CJDR
Caspian Journal of Dental Research
Caspian Journal of Dental Research
e-ISSN: 2322-2395 p-ISSN: 2251-9890
Babol University Of Medical Sciences

Comparison of shear bond strength (SBS) between E-max ceramic and composite resin with two methods of cementation

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[DOR: 20.1001.1.22519890.2021.10.2.3.4]
[DOI: 10.22088/cjdr.10.2.60]

Article Type
Short Communications

Received: 23 Dec 2020
Accepted: 1 Sept 2021

ABSTRACT

Introduction: Today, the use of all-ceramic restorations has increased due to their physical properties as well as translucency and esthetic appearance. The aim of this study was to compare the shear bond strength (SBS) between two methods of e-max ceramic cementing.

Materials & Methods: The study groups were 1 flowable composite as cement (FC group) and 2) choice2 cement (C2 group). The samples were fixed to a KOOPA universal testing machine for SBS testing. The data were analyzed using SPSS 20 through T-test at significant level of $P<0.05$.

Results: The average SBS in the FC group was 10.41±2.17 and the average SBS in the C2 group was 13.28±1.52. There was a statistically significant difference between the SBS of both groups ($p<0.001$).

Conclusion: This study demonstrated that, the use of flowable composite instead of C2 cement is not recommended for cementing e-max ceramics.

Keywords: Ceramics, Lithium Disilicate, Cementation, Composite Resins, Shear Strength

Cite this article: Rouhollahpour E, Rezaei Dastjerdi M, Ahmadnezhad ME, Amirian Chaijan K. Comparison of shear bond strength (SBS) between E-max ceramic and composite resin with two methods of cementation. Caspian J Dent Res 2021; 10:60-4.

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Introduction

High aesthetic properties, strength and tissue compatibility are the main reasons for the popularity of ceramic materials among patients and clinicians. Today, through increasing the strength of ceramics, they can be used in molars even as an alternative to metal crowns. Correct diagnosis and appropriate case selection are critical to the long-term success of dental ceramics. One of the types of ceramics is glass-ceramic restorations with high filler (highly filled glass ceramic restoration). [1] These materials were introduced in 1990 as IPS Empress, reinforced with leucite. Later, a group of lithium disilicate reinforced ceramics (IPS Empress 2 or e-max) was formed. The reported fracture strength of lithium disilicate-reinforced ceramics is approximately 3 times that of leucite-reinforced ceramics. All-ceramic crowns can be cemented with zinc phosphate, glass ionomer, or dual-cure resin cements. Cements based on zinc oxide and eugenol are not recommended for permanent cement. Resin cements have the highest compressive strength and lowest solubility. Recently, to simplify the cementing process, a variety of self-bonding resin cements have been introduced to the market, which has monomers with the ability of etching and bonding to the tooth surface without using a separate adhesive. The use of such materials will make easier the attachment of indirect restorations to the tooth surface, save time and reduce the thickness of the cement layer between the restoration and tooth. The purpose of producing such materials is not only the ease of working with cements such as glass ionomer (no need to prepare the tooth surface), but also its combination with superior mechanical properties, beauty and strength of the bond to the tooth surface in resin cements .[2] Flowable composites which can be used as porcelain cement have some properties[3] including 1. High wetting properties of the tooth surface, leading to the irregularities to be completely filled, 2. Good film thickness 3. High flexibility, reducing the possibility of moving in stressful areas 3. Being radiopaque, and 4. Being available in different colors.[4] Measuring the shear bond strength (SBS) is one of the most common methods to determine the bonding strength of restorative materials to tooth tissue.[5] The aim of this study was to compare the SBS of flowable composite and resin cement (choice2) in e-max ceramic bonding.

Materials & Methods

In this experimental study was approved by the Ethics Committee of Babol University of Medical Sciences (IR.MUBABOL.HRI.REC.1398.096). Based on the information of similar articles, the sample size in each group was 15 cases. Sintered blocks of IPS e-max type were prepared in the laboratory. Next, these blocks were cut into 1 × 8 × 8 pieces by KOOPA universal testing machine (Mecatom Presi t201 France) with saw low-speed diamond 1.

After that, the size of the samples was examined using a digital caliper (Mitutoyo IP67 Resolution: 0.01mm). Samples were sandblasted with Al2O3 particles with a diameter of 52 µm and 3bar pressure at a distance of 12 mm for 12 seconds. Then the samples were placed in an ultrasonic device containing 96% ethanol for two minutes to remove surface contaminants.

A clear plastic tube with an inner diameter of 3 mm and a height of 3 mm, filled with(Filtek Z550, 3M ESPE, St. Paul, MN, USA) resin composite, was cured by 1222 mW / cm2 light curing machine in 2 steps of 40 seconds from both opposite sides, and then the composite cylinder was removed with a blade. The samples were randomly divided into two groups including 1) Using flowable composite as cement (FC group) and 2) Using choice2 cement (C2 group) (light-cured cement).

Group 1: In this group, the FC (Denfil flow), light-cured resin, was used as a cement. Hydrofluoric acid was used for etching on the inner surface of the ceramic for 20 seconds. Next, it was washed and dried. Then, the ceramic primer (Bisco, Chicago, USA) was applied, and the FC is placed on the inner surface of the ceramic. Moreover, the composite blocks were etched with phosphoric acid (condac37-FGM) (37%), washed, dried, used for generation bonding (BISCO) and finally, the FC was placed on the inner surface of the ceramic. The prepared composite cylinder was then placed on the ceramic surface with gentle hand pressure and cured once for 2۰ seconds from the ceramic side as well as once for 40 seconds from the composite side.

Group 2: In this group, C2 cement (BISCO), light-cured cement, was utilized. The inner surface of the ceramic was etched, and after washing, a bonding was applied on it. After curing, the cement was placed on the inner surface of the ceramic. In addition, the prepared composite cylinder was put on it with gentle hand pressure and cured once for 20 seconds from the ceramic side and once for 40 seconds from the composite side. The samples were placed in distilled water at 32 ° C for 24 hours to simulate the oral environment.

The samples were fixed to a KOOPA universal testing machine (Koopa Co. Sari, Iran,) for SBS testing. The device has two jaws at the top and bottom (the upper jaw is movable) (Figure.1). The samples were glued to the rectangular cube mandrels, and the force was applied from the top. The force applied in Newton was recorded on the device monitor, and bond strength was calculated in megapascals (MPa) through the force divided by the cross-section area of the composite cylinder.

$$P = \frac{F}{A} = \frac{1N}{1m^2} = \frac{1Kg}{1m.s^2} = pa$$

P=pressure, F=force, A=area

Finally, the data were analyzed SPSS 20 using T-test at significant level of $P < 0.05$.

Figure1. Sample mounted on the device

Results

In the current study, 30 samples (15 in each group) were selected. The average SBS in the CF group was 10.41±2.17 MPa with a minimum and maximum of 8 and 13.96 MPa, respectively. The average SBS in the C2 group was 13.28±1.52 MPa with a minimum and maximum of 10.6 and 14.90 MPa, respectively.

Based on the comparison of two groups, it was found that there was a statistically significant difference between the SBS of both groups ($p<0.001$). Therefore, the SBS of C2 group was higher than that of FC group (Figure.2).

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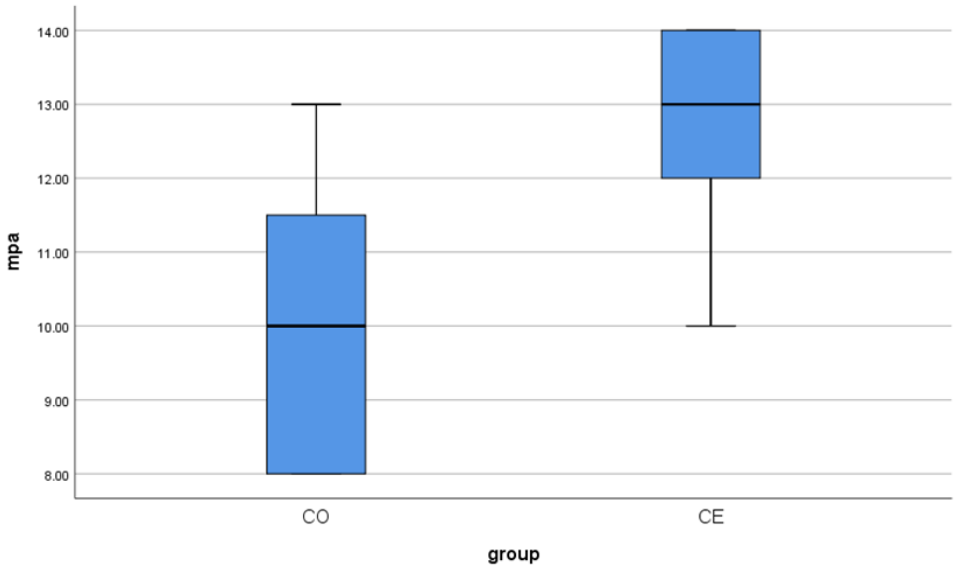

Figure2.Comparison of the shear bond strength between two groups

Discussion

SBS of C2 cement was higher than that of FC for e-max ceramic cementing. Thus, the use of FC instead of C2 cement is not recommended. In evaluating the clinical success of various adhesives, two factors of bond strength and microleakage are very important, so choosing the right cement can be very helpful. It seems that although the fillers of the flowable composite could be an important factor in increasing the bond strength, in the present study, the cement was better than the flowable composite. Chen et al. evaluated the SBS of zirconia to resin as well as the effects of specimen preparation and loading procedure. They concluded that in this procedure, the load flat width, load applied during cementation and various composite resins affected the SBS results.[6] Upadhayaya et al. evaluated the SBS of three various resin cements, self- and total-etch as well as self-adhesive resin cements, utilized to bond the lithium disilicate restorations to human dentin. Their results showed that total-etch resin cements were the best luting agents; therefore, they are highly suggested clinically, making a long-lasting bond between lithium disilicate ceramic and dental substrate.[7] .Romanini-Junior et al. Assessed the effects of the adhesive/silane usage on the bond strength durability to a lithium disilicate ceramic. They have concluded that despite the presence of silane in the composition of single bond universal, the use of silane prior to lithium disilicate cementation is highly recommended.[8]Özdemir et al. evaluated the effects of various surface treatments on bond strength of different resin cements to lithium disilicate glass ceramic in an in vitro study. After the data analysis, they found that self-cure resin cement than dual-cure one had higher bond strength values. Besides, they represented that various surface treatments affected the bonding of different resin cement to IPS e-max Press .[9]Nokar et al. Compared the microSBS of two resin cements to Crecon and Zirkonzahn ceramics. The results have indicated that the type of resin cement has an important effect on their bond strengths to zirconia ceramics.[10]There are different oral forces between the restoration and underlying tooth. In general, bond strength is the maximum force that a material can withstand before it fails. The bond strength test is one of the most popular analyses performed in the evaluation of dental materials. The information obtained from the bond strength test largely depends on the actual test conditions (sample geometry, surface size, composite type, and force input and test temperature). Therefore, it is not surprising that the results obtained from different tests of the above studies are different. Although glass ionomer cements have good properties, they have high fragility, low strength, reduced wear resistance of glass ionomer and inability to completely remove microleakage between the edges of the cavity with restoration, as a result, the use of composite resins in the restoration of posterior teeth is more acceptable. One of the limitations of the present study was the use of teeth instead of composite blocks.

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Conclusion

Based on these limited samples, the SBS of C2 cement was higher than that of FC for e-max ceramic cementing.

Acknowledgments

The authors would like to thank the Dental Materials Research Center and Research Council of Babol University of Medical Sciences.

Funding

This was a part of a thesis and research project (Grant No: 9807525), supported and funded by Babol University of Medical Sciences.

Conflicts of Interest

There is no conflict of interest.

Authors' Contribution

The study was designed by Kamran Amirian Chaijan . The study data were collected by Ehsan Rouhollahpour. Maryam Rezaei Dastjerdi and Mohammad Ebrahim Ahmadnezhad edited and reviewed the article.

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