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RESEARCH AND EDUCATION

Fracture resistance of additive manufactured and milled implant-supported interim crowns

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ABSTRACT

Statement of problem. Interim dental prostheses can be fabricated by using subtractive or additive manufacturing technologies. However, the fracture resistance of implant-supported interim crowns fabricated by using vat-polymerization additive manufacturing methods remains unclear.

Purpose. The purpose of this in vitro study was to evaluate the fracture resistance of anterior and posterior screw-retained implant-supported interim crowns fabricated by using subtractive and vat-polymerization direct light processing (DLP) additive manufacturing procedures.

Material and methods. An implant (Zinic Implant RP ∅4.0×10 mm) was placed in a 15×15-mm polymethylmethacrylate block. An implant abutment (ZiaCam, nonrotatory RP) was positioned on each implant. The virtual implant abutment standard tessellation language (STL) file provided by the manufacturer was imported into a software program (Exocad v2.2 Valletta) to design 2 anatomic contour crowns, a maxillary right central incisor (anterior group) and a maxillary right premolar (posterior group). Each group was subdivided into 2 subgroups depending on the manufacturing method: milled (milled subgroup) and additive manufacturing (additive manufacturing subgroup). For the milled subgroup, an interim material (Vivodent CAD Multi) and a milling machine were used to fabricate all the specimens (N=40, n=10). For the additive manufacturing subgroup, a polymer interim material (SHERAprint-cb) and a DLP printer (SHERAprint 30) were used to manufacture all the specimens at a 50-μm layer thickness and 45-degree build orientation as per the manufacturer's instructions. Then, each specimen was cemented to an implant abutment by using composite resin cement (Multilink Hybrid Abutment HO) as per the manufacturer's instructions. A universal testing machine was used for fracture resistance analysis, and the failure mode was recorded. The Shapiro-Wilk test revealed that data were normally distributed. One-way ANOVA and Tukey multiple comparison were selected (α=.05).

Results. One-way ANOVA revealed significant differences among the groups (P<.05). The anterior milled subgroup obtained a significantly higher fracture resistance mean ±standard deviation value of 988.4 ±54.8 N compared with the anterior additive manufacturing subgroup of 636.5 ±277.1 N (P<.001), and the posterior milled subgroup obtained significantly higher mean ±standard deviation of 423.8 ±68 N than the additive manufacturing subgroup of 321.3 ±128.6 N (P=.048). All groups presented crown fracture without abutment fracture.

Conclusions. Manufacturing procedures and tooth type influenced the fracture resistance of screw-retained implant-supported interim crowns. Milled specimens obtained higher fracture resistance compared with the DLP additive manufacturing groups. The anterior group was higher than the posterior group. (J Prosthet Dent 2020;■:■-■)

Interim restorations are used to restore implants during and after osseointegration, providing esthetics, soft-tissue modeling, and restoring occlusion and function.[1-5] Implant-supported interim restorations should offer adequate mechanical and biocompatibility properties to facilitate the diagnosis and

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