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Comparative evaluation of the fracture strength of monolithic crowns fabricated from different all-ceramic CAD/CAM materials (an *in vitro* study)

A thesis
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Abstract

Fracture strength is considered as one of the essential parameters in determining the clinical success of dental restorations. The objective of this *in vitro* study was to evaluate and compare the fracture strength of monolithic crowns fabricated from five different all-ceramic CAD/CAM materials (lithium disilicate, zirconia, reinforced composite, hybrid dental ceramic, and zirconia-reinforced lithium silicate) using single load to failure test.

Forty sound human maxillary first premolar teeth extracted for orthodontic purposes were selected in this study. Teeth were prepared according to a standard protocol with 1 mm deep chamfer finishing line, 4 mm axial height with planar occlusal reduction and 6º total convergence angle.

Teeth were then divided into five groups of eight teeth each according to the type of material used for the fabrication of the monolithic crowns as follow: **Group A:** Lithium disilicate (IPS e.max CAD, Ivoclar Vivadent), **Group B:** Zirconia (CEREC Zirconia, Dentsply Sirona), **Group C:** Reinforced composite (BRILLIANT Crios, COLTENE), **Group D:** Hybrid dental ceramic (VITA ENAMIC, VITA Zahnfabric), **Group E:** Zirconia-reinforced lithium silicate (CELTRA DUO, Dentsply Sirona).

The prepared teeth of all groups were scanned with CEREC Omnicam digital intraoral scanner and the crowns were then designed using CEREC Premium software (version 4.4.4) and milled using CEREC MC XL milling unit. Post-milling, crowns of each group were subjected to either a firing procedure or to a polishing only according to the manufacturer's instructions of each material.

The internal surfaces of the crowns were then subjected to surface treatment according to the manufacturer's instructions and the crowns were then cemented on their respective teeth using a universal dual-cured adhesive resin cement (Duo-Link Universal, Bisco Inc.).

All teeth with the cemented crowns were then stored in deionized distilled water at room temperature for 24 hours before testing. All samples were then subjected to compressive axial loading until fracture in computer-controlled universal testing machine (Zwick Z010, Ulm, Germany) at a crosshead speed of 0.5 mm/min. The data were statistically analyzed using one-way ANOVA and LSD tests at a level of significance of 0.05.

The results of this study showed that the highest mean value of fracture strength was recorded by Group B (2337.37), followed by Group C (1880.59), Group E (1404.49), Group A (1085.39) and Group D (767.06) respectively, with statistically highly significant differences among the different groups ($p<0.01$). Concerning the fracture mode, the majority of samples of all groups showed severe fracture of the tooth and crown.

From the results of this study, it seems that the differences in the chemical composition and microstructure of the tested CAD/CAM materials may be responsible for the differences in the fracture strength of the fabricated crowns.