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Shear bond strength of ceramic material veneered to zirconia core by layering and pressing techniques

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Abstract
Background: The advantages of the PFM systems are to combine the fracture resistance of the metal substructure with the aesthetic property of the porcelain. The present study compared the shear bond strength of ceramic material veneered to zirconia core by layering and pressing techniques.
Materials and Methods: 50 samples of zirconia blocks were divided into 2 groups. Each group consisted of 25 samples. In group I, ceramic veneered over zirconia core by pressing technique and in group II, ceramic veneered over zirconia core by layering technique was used. The blocks were loaded up to failure which was assessed using universal testing machine.
Results: The mean shear bond strength in group I was 13.4 MPa and in group II was 9.2 MPa. The difference found to be significant ($P< 0.05$).
Conclusion: The mean shear bond strength of specimens veneered on to zirconia core by pressing technique performed was superior in comparison to the layered specimen.

Keywords: Layering technique, shear bond strength, zirconia

Introduction
Since, 40 years the porcelain-fused-to-metal systems have been extensively used in fixed partial dentures and still represents the gold standard. The advantages of the PFM systems are to combine the fracture resistance of the metal substructure with the aesthetic property of the porcelain [1]. However, recently the increasing demand for aesthetic restorations as well as the questionable biocompatibility of some dental metal alloys has accelerated the development and improvement of metal-free restorations [2]. All ceramic dental restorations composed of porcelain veneer on a zirconia substructure are nowadays being commonly used as an alternative to metal ceramic restorations [3]. Chipping and fracturing of layered porcelain (lithium disilicate) applied to zirconia frameworks continue to be a problem with a reported incidence between 0%- 30%. Type of fracture can be adhesive or cohesive [4].
Zirconia is currently of great interest among the all-ceramic materials. Zirconium (Zr) is found in the minerals as baddeleyite and zircon ($ZrSio_4$) and in nature it exists in conjunction with silicate oxides or as zirconia oxide (ZrO_2) [5]. Zirconia oxide stabilized with an addition of yttrium oxide results in a high strength, high elastic modulus and better fracture toughness [6]. The technique involves investing of wax pattern in a refractory material, which is preheated and transferred to a specially designed press furnace [7]. The present study compared the shear bond strength of ceramic material veneered to zirconia core by layering and pressing techniques.

Materials and Methods
The present invitro study consisted of 50 samples of zirconia blocks. Ethical clearance committee approved for the study.
All samples were divided into 2 groups. Each group consisted of 25 samples. In group I, ceramic veneered over zirconia core by pressing technique and in group II, ceramic veneered over zirconia core by layering technique was used. The veneered specimens were mounted on to the centre of a PVC tube using self-cure acrylic resin leaving 3 mm of the veneered surface exposed as cantilever. The blocks were loaded up to failure which was assessed using

universal testing machine. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

Results

Table 1: Distribution of specimens

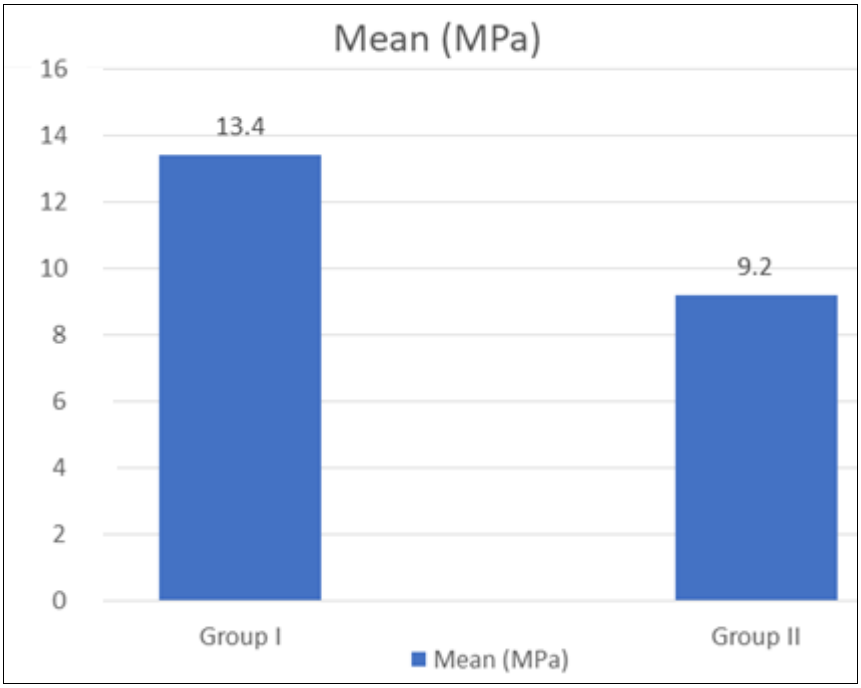
Groups	Group I	Group II
Method	Pressing	Layering
Number	25	25

Table 1 shows distribution of specimens based on technique used for veneering. Each group had 25 specimens.

Table 2: Evaluation of shear bond strength of zirconia core

Groups	Mean (MPa)	P value
Group I	13.4	0.01
Group II	9.2	

Table 2, graph 1 shows that mean shear bond strength in group I was 13.4 MPa and in group II was 9.2 MPa. The difference found to be significant ($P< 0.05$).



Graph 1: Evaluation of shear bond strength of zirconia core

Discussion

Ceramics veneered onto metal alloys or zirconia core have been available for quite some time but the bonding mechanism between zirconia core and ceramic veneer have not been clearly demonstrated [8]. Considerable refinement is required to estimate the interfacial stress at the junction to prevent the fracture and chipping of the restoration [9]. The adhesion mechanism between metal and porcelain is believed to be the micro-mechanical bond, compatible coefficient of thermal expansion (CTE) match, van der Waals force, and mainly the suitable oxidation of metal and interdiffusion of ions between the metal and porcelain [10]. The present study compared the shear bond strength of ceramic material veneered to zirconia core by layering and pressing techniques. In present study, in group I, ceramic veneered over zirconia core by pressing and in group II, ceramic veneered over zirconia core by layering technique was used. Each group had 25 specimens. Cheng *et al.* [11] evaluated the influence of the parameters of blasting on the shear bond strength between zirconia and pressed veneer ceramics. Zirconia was blasted with different alumina particle size subjected to two types of applied pressures. Heat-pressed and layered veneer ceramic blocks were served as an experimental group and control group, respectively. The results indicated that the surface roughness was increased significantly ($P<0.05$) with increasing particle size of alumina and blasting pressure. The alumina particle size had statistically significant influence ($P<0.05$) on shear strength of heat-pressed groups. Among heat-pressed ceramic specimens, the highest and lowest shear strength could be obtained when 50 μm of alumina was used at pressure of 0.3 MPa and 110 μm of alumina was used at 0.5 MPa, respectively. The negligible effect of thermal cycle on shear strength of heat-pressed groups can be seen.

We observed that the mean shear bond strength in group I was 13.4 MPa and in group II was 9.2 MPa. Subhash *et al.* [12] conducted a study in which 20 samples of zirconia blocks were fabricated and the samples were divided into group A & B. Group A - Ceramic Veneered over zirconia core by pressing using Noritake CZR Press. Group B - Ceramic Veneered over zirconia core by layering using Noritake CZR. The shear bond strength was calculated in both groups. The mean shear bond strength for pressed specimens was 12.458 ± 1.63 MPa and for layered specimens was 8.458 ± 0.845MPa. Dundar *et al.* [13] reported shear bond strength in the range of 23 - 41 MPa for commercially available core-veneer all-ceramic systems. Yadav *et al.* [14] in their study 60 samples were fabricated from VITA zirconia discs. Samples were divided into 4 groups with 15 samples each. First is the control group, second is lithium disilicate glass–ceramic liner group, third is silicon dioxide based liner, and fourth is glass–ceramic interlayer group. SBS of samples was recorded using universal testing machine. The intergroup comparison of mean SBS (Mpa) was done using the post hoc Bonferroni test. The mean SBS (Mpa) was significantly more among lithium disilicate and glass–ceramic interlayer groups in comparison to silicon dioxide-based liner group.

Hallmann *et al.* [15] reported that when specimens were blasted with 110 µm alumina at pressure of 0.1, 0.25 and 0.35 MPa, some defects such as flaws, micro-cracks, pits, plastic deformations, melting of the ceramic surface and embedded alumina particles were observed on the surface. In addition, the blasting induced internal stress at the junction between veneer ceramics and zirconia framework could play an important role in the bond strength.

Mechanical anchoring plays a vital role in the bond strength between zirconia and veneer ceramics. In this regard, it is considered that blasting technique is employed to increase the surface roughness for improvement of the ceramic sintered area and the formation of mechanical interlocking between zirconia and veneer ceramics, although opposite arguments are mentioned by some manufacturers [16].

Conclusion

Authors found that the mean shear bond strength of specimens veneered on to zirconia core by pressing technique performed was superior in comparison to the layered specimen.

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