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The Fracture Resistance of Zirconia Based Dental Crowns from Cyclic Loading: A Function of Relative Wear Depth

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Abstract : This in vitro study focused on investigating the fatigue resistance of veneered zirconia molar crowns with different veneering ceramic thicknesses, simulating the relative wear depths under simulated cyclic loading. A mandibular first molar was prepared and then scanned using computer-aided design/computer-aided manufacturing (CAD/CAM) technology to fabricate 32 zirconia copings of uniform 0.5 mm thickness. The manufactured copings then veneered with 1.5 mm, 1.0 mm, 0.5 mm, and 0.0 mm representing 0%, 33%, 66%, and 100% relative wear of a normal ceramic thickness of 1.5 mm. All samples were thermally aged to 6000 thermo-cycles for 2 minutes with distilled water between 5 ˚C and 55 ˚C. The samples subjected to cyclic fatigue and fracture testing using SD Mechatronik chewing simulator. These samples are loaded up to 1.25x10^6 cycles or until they fail. During fatigue, testing, extensive cracks were observed in samples with 0.5 mm veneering layer thickness. Veneering layer thickness 1.5-mm group and 1.0-mm group were not different in terms of resisting loads necessary to cause an initial crack or final failure. All ceramic zirconia-based crown restorations with varying occlusal veneering layer thicknesses appeared to be fatigue resistant. Fracture load measurement for all tested groups before and after fatigue loading exceeded the clinical chewing forces in the posterior region. In general, the fracture loads increased after fatigue loading and with the increase in the thickness of the occlusal layering ceramic.

Keywords : all ceramic, cyclic loading, chewing simulator, dental crowns, relative wear, thermally ageing
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