Comparison of transverse strength of repaired visible light-polymerized resin to pressured auto polymerizing and conventional heat-polymerized acrylic resin.

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ABSTRACT

Background: The flexural strength of a material is the load at which the material fractures under bending load. The aim of this study was to evaluate the effect of using different repair methods (light cure, short cycle, Ivomate) on transverse strength of acrylic resin denture base.

Materials and methods: Thirty specimens were prepared and were divided into three groups, ten (heat cure) specimens repaired with heat cure acrylic and ten (heat cure) specimens repaired with heat pressure steam cold cure acrylic, other ten (light cure) specimens repaired with light cure acrylic resin. The measurement of transverse strength of the specimens under three –point loading using Instron- Testing machine was made.

Results: The higher values of transverse strength were recorded in specimens repaired with cold cure acrylic using Ivomate curing method. The light cure repair acrylic was significantly inferior than other groups there was a non significant difference between heats cure (short cycle) and cold cure (Ivomate) repaired acrylic resin.

Conclusion: The curing method has a considerable influence on transverse strength of repaired acrylic resin. The pressured cold cure acrylic repairs are the best material in comparison with heat cure and light cure acrylic repairs.

Keywords: Acrylic resin, Instron machine, light curing, Ivomate curing. (J Bagh Coll Dentistry 2009; 21(4): 30-32).

INTRODUCTION

The transverse strength measurements were used to a greater extent than either tensile or compressive strength, because this test more closely represents the type of loading applied to a denture in the mouth. [1] Acrylic resin denture bases are susceptible to fracture after periods of clinical use.[2] The repair of the fractured prostheses can be accomplished using acrylic resin that are light polymerized.[3], auto polymerized[4], heat –polymerized.[5] Over the years, curing procedures have been modified to improve the physical and mechanical properties of resin materials.[6] The repair material of choice depends on the following factors: Length of time required for making the repair, transverse strength obtained with the repair material, and degree to which dimensional accuracy is maintained during the repair.[7]The highest transverse strength for repaired dentures is about 80% of the original strength when heat cured resin is used. [8] The superior strength, ease of fabrication, and ease of manipulation of traid visible light – polymerized (VLP) resin, coupled with its short polymerized process that is free of monomer, has led to several useful applications.[9] Andreopoulos and Polyzois Compared the repair strength of visible light cure denture resin with self-cure resin, they found that(VLC)denture resin exhibited a lower repair strength (22%- 58%) and toughness (9 % - 33%) than those of cold cured resin[10].

Dar- Odeh etal.[11] evaluated the suitability of visible light cure as a repair material for heat activated acrylic resin specimens. They found that transverse strength of chemically activated acrylic resin was significantly higher than the light cure repair. Grayower and Goultsching. Found that the application of pressure during curing might improve the contact between heat-cured resin and repair resin, when the viscosity of the latter was high. They also concluded that the sample repaired under pressure had greater strength than those repaired without pressure. [12] Processing the repair in a hydro flask produced transverse strength greater than allowing the material to process on the bench top. [13]

MATERIALS AND METHODS:

Three types of acrylic resin material were used in this study: "unifast LC" Light cured acrylic resin (GC dental industrial, Japan), as in figure (1) "Pyrax" heat cure acrylic resin and repair cold cure acrylic resin (ISO 9001:2000 certified company, India,) .Thirty specimens were prepared in rectangular blocks by investing a wax plate of (65× 10×2.5mm) in dimensions according to ADA specification No.12 [14] For both water bath and light cured acrylic resin in a stone moulds (Elite model thixotropic, Zhermach- Italy) using the conventional dental flasking technique. After setting of stone, wax elimination was done, and then the surface of the mould treated with a separating medium (cold mould seal), Kemdent-UK.Standard proportion in mixing polymer / monomer ratio 3:1 by volume for heat cure acrylic

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resin and 2.5:1 by volume for cold cure acrylic resin and 1g/ 0.5ml for light cure acrylic resin.

Processing Methods:-

1- Conventional curing methods: - using thermostatically controlled water bath with short curing cycle of 74◦C for 1.5 hour followed by 30 minutes at 100 ◦C.

2- Light curing methods: - Powder and liquid mixed till reach dough stage then adapted using finger pressure, light cure unit were used (Yeti dental Produkle / Germany) the curing cycle chosen was
(470nm wave length) for 10 minutes.Then finishing and polishing with acrylic and stone burs followed by 120 grain size sand paper, with continuous water cooling.

Fracture of specimens were made with cutting burs to 45-degree bevel is equal to the thickness of the sample which is 2.5mm. All repaired surfaces were wetted with methyl- methacrylath monomer for 60 second before addition of repair material.

Repair Technique:-

1- Light curing technique was done by adding a new material and allowed to cure by the same light cure processing method.

2- Heat curing technique was done by adding a heat cure acrylic resin and allowed to cure by short curing cycle (1.5hour at 74◦C and 30 minutes at 100◦C)

3- Ivomate curing technique was done by adding a cold cure acrylic resin and allowed to cure at 40 ◦C for 15 minutes at 2 bar pressure. Then finishing and polishing and conditioning of repaired specimens were stored in distilled water at (37◦C) for 48 hours before testing. The measurement of transverse strength of specimens under three- point loading was made using instorn- testing machine (model 1190, high way combe Bucks,UK), the device supplied with a loading roller and repair of supporting rollers of 3.2 mm diameter place in a distance of 50mm.The values of transverse strength were computed by the following equation: **3PI**

$$S = \frac{3PI}{2bd^2}$$

S= Transverse strength.
P= Peak load exerted on specimens (N).
I= Distance between supporting rollers (mm).
b= Width of specimens (mm).
d= depth of specimen (mm).

Figure 1:: Light cure acrylic resin.

RESULTS

The results of the 3-point bending test shows that the highest values of transverses strength were recorded in heat cure specimens repaired with cold cure acrylic using Ivomat curing method. While the lowest values were obtained in light cure specimens repaired with light cure method, as in table 1.

Table 2 the (LSD) multiple comparison test between three tested groups were showed the light cure repaired acrylic was highly significant difference ($P < 0.01$) than heat cure (short cycle) and cold cure (Ivomate) repaired specimens. While there is anon significant difference ($P > 0.05$) between heat cure (short cycle) and cold cure (Ivomate) repaired acrylic resin.

Table 1: Mean distribution of transverses strength of three groups

Studied Groups	No.	Mean N/ mm^2	SD.	SE.	Mini	Maxi
Light cure repair	10	36.60	8.87	3.62	27.60	49.20
Heat cure repair	10	61.80	13.59	5.54	50.40	80.40
Cold cure Ivomat repair	10	66.71	8.90	3.63	54.00	78.00
Total	30	55.03	16.88	3.97	27.60	80.40

Table 2: Multiple comparisons (LSD) between three groups.

Studied Groups		P- Value	Sig.
Light Cure	**Heat cure**	**0.001**	**V.H.S.**
	Cold Ivomate	**0.000**	**V.H.S.**
Heat cure (short cycle)	**Light cure**	**0.001**	**V.H.S.**
	Cold Ivomate	**0.438**	**N.S.**
Cold cure Ivomate)(	**Light cure**	**0.000**	**V.H.S.**
	Heat cure	**0.438**	**N.S.**

The Fracture Site

In light cure and heat cure (short cycle) repaired acrylic resins the fracture site occurred at the bonding region (between the original and

repaired materials).While in cold cure (Ivomate) repaired acrylic the fracture site occurred with in repaired region.

DISCUSSION

The transverse strength of specimens repaired with light curing method were significantly inferior than that of specimens repaired by the conventional water bath and Ivomate curing method, this result is due to higher viscosity exhibited by light cure acrylic which makes the diffusion of the repair material to the original material less than that shown by other groups (poor adhesion). In addition to the fact that the natural and composition of the light cure acrylic which consists of in organic fillers with less homogeneity, thus giving brittle nature, this render the material to have a structure similar to that of a composite material. As suggested by [11, 17, 18, 19]. Also the light cure resin can not be kept under pressure during polymerization process, common defect and internal voids often result. [20] The results of this study showed that when the acrylic resin material was subjected to heat and pressure polymerization significantly superior to the specimens repaired with light cure acrylic and non significantly to the specimens repaired with short curing cycle. This improvement in transverse strength as result of heat and pressure treatment could be attributed to increase cross linking. [21-22] Also the use of pressure and low heat has been reported to reduce the porosity of chemically accelerated acrylic resin thus increasing the repaired strength. [7] In cold cure repaired specimens the fracture site at the center of auto polymerized acrylic resin due to the application of pressure during curing might improve the contact between heat cure resin and repaired resin when the viscosity of the repaired material was high. This agreed with. [12,23]

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