Evaluating the Effects of Layer Height and Software Setting Combinations on the Accuracy of 3D-Printed Dental Models

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Objectives:
Dentists seek to balance quality and efficiency when applying three-dimensional (3D) printing technologies for dental model production. A new Fast Arch setting claims to enable faster printing without sacrificing model quality. This project sought to investigate how various layer height and software setting combinations affect the accuracy and print time of 3D-printed dental models.

Experimental Methods:
Using a Formlabs 3B printer, dental models were fabricated with grey photopolymer resin in all available combinations of layer height (100 µm, 160 µm, adaptive layer height) and software settings (Default, Fast Arch). The printed model surfaces were optically scanned to produce a stereolithographic (STL) file and superimposed on the original digital model using metrology software for comparison. One-way analysis of variance (ANOVA) with Tukey post-hoc testing was used to statistically analyze the results across layer height and print setting groups ($\alpha = 0.05$).

Results:
A statistically significant effect of the combination of layer height and print setting on the percentage of surface points within clinical tolerance limits (±0.250 mm) was found ($p < 0.001$), and the percentage was greater than 98% for all groups. Among layer height and print setting combinations, the 100 µm Default and 100 µm Fast Arch groups resulted in the smallest average deviation from the original dental model and were not significantly different from each other ($P = 0.728$). Notably, the 100 µm Fast Arch group printed significantly faster ($p < 0.001$) than all other groups, averaging an estimated print time of 82 minutes.

Conclusion:
The results of this study suggest that printing with the new 100 µm Fast Arch setting may be advantageous clinically to produce dental models both accurately and efficiently, but ultimately, the choice of layer height and software settings depends on the intended clinical application.

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