

Introduction

New digital workflow options for scanning full arch implants are being continuously introduced with a variety of scanbody designs. However, comparative evidence on intra oral scan accuracy for full arch implant position remains questionable. Errors in capturing implant positions can contribute to misfit at the implant–prosthesis interface and increase mechanical complications. To improve accuracy full arch implant restorations, various scanbody designs and scanning strategies have been proposed with the aim of enhancing the data collection and minimizing errors.

Purpose

To compare the accuracy of three intraoral scanning strategies for complete-arch implant prostheses.

Materials and Methods

A maxillary stone model with four implants was obtained from a patient using a splinted open-tray conventional impression technique. The model was scanned using a desktop scanner (Medit T710; Medit) to generate a reference STL file. Three intraoral scanning strategies were evaluated on the same reference cast:

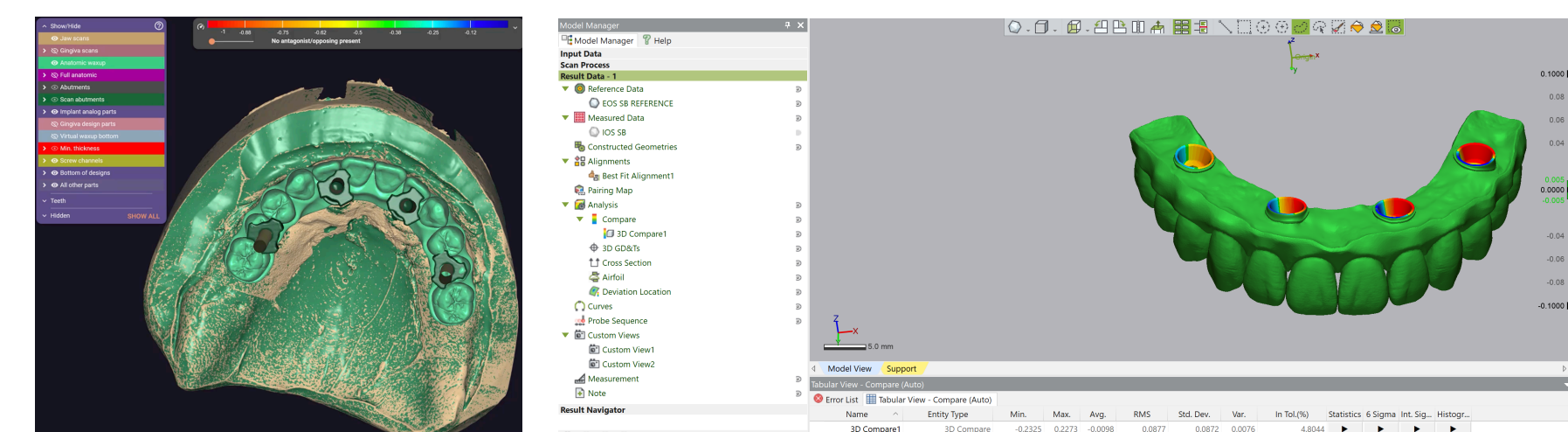
- (1) multi-unit abutment scanbody (SRA 4.6 mm scanbody; Straumann)
- (2) non-symmetrical scanbody (EXACT™ scanbody; Straumann)
- (3) non-symmetrical scanbody with scan aids (EXACT™ scanbody with LINKs; Straumann), scan aids are connected using resin composite

For each strategy, a maxillary complete-arch scan was acquired using an intraoral scanner (SIRIOS; Straumann) by one trained operator (n = 8 per group). Scanning conditions and the scan path were kept consistent across groups.



Figure A. Maxillary stone model with intraoral scan bodies.

Each scan data was imported into CAD software (Exocad; Exocad GmbH) to generate a complete-arch prosthesis design. All prosthesis files were imported into the Metrology software (Geomagic Control X; 3D Systems) for evaluation.



Each group was compared with the reference data. Best-fit alignment was performed on the prosthesis design geometry. The same alignment workflow and settings were applied to all datasets. For each comparison, summary statistics including minimum deviation, maximum deviation, mean deviation, root-mean-square (RMS) deviation, and standard deviation were recorded.

The deviation maps were used to evaluate the intaglio surface of the prosthesis design with the reference scan. Deviation analyses were performed using tolerance ranges of ± 0.10 mm (100 μ m) and ± 0.25 mm (250 μ m).



Comparative study of the accuracy of three intraoral scan strategies for complete-arch implant prostheses: An In Vitro Study

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Results

Based on the 3D deviation maps, the non-symmetrical scanbody with the scan aids showed the greatest deviations compared to the reference scan, as indicated by more prominent red/blue regions. In contrast, the non-symmetrical scanbody demonstrated the least deviation, as shown in green. The multi-unit scanbody showed an intermediate deviation pattern. At the $\pm 100 \mu\text{m}$, deviations were most evident in the regions around the implant connection/intaglio cylinder, whereas the remaining prosthesis body generally appeared stable.

Group	RMS	Min deviation	Max deviation	S.D.
Multi-unit abutment scanbody	87.7 μm	-232.5 μm	+227.3 μm	0.0872
Non-symmetrical scanbody	52.7 μm	-68.4 μm	+111.2 μm	0.0406
Non-symmetrical scanbody with scan aids	119.1 μm	-339.6 μm	+410.2 μm	0.1186

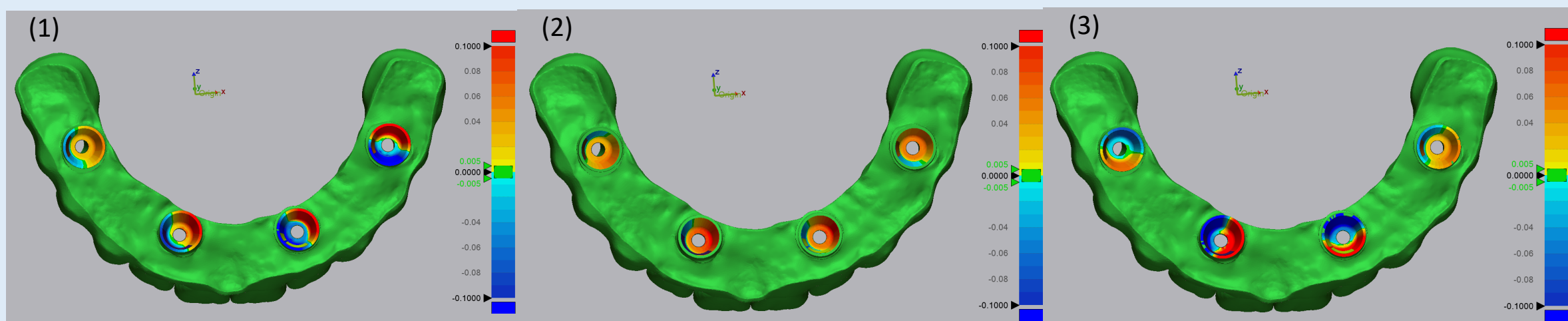


Figure B. 3D deviation maps at $\pm 100 \mu\text{m}$ tolerance relative to the EOS reference prosthesis design.

(1) Multi-unit abutment scanbody, (2) non-symmetrical scanbody. and (3) non-symmetrical scanbody with scan aids

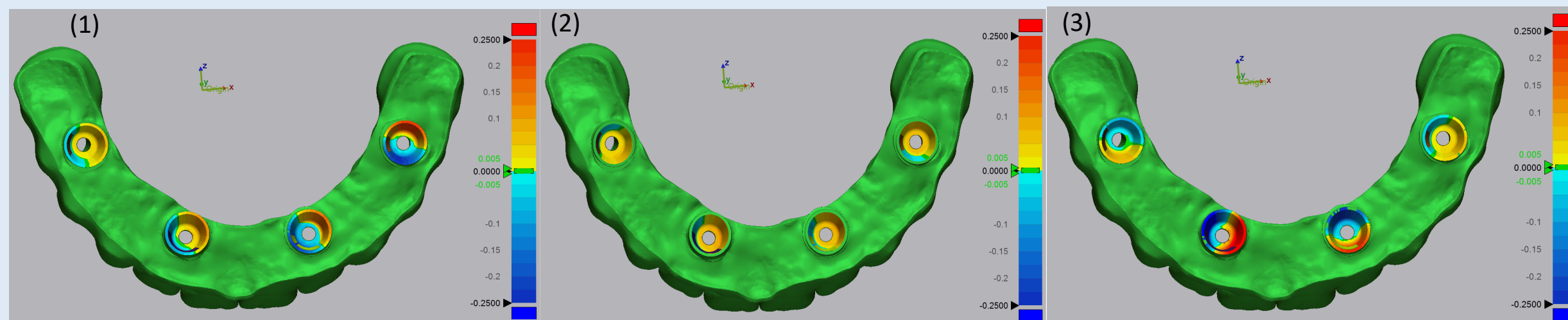


Figure C. 3D deviation maps at $\pm 250 \mu\text{m}$ tolerance relative to the EOS reference prosthesis design.

Conclusion

All three IOS strategies showed similar deviation patterns relative to the control group. In this pilot study, the non-symmetrical scanbody appeared comparable to the control group, while adding scan aids did not improve trueness and may have introduced error by partially obstructing the scanner during image capture. Additional studies with a larger number of repeated scans are required to confirm these findings.

References

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