ORIGINAL RESEARCH PAPER
Volume-9 | Issue-2 | February-2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE EVALUATION OF BOND STRENGTH OF TWO DIFFERENT REPAIR RESIN MATERIALS: AN- IN VITRO STUDY

Prosthodontics

Dr. Ulfat Majeed* Post graduate student Department of Prosthodontics and Crown & Bridge Kothiwal Dental College and research Centre.*Corresponding Author

Dr. Ravi Madan Professor Department of Prosthodontics and Crown & Bridge Kothiwal Dental College and research Centre.

Dr. Swatantra Agarwal Professor and Head, Department of Prosthodontics and Crown & Bridge Kothiwal Dental College and research Centre.

Dr. Sujata Pandey Senior Lecturer Department of Prosthodontics and Crown & Bridge Kothiwal Dental College and research Centre.

ABSTRACT

Statement of problem: There is still dilemma regarding the choice of material for fracture repair and the strength associated with it. **Purpose:** Therefore the study aims to compare the transverse strength of self cure and visible light cure resin as repair material before and after surface treatment. **Material and method:** 60 heat cure resin samples of dimension 65 x 10 x 2.5 mm were cut into 2 equal parts with 45 degree bevel and placed in mould with 3 mm gap in middle for adhering with repair material after surface treatment following which they were tested for transverse strength. **RESULT:** The best bond strength was obtained with self cure resin after surface treatment. **CONCLUSION:** Repair with self cure resin exhibited higher transverse strength than light cure resin especially after surface treatment.

KEYWORDS

Dental prosthesis repair, isopropanol, ethyl acetate, VLC resin

INTRODUCTION:

Polymeric denture base materials are widely used in dentistry ever since it was introduced in 1937. Despite improvement in the properties of materials, denture fracture is still considered to be one of the most common problem encountered by the patient and prosthodontists.[1-2] Denture fracture occurs twice in midline of maxillary complete denture than in mandibular prosthesis. So making a new denture may be impractical as it requires proper scheduling as well as financial planning. Therefore, denture repair seems to be an alternative choice.3 The repair of fractured prosthesis can be accomplished using heat polymerized, auto polymerized light polymerized and microwave polymerized acrylic resins Although use of conventional and microwave polymerized materials demonstrate superior strength, but these materials require significant amount of working time and tends to warp the denture. [3-4] Autopolymerising acrylic denture base resin and visible light cure denture base resin have certain advantages in common i,e convenient to use, fast polymerization, no warpage but due to some biocompatible issues of autopolymerising acrylic resin like residual monomer leeching, irritation to tissues its use is debatable.5 Accordingly the present study has been designed to evaluate the efficacy of visible light cure denture base resin as a replacement of cold cure. The null hypothesis of the present study is that there is no effect of surface treatment and repair material on the bond strength of repair.

MATERIALS AND METHODS

For fabrication of samples of desired shape and size a rectangular shaped prefabricated glass die with dimension of 65 x 10 x 2.5 mm was used whose dimension is in accordance with ADA specification no. 12. Polyvinyl siloxane putty consistency was used to form the mould. Then modelling wax (DPI) was poured into the mould and the wax patterns of desired dimension were made. (Fig.1)

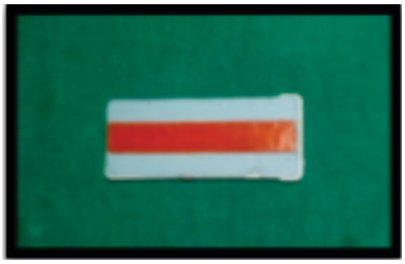

Fig 1: Wax pattern fabrication

The wax patterns were invested in type III gypsum product using hanau flask. Upon completion of setting, the wax was removed by immersing the flask in boiling water for 10 minutes. The softened wax was carefully removed from the surface of the mould by boiling water until all residues of wax were removed and mould left clean. The next step that was done was application of appropriate separating medium onto the walls of mould cavity. After the application of separating medium, polymer and monomer were mixed in the ratio of 3:1 by volume which is an acceptable polymer to monomer ratio and packed. The flasks were kept for bench curing for 30 minutes and then transferred to water bath for curing at 74° C for 2 hrs and then increasing the temperature to 100° C for 1 hour. The acrylized samples were retrieved, finished and polished.(Fig. 2)

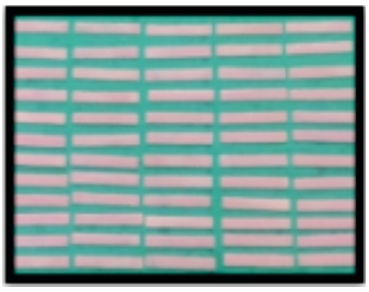

Fig 2: Acrylised samples

Each finished intact specimen was divided into two equal parts, i.e. 31mm each with a bevel of 45 degree and placed in the putty mould of dimension 65 x 10 x 2.5 mm with gap of 3 mm in middle of mould for adhering with the repair material.(Fig.3 & 4) Each fractured sample was surface treated according to their respective groups i.e. Group A (Repaired with autopolymerising resin only), Group B (Repaired with visible light cure followed by application of bonding agent only), Group C (Conditioning with isopropanol for 5 seconds followed by repair with cold cure), Group D (Conditioning with isopropanol for 5 seconds followed by application of bonding agent and repair with VLC), Group E (Conditioning with ethylacetate for 120 seconds followed by repair with cold cure) and Group F (Conditioning with ethylacetate for 120 seconds followed by application of bonding agent and repair with VLC). After repair with autopolymerising resin the samples were kept in the pressure pot under pressure of two bars at 37° for 15 min and samples repaired with visible light cure denture base resin were placed in light curing unit for 10 minutes.

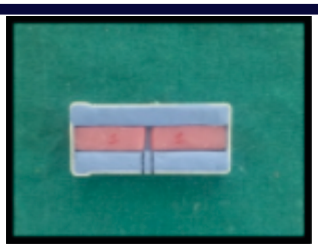

Fig 3: A gap of 3mm was created in middle for repair material.

Fig 4: Samples after repair

TESTING OF SAMPLES

Before testing, the specimens were stored in water at room temperature for 1 day. Repaired samples were tested for transverse strength by three point bending test on Instron universal testing machine.(Fig. 5) The loading jig consisted of two parallel blocks set 20 mm apart. A load was applied centrally to the specimens by a plunger with a blunt spearhead equivalent to a 3 mm diameter rod. Each specimen was fractured at the crosshead speed of 5 mm/min. The transverse strength values of each specimen were calculated with the following formula:

S =3WL/2bd2,
Where S is the flexural strength in (megapascals), W is the fracture load (in newtons), L is the distance between the supports (20 mm), b is the specimen width (10 mm), and d is the specimen thickness (2.5 mm).

Fig 5: Transverse strength testing on UTM

Results: The recorded data was compiled. Analysis of variance (ANOVA) was employed for inter group analysis of data and for multiple comparisons, Bonferroni test was applied. The mean transverse strength values and SDs of the groups are presented in Table 1and 2. The ANOVA in Table 3 shows the differences among the groups.

The results of the present study rejected the null hypothesis that there is no effect of surface treatment and repair material on the bond strength of repair.

Significant differences between control and experimental groups was found ($p<0.05$). In control groups, repair with autopolymerising resin showed higher transverse bond strength (121.1± 17.14 Mpa) when compared with visible light cure denture base resin which showed (49.1±4.78Mpa) respectively. The results also showed that heat polymerized resin have higher transverse strength after surface treatment and its highest with ethyl acetate treatment in both repaired groups.

Table 1: Descriptive statistics of transverse strength among various groups

	N	Mean	SD	95% Confidence Interval for Mean		Min	Max
				Lower Bound	Upper Bound		
Group A	10	121.1	17.14	108.88	133.40	83.56	143.32
Group B	10	49.1	4.78	45.66	52.49	40.89	55.82
Group C	10	129.4	3.55	126.84	131.91	123.12	134.06
Group D	10	67.1	3.25	64.74	69.39	62.54	71.76
Group E	10	141.4	1.32	140.49	142.38	139.20	143.18
Group F	10	85.9	1.93	84.49	87.25	83.18	89.18

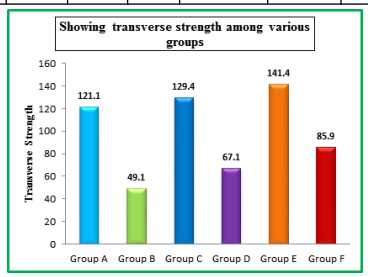

Fig. 6: Mean transverse strength among various groups

Table 2: Analysis of variance (ANOVA) for comparing mean transverse strength among the groups

	Sum of Squares	df	Mean Square	F-value	P-value
Between Groups	68984.6	5	13796.9	239.752	<0.001*
Within Groups	3107.5	54	57.5		
Total	72092.2	59			

Table 3: Bonferroni Post Hoc test for Intergroup comparison based on transverse strength among various groups

Group Comparison	Mean Difference	P-value	95% Confidence Interval	
			Lower Bound	Upper Bound
A vs B	72.1	<0.001*	61.65	82.49
A vs C	-8.2	0.279	-18.65	2.19
A vs D	54.1	<0.001*	43.65	64.49
A vs E	-20.3	<0.001*	-30.71	-9.87
A vs F	35.3	<0.001*	24.85	45.69
B vs C	-80.3	<0.001*	-90.72	-69.89
B vs D	-18.0	<0.001*	-28.42	-7.58
B vs E	-92.4	<0.001*	-102.78	-81.94
B vs F	-36.8	<0.001*	-47.22	-26.38
C vs D	62.3	<0.001*	51.89	72.73
C vs E	-12.1	0.012*	-22.48	-1.64
C vs F	43.5	<0.001*	33.08	53.92
D vs E	-74.4	<0.001*	-84.79	-63.95
D vs F	-18.8	<0.001*	-29.23	-8.39
E vs F	55.6	<0.001*	45.14	65.98

DISCUSSION

The present study evaluated the effect of repair resin type and surface treatment on heat polymerized denture base resin. Significant difference between control and experimental groups was found ($P<0.05$).The control groups showed significantly lower strength than the experimental groups. In control groups, repair with autopolymerising denture base material showed a higher (121.1±17.14 MPa) and with visible light cure denture base material showed a lower (49.1±4.78 MPa) transverse bond strength value.

In the present study transverse bond strength of visible light cure denture base resin to heat polymerized acrylic resin was significantly lower than autopolymerising acrylic resin to heat polymerized acrylic resin this might be because of high viscosity and poor adhesion of visible light cure resin as repair material. This finding was supported by Andreopoulos et al.[2] and Dixon et al.[6] However, surface treatment led to stronger repairs. This is in consistent with the studies done by Lewinstein et al.[7] ,Vallitu et al.[8] , and Nakash et al.[9]

In the present study, 45° bevel was considered as Ward et al.10 and

Harrison et al. 11concluded that the strength of repairs made with round and 45° bevel joint contour were similar and significantly greater than those with a butt joint design.[4]

Repair surface treatment agents used in this study were ethyl acetate and isopropanol. Ethyl acetate is an organic and non-polymerisable solvent with the potential to swell the surface and permit the diffusion of the polymerisable material. Its ability to increase the transverse bond strength can be attributed to enhanced adhesion and infiltration of monomer into pits and cracks.[9,12]

Isopropanol dissolves a wide range of non-polar compounds. It was preferred because it evaporates quickly and is relatively non-toxic, compared to alternative solvents.[9]

The results showed that heat polymerized resin has the highest repair strength after surface treatment and its highest with ethylacetate pre treatment in both repaired groups with autopolymersing resin as well as visible light cure resin.

CONCLUSION

Within the limitations of the study following conclusions can be drawn :

The specimens repaired with VLC resin showed significantly lower transverse bond strength than specimens repaired with autopolymerizing acrylic resin.

The transverse bond strength of repair material to denture base resin increased significantly with chemical treatments.

CLINICAL IMPLICATION

Based on the results of this study, autopolymersing acrylic resin and visible light cure resin both can be used to repair acrylic resin denture base but autopolymersing acrylic resin provide stronger repair than visible light cure acrylic resin.

This study also suggests that to increase the strength of repair chemical surface treatment with either isopropanol or ethyl acetate of the acrylic resin denture base enhances the repair.

REFERENCES

1. Dar-Odeh NS, Harrison A, Abu-Hammad O. An evaluation of self –cured and visible light-cured denture base materials when used as a denture base repair material. J Oral Rehabil 1997;24:755-60.
2. Andreopoulos AG, Polyzois GL, Demetriou PP. Repairs with visible light curing denture base materials. Quintessence Int 1991;22:703-6.
3. Alkurt et al. Effect of repair resin type and surface treatment on the repair strength of heat-polymerized denture base resin. J Prosthet Dent 2014;111:71-78.
4. Vojdani M, Rezaei S, Zareeian L. Effect of chemical surface treatments and repair material on transverse strength of repaired acrylic denture resin. Indian J Dent Res 2008;19:2-5.
5. Faot F, da Silva WJ, da Rosa RS, Del Bel Cury AA, Garcia RC. Strength of denture base resins repaired with auto- and visible light polymerized materials. J Prosthodont 2009;18:496-502.
6. Dixon DL, Eksrand KG, Breeding LC. The transverse strengths of three denture base resins. J Prosthet Dent 1991;66:510-3.
7. Lewinstein et al. Transverse bond strength of repaired acrylic resin strips and temperature rise of dentures relined with VLC reline resin. J Prosthet Dent 1995;74:392-9.
8. Vallittu PK, Lassila VP, Lappalainen R. Wetting the repair surface with methyl methacrylate affects the transverse strength of repaired heat-polymerized resin. J Prosthet Dent 1994;72(6):639-43.
9. Nakash et al. The Influence of Different Chemical Surface Treatment on Transverse Strength of Repaired Heat Cure Acrylic Resins. J of Al Rafidain University College 2013.
10. Ward JE, Moon PC, Levine RA, Behrendt CL. Effect of repair surface design, repair material, and processing method on the transverse strength of repaired acrylic denture resin. J Prosthet Dent 1992;67(6):815-20.
11. Harrison WM, Stansbury BE. The effect of joint surface contours on the transverse strength of repaired acrylicresin. J Prosthet Dent 1970;23(4):464-72.
12. Siddesh CS, Aras MA. In vitro evaluation of transverse strength of repaired heat cured denture base resins with or without surface treatment. J Indian Prosthodont. Soc. 2008;8(2):87-93.