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Load-bearing capacity and the recommended thickness of dental monolithic zirconia single crowns

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Abstract.

Purpose The aim of this study was to evaluate the load bearing capacity and a reasonable thickness of dental monolithic zirconia crowns.

Materials and methods Polymethyl methacrylate (PMMA) abutment tooth specimens were made by CAD/CAM technic. Monolithic zirconia crowns (MZC), monolithic lithium disilicate crowns (MLC), layered zirconia crowns (LZC) and metal ceramic crowns(MCC), of which the occlusal thickness was 1.5mm were thereafter fabricated and cemented on the abutment tooth specimens. MCC with occlusal thicknesses of 0.6mm, 0.8mm, 1.00mm, 1.2mm were also made. All specimens underwent load-to-fracture test. Weibull parameters (σ_0) and (m) were calculated. Fracture modes were also evaluated.

Results The mean fracture load was 1863.16±116.81 for MLC, 2284.77±355.60 for MCC, 2308.0±510.94 for LZC, 4109.93±610.18 for MZC (1.5mm), 3068.31±233.88 for MZC (1.2mm), 2429.88±315.03 for MZC (1.0mm), 1814.60±68.21 for MZC (0.8mm) and 1308.38±111.38 for MZC (0.6mm). The fracture load of MZC was significantly higher than MCC, LZC and MLC ($P<0.05$). The fracture loads for MCC with different thickness were significantly different ($P<0.05$). Similar trend was observed for the characteristic strength (σ_0) and Weibull modulus (m). For MZC and MLC, the fracture mode was catastrophic failure. The predominant fracture mode for LZC was catastrophic fracture. The fracture loads of MZC(1.0mm) and MCC were not statistically different ($P>0.05$).

Conclusions Monolithic zirconia crowns exhibit higher fracture loads than monolithic lithium disilicate crowns, layered zirconia crowns and metal ceramic crowns. The fracture resistance of monolithic zirconia crowns with a thickness of 1.0mm can be equal to metal ceramic crowns. Doubling the monolithic zirconia core from 0.6 mm to 1.5 mm increases the fracture resistance of this restorative system threefold.

Keywords: Zirconia, Thickness, Fracture load, Monolithic, Single crown

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