

ASSESSMENT OF TRANSVERS STRENGTH OF REPAIRED HEAT AND COLD –CURED ACRYLIC RESIN REINFORCED BY 0.7mm STAINLESS STEEL WIRE (A Comparative study)

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Abstract.

The frequent problems that occur with denture bases is fracture ,that caused by such factors as poor fitting of the denture base, poorly balanced occlusion and other problems after years of used.

(30) specimens of acrylic resin were prepared and divided into (3) groups according to curing treatment and types of acrylic resin denture base as follow :. (10) specimens made from heat cured acrylic without metal wire as a control group, (10) specimens made from cold-cured acrylic resin without metal wire, and (10) specimens made from cold – cured acrylic resin with metal wire.

The results showed that, the transverse strength of cold- cured acrylic resin specimens with metal wire were statistically significant different when compared with the two other specimens of heat cure acrylic resin [control group] without metal wire and cold-cure acrylic resin without metal wire

الخلاصة

أن أغلب المشاكل التي تحدث في قاعده الطقم هو الكسر الذي تسببه عوامل عدة مثل ضعف في تثبيت الطقم كذلك ضعف في الأطباق واسباب أخرى ناتجة عن استعمال الطقم لعدة سنوات .
صنعت (٣٠) عينه من مادة الأكريليك الراتنجي وقسمت حسب طريقه المعالجه ونوع الأكريليك المستعمل الى ثلاث مجاميع وكالاتي: (١٠) عينات من الأكريليك الحار وبدون اضافة السلك المعدني , (١٠) عينات من الأكريليك البارد بدون اضافة السلك المعدني و (١٠) عينات من الأكريليك البارد بأضافة السلك المعدني .
أظهرت النتائج عند قياس مقاومه المستعرضة لمادة الراتنج الأكريلكي (الحار والبارد) وجد أنه عند اضافة السلك المعدني للراتنج الأكريلي (البارد) أعطى اعلى نسبة أحصائية مقارنة بالمجاميع الأخرى.

Introduction

Acrylic resin is an indispensable material in removable prosthodontics. Although it is widely used as a denture base material, acrylic resin exhibits certain poor mechanical properties where fractures may occur both outside and inside the mouth.

One of the frequent problem that occur with denture bases is fracture, which is caused by such many factors as poor fitting of the denture base, poorly balanced occlusion and other problem after years of use , regardless of the reason for fracture or the method of repair the ultimate or the method of restore the fracture¹.

Different materials have been used to repair fractured acrylic dentures, including auto polymerized acrylic resin^{2,3,4} ,and heat –polymerization acrylic resin^{5,6,7,8}

However ,the reason for such unfavorable phenomenon is the insufficient transverse strength in auto polymerizing acrylic resin which is lower than that of heat polymerizing acrylic resin. Therefore the various methods for enhancing the strength of the repaired part have been reported by reinforcement the broken acrylic denture base by a mesh of metal.

The present study was carried out to evaluate the different in transverse strength of acrylic mold made from different acrylic resin material (hot and cold) and different curing methods (auto and heat) with or without clasp wire after their repair.

Materials and methods

Metal pattern

Stainless steel plate with dimensions of (65 x 10 x 2.5 ± 0.03) mm length, width and depth respectively were constructed for transverse strength analysis to save time and effort.⁹

Mould preparation

The metal pattern was included in metal flask, the lower half of each flask was completely filled with type III dentals stone (Elite model, Italy) whose surface was flattened with 320 and 400 Mm silicon carbide paper discs

(Germany) after the setting reaction. The patterns were positioned on the stone surface; additional dental stone filled the upper half of flask which was opened after complete setting under compression (0.5 tan), and the metal mold remover, inspecting the cavities for integrity. The mold was washed with water and neutral detergent, and coated with separating medium.

Pink heat and cold cured acrylic resin (Triplex hot Ivoclar vivadent , Liechtenstein) were used to fabricate the samples in this study, following the manufacturers' instructions of powder\ liquid ratio by volume, as followed :-Heat – cured acrylic were mixed (3:1), while the cold –cured acrylic was (2.5:1) by volume, and then left to reach the dough phase at room temperature (approximately 23 °C). After filling the mold with the dough, the flasks were fitted and pressed to gather in a hydraulic bench press for (5) min. before polymerization process.

Curing was carried out by placing the clamped flask in a water bath and processed by heating at 74 °C for about (1.30) hr, the temperature was than increased to 100 °C for (30) min.¹⁰, and then the flask was allowed to cool slowly at room temperature for (30) min. followed by complete cooling of the flask with tap water for (15) min. before deflasking. While in case of cold cure acrylic resin, flasks containing the acrylic resin dough were left in a bench press for (2hrs) at 23 °C± 5 °C¹¹. The acrylic patterns were then removed from the mold. (as shown in figure (1)



Figure (1): acrylic sample

All the samples were hand finishing using progressively finer grades of the silicone carbide paper (Grandees 120 to 500) with continues water cooling unless otherwise stated; all the measurements were done using the starlet micrometer vernier. Polishing was accomplished by using the rag wheel and dental pumice by a dental lathe.

Prepare the specimens for repair

Cut the acrylic specimens in middle (center of the specimens) by hard metal disk bur and repaired them in a procedure similar to that repaired base plate of complete and partial denture base.

The periphery surface in both sides of the fracture surface were reduced and after that made a (T) shape scratches on both parts by metal wire gauge 0. 7mm. And then put the wire clasp that we made it between the two fracture pieces of acrylic in their position in the flask mold to maintain its

dimension correctly and put the (w) shaped wire just above the scratches between the two broken pieces.

Painted the halves of the flask by separating medium and mixed enough amount of heat cure acrylic resin like when do it before and when the acrylic reach the dough stage. Wet the fracture area with a monomer and put acrylic resin above the (W) shaped wire clasp on the fracture area. Close the half on the lower half and put them under compress and transfer to its clamp. Make curing to them as in the first stage and then open the flask. Checked the two pieces become joint together and appear like one piece.

* The same procedure in cold cured acrylic resin denture base. The wire becomes embedded inside the acrylic specimens. Finishing and polishing them so they become ready to test the transverse strength to these specimens.

A master acrylic plates measuring (65 x 10 x 2.5 ± 0.03) mm from each material were prepared⁹.

In order to avoid excessive temperature rise which may result in specimens distortion, large amount of water was used in this polishing operation, the specimens were then polished with silicon carbide grit papers starting with the grade 120 and ending with grade 500.

Transverse strength test (equipment and procedure)

An instron testing machine was used to measure the transverse strength of samples in air by three points bending (Figure 2). The device was supplied with a central leading plunger and two supports with polished cylindrical surface, (3.2 mm) and least (10.5 mm) long and perpendicular to the centers of the support was in the range of 50 mm ± 0.1 mm, and the loading plunger was midway between the supports within 0.1 mm. the tests were carried out a constant cross head speed of (5 mm/min), and the load was measured by a compression load cell of maximum capacity of (5kN).

The test samples were held at each end of the two supports, and the loading plunger was midway between the supports. All samples were tested after immersed for (2) days in distilled water.

The samples were deflected until fracture occurred. The transverse was calculated using the following equation¹.

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

S= Transverse strength (N/mm²)

P= Maximum force exerted on sample (N)

I= Distance between the supports (mm)

b= Width of sample (mm)

d= Depth of a sample (mm) .



Figure (2): Instron testing machine

Statistical analysis

Transverse strength data were analyzed by analysis of variance (ANOVA) and less significant deference (LSD).

Tests were performed at a confidence level of 95% ¹².

Results

The values of transverse strength varied according to adding of metal wire. The highest mean transverse strength values was obtained in cold- cure acrylic resin denture base with metal wire(80.89), while the lowerest mean transverse strength values was obtained in cold-cure acrylic resin denture base without metal wire(69).fig(3) .

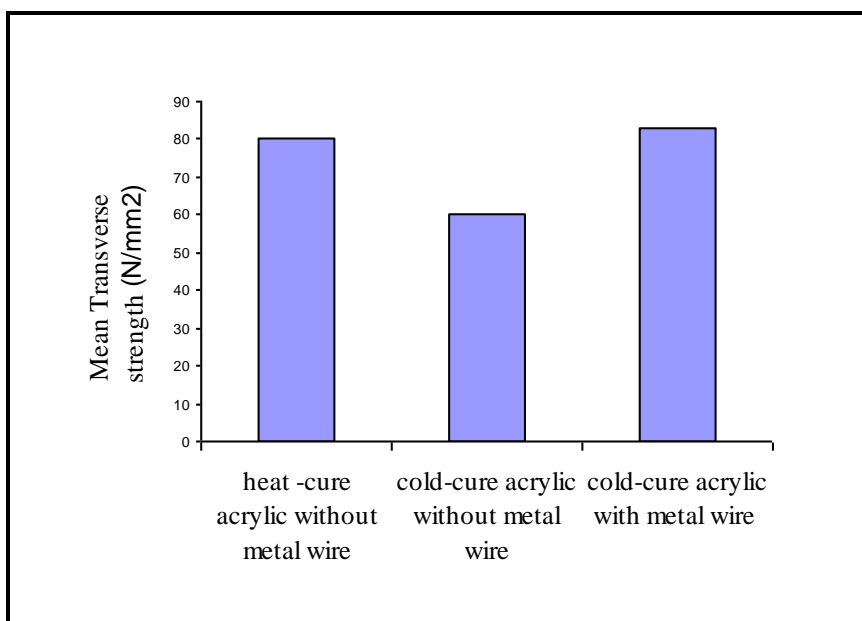


Figure (3); Bar chart show mean values for transverse strength (N\mm²) of heat and cold –cured acrylic resin denture base as influenced by metal wire.

Table (1), ANOVA analysis showed that there was a significant difference at (P<0.05) between specimens made from heat-cured acrylic resin without metal wire and cold –cured acrylic resin without metal wire, cold-cured acrylic resin with metal wire and cold –cured acrylic without metal wire.

There were no – significant difference between heat-cured acrylic without metal wire and cold –cured acrylic resin with metal wire.

Table (1) : (ANOVA) least significant difference for transverse strength of heat and cold –cured acrylic resin denture base repair as influenced by metal wire.

ANOVA=S

Tested Cure acrylic groups		LSD test
cold –cured acryl without metal wire	Heat cured acrylic Without metal wire(control group)	S
	cold-cured acrylic with metal wire	N.S
cold –cured acrylic with metal wire	Cold –cured acrylic without metal wire	S

* P<0.05=S=Significant, P>0.05=N.S=Non significant.

Discussion

The result of the present study showed that the transverse strength reveled significant difference among the tested materials and showed that the specimens of cold-cured acrylic resin with metal wire has higher mean value of transverse strength than specimens of heat-cured acrylic resin and cold-cured acrylic resin without metal wire. This may be due to adding of metal wire give support to acrylic materials and give higher tendency and ability with stand the higher strength. Similar results are observed by polyzois et al.,⁶.

Also Al-Mudarris¹³ concluded the measured of transverse strength of repaired acrylic resin joint reinforced with wire or glass fiber.

Conclusion

From the result obtained ,the added of clasp wire to the specimens give support to the acrylic material for this reson ,the transverse strength of cold –cured resin specimen with metal wire has higher strength than specimens of heat –cured acrylic resin and cold-cured acrylic resin without metal wire. This due to action of metal wire to give resistance to pressure directs force.

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