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Effect of Retention Hole Size of 3D-Printed Zirconia Artificial Teeth

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Objectives The purpose of this study was to analyze how the retention hole size of 3D-printed hollow zirconia artificial teeth affects the shape accuracy.

Methods Data sets for the different hollow artificial teeth resembling a mandibular right first molar were created (Geomagic Design X, 3D systems) with a wall thickness of 1.0 mm. On the designed artificial tooth surface, measurement planes which are mesiobuccal plane (MB), mesiolingual plane (ML), distobuccal plane (DB), and distolingual plane (DL) were created. While the outer geometry was identical, retention holes with diameters of either 3.0 mm or 6.0 mm were implemented. For each group, n=10 artificial zirconia teeth were fabricated using a 3D printer (SZ-1100, Sk Fine) and fired (debinding and sintering). Then, the teeth were scanned using a laboratory scanner (D2000, 3Shape) to obtain the fabrication data of all the specimens. After that, the design data and fabrication data were aligned and the deviation values of each measurement points were calculated using a software (GOM Inspect, GOM). Mann-Whitney U-test was used to analyze differences in shape accuracy between the zirconia artificial teeth test groups. The significance level was $\alpha = 0.05$.

Results Measured deviations at all measurement planes ranged from -59.2 μm to 104.0 μm. For each measurement plane, there was no statistically significant difference between ML and DL. On the other hand, 6.0 mm had lower deviation at both MB and DB, and statistically significant differences were found at both MB and DB. Thus, 6.0 mm had higher accuracy than 3.0 mm at both MB and DB. This suggests that the accuracy was higher for the 6.0 mm, which has a larger retention hole.

Conclusions The size of the retention hole of the artificial tooth affects its shape accuracy, suggesting that the larger its diameter, the higher the shape accuracy of the zirconia artificial tooth.