Factors Influencing the Dimensional Accuracy of 3D-Printed Full-Coverage Dental Restorations Using Stereolithography Technology

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Purpose: The aim of the present study was to evaluate the effect of the build angle and the support configuration (thick versus thin support) on the dimensional accuracy of 3D-printed full-coverage dental restorations. **Materials and Methods:** A full-coverage dental crown was digitally designed and 3D-printed using stereolithography-additive manufacturing (SLA-AM) technology. Nine different angles were used during the build process: 90, 120, 135, 150, 180, 210, 225, 240, and 270 degrees. In each angle, the crown was printed using a thin and a thick support type, resulting in 18 specimens. The specimens were digitally scanned using a high-resolution optical surface scanner (IScan D104i; Imetric 3D). The dimensional accuracy was evaluated by digital subtraction technique. The 3D digital files of the scanned printed crowns (test model), exported in standard tessellation language (STL) format, were superimposed with the STL file of the designed crown (reference model) using Geomagic Studio 2014 (3D Systems). **Results:** The root mean square estimate value and color map results suggest that the build angle and support structure configuration have an influence on the dimensional accuracy of 3D-printed crown restorations. Among the tested angles, the 120-degree build angle showed a minimal deviation of 0.029 mm for thin support and 0.031 mm for thick support, indicating an accurate fit between the test and reference models. Furthermore, the deviation pattern observed in the color map was homogenously distributed and located further away from the critical marginal area. **Conclusions:** Within the limitations of this study, the selection of build angle should offer the crown the highest dimensional accuracy and self-supported geometry. This allows for the smallest necessary support surface area and decreases the time needed for finishing and polishing. These properties were mostly observed with a build angle of 120 degrees combined with a thin support type. *Int J Prosthodont 2016;29:503–510. doi: 10.11607/ijp.4835*

With the advances in computer-aided design/computer-assisted manufacture (CAD/CAM) technology, additive manufacturing (AM) or the so-called 3D-printing technique is emerging in the dental field and is promising for the manufacturing of dental restorations. Among the various additive manufacturing techniques, stereolithography (SLA) offers the highest accuracy and resolution, a smooth surface finish, and fine building details.[1–4]

In traditional SLA, the object is built layer by layer using a laser beam that follows a particular path to cure a photosensitive vat containing resin according to CAD design. After the first layer is cured, the platform is lowered, moving in the z-direction, and the second layer is cured.[2] This process is repeated until the whole structure is manufactured. A modified, top-down SLA approach is introduced where the build platform is dipped into the resin from above and raised in the z-direction along the building process. This approach offers several advantages over the traditional SLA technique: less resin volume is required and an oxygen inhibition layer on the surface is eliminated.[1] The latter minimizes the total amount of porosities trapped in the final manufactured structure. The modified SLA technique offers high manufacturing accuracy along the x-y axis, while in the z-direction the accuracy is more critical and depends on the layer thickness and slicing procedures of the virtual model, especially in curved or angled surfaces.

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