

Biomimetic Multi-Material 3D Printing for Shade-Accurate, Lifelike Dentures

3D printed denture with teeth consisting of enamel, dentin and root layers printed to match the A2 shade. The tooth below is a conventionally manufactured shade reference.

This monolithic denture was created via multi-material jetting leveraging a novel biomimetic 3D-printing workflow that replicates the internal optical structure of natural teeth. The method digitally embeds enamel, dentin, and root layers into each digital tooth, and computes material mixtures for each of these layers using an AI model to reproduce given shades and translucencies. This allows dental technicians to fine-tune the layer translucencies to enhance aesthetics without changing the overall shade. The process is fully compatible with standard dental CAD and slicing environments, making integration into digital workflows straightforward.

This approach can produce naturally looking teeth while achieving shade accuracies within clinically accepted limits ($\text{CIEDE2000} < 1.5$) and reduce production costs by up to 75% compared to traditional manufacturing.

Demonstrated here is a full upper denture fabricated in shade A2.

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