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Digital vs Conventional Implant Impressions: Influence of the technique on the fit accuracy of 3-unit implant-supported screw retained fixed dental prostheses

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Statement of the problem

Poor fit of implant-retained prostheses can lead to mechanical and biological complications. The foundation of an optimally fitting restoration is established with an accurate impression.

There is limited evidence comparing the marginal fit of implant restorations made using conventional impression techniques and intra-oral scanning. The direct measurement of the accuracy of fit of implant-supported fixed frameworks produced by conventional and digital impressions has not been addressed so far in the literature.

Purpose

The purpose of this study was to compare the accuracy of fit of 3-unit implant-supported screw-retained fixed dental prostheses that were produced by conventional silicone impressions and digital impressions by an intra-oral scanner.

Materials & Methods

- Ten digital and ten conventional impressions were made from a urethane-based typodont model which had two tissue level implants replacing the left maxillary first molar and first premolar.
- The digital implant impressions were made with an intraoral scanner using the manufacturer recommended scan bodies (Fig. 1) (Dental Wings IOS) and the addition silicone impressions were made using 3D printed custom trays (Fig. 2). The casts were digitized with a laboratory scanner (Dental Wings Series7).
- Twenty identical frameworks were designed (Fig. 3) and milled from Cobalt-Chromium alloy (Coron®) and were tested for their fit accuracy using a scanning electron microscope. To directly visualise the implant-abutment junction, the master model was trimmed (Fig. 5).

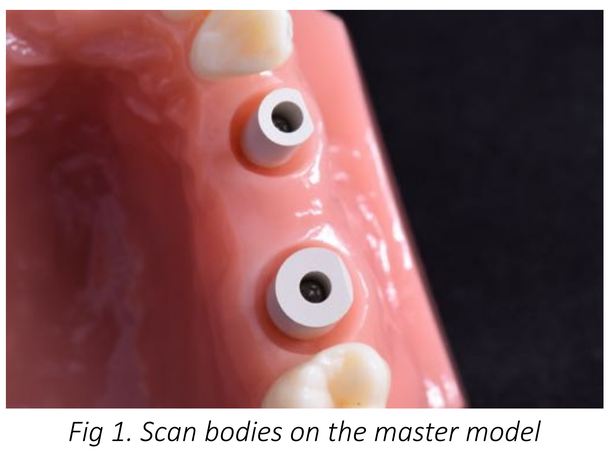


Fig 1. Scan bodies on the master model

Fig 2. PVS open tray impressions with identical printed trays

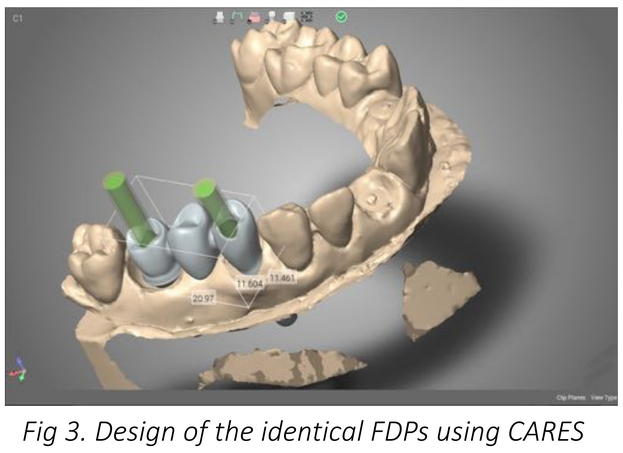


Fig 3. Design of the identical FDPs using CARES Visual 11 software

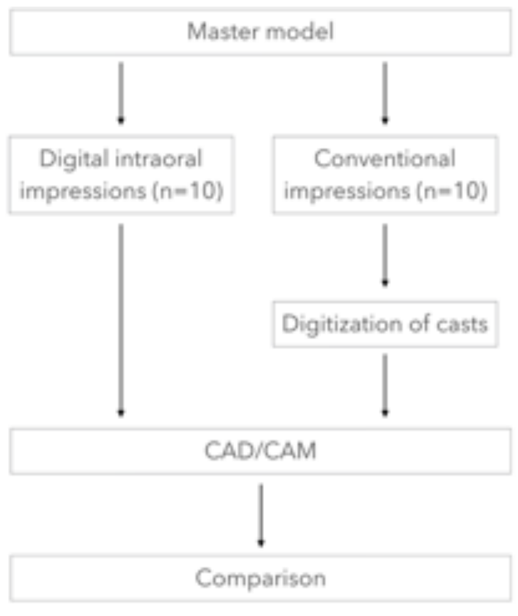


Fig 4. Flow of the study protocol

The measurement groups were:

CM (control molar – distal surface), **CP** (control premolar – mesial surface), **CMB** (control molar – buccal, palatal surfaces), **CPB** (control premolar – buccal, palatal surfaces), **TM** (test molar – distal surface), **TP** (test premolar – mesial surface), **TMB** (test molar – buccal, palatal surfaces), **TPB** (test premolar – buccal, palatal surfaces).

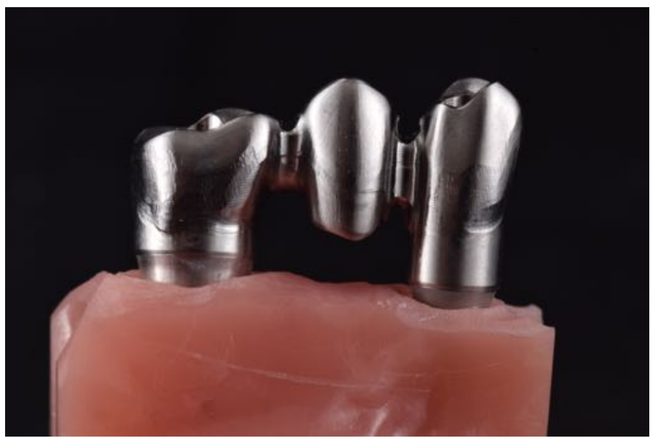


Fig 5. One of the produced FDPs on the trimmed model – buccal view

Fig 6. The SEM chamber at the QMUL Nanovision Centre

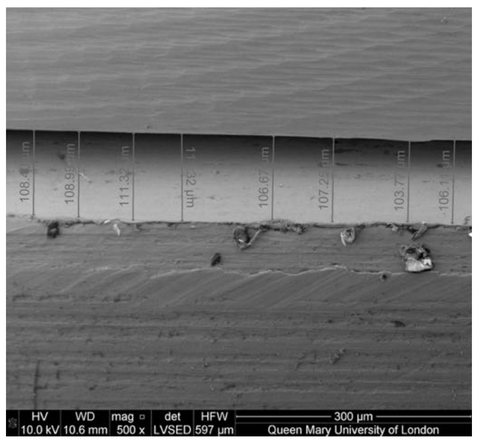


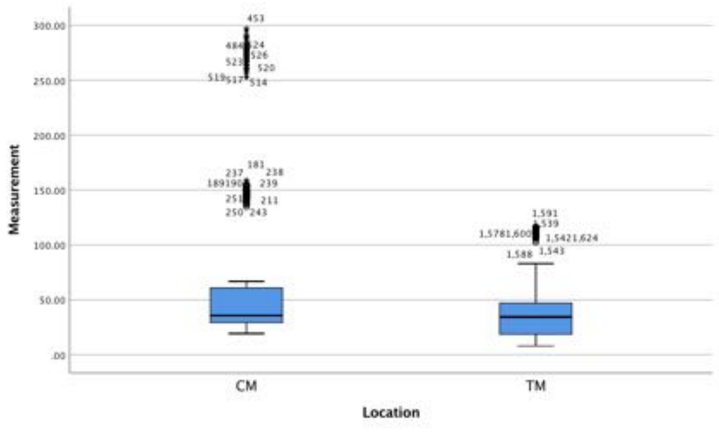
Fig 7. Direct gap measurements on the SEM computer

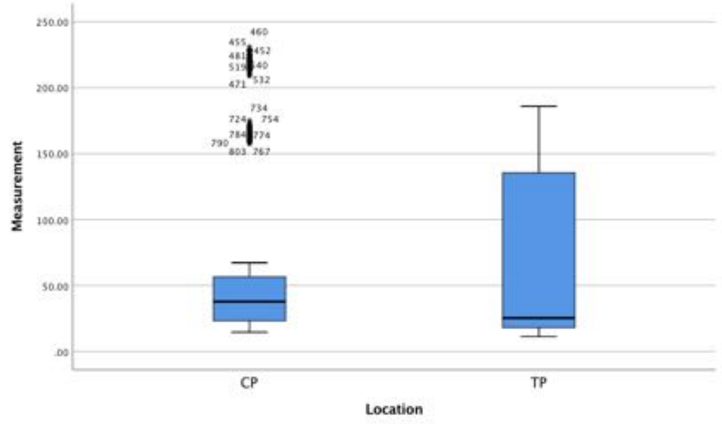
Fig 8. Gap measurements on ImageJ software. Ninety random measurements per abutment and a total of 7,200 measurements.

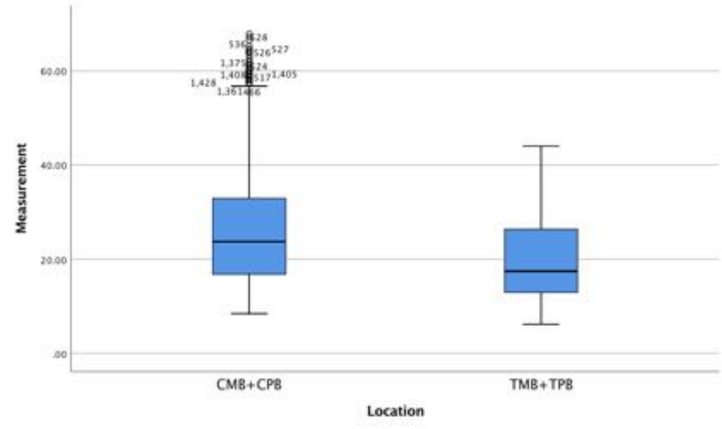
- The "passivity" of fit was compared between (i) CM and TM, and (ii) CP and TP with one abutment screwed in at 15Ncm^2 (one-screw test).
- The "accuracy" of fit was compared between (iii) CMB and TMB, (iv) CPB and TPB, and (v) CMB+CPB and TMB+TPB when both abutments were tightened at 35Ncm^2.

Results

The Mann-Whitney-U test revealed that digital impressions resulted in statistically significantly smaller marginal gaps for all comparisons ($p < .001$). The 95% confidence intervals of the medians of all groups showed that the median marginal gap when both abutments were torqued at 35 Ncm^2 was <25 µm and when one abutment was torqued at 15 Ncm^2 was <50 µm. The results suggest that implant-supported 3-unit screw-retained fixed dental prostheses manufactured following impressions from an intra-oral scanner have a more passive and more accurate fit than the ones manufactured following conventional silicone impressions and digitization of the casts.







There were two prostheses from each group (both the test and the control) that had significantly larger marginal gaps. The outliers in the control group presented larger measurement values than the outliers in the test group, increasing the range from the minimum to the maximum values and resulting in statistically significant results.

The fundamental limitation of this study is the fact that it is in-vitro. Nevertheless, the key strengths are that the inaccuracies were directly visualized and measured, and that the prostheses manufacturing protocol was the one that would be normally followed in clinical practice. The clinical implications of lack of accurate and/or passive fit are difficult to quantify and they are controversially discussed between studies. There is no overall consensus on the maximum marginal discrepancies accepted for the aforementioned fit measurements. In this study the results are statistically significant, however it is unsure whether they are of any clinical significance.

Conclusions

- Prostheses manufactured following impressions from an intra-oral scanner had a statistically significantly more passive fit when compared to the ones manufactured following silicone impressions and digitization of the casts.
- Prostheses manufactured following impressions from an intra-oral scanner had a statistically significantly more accurate fit when compared to the ones manufactured following silicone impressions and digitization of the casts.
- The impressions from an intra-oral scanner seem to be more consistent than the ones from silicone impressions and cast digitization.

References

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