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Comparative Study: Evaluating Intraoral Scanning Systems for Subgingival Anatomy

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Objectives This study conducted a comprehensive comparative analysis of three intraoral scanners (CEREC Primescan, TRIOS, CEREC Omnicam) and a lab scanner (inEosX5) assessing their precision in simulating subgingival tooth preparations

Methods Utilizing a dental simulation mannequin with a 3D-printed Teflon structure, 100 structures with depths ranging from 0.5 to 4.0 mm were created within a square mimicking a rectangular tank surface. Four scanner groups (A-D) and five subgroups were established. Two digitization methods, a customized parallelometer and an intraoral simulation, were applied, ensuring a standardized scanning sequence.

Trueness was evaluated by comparing CAD-calculated surface areas with actual dimensions, and qualitative trueness analysis was conducted using MeshLab. Surface areas were computed using the formula $SA = 2lw + 2lh + 2wh$. Statistical analyses, including Pearson's correlation coefficient, Kolmogorov–Smirnov and Levene's tests, three-way ANOVA, and paired sample t-tests, elucidated relationships and differences ($\alpha=0.05$).

Results A robust correlation ($r = 0.850$, $p < 0.001$) between intraoral scanner choice and scanned area depth was found. Inverse correlations were noted for experimental methods. Three-way ANOVA demonstrated significant scanner-depth interaction ($F(12,760) = 760.801$, $p < 0.001$).

Conclusions Emphasizing high-resolution sensors and advanced technologies, the study underscores the optimal choice for subgingival digitization, acknowledging variations among scanners.