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AN INVESTIGATION IN TO THE TRANSVERSE STRENGTH OF LIGHT CURE DENTURE BASE MATERIAL REINFORCED WITH GLASS FIBER

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ABSTRACT

Background: Visible light cured acrylic resin denture materials are one of the developed polymeric acrylic denture base and are manufactured in the form of sheets and rapes, and also in powder and liquid system, they can be adapted for various dental uses and provides rapid service at low cost. This study aimed to compare the transverse strength of heat cured acrylic resin and visible light cured acrylic resin. **Materials and Methods:** Forty samples of acrylic denture base materials were prepared, ten samples of heat cured acrylic denture base materials, ten samples test group with additional glass-fiber, ten samples of visible light cured acrylic resin denture materials and ten test group with additional glass-fiber. After curing of both groups, the materials were subjected to transverse strength test with the use of flexural strengths testing machine. **Results:** The results of the present study showed a high significant difference comparing between the two groups; heat cured acrylic denture base material showed a high significant transverse strength than the visible light cured acrylic denture base material. **Conclusion:** Heat cured acrylic denture base resin showed superiority in the tensile strength values than the visible light cured acrylic denture base material.

KEYWORDS: Heat cures acrylic, visible light cure acrylic, glass-fiber, transverse strength.

INTRODUCTION

The most widely used materials in dentistry due to its aesthetics, ease in production, processability and better mechanical properties is Polymethylmethacrylate (PMMA). It has been used as the only material since 1930's to produce denture base acrylic resin.[1] Fracture may occur because of insufficient transverse, impact, flexural, and fatigue strengths. Recent advancements in the field of Dental Materials and the development of newer and more novel forms of denture base materials have enabled acrylic denture base resins to overcome some of these drawbacks. For example, polycarbonate and nylon based materials have been developed to overcome the mucosal irritation and polymerization shrinkage that is associated with the conventional Polymethyl methacrylate (PMMA) resins.[2,3] Strengthening the acrylic resin prosthesis can be approached by modifying or reinforcing the resin. One method is to incorporate a rubber phase in the bead polymer which produces high impact resin but unfortunately the high cost of these materials restricts their use.[4,5] One of the most common reinforcing technique is the use of metal wires embedded in prosthesis[6,7] however, the primary problem of this technique is poor adhesion between resin and wires. Another approach is the reinforcement of acrylic resin dentures with fibers. Various types of fibers including carbon, Kevlar, glass, polyethylene have been tested Glass fibers are the most common form of all used fibers; they improve mechanical properties of denture base polymers, have easy manipulation, and they are esthetic.[8,9] Reinforcement with fibers enhances the mechanical characteristics of denture bases, such as the transverse strength, ultimate tensile strength and impact strength.[10,11]

MATERIAL AND METHODES

A total of 40 specimens were prepared according to ISO 1567 standard with 2 different resins light cured acrylic denture base resin (Palatray, RXL, Germany) and heat cured acrylic denture base resin (Vertex Netherland) and divided into (20 specimens for each group : heat cured, and light cured acrylic resin dimensions were 65 length*10 width*3 thickness mm.

A 3-point bending test device (MTS Mini-bionics, model 858,MTS corporation MN, USA) was used to determine the flexural strengths a The device consisted of a loading wedge and a pair of adjustable supporting wedges placed 50 mm apart. The specimens were centered on the supporting wedge and the loading wedge was set to travel at a crosshead speed of 5 mm/min Specimens were loaded until fracture occurred. Transverse strengths were calculated using the following equation;

S=3PI/2BD2

Where S= transverse strength (N/mm2)

P= load at fracture (N)

I= distance between the supporting wedges (mm)

B= width of the specimen (mm)

D= thickness of the specimen (mm)

RESULT

The descriptive and inferential statistical analysis used, Transverse strength values, standard deviation, standard error minimum and maximum values of all groups are presented in table (1) were the highest mean transverse strength values belong to the heat cure acrylic resin with glass fiber addition and the lowest mean transvers strength values belong to the light cure acrylic resin. Comparison between all groups show high significant differences between all tested group except the last one which the comparison between the mean differences of group 3and group 4 representing the light cure acrylic resin without reinforcement and with reinforcement respectively shown in table(2)

Table (1): The mean and standard deviation of transverse strength of all groups.

	heat cure acrylic resins		Light cure acrylic resins	
	control	test group with glass fiber	control	test group with glass fiber
Mean	290.5	392.3	207.2	240.1
SD	52.36888389	37.36025815	24.9968887	7.309810759
SE	16.6779885	11.89817138	7.960792578	2.32796521
Min	212	337	160	230
Max	364	435	227	252

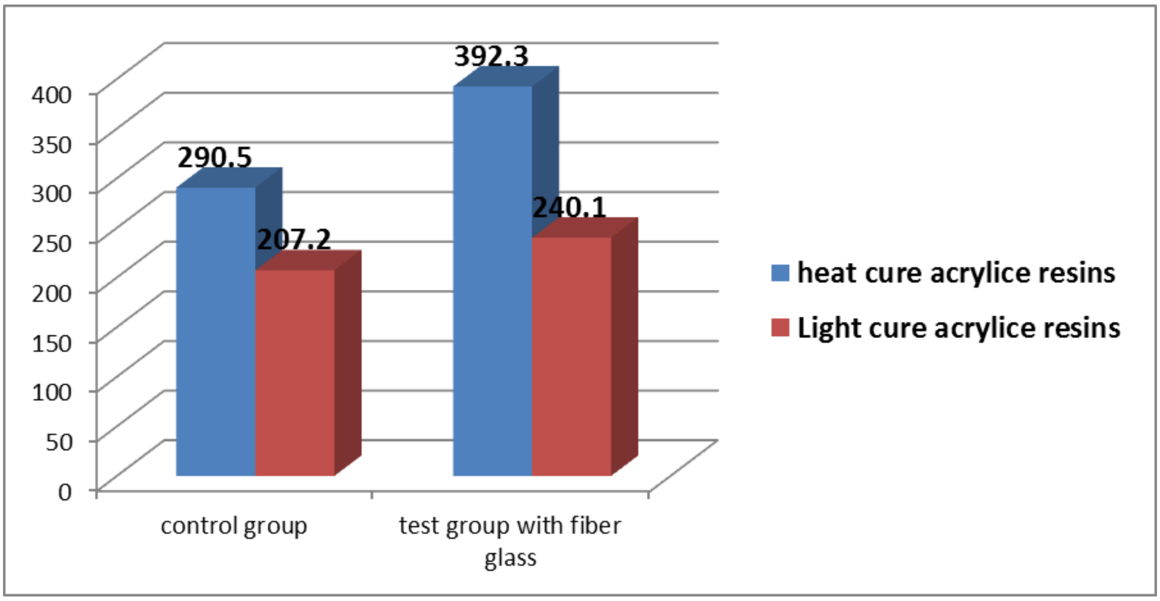

Figure 1: Bar chart show the mean of transvers strength of groups.

Table (2): LSD between groups.

	Mean difference	p	Sig
1&2	-101.8	P<0.01	HS
1&3	83.3	P<0.01	HS
1&4	50.4	0.003	HS
2&3	185.1	P<0.01	HS
2&4	152.2	P<0.01	HS
3&4	-32.9	0.041	s

**P<0.01 highly Significant*

***P>0.01 significant*

ANOVA test revealed high significant result since P<0.01

Table (3)

ANOVA	
F-test	54.224
p	P<0.01
Sig	HS

DISCUSSION

There is an ongoing effort to improve the properties of denture base materials the ultimate goal has been to develop a more biocompatible denture base with better mechanical properties and simpler processing techniques that require shorter time for fabrication.[12] The incorporation of fibers as impact modifiers into the denture base acrylic resin appears to be a good approach to produce stronger and more fracture resistant materials.[13,14] It has been studied that the transverse strength of PMMA can be slightly increased by addition of metal strengtheners but they have poor aesthetics. Since the discovery of Carbon Nanotubes (CNTs) by Iijima in 1991 they have been used frequently in experimental studies by incorporation in PMMA to increase their mechanical properties.[15]

In order to compare the performance of different denture resins, various mechanical tests can be performed. The transverse strength test, one of the mechanical strength tests, is especially useful in comparing denture base materials in which a stress of this type is applied to the denture during mastication.[16] The transverse (flexural) strength is a combination of compressive, tensile and shear strengths, all of which directly reflect the stiffness and resistance of a material to fracture.[17,18]

The present in vitro investigation was designed to compare the transverse strength of two denture base resins (heat cure) conventional resin and visible light cure before and after reinforcement with fiber glass.

Visible light cured resin showed the lowest mean transverse strength value even after adding the glass fiber (240.1MPa) compare to conventional acrylic resin (392.3 MPa) this may attributed to that glass fiber affect the surface of the light cure acrylic and likely act as impurities reducing the bonding between particles However, a previous study, carried out in 1987 Khan Z[19], reported that visible light-cured (VLC) denture base material exhibited superior transverse strength properties since the mean (125.23±14.71 MPa) compared to conventional acrylic resins mean (97.67±8.83 MPa) even without adding glass fiber This finding was not in agreement with the present study, The findings of the present study were consistent with those of two other studies, one of which was performed in 2007 by Machado et.al and Al Mulla in 1988.[20,21] The reason for the lower transverse strength values of visible light-cured resin compared with the conventional acrylic resin might be due to the presence of the large number porosities in this material.[22] It was concluded that these materials could not be kept under pressure during the polymerization process; common defects and internal voids often result.[22] It has been proposed that internal porosities concentrated stresses in the matrix and contributed to the formation of microcracks under loading. It should also be noted that, consistent with manufacturer's recommendations, the urethane methacrylate material was polymerized on one side only. Because the material was not packed and flasked under pressure, it was difficult to attain consistently dense specimens. Increased degree of conversion may serve to increase the bulk flexural and fatigue strength of light-cured resin.[23]

CONCLUSION

This investigation evaluated the transverse strength of two different denture resin materials, Within the limitations of this study, the following conclusions were drawn: the conventional (heat cure) acrylic resin showed the highest mean transverse strength value, whereas visible light-cured acrylic resin showed the lowest.

There was highly statistically significant difference among them (<P0.01) There was statistically significant difference between the mean transverse strength values of visible light-cured resin before and after adding of glass fiber (P>0.01).

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