A comparative study to evaluate the shear bond strength of two commercially available intraoral ceramic repair systems with Ni-Cr base metal alloy- An in vitro study.

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Abstract

Background: Metal ceramics, are normally used materials nowadays in Prosthodontics. These materials are used to fabricate dental prostheses which replace missing or damaged dental structures. This existing research was undertaken to differentiate and appraise the shear bond strength of two commonly obtainable intraoral repair systems for dental ceramics.

Materials and procedures: Overall 52 specimens were incorporated into this research and were split into groups, each group comprising 26 samples.

Group A – Contains Ceramic repair N system (Ivoclar, Vivadent), Group B –Contains Clearfil repair system (Kuraray, Japan). A total of 52 discs were prepared by using base metal alloy i.e. (Ni-Cr). The dimension of each disc is 20 mm in diameter and thickness was 1.5 mm, for evenness of base metal thickness of 1.5 mm and 2mm thickness of the repair system, the wax pattern was concocted. Universal testing machine was incorporated into this research to access the bond (shear) strength of these materials. The data was collected and inspected by using Statistical Package for Social Sciences (SPSS) 21.0 version software application.

Result: Mean value of samples for shear bond strength in group (A) was 14.44 MPa whereas for group (B) was 17.006 MPa. Despite the fact differentiating the value (mean) of shear bond strength between these groups, remarkable results were obtained.

Conclusion: This study concluded that the bond potency of the Clearfil repair system is more than Ceramic repair N system.

Keywords- Bond strength, Ceramic repair systems, Dental materials, Universal testing machine.

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Introduction

The dental product known as ceramics are used to fabricate dental prostheses which are incorporated to put back missing or traumatized dental structures. The materials are part ofsystems created to produce dental prostheses which are used as a substitute for missing or damaged dental structures. Nowadays dental ceramic crowns are more frequently used in dental practice.[1]

Even after the introduction of ceramic (metal-free), porcelain intermingled with metal restoration has been the constant choice of restoration used in regular practice, because of the higher strength, and belongings of the metal, long-lasting with the additional cosmetic presence of porcelain.[2]

Even though metal fused with porcelain crowns is generally accepted and frequently used in general dentistry.[2] However, they often show trauma to brittle ceramic crowns because of many causes like impact pressure of load on occlusion, incompatible coefficient of thermal expansion among the ceramic and metal structures, metal present with low elastic modulus, high sitting load while trial, inadequate pattern, small defects involved in the material, poor coping fabrication, insufficient preparation of supporting tooth, errors in technique, impurities, fracture due to physical trauma, occlusal premature contacts, besides these oral fluids, changes in pH, thermal variations also play a role in adhesive interfaces between ceramic metal bond hence failure in porcelain are general and reported in between the rangeof 2.3 to 8%.[2-5]

Although fracture of the porcelain component fused to metal does not cause the restoration failure, fractured porcelain will affect the esthetic and proper function of the restoration which may lead to a patient going for immediate treatment.[6] There are three common causes to rebuild fractured porcelain: (1) only porcelain breaks with no exposure to the metal, (2). Both porcelain and metal break, leading to exposure of metal, and (3) trauma causes chipping of metal.[7] In that case we have two options; either removal of the prostheses, which will have the chance to fracture the whole restoration, or harmful effecton the supporting tooth or recreating the restoration, and these both techniques are time taking and high-priced, and it is easy to rehabilitate the composite intraorally, mainly in less traumatized cases.[8]

Chairside intraorally porcelain repair system is less time taking, without pain, and highly patient-acceptable procedure without making a new one or dislodging the restoration.[9] Build of a portion of the fractured metal ceramic substrate, purpose to re-create functions and appearance of restoration with the help of various components of intra-oral repair systems. Many repair kits are obtained & every repair kit has its particular guidelines for use as advised instructions given by the manufacturer.

In this study, we have compared and appraised the strength (shear bond) of two commonly accessible repair systems intraorally (the Ivoclar Ceramic N system) and (the Kuraray Clearfil repair system) by using universal testing machine.

Materials and methods:

This research was undertaken to differentiate and evaluate the bond (shear) strength of two economically obtainable ceramic patch-up systems i.e. Ceramic N system (Fig. 1) and Clearfil system (Fig. 2).

Total 56 Ni-Cr (Bellabond, Bego, Germany) base metal alloy metallic discs (Fig. 3) were fabricated with dimensions 1.5 mm thick and 20mm diameter using a metallic die (Fig. 4).

They were split broadly into two categories, with 26 samples in each category-

Group A – Having (Ceramic N system) (Vivadent, Ivoclar). Group B -Having (Clearfil system) (Kuraray, Japan). The study involved the following steps-

Followed by the surface treatment of samples, was done to promote mechanical retention by roughening with a diamond rotary cutting bur. After surface treatment, all samples were categorized into two groups, based on the above-mentioned system.

1. Repaired with intraoral Ceramic repair N system.
2. Repaired with intraoral Clearfil repair system.

After that, repairing of all samples with the respective ceramic systems was carried out according to the given instructions by the manufacturer (Fig. 5). After that, every repaired sample was, placed in water (distilled) for the next 24 hours before thermo-cycling. Thermo-cycling was done at 60° C. After the thermo-cycling procedure, the samples were placed in distilled water for a week. Then testing by universal testing machine was done with 10 KN (Kilo-Newton) load and the values were recorded (Fig. 6).

Results

Data were entered into the excel sheet (Table No.1). Data were analysed using SPSS (Statistical Package for Social Sciences) 21.0 version. Data were analysed for probability distribution using Kolmogorov-smirnov test, p value >.05 indicated that the data were normally distributed. Descriptive statistics was performed. Inter-group comparison of continuous variable was done using Independent ‘t’ test. p value <.05 was considered statistically significant. Values of mean shear bond strength for group (A) was 14.44 MPa and for group (B) 17.00MPa was obtained (Table No. 2 and 3). While differentiating the value (mean) for group B was significantly superior than group A (Table No. 4 and 5) (Fig. 7).

Discussion:

The main aim of fractured metal-ceramic recontour is to stabilize functions and esthetics of restoration with application of various repair materials, intraorally. Prostheses must bear masticatory loads and be appealingly acceptable, so the bond in between the repaired material and other remaining prostheses in general practice must be durable and strong.[10] Due to the scarcity of constituents with a proper or adequate guidelines for reconstruction of metal-ceramic restoration, it was very common practice to work with various combinations of the easily obtainable adhesive substance and composite resin substrate in aggregation with numerous surface modification like air abrasion, diamond bur roughening, and etching.[11,12,13] In current times, with the arrival of newly developed intraoral repair things, there is a prerequisite for an optimum bond strength value and a properly standardized performance.

The purpose of current work was to compare and assess the bond strength (shear) of two commonly available intraoral repair compounds with a Ni-Cr base metal alloy.[14.15] In this study, fifty two Ni-Cr base metal alloy discs were fabricated, then further split into two groups, group (A)and group(B), after surface roughening with diamond bur. Which includes 26 specimens in each group. Group A was rebuilt with the ceramic repair N system, Group B was rebuilt with Clearfil repair system. Group B has a higher mean value (17.0062 MPa) than Group A (14.44 MPa).

The study revealed that the Clearfil system achieved remarkable shear bond strengths to metal substrates.

In a previous study, Tulunoglu et al., Santos et al.,[3] Jain Sidharth et al.[10] found that the shear bond strength of the Clearfil repair component (18.40 MPa) to metal was outstanding compared to the porcelain repair component (16.26 MPa). According to Jain Sidharth et al.,because of the existence of an alloy primer having MDP (10-methacryloxydecyl dihydrogen phosphate substrate), the ceramic system showed a greater shear bond value to metal. [10]

MDP is composed of an ester phosphate, which helps form a highly strong bond with the surface layer of oxide on the upper surface of the alloy for maximum bonding of the resin tothe alloy. But when surface roughening was done with a diamond bur, the Clearfil repair substrate showed more bond (shear) strength than the ceramic repair system.

In another previous study, which was done by Yadav et al. evaluated that the bond strength values of Clearfil repair system were meaningly greater than the other repair system for cohesive fracture.[2]

Another previous study conducted by Chung and Hawang et al. concluded that the Clearfil repair system with metal alloy showed maximum bond power compared to other repair systems. They did surface treatment by sand blasting. [7]

According to previous studies, the bond strength (shear) of composite to porcelain repair systems has been recognized in the range of 6.0 MPa – 29.7 MPa. Facts reported in the works has shown the power (strength) of the bond between metal and ceramic substrate in an average of 43–72 MPa, an optimum bond for metal to ceramic has been acknowledged when the fracture stress is superior than 25 MPa. As per other authors, bond strength values of more than 10 MPa are clinically acceptable and show healthier bond, which is important to make the clinical flow evenly in between metal and ceramic. First step of testing any subject or material to find the belongings and potential of the material is, in vitro assessment. The current study only investigates shear bond asset of porcelain repair substance to metal substrate; it is recommended that extra bond findings, such as the effect of diverse mechanical test designs, cause of damage, and cause microleakage, be investigated for a morewide-ranging and correct evaluation of repairing things. The data was gained from the current work are within the ideal range of data gained in the previous work. But again, more in vitro research subjecting samples to cyclical loading and storage in water over a long period shouldbe explored for oral fluids and to gain more information about the durability of the repairing material will be done.

Conclusion

Under the given scenario of this study, both intraoral repair systems were examined and showed reasonable bond strength to metal substrates.

The shear bond strengths of the Clearfil system (17.0062 MPa) and the ceramic N system(14.44 MPa).

The study concluded that the Clearfil repair system achieved optimal bond strength to a metalsubstrate.

For the metal surface of fractured metal ceramic restoration, the Clearfil repair (system) hassuperior strength (shear bond).

It is suggested that additional clinical researches with larger sample sizes are vital to appraise the shear bond strength of several repair materials with different surface treatments for evaluate the outcomes and cross-check the materials to determine which offers the finest properties.

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TABLES

Specimen number	GROUP A	GROUP B
1	14.36	16.35
2	13.58	15.32
3	13.42	15.39
4	15.38	20.48
5	16.53	16.32
6	12.63	17.52
7	17.45	19.85
8	16.36	14.73
9	13.45	15.39
10	12.56	16.21
11	14.83	19.11
12	13.12	15.25
13	17.62	15.47
14	12.42	14.69
15	14.35	20.86
16	13.26	19.38
17	16.52	17.58
18	16.87	19.67
19	13.15	15.38
20	12.64	17.45
21	14.73	19.32
22	16.82	20.37
23	11.32	15.38
24	12.68	14.57
25	15.37	14.35
26	14.26	15.85

Table 1. The following results were obtained for the shear bond strength (MPa).

Shear bond strength (MPa)	
Mean	14.4492
Standard deviation	1.78521
Minimum	11.32
Maximum	17.62

Table 2. Description of shear bond strength of group A samples.

Shear bond strength (MPa)	
Mean	17.0062
Standard deviation	2.14448
Minimum	14.35
Maximum	20.86

Table 3. Description of shear bond strength of group B samples.

	Mean	Standard deviation	T value	P value[a]
Group A	14.4492	1.78521	-4.673	.001*
Group B	17.0062	2.14448		

Independent test ‘t’. < .05 *p value was considered as statistically significant.

Table 4. Inter-group comparison of shear bond strength of group A and group B samples.

Group	Mean	Standard deviation
A	14.4492	1.78521
B	17.0062	2.14448

Independent test ‘t’. < .05 *p value was considered as statistically significant.

Table 5- shear bond strength (mean)

FIGURES

Fig 1.

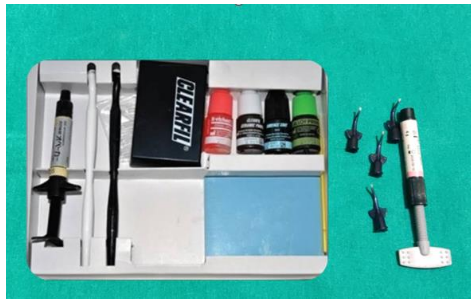

Fig 2.

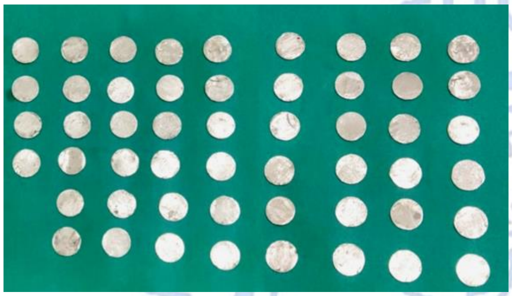

Fig 3.

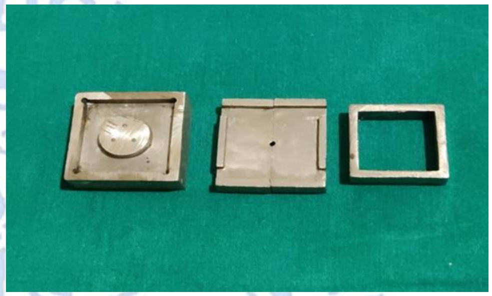

Fig 4.

Fig 5.

Fig 6.

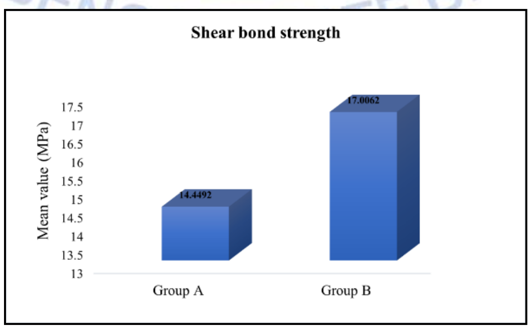

Figure 7. Shear bond strength of group A and group B samples.