Build Angle: Does It Influence the Accuracy of 3D-Printed Dental Restorations Using Digital Light-Processing Technology?

Reham B. Osman, BDS, MSc, PhD[1]/Nawal Alharbi, BDS, MSc[2]/Daniel Wismeijer, DDS, PhD[3]

Purpose: The aim of this study was to evaluate the effect of the build orientation/build angle on the dimensional accuracy of full-coverage dental restorations manufactured using digital light-processing technology (DLP-AM). ***Materials and Methods:*** A full dental crown was digitally designed and 3D-printed using DLP-AM. Nine build angles were used: 90, 120, 135, 150, 180, 210, 225, 240, and 270 degrees. The specimens were digitally scanned using a high-resolution optical surface scanner (IScan D104i, Imetric). Dimensional accuracy was evaluated using the digital subtraction technique. The 3D digital files of the scanned printed crowns (test model) were exported in standard tessellation language (STL) format and superimposed on the STL file of the designed crown [reference model] using Geomagic Studio 2014 (3D Systems). The root mean square estimate (RMSE) values were evaluated, and the deviation patterns on the color maps were further assessed. ***Results:*** The build angle influenced the dimensional accuracy of 3D-printed restorations. The lowest RMSE was recorded for the 135-degree and 210-degree build angles. However, the overall deviation pattern on the color map was more favorable with the 135-degree build angle in contrast with the 210-degree build angle where the deviation was observed around the critical marginal area. ***Conclusions:*** Within the limitations of this study, the recommended build angle using the current DLP system was 135 degrees. Among the selected build angles, it offers the highest dimensional accuracy and the most favorable deviation pattern. It also offers a self-supporting crown geometry throughout the building process. *Int J Prosthodont 2017;30:182–188 . doi: 10.11607/ijp.5117*

Recently there has been a burgeoning increase in the implementation of digital tools in the field of restorative dentistry. Digital fabrication technologies involve computer-aided design/computer-assisted manufacture (CAD/CAM) techniques through either subtractive (milling) or additive (3D printing) manufacturing (AM).

[1]*Lecturer, Removable Prosthodontics Department, Faculty of Dentistry, Cairo University, Giza, Egypt; Research Associate, Department of Oral Implantology and Prosthetic Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), Universiteit van Amsterdam and Vrije Universiteit, Amsterdam, The Netherlands.*

[2]*PhD Candidate, Oral Implantology and Prosthetic Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), Universiteit van Amsterdam and Vrije Universiteit, Amsterdam, The Netherlands; Lecturer, Prosthetic Dental Science Department, College of Dentistry, King Saud University, Riyadh, Saudi Arabia.*

[3]*Professor of Oral Implantology and Prosthetic Dentistry and Head of the Department of Oral Implantology and Prosthetic Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), Universiteit van Amsterdam and Vrije Universiteit, Amsterdam, The Netherlands.*

Correspondence to: *Dr Nawal Murshed Alharbi, Department of Oral Implantology and Prosthetic Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), Gustav Mahlerlaan 3004, 1081 LA Amsterdam, The Netherlands. Email: nawalmurshed@gmail.com*

AM has a unique advantage over conventional milling production methods: it produces practically no waste material, there is no restriction in geometric shape of the products, and tolerance of milled parts is no longer an issue.[1,2] This allows AM technologies to be a key component in the mass production of parts with special geometric requirements.[2] The fabrication of fixed dental crown and bridge restorations with their unique buccal, lingual, mesial, and distal contours and sophisticated occlusal outlines is an example.

Among the various AM techniques, digital light processing (DLP) is gaining increased popularity in the production of dental parts.[3–5] In a DLP build process, a highly complex structure is fabricated on a layer-by-layer basis directly from 3D data, whereby consecutive liquid photoactivated monomer layers are exposed to UV light and cured based on the final shape of the required product. The DLP process involves a digital micromirror device (DMD) that is used to dynamically define a mask image that is projected on the resin surface.[6–9] DMDs consist of hundreds of thousands of individually moving micromirrors that control the reflection path of light. Each pixel of the image corresponds to an individual micromirror, the orientation of which can be switched among several degrees based on the geometry of the part to be printed.[9,10]

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