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The effect of using Detery Isolate as a separating medium on the transverse strength of cold–cure acrylic resin under different curing pressure

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Abstract

Objectives : The present investigation was undertaken to determine the effect of using Detery Isolate (homemade cold mold seal) as a separating medium on the transverse strength of cold – cure acrylic resin material under different curing pressure.

Methodology : One hundred identical cold–cure acrylic resin specimen were made and grouped according to curing process, type of separating medium and the amount of pressure applied during processing (30psi, 50psi, 70psi and 90psi).

Results: The differences in curing process and pressure applied had considerably different effect on the transverse strength of cold-cure acrylic resin. And there was a significant improvement in transverse strength at high pressure (70psi and 90psi). While there was no significant differences between Detery Isolate and cold mold seal separating media among the tested group.

Conclusion: The result suggested that the transverse strength of cold-cure acrylic resin improved by polymerization type and pressure applied and there is no side effect of using Detery Isolate as a separating medium on the transverse strength of cold cure acrylic resin.

الخلاصة

الأهداف : أجريت الدراسة الحالية لتحديد أثر استخدام مادة الديتري ايزوليت (مادة صوديوم ختم القالب مصنعة محليا") كمادة عازله على القوة المستعرضة لمادة الراتنج الاكريلي البارد باستخدام ضغوط مختلفة إثناء البلمرة . أخذت مائة عينة متماثلة من عينات الراتنج الاكريلي البارد, تم تجميعها وفقاً لمواد وأساليب عملية المعالجة ونوع المادة العازلة وكميات الضغط المختلفة أثناء العملية (30 باسكال/انج^2 و 50 باسكال/انج^2 و 70 باسكال/انج^2 و90 باسكال/انج^2).

النتائج: استخدام عمليات مختلفة للمعالجة والضغط كان لها تأثير ملحوظ على القوة المستعرضة لمادة الراتنج الاكريلي البارد. وكان هناك تحسن كبير في القوة المستعرضة تحت الضغط العالي (70 باسكال/انج^2 و90 باسكال/انج^2) . في حين لم يكن هناك فروق ذات دلالة إحصائية بين الديتري ايزولينت وصوديوم ختم القالب خلال المجاميع التي تم اختبارها.

الاستنتاج: أظهرت النتائج أن القوة المستعرضة لمادة الراتنج الاكريلي البارد تتحسن بالبلمرة تحت درجات ضغط عالية بالإضافة إلى أنه لا يوجد أي آثار جانبية لاستخدام الديتري ايزولينت كمادة عازلة على القوة المستعرضة للراتنج الأكريلي البارد.

Introduction

Poly-methyl-methacrylate (PMMA) commonly known as acrylic resin is the most popular dental material used in the construction of contemporary removable prostheses. Since its invention in 1936, nearly all conventional removable partial and complete dentures are made in this material[1-3]. Despite the wide use of acrylic resin in removable denture work over a period of 76 years, the search for the understanding and improvement of its behavior continues[3].

The strength properties of the self – cured acrylic resin are less than that of the heat cured type due to lower degree of polymerization of the self – cured acrylic resin with high residual monomer which acts as a plasticizer lowering its strength properties[4]. Pressure may affect mechanical and physical properties during curing of acrylic denture base. [5].

Separating media is a coating applied to a surface and serving to prevent a second surface from adhering to the first. When polymers were first used for the construction of denture, it is necessary to apply some of the separating medium to the plaster surface before packing to prevent the absorption of monomer into the plaster [6-8].

Many authors classified the separating medium as alcoholic, ethereal or aqueous solutions and oils, but the most popular separating agent are water – soluble alginates which produce a very fine film on the applied surface. However, oils such as vaseline was used as a separating medium for acrylic work [7], and glycerin oil was also used as a separating medium in 2005 [9].

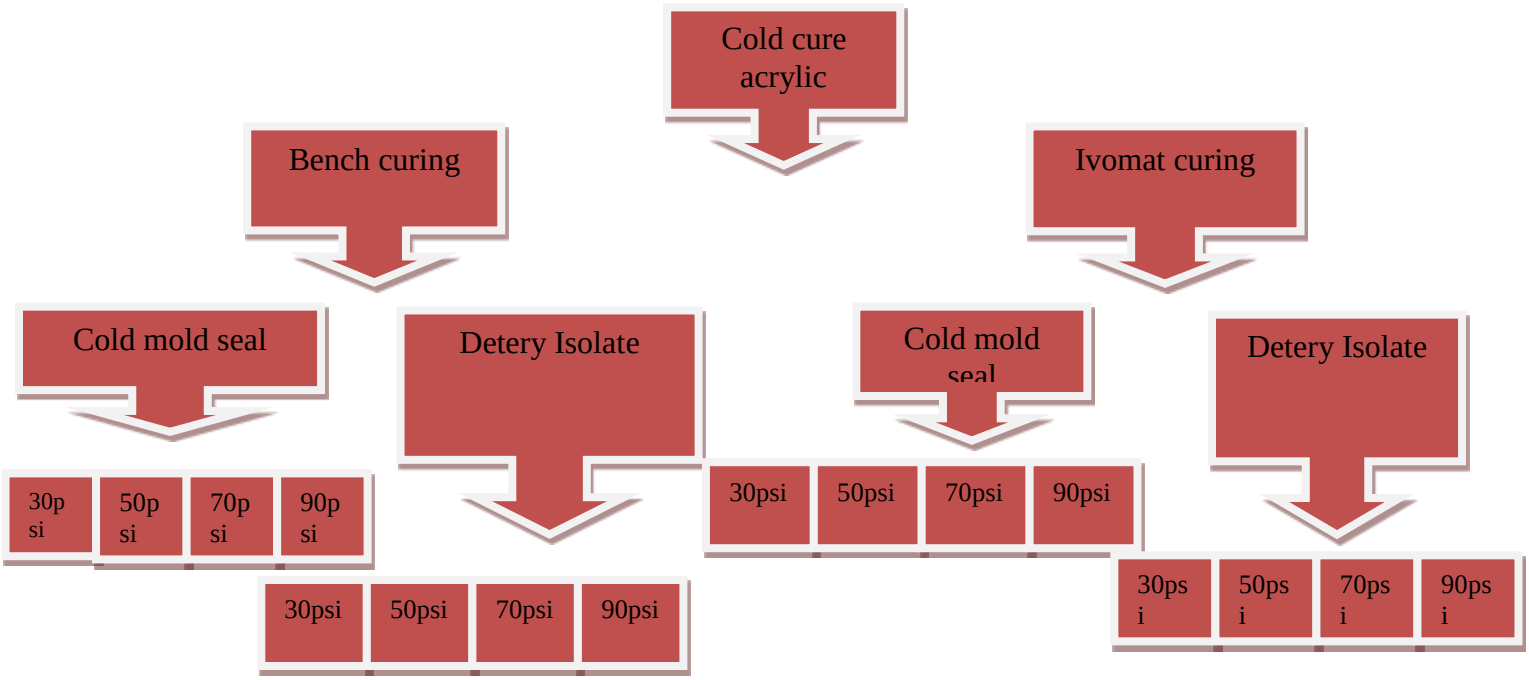
Transverse strength is a combination of tensile and compressive strength and includes some of the elements of the proportional limit and elastic modulus. It is also described as modulus of rupture or flexural strength [8]. Particle size could affect transverse strength of the acrylic resin and average polymer chain length undoubtedly affects the transverse strength. [10]. Although transverse strength of cold-cured PMMA is approximately 80% of the heat-cured material[11].

The purpose of this study is to evaluate Detery Isolant as aseparating medium on the transverse strength of cold-cure acrylic resin cured in (bench curing and in ivomat curing device under different pressure degrees (30psi, 50psi, 70psi, and 90psi) and compare with cold mold seal.

Materials and Methods:

1- Sample grouping

One hundred identical cold–cure acrylic resin specimen were made and grouped according to curing process, type of separating medium and the amount of pressure applied during processing. The study include 16 group. Each group of them contain 8 specimens.



Metal pattern

Metal patterns was constructed with (65mm x 10mm x 2.5 ± 0.03mm) length, width and depth respectively according to ADA specification no. 12 (1999) for denture base polymer[7].

Separating medium application

Cold-mould seal (11b, Switzerland) and Detery Isolate (homemade cold mold seal) used as a separating medium[12]. and measured with (2cc) by using a disposable syringe and applied onto the stone surface in the flask, with a fine brush (no.0) [13, 14].

Mould preparation

Using a conventional denture flasking technique. The metal pattern was included in metal flask, the lower half of each flask was completely filled with dental stone (pasom, Dental product, SP Brazil) The patterns were positioned on the stone surface, additional dental stone filled the upper half of the flask which was opened after complete setting under compression. The mold was washed with water and neutral detergent, and coated with a separating medium.

Proportioning and Mixing of Acrylic Resin Dough:

Pink cold-cured acrylic(pan acryl-cold cure acrylic-Istanbul) was used to make the samples in this study ,it mixed according to manufacturer's instruction (2.5:1) by volume. The liquid was placed in a clean and dry mixing vessel followed by slow addition of powder. The mixture was then stirred with wax knife and left to stand in a closed container at room temperature (23°C ± 5°C) until reach the dough stage. After filling the mold with the dough, the flasks were fitted and pressed together in a hydraulic bench press for (15) minutes.

Curing:

Flasks with the acrylic resin dough that use to prepare the first group of specimens (control group) were left to cure in bench curing for two hours at 23°C ± 5°C [15]. While in case of preparing the second group of specimens, flasks with acrylic resin dough were transfer for curing in the ivomat curing device, containing water at 70°C for 15 minutes under different pressure (30 psi,50psi,70 psi and 90psi). After completing the curing, the flask was allowed to cool slowly at room temperature for 30 minutes. Followed by complete cooling of the flask with tap water for 15 minutes. The acrylic patterns were then removed from the stone mould. All the acrylic resin specimens were finished and polished and the final measurements were obtained using the micrometer and venire mould, as shown in figure (1).

Figure (1) – Transverse strength acrylic sample

Testing Procedures:

The transverse strength of acrylic resin specimens was measured in air by three points bending on an Instron testing machine. The device was supplied with a central loading plunger and two supporting rollers of 3.2mm in diameter and (10 mm) in length. The supports were parallel to each other and perpendicular to the longitudinal center line. The distance between the centers of the supports was (50mm) The test specimen was held at each end of two supports, with a constant cross head speed (5mm/minute) and the load was measured by a compression load cell of maximum capacity (5 KN).

The values of transverse strength were calculated by the following equation:[8]

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

S = Transverse strength (N/mm^2).
P = Maximum force exerted on specimen (N).
I = Distance between the supports (mm).
b = Width of a specimen (mm).
d = Depth of a specimen (mm).

Results

Descriptive statistics which include tables of (mean, SD, SE) were used along with inferential statistics in order to accept or reject the statistical hypothesis which include ANOVA table with the result of multiple comparison test (LSD).

The results show that the transverse strength values vary with the difference pressure applied during curing procedure . The highest mean values of transverse strength were obtained in samples with detery isolate separating medium under 70psi which was (79.01 N/mm^2), while the lowest mean values of transverse strength were obtained in samples with cold mold seal separating medium at bench curing which was (46.78 N/mm^2) as shown in Table (1) .

One way ANOVA with LSD of multiple comparison test, showed that there was a highly significant difference at ($P<0.01$) between most of the pressure applied and in bench curing , except for a non significant difference at ($P>0.05$) between samples cured under 70 psi and 90 psi ,as well as there was none significant difference in samples with detery isolate cold mold seal separating medium as shown in Table (2).

Table (1): Descriptive statistics for transverse strength of cold-cure acrylic resin cured in different curing process under different pressure and separating medium.

Pressure Applied	Mean		SD		SE	
	Detery Isolate	Cold mold seal	Detery Isolate	Cold mold seal	Detery Isolate	Cold mold seal
Control	48.08	46.78	1.60	1.82	0.51	0.58
30 psi	55.18	54.82	1.43	1.282	0.44	0.42
50psi	66.81	65.29	1.97	1.60	0.62	0.51
70psi	79.01	78.47	1.20	0.921	0.41	0.31
90psi	77.40	78.38	2.32	2.21	0.68	0.62

Table (2): Least significant difference (LSD) of tested groups.

Curing tech.		DI					C.M.S				
		control	30psi	50psi	70psi	90psi	control	30psi	50psi	70psi	90psi
DI	control		S	S	S★	S★	N.S	S	S	S★	S★
	30psi			S	S★	S★	S	N.S	S	S★	S★
	50psi				S	S	S★	S	N.S	S	S
	70psi					N.S	S★	S★	S	N.S	N.S
	90psi						S★	S★	S	N.S	N.S
C.M.S	control							S	S	S★	S★
	30psi								S	S★	S★
	50psi									S	S
	70psi										N.S
	90psi										

DI = Detery Isolate N.S =Non Significant P value >0.05
C.M.S= Cold mold seal S= Significant P value <0.05 ★=High Significant

Discussion

Cold cure acrylic samples processed in Ivomat curing device under high pressure generally showed more increase in transverse strength than those with bench curing ,this could be related to the higher conversion of the monomer into the polymer. These finding have an agreements with AL-Berqdar et al in (2009)[5] The high values of transverse strength at 70psi compared with other tested groups might be related to increase the molecular weight and long polymer chain length resulted from more complete polymerization at this pressure that could increase the transverse strength. this agree with Ray (1998)[11].While the reduction of transverse strength in samples with bench curing may be associated with insufficient pressure which lead to increase the distance between molecular chains which decrease the transverse strength. This result was agree with Harrison A et al in (1995)[10] .

Statistically no significant differences between specimens processed with Detery Isolate as a separating medium and those samples processed with cold mold seal separating medium

Conclusion

The study suggests that the cold cure acrylic specimens frequent showed a considerable improvement in transverse strength when cured in Ivomat curing device under(70psi and 90psi) pressure .In addition, it can be concluded that the using of Detery Isolate as a separating medium showed a satisfactory result in regarding to transverse strength of cold cure acrylic resin material when compared with specimens that separated with cold mold seal separating medium.

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