



Influence of Manufacturing-Technology on the Accuracy of Static Computer-Aided Implant-Surgery: An In-Vitro Study

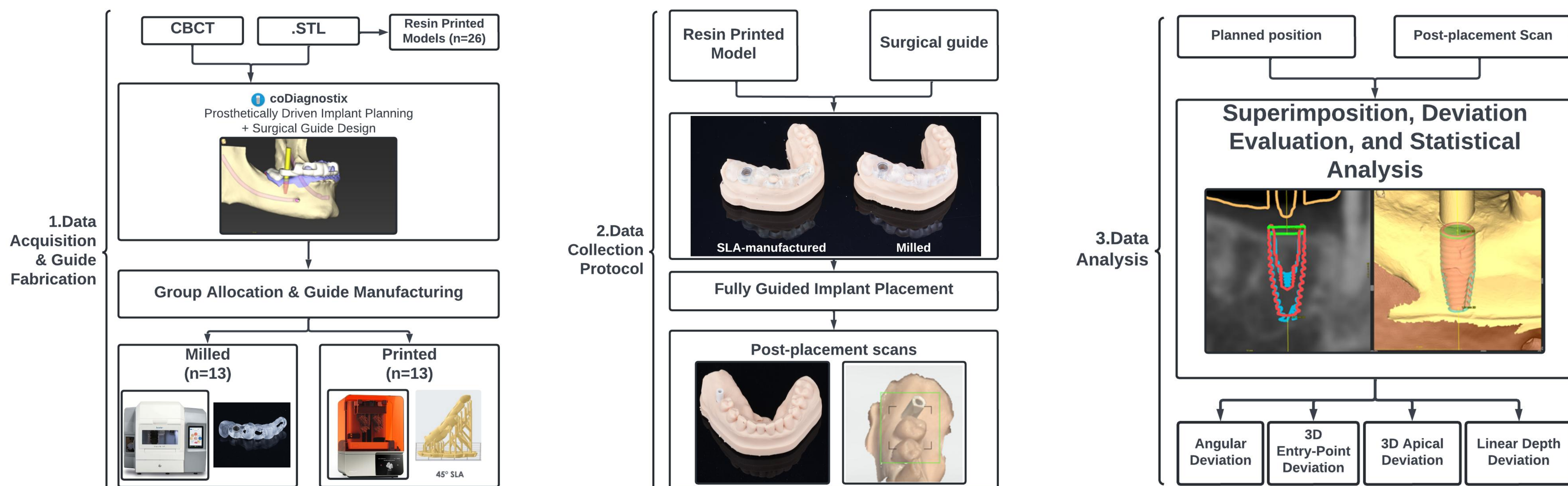
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Aim: The aim of this in vitro study was to evaluate and compare the accuracy of milled and SLA-printed surgical guides for static computer-aided implant surgery (S-CAIS).

Materials and Method:



Post-hoc Tukey pairwise comparison tests were used to compare the means, with a significance level set at $p < 0.05$ ($\alpha = 0.05$) using R Programming language.

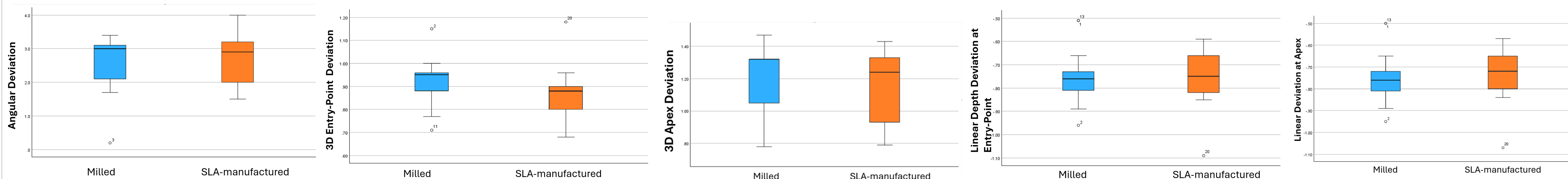
Results:

Summary of the mean deviations quantified at the measured parameters.

	N	Angular Deviation \pm SD	3D Entry-Point Deviation \pm SD	3D Apex Deviation \pm SD	Linear deviation \pm SD	
					at entry-point	at apex
Milled	13	2.5 \pm 0.9°	0.91 \pm 0.1mm	1.19 \pm 0.2mm	-0.75 \pm 0.1mm	-0.74 \pm 0.1mm
SLA	13	2.8 \pm 0.9°	0.86 \pm 0.1mm	1.16 \pm 0.2mm	-0.75 \pm 0.1mm	-0.74 \pm 0.1mm
P-value		P=0.495	P=0.295	P=0.707	P=1.000	P=0.871

Data was expressed by using mean \pm standard deviation (SD).

Note: Negative means for linear deviations indicate the implant was placed shallower than the planned depth.



Discussion:

- Both milled and SLA-printed surgical guides demonstrated comparable accuracy in angular and linear deviations at the entry-point and apex deviations relative to the planned implant positions.
- The findings of this study align with systematic reviews reporting mean deviations of 1.2-1.4 mm and angular deviations of 2.2-3.5° as clinically acceptable. However, outliers can reach up to 8 mm, thus emphasizing the importance of incorporating adequate safety margins in treatment planning.
- SLA technology offers advantages including reduced material waste, lower costs, greater accessibility, and superior design flexibility for complex geometries. However, milled acrylic guide materials demonstrate superior mechanical properties, particularly higher flexural strength and better dimensional stability under moisture conditions.

Conclusion:

Based on the findings and within the limitations of this in-vitro study:

- Both manufacturing methods, milled and SLA-printed demonstrated similar accuracy with no statistically significant differences ($p > 0.05$) for Angular and Linear deviation, and fell within clinically acceptable ranges according to ITI consensus.
- Using a fully guided approach when placing implants resulted in implants placed shallower relative to the planned positions, regardless of surgical guide fabrication techniques.

References:

