Fracture Strength of Ceramic Posterior Occlusal Veneers for Functional Rehabilitation of an Abrasive Dentition

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 Purpose: To evaluate the load at fracture and influence of artificial aging of posterior teeth occlusal veneers (“table tops”) made of two different ceramics. Materials and Methods: A total of 80 table tops were produced from feldspathic ceramic (VM) and zirconia-reinforced lithium silicate ceramic (CD) using computer-aided design/computer-assisted manufacturing (CAD/CAM). Half of the specimens from each ceramic were aged prior to the load test.

 Results: Mean ± standard deviation (SD) load at fracture was significantly higher for CD (1,571.1 N ± 297.0 N) than for VM (573.6 N ± 86.4 N) (P < .001). After aging, load at fracture increased significantly to 1,819.0 N (± 310.6 N) for CD and to 745.2 N (± 168.3 N) for VM.

 Conclusion: The use of zirconia-reinforced lithium silicate ceramic for molar nonprep table tops should be uncomplicated according to the high load-at-fracture values. Mechanical stability of either ceramic is not compromised by aging. Int J Prosthodont 2018;31:451–452. doi: 10.11607/ijp.5817

 Various types of ceramic restorations are currently used. Minimally invasive veneers of the occlusal surfaces of posterior teeth are called table tops (Fig 1). Survival rates for table tops of approximately 90% after 10 years have been found; however, there are no studies currently available that describe table tops produced from a zirconia-reinforced ceramic. The aim of the current study was therefore to analyze in vitro whether load at fracture of table tops is influenced by the type of ceramic and by artificial aging.

 Materials and Methods

A total of 80 table tops with a thickness between 1.5 and 2.0 mm for an occlusally worn posterior left first molar (Fig 2) were produced: 40 from feldspathic ceramic (VITABLOCS Mark II, VITA Zahnfabrik; VM group) and 40 from zirconia-reinforced lithium silicate ceramic (CELTRA DUO, DeguDent; CD group) (Fig 3) using computer-aided design/computer-assisted manufacturing (CAD/CAM) (Sirona CEREC machine, Sirona Dental Systems; and DeguDent brain MCXL machine, DeguDent). Twenty specimens from each group (VM-A, CD-A) were subjected to thermal aging (10,000 cycles, 5/55°C) and to 10 million cycles of mechanical aging in a chewing simulator (machine shop, Hannover Medical School, Germany) with a load of 50 N at a frequency of 2.5 Hz. The remaining 20 table tops of each ceramic were stored in distilled water.

All table tops were cemented adhesively onto polyurethane models with the resin luting cement Calibra (Dentsply) and subjected to a load test in a universal testing machine (Type 20K, UTS Testsysteme).

The statistical analysis was performed using SPSS for Windows, version 22.0 (SPSS Software). Power analysis based on the first five specimens of each ceramic revealed that a group size of 20 samples was necessary to achieve a statistical power of 90%. The Kolmogorov-Smirnov and Levene tests were used to check the normal distribution of data and homogeneity of variance. The comparison of the ceramic groups and the influence of artificial aging on load at fracture was analyzed using the t test. The level of significance was set at P < .05.

 Results

As all specimens withstood the mechanical loading, no failure due to loss of retention occurred. In the VM group, the mean load at fracture was 513.6 N (standard deviation [SD] 86.4 N). The VM-A group had a mean load at fracture of 745.2 N (SD 168.3 N). In the CD group, the mean load of fracture was 1,571.1 N (SD 297.0 N). The CD-A group showed a mean load at fracture of 1,819.0 N (SD 310.6 N) (Fig 4).

Load at fracture in the CD group was statistically significantly higher than in the VM group (P < .05). Comparison of data with and without artificial aging showed that load at fracture for each ceramic was significantly higher after aging (VM vs VM-A: P < .05; CD vs CD-A: P < .05).
Load at fracture of table tops fabricated from zirconia-reinforced lithium silicate was more than 2-fold higher than for feldspathic ceramic, which can be attributed to the zirconia content of CELTRA DUO.

Restorations of both ceramics with artificial aging had a significantly higher mean load at fracture than without artificial aging. Various studies have reported that aging reduces fracture resistance.\textsuperscript{2,3} However, similar to the present results, Shirakura et al found a significant increase in the load at fracture of veneered aluminum oxide ceramic after simulated aging.\textsuperscript{4} The increase in load at fracture after aging in the current study could be explained by a longer postcuring time of the adhesive cement and the polyurethane of the artificial teeth. In addition, the hydrothermal aging of CELTRA DUO table tops might have caused an initial phase transformation from tetragonal to monoclinic in the zirconia, resulting in a retarded crack extension and a higher load at fracture.

Within the limitations of an in vitro study, zirconia-reinforced lithium silicate ceramic CELTRA DUO can be recommended for molar nonprep table tops of a thickness in accordance with the manufacturer’s recommendations. In contrast, feldspathic ceramic VITABLOC Mark II should be considered very carefully, as the mean load at fracture after artificial aging was lower than the mean maximal bite force value for chewing forces in the posterior region (847 N)\textsuperscript{5}. Further research is necessary to investigate the fracture stability clinically.

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**References**