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COMPARISON OF SHEAR BOND STRENGTH OF TWO COMMERCIALLY AVAILABLE VENEERING CERAMICS TO ZIRCONIA CORE BY LAYERING TECHNIQUE-'AN IN VITRO STUDY'.

Dental Science

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ABSTRACT

AIM: The aim of the study was to compare the shear bond strength of two commercially available veneering ceramics to zirconia core using layering technique. **MATERIALS AND METHODS:** The study was done on 24 milled specimens of zirconia blocks (Sagemax), of which 12 specimens(Group-A) were veneered with ceramic(Noritake)on to zirconia core by layering and the remaining 12 specimens (Group B)were veneered with ceramic(E-Max)on to Zirconia core by layering.The shear bond strength was tested using universal loading machine(Lloyd).Kolmogorov-smirnov and shaprio-wilk tests were used for Data analysis. Parametric student's t test was done to compare mean values of the two materials. **RESULTS:** The comparison of the shear bond strength of Noritake and E-max veneering ceramics did not show significant difference in shear bond strength(P=0.347). **CONCLUSIONS:** Even though,they did not show much difference,Noritake veneering ceramic samples showed little higher bond strength as compared with E-max veneering ceramic samples.

KEYWORDS

Zirconia Blocks(Sagemax),Veneering Ceramics(Noritake And E-Max), Shear Bond Test.

INTRODUCTION

The metal ceramic restoration has been known as a reliable choice of treatment for fixed partial dentures for more than four decades.[1] The advantages of metal ceramic restoration are include the fracture resistance of the metal substructure with the esthetic property of the porcelain. High noble alloys are relatively expensive, and the alternatives may have disadvantages, such as risk of metal allergy, bond failure, or porcelain discoloration, noble metal content alone is not indicative of clinical performance.[2]The increased demands for improved esthetics have prompted dentists to evaluate various new materials and procedures.[3] The dental profession seeks an ideal all ceramic restoration with excellent physical properties, strength, marginal fit and esthetics necessary for anterior as well as posterior restorations.The introduction of zirconia ceramics to dentistry has initiated far-reaching discussion on the design and application limitations of ceramic restorations. Zirconia is used as a framework structure for ceramic restorations and fixed partial dentures.[4] Clinical failure of all-ceramic restorations is a very complex process involving patients variables, dynamic loads, restoration geometry, material properties, fatigue phenomenon, and multiple failure modes.[5] Many variables may affect the zirconia core-veneer bond strength, which can affect the retention of the veneering ceramics to the core.[6] So the purpose of the study is to evaluate the shear bond strength of two commercially available veneering ceramics to zirconia core.

MATERIALS AND METHODS

FABRICATION OF ZIRCONIA BLOCK :

A total of 24 milled sandblasted specimens of zirconia specimens(Sagemax . USA) to the dimensions of 10mm length x 10mm breadth x 2mm thickness is prepared by using a standard procedure of CAD-CAM milling.To prepare the specimens the unmilled zirconia block is placed in CAD-CAM machine (imes- i core) which consists of a rigid cast iron construction housing a fully - integrated 5-axis automation system built to hold up to 8 material blanks or "pucks" frequently used by dental labs. This integrated 8- piece handling system loads and unloads blanks for un- attended operation. The specimens are then subjected to 50µm alumina particle sandblasting at a temperature of about 1800^0 C and later kept overnight.

VENEERING THE CERAMICS ON ZIRCONIA BLOCKS BY LAYERING TECHNIQUE :

Of the total 24 milled specimens of zirconia, 12 specimens were divided as Group A and remaining 12 specimens were divided as Group B. In this, Group A Zirconia specimens were veneered using with the Layering technique using Noritake ceramic material which comprises of shade base firing, layering build up firing (Enamel) and glaze firing [FIGURE 1]. Group B Zirconia specimens were also veneered with layering technique with E max ceramic [FIGURE 2].

Fig.1.zirconia specimen after glazing(noritake)

fig 2. zirconia specimen after glazing (E-Max)

TESTING THE SAMPLES FOR SHEAR BOND STRENGTH :

Veneered zirconia ceramic specimens were inserted into the recess of the metal die.The metal die is then placed into the platform of the universal testing machine[Lloyd Instruments LR 50 K] with the help of the flat base provided.

The samples of both the groups were subjected to the shear bond strength test and the results obtained at debonding were analyzed and compared.

RESULTS

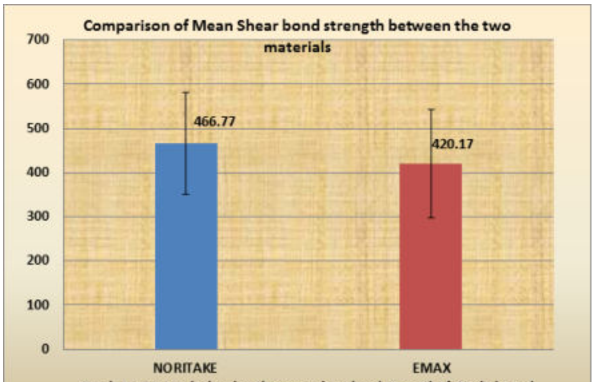
The individual results were averaged (mean ± standard deviation) for continuous data and, number and percentage for dichotomous data are presented in the Graph 1 & 2. The normality assumption was tested using Shapiro Wilks test. If data met the assumption of normality then parametric test was used to compare between the means otherwise nonparametric test was used.

Table 1 : Table showing the results of the Normality tests

Tests of Normality							
	Material	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Shearbond strength	NORITAKE	0.143	12	0.200	0.938	12	0.478
	EMAX	0.177	12	0.200	0.944	12	0.554

Table 2 : Table showing the results of student's t test for the comparison of shear bond strength of Noritake ceramic and E-Max ceramic

	N	Mean	Std. Deviation	Minimum	Maximum	t value	P value
NORITAKE	12	466.77	115.374	303.5	655.9	0.924	0.347
EMAX	12	420.17	122.027	222.7	611.6		



Graph 1 : Bar graph showing the mean shear bond strength of Noritake and E-Max veneering ceramic to the zirconia core

The data collected were checked for the assumption of Normality (Table 1).

Since data had met the assumption of normality, parametric student's t test was done to compare mean values of the two materials (NORITAKE and E-MAX)

The shear bond strength of Noritake ceramic and E-Max ceramic was compared using the parametric student's t test(Table 2). It was found that both the materials mentioned above are not statistically significant with a 'p' value of 0.347 which is greater than 0.05 (Graph 1).

DISCUSSION

Despite the increased effort to prevent dental decay, there is still a need for prosthetic reconstruction.[18] Dental ceramics have become increasingly popular because of their bio compatibility and superior esthetic qualities. During the past 40 years the porcelain fused to metal technique has proven to be a reliable treatment option for fixed partial dentures and therefore still represents the gold standard.[24]In recent years, patient demand has stimulated efforts to improve the appearance of dental restorations, particularly crowns and fixed partial dentures. The metal ceramic technique has been successfully applied but has limitations in that, the colour of the cast metal substructure must be masked with opaque porcelain and sufficient bulk of body and incisal porcelain applied to mimic natural tooth substance. Aesthetic problems arise if adequate tooth reduction is not obtained, particularly as this layered system is very different from the morphological characteristics of dentin and enamel. Esthetic restorative treatment in dentistry has made dental ceramics an often used alternative for both anterior and posterior restoration. The dental profession seeks an ideal all ceramic restoration with excellent physical properties, strength, marginal fit, and esthetics necessary for anterior, as well as posterior restorations.[2] In early 1990s, yttrium oxide partially stabilized tetragonal zirconia polycrystal was introduced to dentistry as a core material for all ceramic restorations has been made available through the CAD/CAM technique. Y-TZP has proved to be superior in mechanical properties compared with other all ceramic systems due to transformation toughening mechanism.[1]The introduction of zirconium di oxide (zirconia) ceramics to dentistry has initiated far reaching discussions on the design and application limitations of ceramic restoration. Zirconia is used as a framework structure for ceramic restoration and fixed partial dentures, which are further layered with veneering porcelains to optimize the esthetic outcome.[4]Numerous clinical studies have evaluated zirconia ceramic restorations. High stability of zirconia framework has been reported the success rate of zirconia frameworks exceeded 97.8% over a 5 year period.[4] There have been no fractures of the zirconia framework reported to date.[1] However delamination or minor chip off fracture of veneering porcelain has been described as the most frequent reason for the failure of zirconia FPDs. The incidence of veneer fractures in zirconia FPDs was significantly higher compared with those in metal ceramic FPDs. Therefore, the bond between core and veneer or the veneer material itself is one of the weakness in layered zirconia based restorations and plays a crucial role in their long term success. Chip off fracture rates of 15% after 24 months, 25% after 31 months 15.2% after 60 months and 8% and 13% after 36-38 months, were observed respectively. The cause of fracture of veneering ceramic on zirconia all ceramic cores was reported to be multifactorial in clinical application. The present study is carried out to analyse and compare the shear bond strength of two different commercial ceramic bonded on the highly popular zirconia core using a layering technique.The present study evaluated the effect of different ceramic bonding system on a zirconia surface with a minimal surface mechanical treatment, i.e , surface roughness with a sandblasting procedure using 50μm Al_2O_3 particles. This procedure was done to analyze possible mechanical interactions between zirconia and ceramic.

In this study, the SBS test method was selected because of its simplicity, such as ease of specimen preparation, simple test protocol and the ability to rank different products according to bond strength values. In metal ceramic systems, excessive stresses arising from coefficient of thermal expansion mismatch may be compensated to some extent by plastic or elastic deformation of the metallic framework. However, unlike metals, the zirconia framework has a higher rigidity and this feature cause more destructive stresses to be formed in the veneer layer of zirconia based restortions. After analysing the results and their various criteria, it was found that shear bond strength between the zirconia core and layering ceramic, was found higher in Noritake compared to E-max. However, there are other limitations also to this In-vitro study. The oral cavity presents a different testing environment. For example, the presence of saliva, temperature changes, and pH level in oral cavity may considerably affect bond strengths of zirconia to veneering ceramic. In addition, In-vitro information cannot be used as a direct, straightforward prediction for the clinical situation. Therefore, further In-vitro studies are required to elaborate upon the interfacial bond strength between zirconia and veneering ceramic material.

CONCLUSIONS

Within the limitations of this In-vitro study, Noritake veneering ceramic samples showed little higher shear bond strength as compared with E-Max veneering ceramic samples. Therefore Noritake veneering ceramics adheres better to the zirconia core than E-Max.

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