

Fractographic analysis of zirconia molar crowns – in vitro.

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Objectives: The aim of this study was to examine the surfaces of all-ceramic restorations with fractographic methods. For evaluating the influence of aging and cementation, the crowns were investigated after thermal cycling and mechanical loading with two different types of cementation.

Methods: 32 extracted human molars were provided with zirconia framework and veneering ceramic. 16 crowns were provided of Cercon base with Cercon Ceram Kiss (DeguDent, G) and Lava Zirconia with Lava Ceram (3M-Espe, G). Eight crowns of each group were either adhesively luted with Syntac classic/Variolink II (Ivoclar-Vivadent, FL) or cemented with Harvard Cement (Richter&Hoffmann, G). After thermal cycling and mechanical loading (TMCL: 6000 x 5°C/55°C, 1.2×10^6 x 50N, 1.66 Hz, human antagonists) all crowns were loaded to failure under three-point contact loading (Zwick 1446; v=1mm/min). The surfaces of the partially failed veneering ceramics were examined utilizing visual (Light optical microscope SV8, Zeiss, G) and scanning microscopy (Field emission SEM 400, Quanta, Philips, G). The surfaces were inspected for fractographic features such as wake hackles, compression curls and arrest lines for determination of the location of the origin and the direction of crack propagation.

Results: Mean load to failure data were found for Lava: 1112N±267N (Harvard) / 1311N±456N (Variolink) and Cercon: 1967N±767N (Harvard) / 2296N± 848N (Variolink II). The visual examination showed occlusal wear traces for all specimens. All materials provided fracture of one cusp. The broken fragment was between 2 and 6 mm. The zirconia framework was partly exposed or a veneering layer partly covered the core. All but one cementations with Harvard debonded. Compression curls and arrest lines were found in the fractured surfaces. Wake hackles could be determined when an approaching crack front sweeps by discontinuity. The resulting trails showed the crack progression from the initial starting area on the occlusal surface on all specimens.

Conclusion: Both zirconia based ceramics showed similar fractographic features, independent of different veneering and cementation.