



Influence of Gingival Retraction Cord on the Accuracy of Intraoral Scanner for Subgingival Finish Line

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Objectives

A previous clinical pilot study showed that intraoral scanners have limited predictability in scanning subgingival finish lines⁽¹⁾. Therefore, supragingival finish lines or the use of gingival retraction were recommended to improve accuracy of digital impressions⁽²⁾.

Objectives: To evaluate the accuracy of intraoral scanner (TRIOS3 by 3shape) in capturing subgingival finish lines with **differing horizontal gingival displacements**, and **with** and **without** a retraction cord. The secondary objective is to evaluate if this would **influence** the accuracy of **CAD crown** design process.

Methods

- A 3D printed resin dental model (Figure 1a and 1b) was fabricated with a single removable zirconia milled die of a prepared tooth #46.

- Six groups were fabricated from removable 3D printed resin gingiva with varying horizontal gingival displacement (0.12mm, 0.25mm, 0.45mm) and 2 subgingival finish line positions of 0.5mm and 1mm. Groups 1, 2, and 3 are 0.5mm subgingival finish line with 0.12, 0.25 and 0.45mm horizontal gingival displacement. Where as groups 4, 5, and 6 are 1mm subgingival finish line with 0.12, 0.25, 0.45mm horizontal displacements.

- Intraoral scanner (TRIOS3 3shape) was used to scan each group (18 scans per group) and the STL files were superimposed with a reference scan (Figure 2a) obtained by scanning the die separately using the intraoral scanner. Absolute marginal discrepancies were measured (Figure 2b) on 8 fixed points around the scanned die; buccal, mesiobuccal, mesial, mesiolingual, lingual, distolingual, distal and distobuccal.

- One-way ANOVA test was planned to measure statistical differences between the 6 groups and post hoc test to compare each group.

Table 1. Mean marginal discrepancy as compared to the reference scan per group in mm.

Groups	Buccal	Mesiobuccal	Mesial	Mesiolingual	Lingual	Distolingual	Distal	Distobuccal
G1	0.122	0.047	0.062	0.050	0.018	0.026	0.105	0.041
G2	0.079	0.058	0.051	0.019	0.006	0.019	0.088	0.022
G3	0.046	0.033	0.016	0.020	0.010	0.042	0.021	0.089
G4	0.059	0.035	0.02	0.072	0.071	0.029	0.301	0.016
G5	0.059	0.053	0.024	0.045	0.021	0.033	0.087	0.036
G6	0.064	0.043	0.022	0.021	0.006	0.019	0.062	0.069

G1: 0.5mm subgingival + 0.12mm horizontal displacement, G2: 0.5mm + 0.25mm, G3: 0.5mm + 0.45mm, G4: 1mm + 0.12mm, G5: 1mm + 0.25mm, G6: 1mm + 0.45mm

3D Printed Dental Model



Figure 1a. Occlusal view of zirconia die and 3D printed model.



Figure 1b. Buccal view of zirconia die and 3D printed model.

3D Virtual Analysis

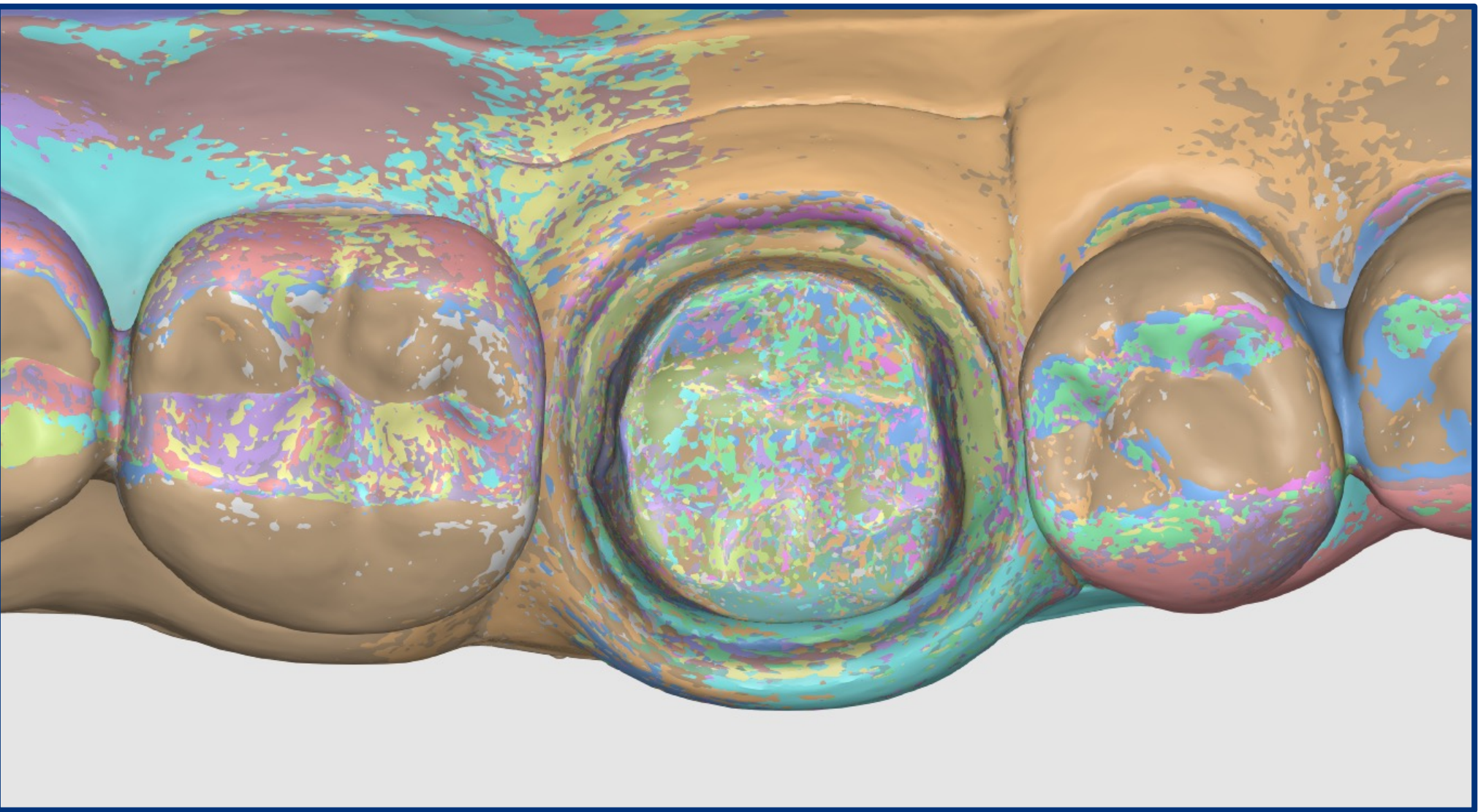


Figure 2a. Occlusal view of superimposed STL files.

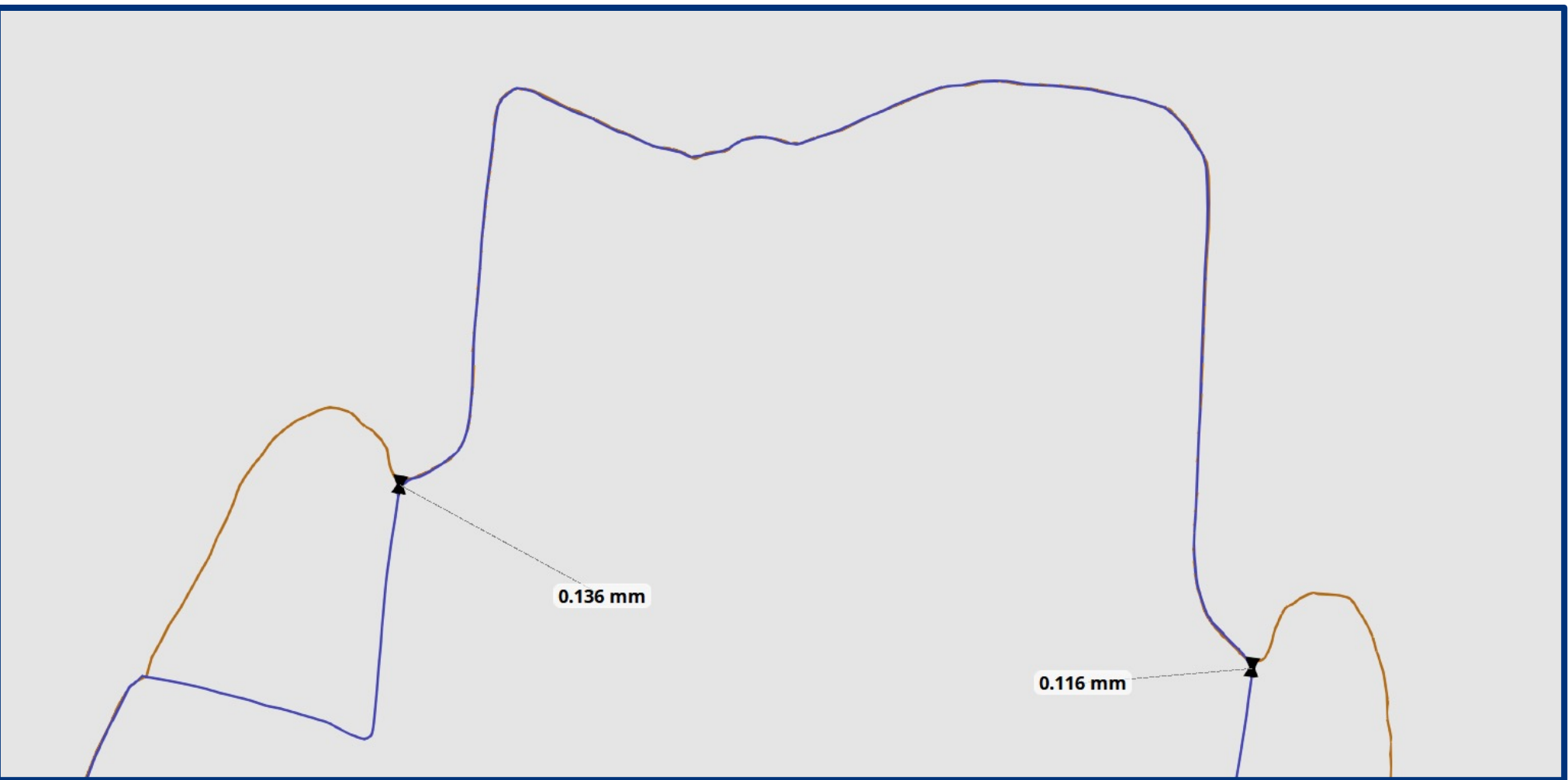


Figure 2b. Superimposed scan with zirconia reference scan (blue).

Results

Preliminary results showed all groups had larger marginal discrepancy on the buccal, distal and mesial surfaces. Largest marginal discrepancies were found in Group 1 and 4 (0.5 mm and 1 mm subgingival finish lines). Those discrepancies were found on the buccal and distal area with values higher than 100 microns, as shown in Table 1. However, very small marginal discrepancies were also found in Group 1 and 4.

Conclusion

Within the limitation of this preliminary in-vitro study, having ideal clinical simulation of subgingival finish lines, intraoral scanner tends to show higher accuracy with at least 0.25mm horizontal displacement of the gingiva. Larger inaccuracy were found on the distal proximal margins independent of the gingival horizontal displacement. However, the preliminary data shows some unanticipated inconsistency. Further development of the model is needed to better simulate subgingival finish lines.

References

1. Ferrari Cagidiaco, Edoardo, Fernando Zarone, Nicola Discepoli, Tim Joda, and Marco Ferrari. 2021. "Analysis of The Reproducibility of Subgingival Vertical Margins Using Intraoral Optical Scanning (IOS): A Randomized Controlled Pilot Trial" *Journal of Clinical Medicine* 10, no. 5: 941.
2. Son K, Lee KB. Effect of finish line locations of tooth preparation on the accuracy of intraoral scanners. *Int J Comput Dent.* 2021;24(1):29-40.