

Metrological Analysis of the Trueness of Prosthetic Metal Structures Obtained with Digital Methods

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INTRODUCTION & AIM

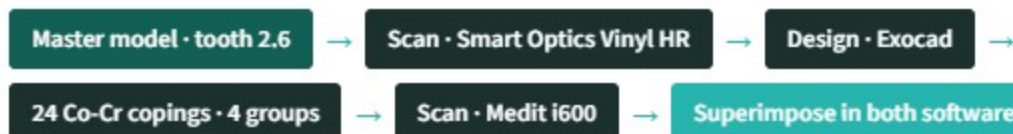
CAD/CAM, additive manufacturing and 3D scanning have transformed digital dentistry, yet the clinical value of these workflows depends on the **reliability of the measurement software** used to verify the restorations.

Dedicated dental tools such as **Medit Crown Fit** are increasingly used for quality control, but their accuracy has rarely been benchmarked against established **engineering metrology software**.

AIM

To **validate the dental-dedicated Medit Crown Fit software** by comparing its trueness measurements against the professional engineering software **Meshmixer (Autodesk)**, on 24 Co-Cr copings produced by four digital methods.

METHOD



R • Resin

3D-printed MSLA pattern (ELEGOO Mars 3 Pro), then cast in Co-Cr

W • Wax

Milled wax pattern (Ceramill Matron), then cast in Co-Cr

M • Milling

Direct 5-axis milling of Co-Cr disc (Magnum Splendidum)

S • Sintering

Direct laser sintering (Riton Dual-150, 20 μm layers)

An analysis grid (Autodesk Fusion 360) split each coping into **8 sections on 2 axes** — palato-buccal & disto-mesial — giving **16 reference points**. Over **6,720 measurements** (~280 images/layer) were compared. Statistics: Shapiro-Wilk, Wilcoxon signed-rank, and Kruskal-Wallis H with Dunn–Bonferroni post-hoc ($p < 0.05$).

RESULTS & DISCUSSION

< 0.01 mm

Difference between the two software — practically insignificant

< 1.5 %

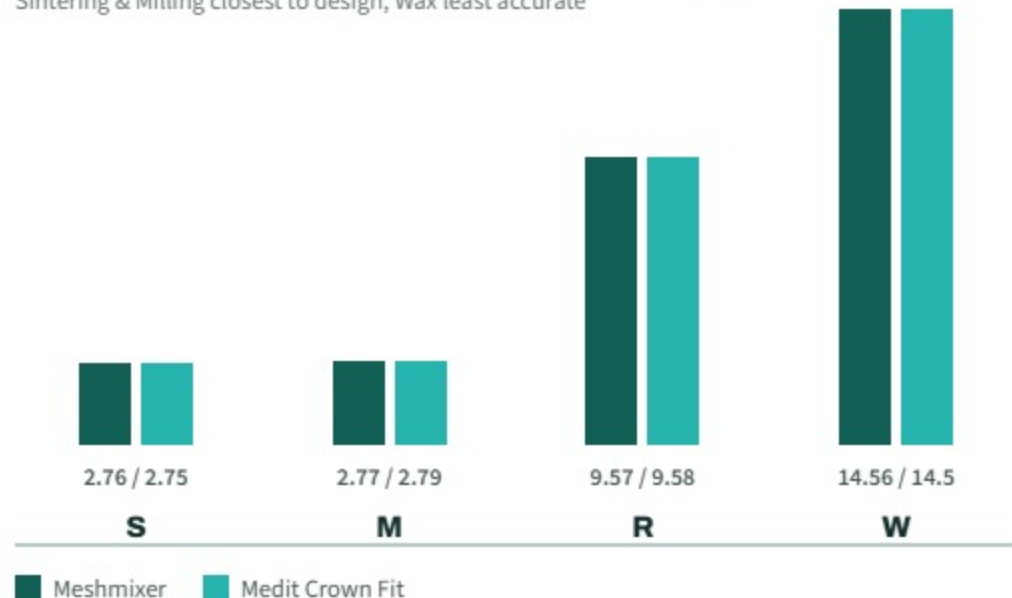
Mean variation Meshmixer vs Medit (best: group M, 1.05%)

p > 0.05

No significant median difference between software (Wilcoxon)

Surface deviation from design — Disto-Mesial (%)

Sintering & Milling closest to design; Wax least accurate



Mean area deviation — Palato-Buccal (mm²)

Both software near-identical (Medit values shown)

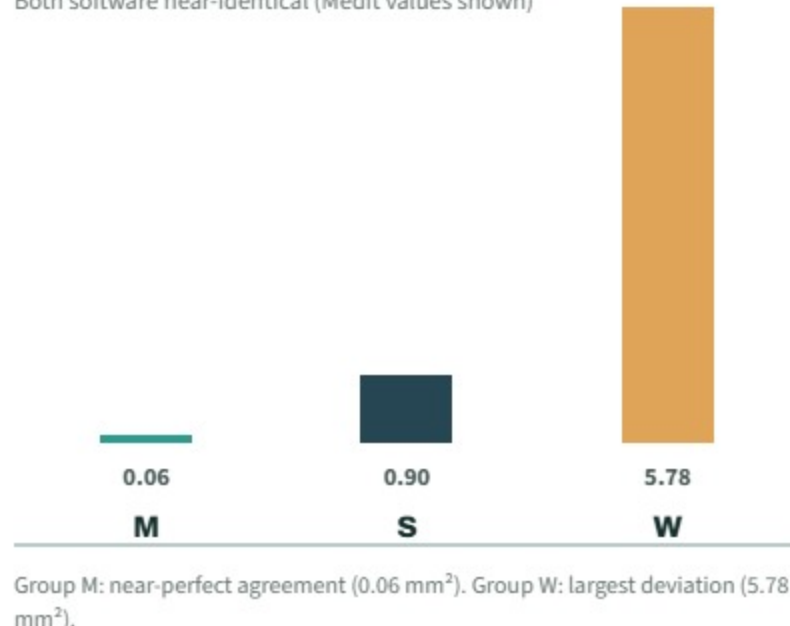


Table 1 • Group comparisons — Palato-Buccal deviation (Kruskal-Wallis, overall $p < 0.0005$)

Comparison	Meshmixer	Medit
R – W	0.849	0.847
R – M	0.020 *	0.019 *
R – S	0.850	0.847
W – M	<0.0005 *	<0.0005 *
W – S	0.021 *	0.019 *
M – S	0.848	0.847

Table 2 • Group comparisons — Disto-Mesial surface % (Kruskal-Wallis, overall $p < 0.0005$)

Comparison	Meshmixer	Medit
R – W	0.844	0.847
R – M	0.297	0.815
R – S	0.084	0.021 *
W – M	0.004 *	0.018 *
W – S	0.001 *	<0.0005 *
M – S	0.989	0.916

Interpretation. Both software produced statistically equivalent results (deviations < 0.01 mm; $p > 0.05$). The significant differences are driven by the **fabrication method**, not the software: full-digital **Milling** and **Sintering** matched the design best, while **Wax** showed the largest deviations. Occlusal OB/BO points were excluded as casting-rod artifacts.

CONCLUSIONS

- **Medit Crown Fit is validated:** its trueness measurements are interchangeable with engineering-grade Meshmixer (differences < 0.01 mm).
- The integrated dental measurement module precisely quantifies surfaces and thicknesses of finished structures, non-invasively.
- **Milling and Sintering** gave the highest dimensional fidelity; **Wax** deviated most; **Resin** was acceptable but slightly above ideal.
- Accuracy is governed by the **fabrication method & material**, independent of the analysis software.

FUTURE WORK • REFS • ACK.

Future work: longitudinal, in-vivo studies on long-term masticatory load and marginal integrity across full-digital vs partial-digital workflows.

Selected refs: Goldstein, J Prosthet Dent 2024; Al-Saleh et al., Medicina 2022; Yilmaz et al., J Dent 2022; Watanabe et al., Dent Clin North Am 2022.

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