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Original Research

Assessment the effect of different liners on the shear bond strength (SBS) of a commercially available veneered zirconia block- An in-vitro study

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ABSTRACT:
Background: The present study was conducted to assess the effect of lithium disilicate glass–ceramic liner, silicon dioxide based liner, and glass–ceramic interlayer on the shear bond strength (SBS) of a commercially available veneered zirconia block. **Materials & Methods:** The present study was conducted on 40 samples fabricated from VITA zirconia discs. Samples were divided into 4 groups. Each group had 10 samples. Group I is control group, group II is lithium disilicate glass–ceramic liner group, group III is silicon dioxide based liner, and group IV is glass–ceramic interlayer group. SBS of samples was recorded using universal testing machine. **Results:** The mean shear bond strength in group I was 22.3 MPa, in group II was 61.3 MPA, in group III was 62.5 MPa and in group IV was 34.2 MPa. The difference was significant ($P < 0.05$). The mode of failure was cohesive seen 8 in group I and 7 in group IV, adhesive seen 10 in group II and 8 in group III and combined seen 2 in group I, 2 in group III and 3 in group IV. **Conclusion:** Authors found that disilicate liner showed maximum shear bond strength. Maximum adhesive failures were found with lithium disilicate liner, and silicon dioxide-based liner group showed cohesive failures.
Key words: Cohesive failures, disilicate liner, shear bond strength

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INTRODUCTION

Metal ceramic fixed partial dentures (FPDs) are considered the gold standard, as reliable materials. However, the request for esthetic dentistry as well as the rising question regarding biocompatibility of dental alloys supports the commercialization of new products. Nowadays, all ceramic prostheses are replacing, more and more, metal based restorations. A variety of ceramic systems are developed for single crowns or fixed dental prostheses (FDPs) with an excellent esthetic outcome.[1]

Transformation-toughened zirconia is prone to be a successful alternative in the different clinical situations compared to other all-ceramic systems. Their

mechanical and optical properties allowed them to be used as a framework material.[2] In vitro studies demonstrated a flexural strength of 900–1200MPa and a fracture toughness of 9–10MPam1/2. The restorations are processed either by soft machining of presintered blanks followed by sintering at high temperature, or by hard machining of fully sintered blanks.[3]
The adhesive fracture of layered porcelain indicates its poor shear bond strength (SBS). Lithium disilicate with coefficient of thermal expansion (CTE [25°C –800°C]: ~9.3–9.9 × 10 − 6 K−1) is a type of glass ceramic which offers thermal shock resistance, thus leading to a more stable CTE even after multiple firings.[4] The SBS indicates interceramic bond between zirconia core and veneering ceramics. Strong discrepancies in CTE between veneering porcelains and zirconia significantly affect their bond strength.[5] The present study was conducted to assess the effect of lithium disilicate glass–ceramic liner, silicon dioxide based liner, and glass–ceramic interlayer on the shear bond strength (SBS) of a commercially available veneered zirconia block.

MATERIALS & METHODS

The present study was conducted in the department of Prosthodontics. It comprised of 40 samples fabricated from VITA zirconia discs. Samples were divided into 4 groups. Each group had 10 samples. Group I is control group, group II is lithium disilicate glass–ceramic liner group, group III is silicon dioxide based liner, and group IV is glass–ceramic interlayer group. SBS of samples was recorded using universal testing machine. Samples were further analyzed for fractographic behavior using scanning electron microscope (SEM). Results were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of blocks in groups

Groups	Group I	Group II	Group III	Group IV
Materials	Control	Lithium disilicate glass–ceramic	Silicon dioxide	Glass–ceramic
Number	10	10	10	10

Table I shows distribution of blocks. Group I is control group, group II is lithium disilicate glass–ceramic liner group, group III is silicon dioxide based liner, and group IV is glass–ceramic interlayer group.

Table II Shear bond strength of zirconia samples

Groups	Mean	P value
Group I	22.3	0.01
Group II	61.3	
Group III	62.5	
Group IV	34.2	

Table II, graph I shows that mean shear bond strength in group I was 22.3 MPa, in group II was 61.3 MPA, in group III was 62.5 MPa and in group IV was 34.2 MPa. The difference was significant ($P < 0.05$).

Graph I Shear bond strength of zirconia samples

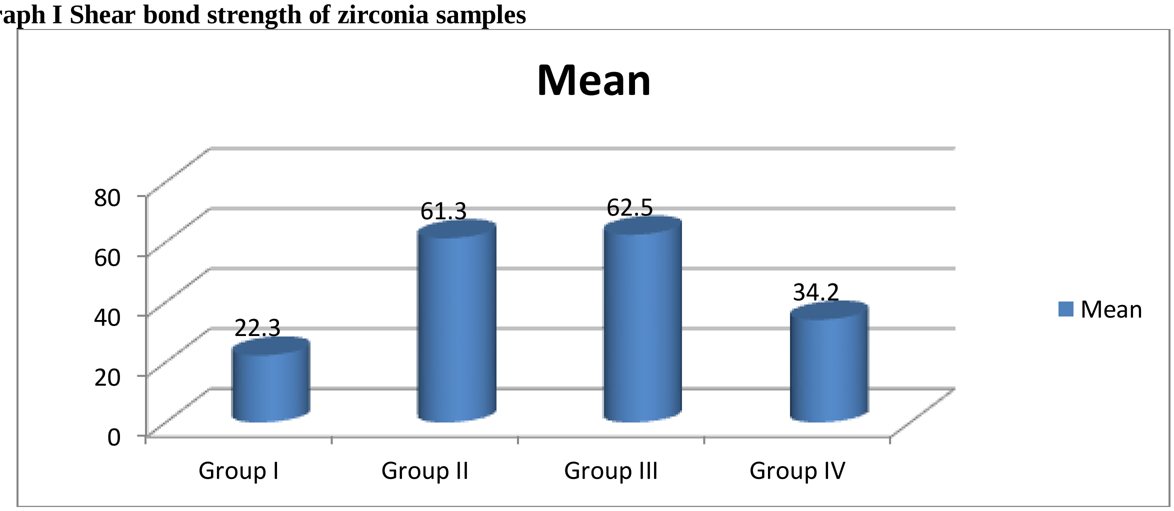
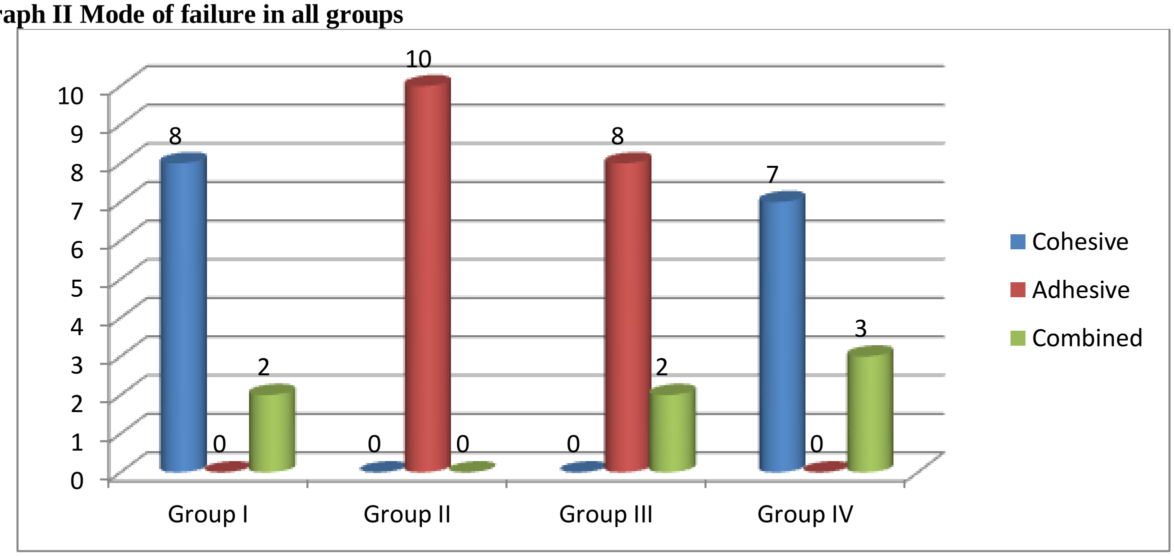


Table III Mode of failure in all groups

Groups	Cohesive	Adhesive	Combined
Group I	8	0	2
Group II	0	10	0
Group III	0	8	2
Group IV	7	0	3

Table III, graph II shows that mode of failure was cohesive seen 8 in group I and 7 in group IV, adhesive seen 10 in group II and 8 in group III and combined seen 2 in group I, 2 in group III and 3 in group IV.

Graph II Mode of failure in all groups



DISCUSSION

Zirconia surface can be layered with two commercially available glass ceramic that is feldspathic porcelain or feldspathic porcelain with leucite crystal. Use of interlayer liquid suspension of ceramics as liner between zirconia substructure and veneered porcelain can enhance bond strength to great extension.[6] Bond strength evaluation of layered porcelain over zirconia substructure can be done using shear bond strength test, three and four point flexure, tensile and microtensile bond test. Shear bond tests have been reported as one of the most established bond strength tests in literature. SBS measurements showed that veneering porcelain on zirconia with lithium disilicate glass–ceramic liner fired at 85°C had the highest mean SBS.[7]

Chipping is defined as "a typical failure of contact loadings, normally produced when a crack generated or propagated by contact loads deflects due to the presence of a free surface nearby". Tensile stress induces fracture of the brittle ceramic usually perpendicular to the applied force.[8] Thermal coefficient mismatches, processing (porosity, impurity inclusion) and inherent material defects (large grains, residual scratches) will increase the probability of crack propagation under loading. Brittle fracture of ceramics will be triggered adjacent to these zones.[9] The present study was conducted to assess the effect of lithium disilicate glass–ceramic liner, silicon dioxide based liner, and glass–ceramic interlayer on the shear bond strength (SBS) of a commercially available veneered zirconia block.

In present study, there were 40 samples fabricated from VITA zirconia discs. The mean shear bond strength in group I was 22.3 MPa, in group II was 61.3 MPA, in group III was 62.5 MPa and in group IV was 34.2 MPa. Yadav et al[10] evaluated the effect of lithium disilicate glass–ceramic liner, silicon dioxide based liner, and glass–ceramic interlayer on the shear bond strength (SBS) of a commercially available veneered zirconia block and to study fractographic behavior of the samples using universal testing machine, scanning electron microscope (SEM). 60 samples were fabricated from VITA (vita zahnfabrik. Bad sackingen, Germany) 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.

We found that mean shear bond strength in group I was 22.3 MPa, in group II was 61.3 MPA, in group III was 62.5 MPa and in group IV was 34.2 MPa. Mode of failure was cohesive seen 8 in group I and 7 in group IV, adhesive seen 10 in group II and 8 in group III and combined seen 2 in group I, 2 in group III and 3 in group IV.

Al-Dohan et al[11] demonstrated that most of the studies that performed macro shear bond test showed that most fractures occurred in the veneering layer (cohesive failure). The SBS of veneering ceramics was higher than SBS between core and veneering ceramics, and the failure mode observed was mainly combined as adhesive at the interface and cohesive in the veneering ceramic. SBS between zirconia core and veneering ceramics was not affected by thermocycling.

CONCLUSION

Authors found that disilicate liner showed maximum shear bond strength. Maximum adhesive failures were found with lithium disilicate liner, and silicon dioxide-based liner group showed cohesive failures.

REFERENCES

1. Attia A. Bond strength of three luting agents to zirconia ceramic – Influence of surface treatment and thermocycling. J Appl Oral Sci 2011;19:388-95.
2. Piwowarczyk A, Lauer HC, Sorensen JA. The shear bond strength between luting cements and zirconia ceramics after two pre-treatments. Oper Dent 2005;30:382-8.
3. Guess PC, Kulis A, Witkowski S, Wolkewitz M, Zhang Y, Strub JR. Shear bond strengths between different zirconia cores and veneering ceramics and their susceptibility to thermocycling. Dent Mater 2008;24:1556-67.
4. Chaiyabutr Y, McGowan S, Phillips KM, Kois JC, Giordano RA. The effect of hydrofluoric acid surface treatment and bond strength of a zirconia veneering ceramic. J Prosthet Dent 2008;100:194-202.
5. Taskonak B, Yan J, Mecholsky JJ Jr., Sertgöz A, Koçak A. Fractographic analyses of zirconia-based fixed partial dentures. Dent Mater 2008;24:1077-82.
6. Aboushelib MN, de Jager N, Kleverlaan CJ, Feilzer AJ. Microtensile bond strength of different components of core veneered all-ceramic restorations. Dent Mater 2005;21:984-91.
7. Hjerppe J, Vallittu PK, Fröberg K, Lassila LV. Effect of sintering time on biaxial strength of zirconium dioxide. Dent Mater 2009;25:166-71.
8. Aktas G, Sahin E, Vallittu P, Ozcan M, Lassila L. Effect of colouring green stage zirconia on the adhesion of veneering ceramics with different thermal expansion coefficients. Int J Oral Sci 2013;5:236-41.
9. Choi BK, Han JS, Yang JH, Lee JB, Kim SH. Shear bond strength of veneering porcelain to zirconia and metal cores. J Adv Prosthodont 2009;1:129-35.
10. Yadav P, Dabas N, Phukela SS, Malhotra P, Drall S, Ritwal PK. A comparative evaluation of the effect of liners on the shear bond strength of veneered zirconia block: An in vitro study. J Indian Prosthodont Soc 2019;19:338-44.
11. Al-Dohan HM, Yaman P, Dennison JB, Razzoog ME, Lang BR. Shear strength of core-veneer interface in bi-layered ceramics. J Prosthet Dent 2004;91:349-55.