Effect of Adaptive Layer Height on Accuracy of 3D-Printed Models

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Introduction: Three-dimensional printing technologies generally involve manifesting a physical part from a digital file in a layer-by-layer fashion, in which the height of the layers is a constant throughout printing. However, recent software advances enable printing models with adaptive layer heights, in which the layer height can be greater in areas of less detail and smaller in areas of high detail. While adaptive layer heights may increase the temporal efficiency of model fabrication, they may affect the dimensional accuracy of resulting models.

Objective: This project sought to investigate the effect of adaptive layer height on the accuracy of 3D-printed dental models. Specifically, dimensional deviations of models printed with adaptive layer height were compared with those of models printed with layer heights of 25 μm and 160 μm.

Methods: Thirty-six identical dental models were 3D-printed on a Form 3B desktop printer using Grey V4 Resin at 25 μm, 160 μm, and adaptive layer height settings (n=12/group). All models were digitally scanned, superimposed on the digital reference file, and analyzed using a best-fit algorithm to quantify dimensional deviations. Statistical analyses were conducted using generalized linear models with post-hoc Tukey Contrasts where warranted.

Results: For each response variable (except percent out of lower bounds), the 160 μm group was significantly different from the 25 μm and adaptive layer height groups, which were not significantly different from each other. For the percent out of lower bounds, no significant effect of layer height was observed, indicating that the printer tended towards overbuilding the models' features rather than underbuilding.

Conclusion: With no significant difference between the deviations of 25 μm and adaptive layer height models, the temporal efficiency of adaptive layer height could be advantageous for clinicians. Despite variations in dimensional accuracies, the average deviations for all three groups comply with reported tolerances for clinical acceptability.

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