Effect of Cement Layer on Load-bearing Capacity of Occlusal Veneers

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Objective

To evaluate the influence of cement layer thickness on load-bearing capacity of tooth restored with hybrid-ceramic (HC) and lithium-disilicate glass ceramic (LDGC) occlusal veneers.

Materials & Methods

Cement layer thickness was set at either 50μm or 200μm to study the effect of the thickness on load-bearing capacity of tooth restored either with 0.5mm or 1.8mm thick HC Cerasmart270 (GC) or LDGC IPS e.max CAD (Ivoclar Vivadent) occlusal veneers. 64 extracted human molar teeth were selected and divided into 8 groups (n=8/group) according to veneer material and thicknesses of cement layer and veneer. Flat occlusal surface with chamfer was prepared to simulate minimally invasive tooth preparation. Preparations were scanned and occlusal veneers designed and milled using CAD/CAM technology (Cerec, Dentsply-Sirona). Finalized veneers were luted using self-adhesive resin cement (G-CEM ONE) to the preparations according to manufacturers' instructions.

Quasi-static loading test was used as testing method. The ultimate fracture load was recorded, and fracture types were analyzed and classified visually. Statistical analysis was performed by two-way ANOVA.

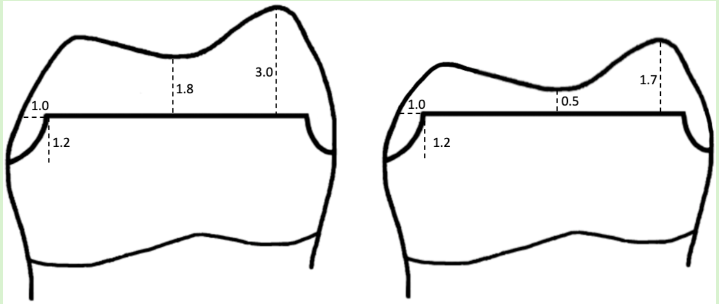


Figure 1. Dimensions of occlusal veneers (mm).

Table 1. Materials used in this study

Material	Composition	LOT	Manufacturer
IPS Ceramic Etching Gel	4.5% Hydrofluoric acid	Z037BV	Ivoclar Vivadent, Schaan, Liechtenstein
Scotchbond Universal Etchant	37% Phosphoric acid	9250920, 9250920	3M ESPE, Neuss, Germany
G-Multi Primer	Ethyl alcohol (90-100%), MDP, MDTP, silane	2202071	GC Europe, Leuven, Belgium
Adhesive Enhancing Primer	Ethyl alcohol (25-50%), MDP, 4-MET, MDTP	2206271	GC Corporation, Aichi, Japan
Self-Adhesive Resin Cement	UDMA, DMA, MDP, inhibitor, initiator	2201121, 2304121	GC Europe, Leuven, Belgium
Cerasmart270	71wt% silica (20nm) and barium glass (300nm) nanoparticles, Bis-MEPP, UDMA, DMA	2103011	GC Corporation, Aichi, Japan
IPS e.max CAD	SiO_2 57-80wt%, Li_2O 11-19wt%, K_2O 0-13wt%, P_2O_5 0-11wt% and other oxides.	YB54P7	Ivoclar Vivadent, Schaan, Liechtenstein

Results

With HC occlusal veneers, thickness of both veneer and cement layer had no significant influence on fracture load. The lowest mean ultimate fracture load value was found in 0.5mm thick LDGC veneers group with 200µm cement layer, which was significantly lower loading value compared to that of 1.8mm thick LDGC veneers or HC veneers ($p \leq 0.0280$). LDGC veneers with 0.5mm thickness showed fractures within the veneer, whereas in other groups fractures of the tooth substance was also detected.

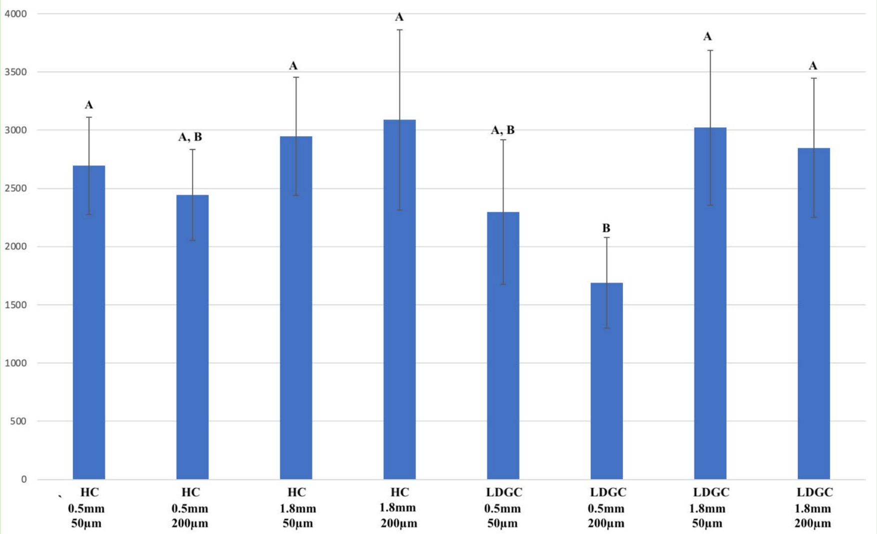


Figure 2. Mean ultimate fracture loads according to veneer material (HC/LDGC), thicknesses of veneer (0.5mm/1.8mm) and cement layer (50µm/200µm), respectively. Groups not connected by the same letter are statistically significantly different.

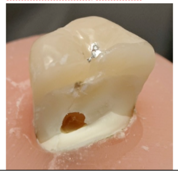
	Fractured tooth 	Fractured veneer 
HC, 0.5mm, 50µm	6/8	2/8
HC, 0.5mm, 200µm	8/8	
HC, 1.8mm, 50µm	7/8	1/8
HC, 1.8mm, 200µm	8/8	
LDGC, 0.5mm, 50µm	1/8	7/8
LDGC, 0.5mm, 200µm	3/8	5/8
LDGC, 1.8mm, 50µm	8/8	
LDGC, 1.8mm, 200µm	8/8	

Figure 4. Fracture type analysis of the groups.

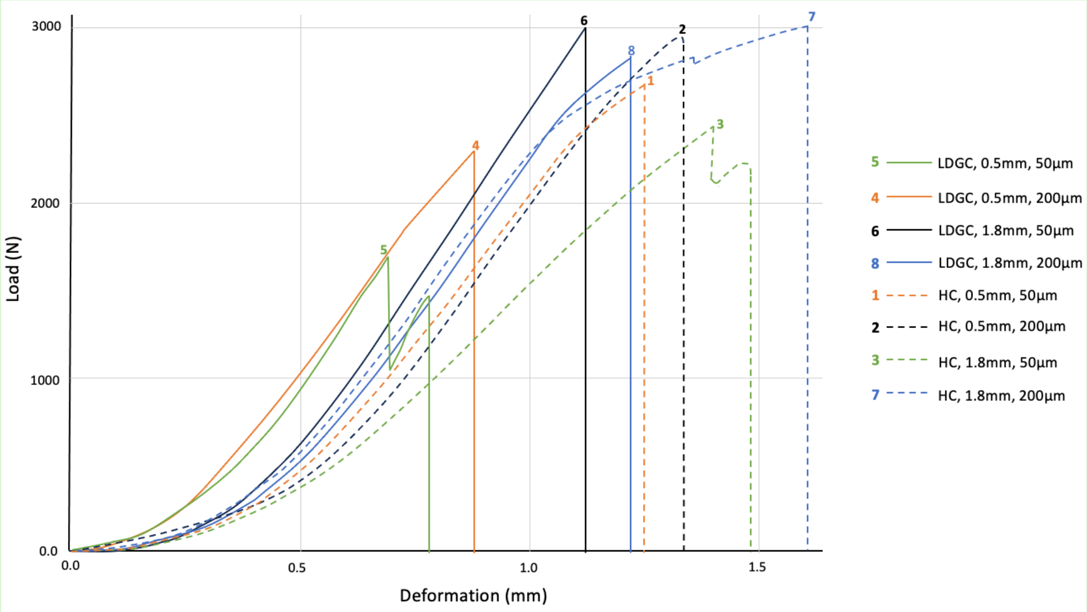


Figure 3. Load-deformation curves according to each group.

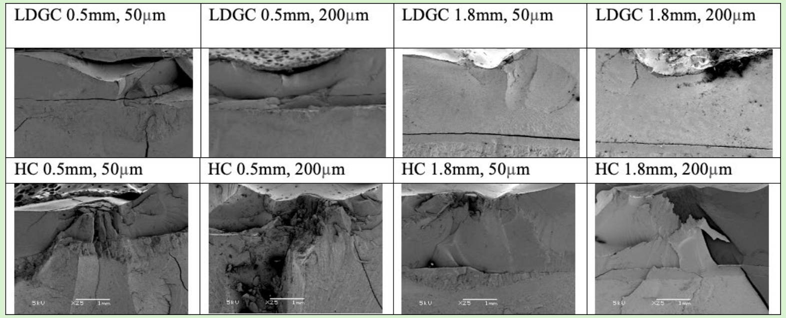


Figure 5. SEM-analysis according to each group (magnification 25x, bar 1mm).

Conclusions

Within the limitations of this study, it can be concluded that thin HC occlusal veneers provided higher load-bearing capacity than LDGC counterparts of the same thickness. HC veneers were also less sensitive to the effect of cement layer thickness.

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