A New Generation of Digital Resins: Comparing the Accuracy of 3D-printed versus Milled Composite Inlays

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Objectives: Modern dental practices use subtractive manufacturing (milling) to fabricate indirect restorations. Three-dimensional (3D) printing has recently emerged as a cost-effective alternative. This study aims to compare the accuracy of 3D-printed versus milled composite inlays by evaluating their internal gap and marginal fit.

Experimental Methods: A Kilgore typodont tooth #14 MOD preparation was modified to a resin inlay by an experienced clinician. The preparation and preoperative unprepared tooth were captured using a Planmeca Emerald Scanner. A digital inlay restoration was designed in 3Shape Dental System to ideal contours, generating an STL which was exported for manufacturing via two methods: (1) milling and (2) 3D printing. Twenty-five restorations were generated per method, without alteration, finishing, or polishing. Samples were scanned with 3shape E3 and aligned in Exocad to digitally seat the inlays onto the preparation. Aligned samples were imported into GeoMagic Control X for evaluation of internal gap and marginal fit. Statistical analyses were performed using R software, with $p<0.05$ indicating significance.

Results: ANOVA LR revealed no statistically significant relationship between the production method of inlays and the internal gap and marginal fit. Milled inlays exhibited significantly greater accuracy at the gingival margins of mesial and distal boxes and gingival floor of the mesial box compared to 3D-printed inlays. Conversely, 3D-printed inlays showed significantly greater accuracy at the buccal walls of mesial and distal boxes and the lingual wall of the mesial box.

Conclusion: The null hypothesis that 3D-printed inlays are more accurate than milled inlays was rejected. All restorations had clinically acceptable deviations within 120 microns. Both milling and 3D printing are clinically acceptable methods with similar tolerance levels for internal gap and marginal fit.

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