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Comparative Evaluation Of Flexural Strength Of Bis-Acryl Composite Resin And Fiber Reinforced Heat Cure And Self Cure PMMA Resin Used In Provisional Restoration : An In-Vitro Study.

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Abstract

INTRODUCTION- Provisional restoration is an important clinical procedure in achieving succesful fixed prosthodontic treatment .PMMA resin is generally used satisfactory for short term provisionalization but exposure to saliva and other fluids results in progressive color changes , wear and loss of surface finish. Provisional restoration for long span bridges and full mouth rehabilitation treatment requires mechanical properties such that it should be strong, retentive, repair work should be possible and dimensionally stable. Bis-acryl composite resin is newer material introduced which have improved flexural strength in comparison to PMMA.

AIM.. of this study is to evaluate and compare flexural strength of un-reinforced Bis- acryl composite resin with fiber reinforced self cure and heat cure PMMA resin.

MATERIALS AND METHODS-

Total 30 samples were prepared for evaluation of flexural strength. 6 samples were of unreinforced bis-acryl composite resin. 12 samples were of self cure and heat cure PMMA resin. Each subdivided into two groups each of 6 samples reinforced with glass fibers and polyethylene fibers.

TESTING OF SAMPLES- Samples were tested using universal testing machine. (UTM, INSTRON)

RESULTS- Bis- acryl composite resin samples possessed greater flexural strength than the fiber reinforced group.Glass fiber reinforced samples had the highest flexural strength than polyethylene fiber reinforced samples.

CONCLUSION- Flexural strength is best for Bis acryl composite resin , flexural strength of PMMA resin can be increased by incorporating glass fibers.

Keywords: Bis-acryl composite resin, self cure and heat cure acrylic resin, silanized glass fibers and polyethele fibers, provisional restoration

Introduction

Fixed prosthodontics is the art and science of resotoring damaged teeth with all metal, metal ceramic, or all ceramic restorations, and of replacing missing teeth with fixed prosthesis. Provisional restoration is an important clinical procedure in achieving a successful fixed prosthetic treatment[1,2] The basic requirement of an interim restoration are essentially the same for definitive restoration, with the exception of longevity and possibly the sophistication of color of the interim restorations. Flexural strength and marginal integrity are an important mechanical property particularly, when patient use provisional restoration for an extended period of time such as for long span bridges and when patient exhibits para-functional habits. [3,4,5]. In addition fluid absorption by the over a period of

time decreases strength and stability. Heat processed acrylic resin as compared to auto polymerizing resin is inherently stronger, of greater stability, more resistant to polymer breakdown. This study was done to compare flexural strength of different un-reinforced and fiber reinforced provisional restorative materials..

Materials and methodology

Bis acryl composite resin (luxa temp) and heat cure and self cure PMMMA resin (Dpi) , undirection silanized glass fibers and polyethylene fibers were used.(Figure 1,2,3,4,5,6)

Mandibular 2nd premolar and 2 nd molar with missing pontic space of 1st molar is selcted . tooth preparation was done with 1mm shoulder finish line, 1.5 mm of axial reduction, 2mm of occlusal reduction (Figure 7,8) Indexing notches of 5mm depth was created on each end of model for proper orientation of silicone index. Impression was made and cast was poured (Figure 9)

Two silicone indexes were prepared one for primary resin coping for thickness of 1mm by preparing wax pattern of 1mm thickness and other for final resin coping of 2mm thickness. (figure 10,11)

Preparation of un- reinforced composite resin samples for control group

Final silicone index is used for making final resin coping .It is kept for polymerization for 4 minutes then it is removed and excess material is trimmed off.(Figure 12)

Preparation of fiber reinforced self cure resin samples

First initial coping is prepared using primary silicone index then Undirectional s- glass fibers of 20mm length was adapted over the occlusal surface. Then final resin coping was prepared over it using final silicone index.

Similarly polyethylene fibers reinforced samples were prepared

Preparation of fiber reinforced heat cure resin samples

Flasking was done by attaching final silicone index with die stone model. Flask was opened and Primary resin coping was prepared with primary silicone index . fiber was attached over the occlusal surface and final silicone index was filled with heat cure resin and flask was closed, bench pressing done followed by bench curing and kept for acrylisation for 1hr.(Figure 13,14)

Grouping of samples

Total samples- 30 Control group- 6 samples of bis-acryl composite resin

Test group- 12 samples each of self cure and heat cure resin further subdivided into 6 samples each with reinforcement of glass fibers and polyethylene fibers.

Testing of samples

After sample preparation they were stored in distilled water for one day and then subjected to 3 point bend test using universal testing machine. (Figure 16)Samples were placed horizontally and supported on jig with a span of 28 mm between them..(Figure 11) Linear contact was obtained between the samples and both supporting and loading levers and load was applied perpendicular to the samples at their center. (Figure 17)They were subjected to loading until fracture (Figure18,19)occurred and maximum flexural load during fracture was recorded as fracture in Newtons using formula . The flexural strength (MPa) was calculated from the fracture load using formula

FS= 3WL/ 2 bd2 FS= flexural strength (MPa or MN/m2, W= Maximum load before fracture(N), L= Distance between the supports (mm), b= Width of the samples (mm). d= Thickness of the samples(mm).

RESULTS

Bis-acryl composite resin had the greatest flexural strength as compared to reinforced PMMA resin samples.

Heat cure PMMA resin had better flexural strength than self cure PMMA resin and slightly less than un-reinforced Bis acryl composite resin.

Glass fiber reinforcement had better strength than polyethylene fiber.

Heat cure resin reinforced with glass fibers had comparable strength to bis acryl composite resin.

STATISTICAL ANALYSIS

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The mean value and Standard deviations of the flexural strength (MPa) of the 5 groups and marginal integrity (mm) of the 3 groups are given in table 1 and 2 . The data was subjected to 62

1. One way ANOVA analysis.

2. Tukey multiple comparison tests.

DISCUSSION Provisional restoration in an important phase in fixed prosthodontic therapy. [6]It should provide both pulpal and periodontal protection, have good marginal integrity and esthetics , have sufficient durability to withstand the forces of mastication (37, 38, 52) by providing a matrix for surrounding gingival tissue. Bis –acryl composite resin is material of choice but it is relatively expensive than commercially available PMMA .

In cases such as, patients with bruxism, patient whose treatment requires long- term use of provisional restorations, provisional restorations with improved mechanical properties are required.

In this study we had taken Bis- acryl composite resin as a standard material because its mechanical properties are already proved best material..Bis-acryl composite resin the most popular shows low exotherm during setting delivered through a syringe; can be smoothed and polished can be characterized by modifying color minimal shrinkage allows The silanized glass fibers [3] and braided polyethylene fibers[7] were incorporated in the tooth colored self cure and heat cure acrylic resin and the fibers are placed perpendicular to the long axis of tooth in the provisional restoration samples. Maximum forces in oral cavity are in occlusal direction , so these fibers are placed perpendicular to these forces so that these fibers will absorb the load and provide longevity to the restoration . The catastrophic failures occurred on the un-reinforced samples of composite resin. In the unreinforced samples, cracks initiated by excessive load application are able to propagate, unhindered, through the cross section of the restoration and thus cause a complete fracture of the material.

The mode of failure of fiber reinforced resin samples show a **—partial** fracture pattern, where the joints remained intact and a small portion of the pontics was separated as a result of cohesive failure of resin material. In fact, crack would occur on the tension side but would not propagate through to the compression point. The embeded fiber could not be stretched enough for the crack in the resin to continue.the fiber appear to hold the two pieces together. Because a fracture failure is usually related to the initiation of a crack and its subsequent propogation until displacement, a complete failure with the embedded fiber may not occur . Comparing flexural strength Bis -acryl composite resin has a maximum flexural strength.than fiber reinforced heat cure followed by fiber reinforced self cure PMMA.

CONCLUSION

Fiber reinforcement can remarkably improve flexural strength of PMMA resin and it is close to Bis- acryl composite resin.It can be sued for long span bridges and for full mouth rehabilitation

.Bis- acryl composite resin samples possessed greater flexural strength than the fiber reinforced group . Glass fiber reinforced samples had the highest flexural strength than polyethylene fiber reinforced samples

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TABLE 1.1. Flexural Strength in MEGAPASCALS (MPa)

	Control Group 1	Group IIA	Group IIB	Group IIIA	Group IIIB
1	334.00	278.320	130.680	267.870	212.660
2	308.700	251.076	156.430	261.366	316.932
3	307.450	235.670	154.350	246.540	202.360
4	309.000	267.540	188.160	277.450	205.800
5	321.450	200.900	234.612	265.670	216.090
6	327.560	242.844	167.580	268.230	267.540

Table 1.2: Mean flexural strength of control group and fiber reinforced group.

Groups	Samples	Mean	Std. Deviation
Control	6	318.02667	11.296764
Group IIA	6	246.05833	27.147665
Group IIB	6	171.96867	35.950601
Group IIIA	6	264.52100	10.263743
Group IIIB	6	236.89700	45.879812

Table 1.3 : Flexural strength mean values , S.D and results of One –way ANOVA and Tukey HSD of control group 1 and test group 2.

S. No.	Groups	Mean	S.Ds	P value
1.	1	318.02	11.29	.022*
S 2.	2	209.01	49.18	

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Table 1.4 : Flexural strength mean values , S.Ds and results of one- way ANOVA and Tukey HSD of group 2 and 3 test groups.

Serial No.	Groups	Mean	S. Ds	P value
1.	2	209.01	49.18	.601
2.	3	250.70	34.82	

Table 1.5 : Flexural strength mean values, S.Ds and results of one- way ANOVA and Tukey HSD of group 1 and 3 test groups.

Serial No.	Groups	Mean	S.Ds	P value
1.	1	318.02	11.29	.117
2.	3	250.70	34.82	

Table 1.6 : Flexural strength mean values, S.Ds. and results of one- way ANOVA and Tukey HSD of subgroups 2A, 2B, 3A, 3B

S No.	Sub groups	Mean	S. Ds	P value
1.	2 A	246.05	11.20	.002**
2.	2B	171.96	35.05	.000**
3.	3A	264.52	10.26	.032*
4.	3B	236.89	45.87	.001**

Table 1.7 : Flexural strength mean values , S.Ds. and results of one- way ANOVA and Tukey HSD of subgroups 2B and 3B.

S No.	Subgroups	Mean	S Ds	P value
1.	2B	171.96	35.95	0 .007**
2.	3B	236.89	45.87	

Table 1.8 : Flexural strength mean values, S.Ds. and results of one- way ANOVA and Tukey HSD of subgroups 2A and 2B.

GROUP 2A= glass fiber reinforced self cure resin, GROUP 2B= polyethylene fiber reinforced heat cure resin.

Serial no.	Subgroups	Mean	S Ds	P value
1.	2A	246.05833	27.147665	.002**
2.	2B	171.96867	35.950601	

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Materials and Methodology

PROVISIONAL MATERIALS AND FIBERS

SAMPLE FABRICATION

TESTING OF SAMPLES

UTM

FRACTURED SAMPLE

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