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Effect of Cementation Protocol on the Marginal Adaptation and Fracture Strength of Indirect Overlay Restorations Fabricated from Two Different All-Ceramic CAD/CAM Materials (A comparative *in vitro* study)

A Thesis

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Abstract

The marginal adaptation is considered an important criterion for the long-lasting of all-ceramic restorations, which is influenced by several factors, one of them cementation protocol. The fracture strength of all-ceramic restorations is strongly dependent on the support materials. Also, preparation design, dentin thickness, cement type, and thickness can be influential factors. This *in vitro* study aimed to evaluate and compare the effect of cementation protocol on the marginal adaptation and fracture strength of indirect overlay restorations fabricated from two different all-ceramic CAD/CAM materials.

Forty-eight human maxillary first-premolar teeth were prepared for receiving indirect overlay restorations with butt joint occlusal preparation design according to *adhesthetics clinical protocol for Posterior Indirect Adhesive Restorations* (PIAR) proposed by Ferraris in 2017. The prepared teeth were then divided into two main groups of twenty-four teeth each according to the type of CAD/CAM material used for the fabrication of the restorations: Group A: overlays fabricated from lithium disilicate blocks (IPS e.max CAD, Ivoclar Vivadent, Liechtenstein), Group B: overlays fabricated from reinforced resin blocks (BRILLIANT Crios, Coltene/ Whaledent AG, Switzerland). Each group was then further subdivided into three subgroups of eight teeth each according to the cementation protocol used: Subgroups (A1, B1): cemented with adhesive resin cement (RelyX Ultimate, 3M ESPE, USA), Subgroups (A2, B2): cemented with preheated composite (Filtek Z350 XT, 3M ESPE, USA) and Subgroups (A3, B3): cemented with sonically activated composite (SonicFill 2, Kerr Corp., USA).

The preparation was done using a high-speed air-turbine handpiece with water cooling mounted in a modified dental surveyor. Preparation was done in two steps: occlusal reduction and proximal reduction. The teeth received an occlusal reduction of 1.5 mm by using the Barrel-shaped trapezoid bur, following the slopes of the cusps and the central groove. For the interproximal reduction, a slot preparation design of 1 mm depth was done by using a flat-end diamond fissure bur held parallel to the long axis of the tooth to produce a round-shoulder finishing line with a width of the gingival floor of the interproximal box of 1.5 mm with rounded inside angles.

The prepared teeth were then scanned using CEREC Omnicam digital intra-oral scanner, then overlay restorations were designed using Sirona InLab 15.1 software and milled with InLab MC XL milling unit. Overlay restorations of group A were then subjected to crystallization /glaze firing at 840 °C while those of group B were finished and polished only. Each restoration was then seated on its respective tooth under a standard static load of 5 Kg using a custom-made specimen holding device. The vertical marginal gap was then measured at four points on each surface of the tooth by digital microscope at a magnification of 230X using Image J software. For each specimen, sixteen measurements were taken, and the mean of that measurement was used to be the value of the pre-cementation gap.

Before cementation, the surface treatment was done first for both restoration and tooth according to the manufacturer's instructions then the restorations seated on its respective prepared teeth. Each restoration cemented on its respective tooth according to the aforementioned sample grouping following the manufacturer's instructions of each material. The measurement of the marginal gap was then done at the same predetermined points used for the measurement of the marginal gap pre-cementation.

All specimens were subjected to compressive axial load at a crosshead speed of 0.5 mm/min using a computer-controlled universal testing machine (LARYEE, China) until the fracture occurred.

The data were analyzed statistically using independent t-test, one-way ANOVA test, Levene test, LSD test, and DunnettT3 test at a level of significance of 0.05.

Concerning the marginal adaptation, the results of this study showed that the overlay restorations fabricated from reinforced resin blocks (BRILLIANT Crios) recorded less marginal gap than those restorations fabricated from lithium disilicate blocks (IPS e.max CAD) with statistically significant differences (p<0.05), pre-and post-cementation regardless of cementation protocol used. The results of this study also showed that, for both block types, cementation with adhesive resin cement provided significantly better marginal adaptation than cementation with preheated composite and sonically activated composite, with the statistically non-significant difference between the latter two cementation protocols.

Regarding the fracture strength, the results of this study showed the same scenario as in the marginal gap. Overlay restorations fabricated from reinforced resin blocks (BRILLIANT Crios) recorded a higher fracture strength than those restorations fabricated from lithium disilicate blocks (IPS e.max CAD) with statistically significant differences (p<0.05), regardless of cementation protocol used. The results of this study also showed that, for both block types, cementation with adhesive resin cement provided significantly higher fracture strength than cementation with preheated composite and sonically activated composite, with the statistically non-significant difference between the latter two cementation protocols.

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