Various primers effect on resin-cement adhesion to zirconia and lithium-disilicate

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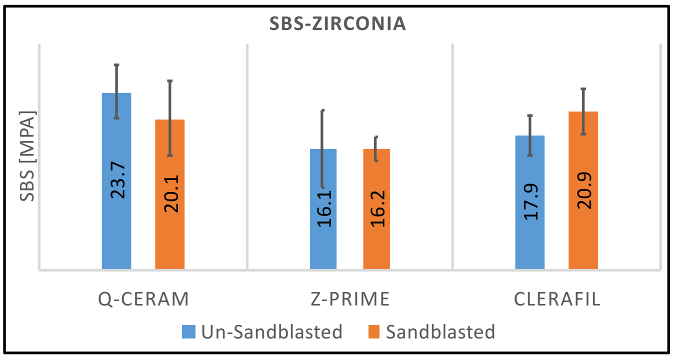
Objectives

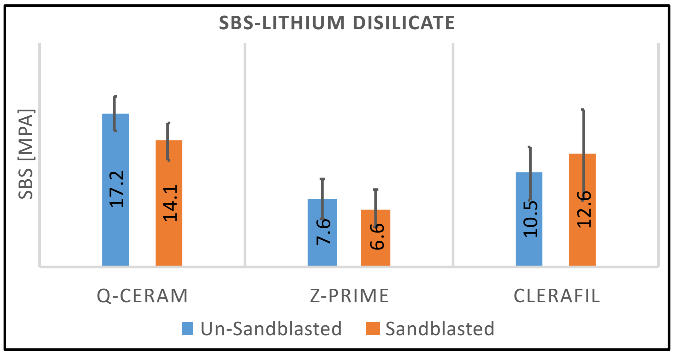
The objective of the following study is to evaluate (in vitro) the shear bond strength (SBS) of adhesive resin cement to Zirconia and Lithium-disilicate ceramics while using various ceramic primers. In addition, to evaluate the SBS prior and after thermocycling.

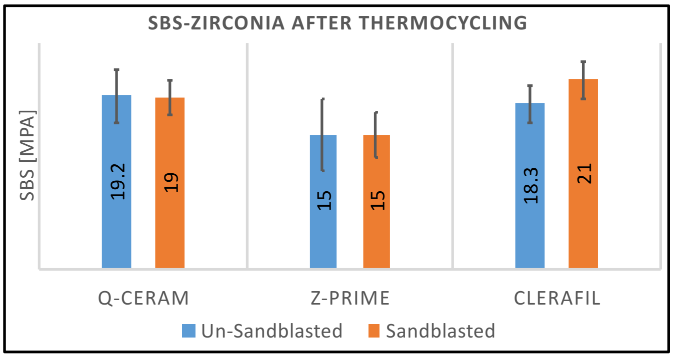
Materials and Methods

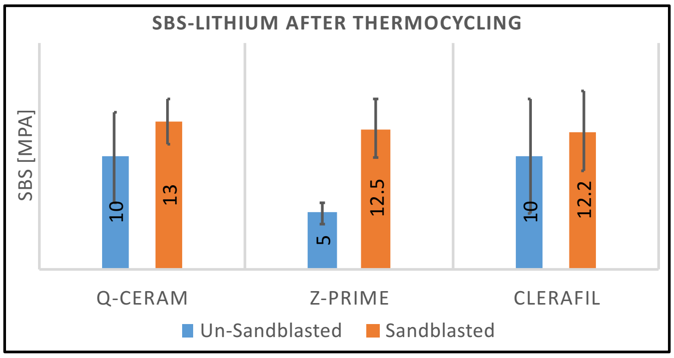
SBS test was performed in accordance with ISO 29022. Sandblasted (n=8) and un-sandblasted (n=8) Zirconia blocks *(ZirCom Zirkonblank, Compro-dent)* and Lithium di-silicate blocks *(E.max Cad LTA2, Ivoclar-Vivaden)* were used for each test group. All experimental groups were surface treated with three different ceramic primers: *Q-Ceram,* BJM (QC), *Z-Prime Plus,* Bisco (ZP)*, and Clearfil Ceramic-Primer,* Kuraray (CR). High-Q-Bond Adhesive Resin-Cement, BJM was applied on all substrates. Specimens were stored for 24 hours at 37°C in 100% humidity. Additionally, another group of specimens (same amount) prepared in the same fashion in order to evaluate SBS values after thermocycling. The bonded specimens were stored in water at 37°C for 24 hours in 100% humidity and then thermocycled 500 cycles between 5°C and 55°C (in distilled water) prior to SBS testing. Specimens debonded in shear utilizing the Ultradent shear jig on a Shimadzu AGS-X universal testing machine at a crosshead speed of 1.0 mm/min. Mean SBS (MPa) was analyzed with one-way analysis of variance ANOVA ($p<0.05$).

Results









Discussion

Interesting artifacts were found with regard to QC and ZP Primers. As can be seen SBS test results of QC group were higher when the samples pasted on un-sandblasted substrate. For ZP group it can be said that there was no difference between sandblasted and un-sandblasted samples. Allegedly, this findings create a contradiction. Namely, surface treatment by sandblasting supposed to create microstructure with higher surface area/roughness which increases surface energy, improves wettability and interfacial adhesion. The only exception seen in lithium-disilicate after thermocycling. However, for CR group the SBS improved after applying sandblasting. This phenomenon can be explained from the rheological aspect of each primer. The assumption is that QC and ZP are more "viscous" than CR primer. In other words, CR primer is more diluted and can penetrate/percolate more easily to the created rough surface after the sandblasting process. In contrast, QC and ZP Primers are not diluted enough to penetrate to the micro-holes and occupy more surface area, i.e. the rough surface create a sort of obstacle.

SBS Results [MPa]-Summary Table

Substrate	Q-Ceram	Z-Prime	Clerafil
Zirconium	23.7(3.5)	16.1(5.0)	17.9(2.7)
Sand-blasted Zirconium	20.1(5.0)	16.2(1.5)	20.9(3.0)
Lithium	17.2(2.0)	7.6(2.2)	10.5(3)
Sand-blasted Lithium	14.1(2.1)	6.6(2.0)	12.6(4.9)
Zirconium after thermocycling	19.2(3.0)	15.0(4.0)	18.3(2.0)
Sand-blasted Zirconium after thermocycling	19.0(2.0)	15.0(2.5)	21.0(2.0)
Lithium after thermocycling	10.0(4.0)	5.0(1.0)	10.0(5.0)
Sand-blasted Lithium after thermocycling	13.0(2.0)	12.5(2.5)	12.2(3.5)

*All examined groups exhibited adhesive primer-cement failure

Conclusions

Almost in all test groups un-sandblasted blocks exhibited the best results while using Q-Ceram, both for Zirconia and Lithium-disilicate. Furthermore, since the sandblasting has no effect on SBS and even aggravates the adhesion strength in QC and ZP groups, there is no need for prior surface treatment in order to achieve better adhesion.