, Gallucci GO. Accuracy of digital versus conventional implant impressions. Clin Oral Implants Res 2015;26:715-9.
7. Papaspyridakos P, Gallucci GO, Chen CJ, Hanssen S, Naert I, Vandenberghe B. Digital versus conventional implant impressions for edentulous patients: accuracy outcomes. Clin Oral Implants Res 2016;27:465-72.

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