



Combined analog-digital workflow for treatment planning, digital dentures fabrication, and assessing accuracy of intraoral scanning: case report.

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Abstract:

Purpose: To demonstrate a combined analog-digital workflow for treatment planning and fabrication of digital dentures in two patients and investigate the accuracy of intraoral scanning (IOS).

Materials and Methods: The patients' edentulous arches, existing dentures both with suboptimal retention, and maxillomandibular relationship (MMR) were recorded using IOS. Reversing the scan data of the edentulous arches was performed to facilitate alignment of the 3 scans (Medit software) during treatment planning (virtual mounting) for implant-retained dentures. Combining the existing dentures scan with properly extended borders with the IOS of the edentulous arch was performed to 3D-print custom trays, to reduce the possible inaccuracy of the IOS in recording the vestibular anatomy. The custom trays were used for the dual purpose of recording the denture foundation areas (DFA) and maxillomandibular relationship in one visit followed by digitizing with a lab scanner (3 Shape). The IOS of the edentulous arches were superimposed on the reference analog impressions and the deviation between them was measured in 3 areas: DFA, segmented vestibules, and segmented DFA excluding vestibules (Medit). Digital diagnostic dentures were 3D-printed for the purpose of implant planning.

Results: Dentures of acceptable retention and stability were inserted. The deviation between IOS and analog impressions showed highest absolute mean values of 0.542 ± 0.696 and 0.458 ± 0.647 mm in the maxilla and mandible respectively. The greatest deviation was recorded in the vestibules of maxilla and mandible with corresponding absolute mean values of 0.663 ± 0.821 and 0.831 ± 0.716 mm.

Conclusion: Treatment planning can be facilitated by reversing the scan data to align different digital scans. A combined analog-digital workflow can overcome IOS limitations in recording vestibules for denture fabrication.

1

Patient A



Intraoral Frontal (With and without the pre-existing ill-fitting dentures) and occlusal views of patients A and B. Photos and IOS (Trios 3, 3 Shape) were captured as part of implant planning for the maxilla for patients A and B and for the mandibular arch for patient A.

Patient B



2

Figure 1

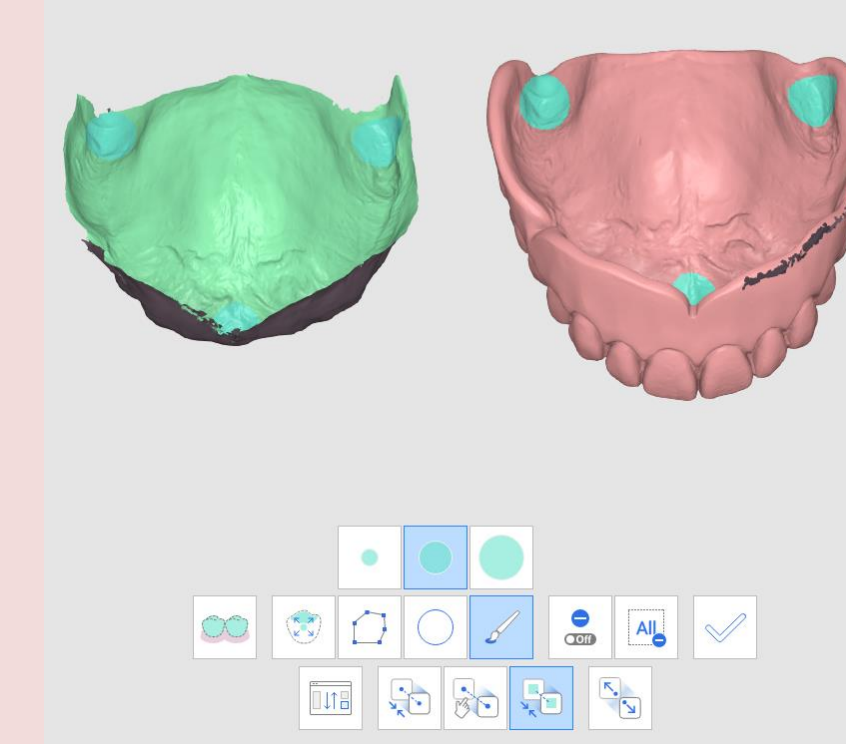


Figure 3

IOS of the edentulous arches (Figure 1) and dentures as well as MMR scans for the dentures were captured. The 3 scans were aligned on Medit through reversing the scan data creating negative replicas of the edentulous arches (Figure 2) which is identical to the intaglio surface of the denture. Three widely distributed area-based alignment (Figure 3) was used for virtual mounting and treatment planning (Figure 4).

Figure 2

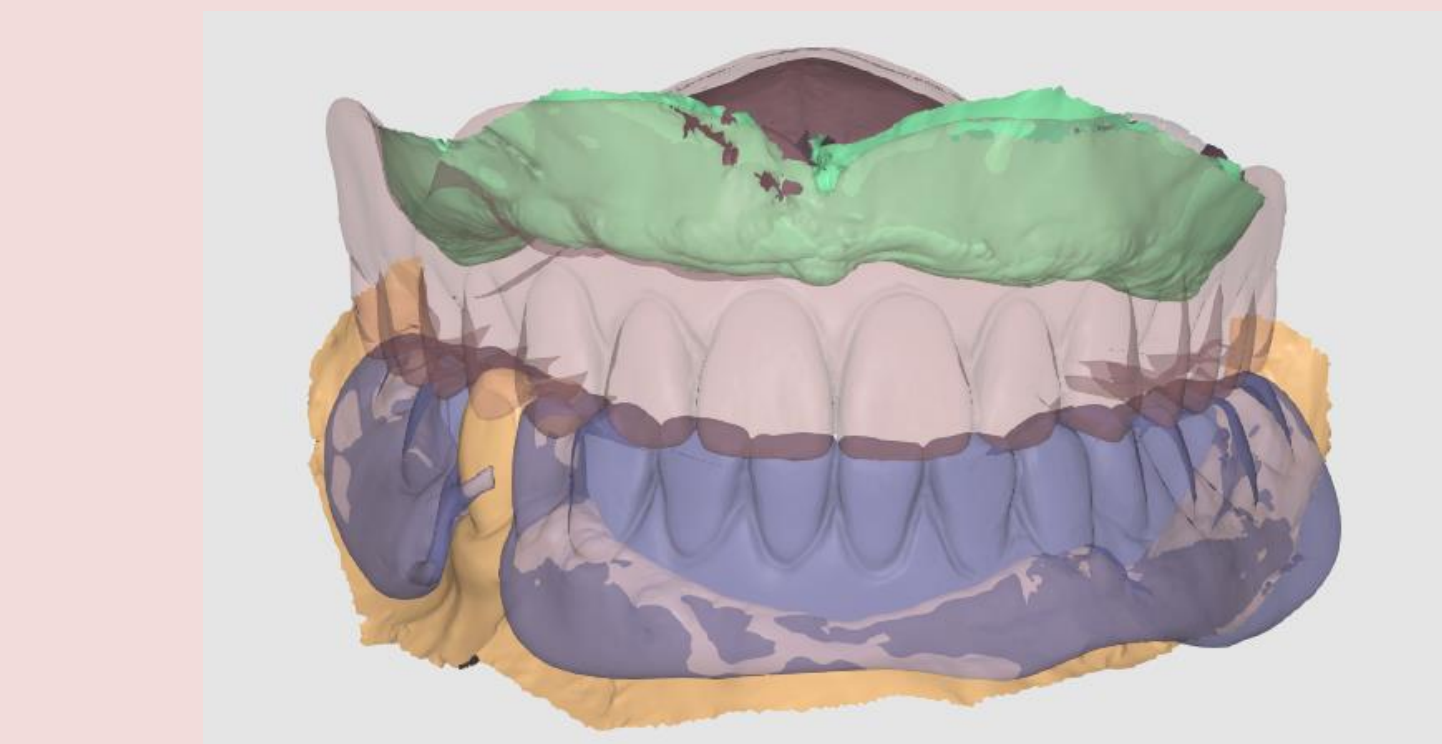


Figure 4

3

Patient A

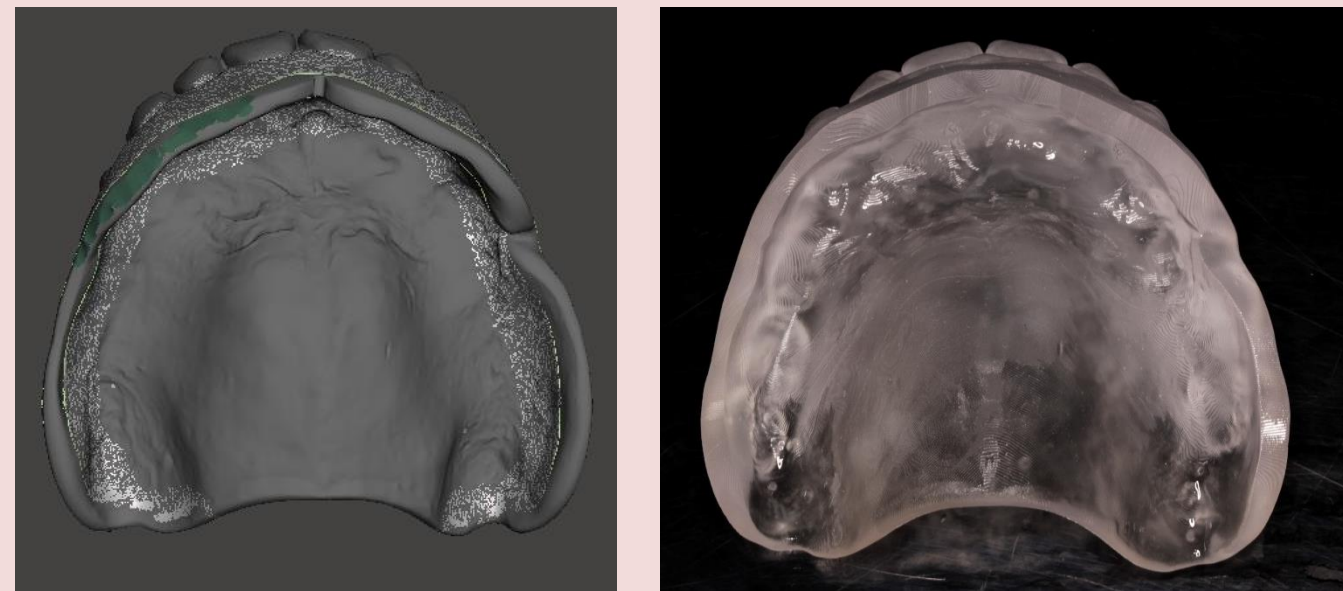


Figure 5

Figure 6

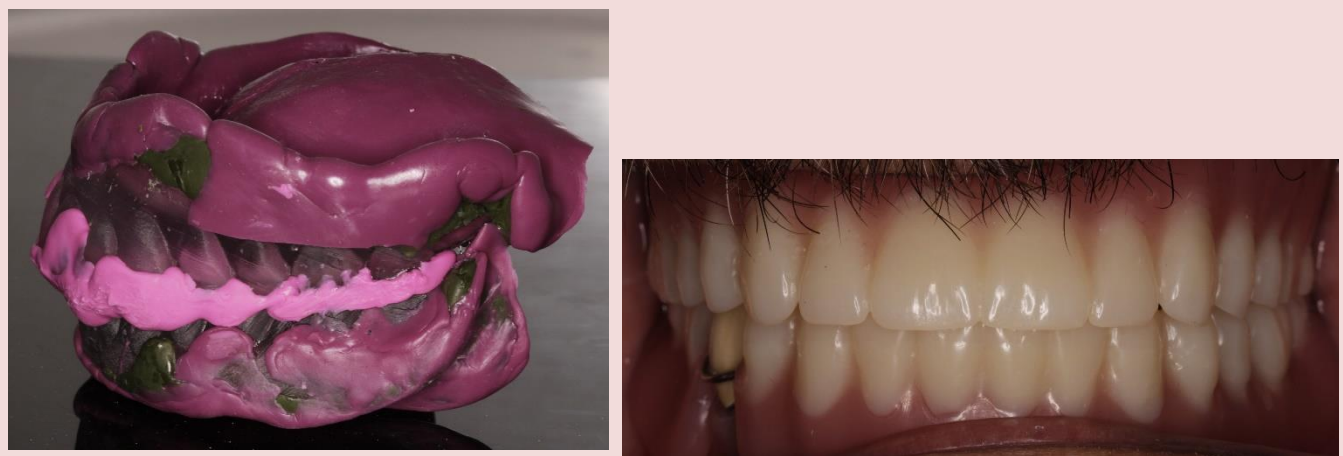


Figure 7

Figure 8

Patient B

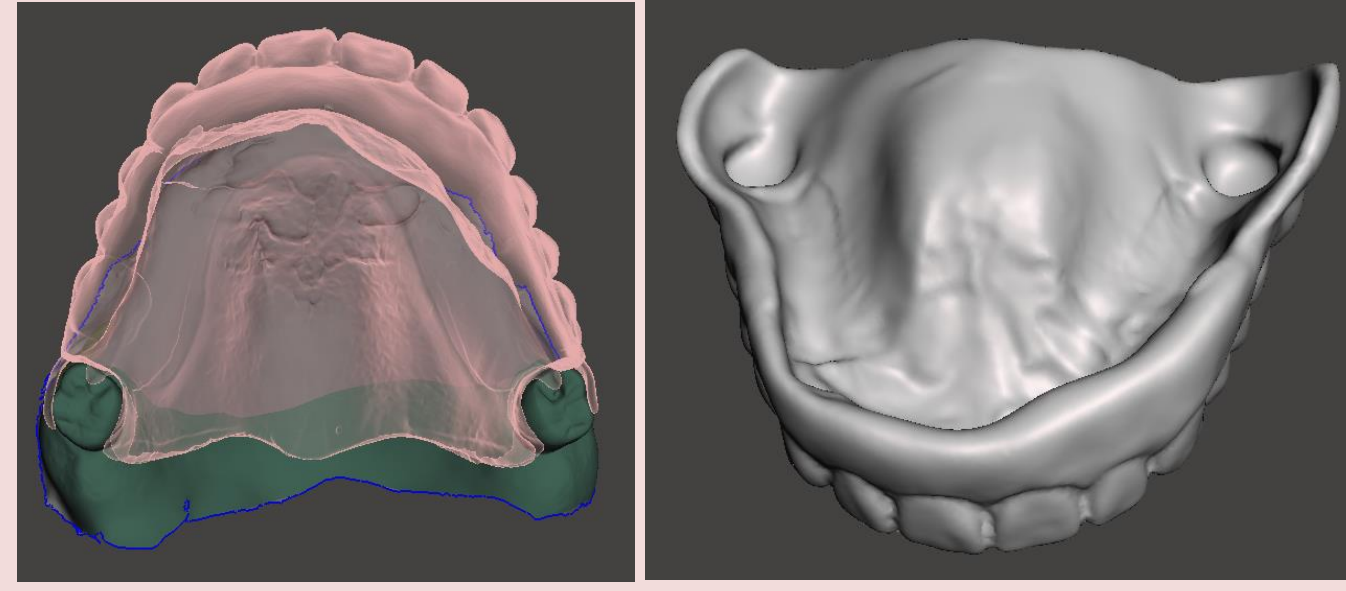


Figure 9

Figure 10



Figure 11

Figure 12

For Patient A, the scanned dentures were reduced by 2 mm on Meshmixer (Figure 5) and then 3D-printed (Figure 6) for the dual purpose of analog impressions and MMR at the same clinical visit (Figure 7). For patient B, the scanned denture was combined into a single STL file with the posterior extension of the IOS (Figure 9) to design a custom tray (Figure 10), whilst reducing the possible inaccuracy of the IOS in recording vestibular anatomy(1). The custom tray was used for capturing the analog impression (Figure 11). The analog impressions were then digitized using lab scanner (3 Shape) as a reference. The diagnostic dentures for the purpose of implant planning and CBCT acquisition were inserted for patient A (Figure 8) and patient B (Figure 12).

4

Figure 13

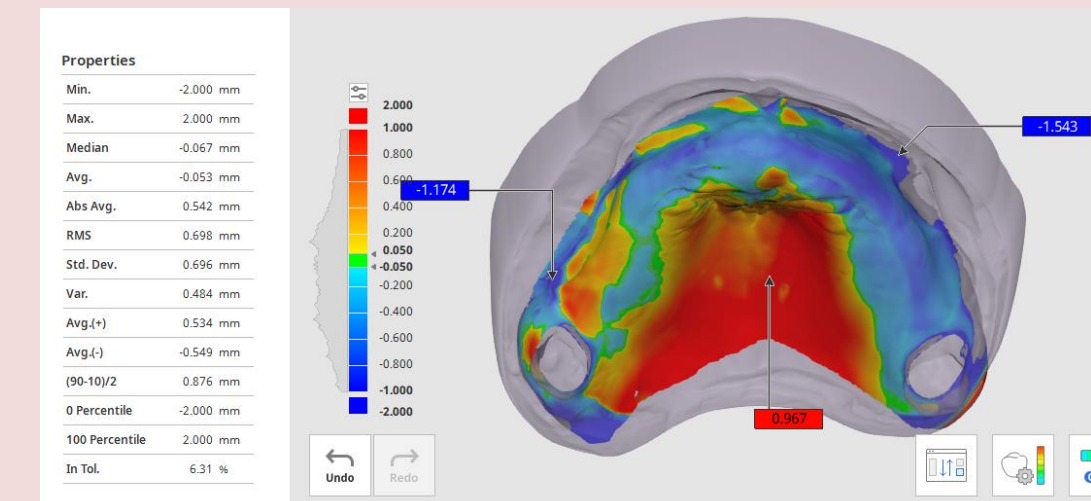


Figure 14

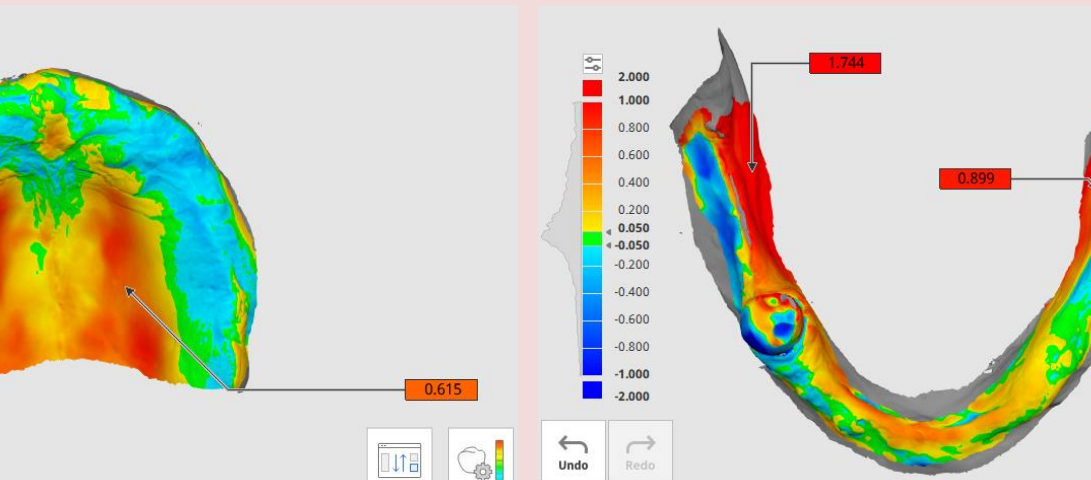
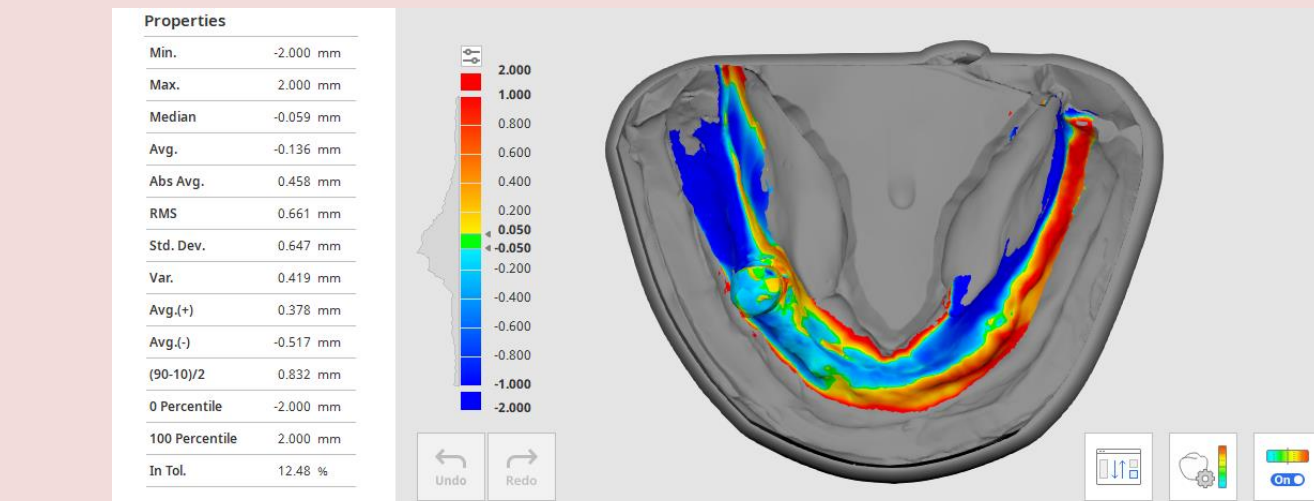


Figure 15

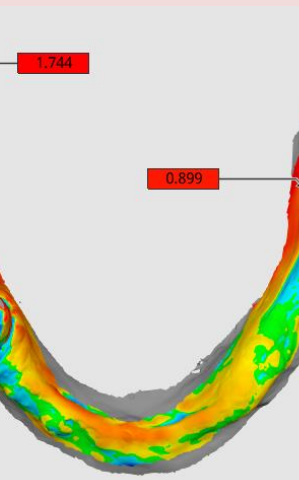


Figure 16

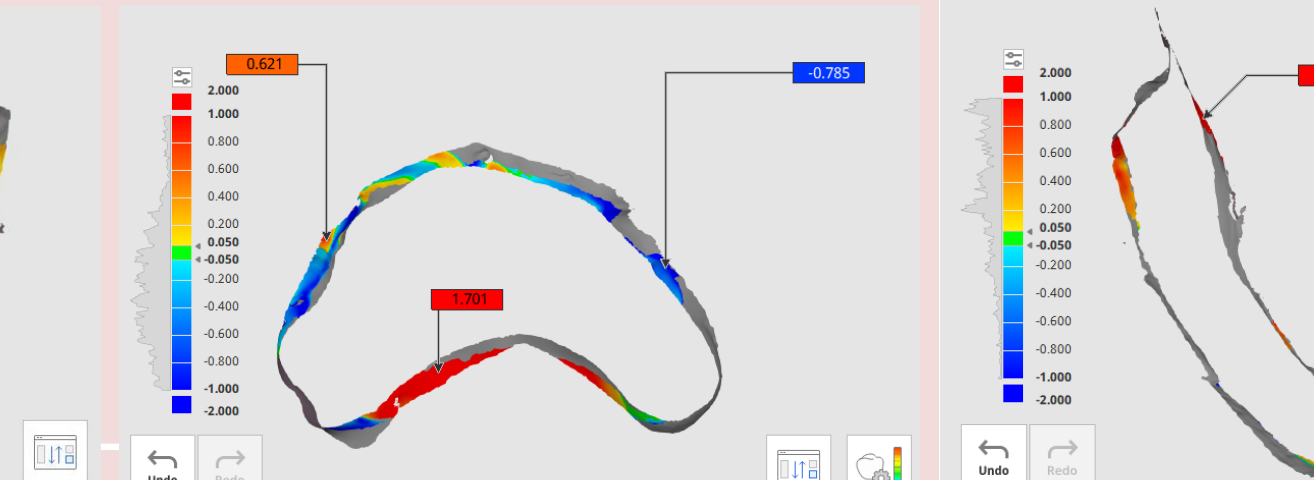


Figure 17

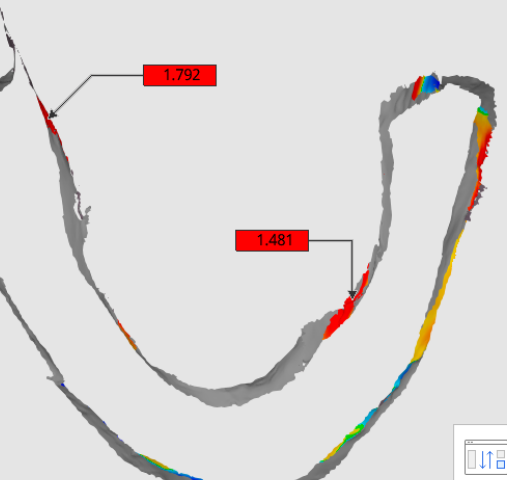


Figure 18

Deviation between the IOS impression and the digitized analog impression (Mean ± SD)	DFA (mm)	DFA excluding peripheries (mm)	Peripheries (mm)
Patient (A) Maxilla	0.245±0.344	0.190±0.265	0.416±0.478
Patient (A) Mandible	0.458±0.647	0.414±0.536	0.831±0.716
Patient (B) Maxilla	0.542±0.696	0.463±0.586	0.663±0.821

Table 1

The deviation between the IOS and the analog impressions was measured in three segmented distinct areas: DFA (Figure 13, and 14), DFA excluding peripheries (Figure 15 and 16), and peripheries or vestibular areas (Figure 17 and 18). The greatest deviation was recorded in the mandibular retro-mylohyoid vestibular area. In the maxilla, the greatest deviation was recorded in the vestibular area as well as the rugae and median palatine raphe areas. This is aligned with what is reported in the literature (1, 2) regarding the inferior accuracy of the IOS in recording mobile tissues when compared to analog impressions.

References:

- 1) Rasaie V, Abduo J, Hashemi S. Accuracy of intraoral scanners for recording the denture bearing areas: a systematic review. Journal of Prosthodontics. 2021 Jul; 30(6): 520-39.
- 2) Wang Y, Li Y, Liang S, Yuan F, Liu Y, Ye H, Zhou Y. The accuracy of intraoral scan in obtaining digital impressions of edentulous arches: A systematic review. Journal of Evidence-Based Dental Practice. 2023 Oct 18: 101933.