

## **Effects of Three Different Types of Separating Medium on The Compressive Strength of Cold Cure Acrylic Resin.**

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### **Abstract**

**Background:** In the present study evaluation of the effect of three different types of separating medium of the effect of compressive strength of cold-cure acrylic resin material cured at room temperature.

**Methods:** Forty five cylinder design of cold cure acrylic were fabricated in order to provide an a standardized dimensions of tested specimens (11 x 22 mm). These cylinders were invested by either cold mold seal or glycerin or tin foil group.

**Results:** The results of this study revealed that there was highly significant differences on the compressive strength of cold-cure acrylic resin material lining with both glycerin and tin foil separating medium in comparison with cold-mold seal separating medium.

The aim of this study was to study the effect of three different Types of separating medium (cold mold seal, Tin foil and glycerin on compressive strength of cold cure acrylic resin material.

**Conclusions:** it can be concluded that when the mold lined with glycerin and tin foil separating medium the degree of compressive strength showed highly significant differences in all cold cure acrylic resin specimens. In comparison with cold mold seal.

### **الخلاصة:**

في الدراسة الحالية تأثير ثلاثة أنواع مختلفة من الوسيط العازل لتأثير القوة الانضغاطية لمادة (الأكريليك البارد) معالجة في درجة حرارة الغرفة. تم جمع خمسة وأربعين عينة اسطوانية من الأكريليك البارد المعالج لغرض توفير أبعاد قياسية لأنواع مفحوصة (11×22 ملم). هذه الاسطوانات يتم تغميسها إما في (Cold Mould Seal) أو (Glycerin) ماو (Tin Foil) هذه الأنواع الخمسة والأربعين تم تقسيمها إلى ثلاث مجموعات ثانوية (فرعية) حسب نوع الوسيط العازل المستخدم (خمسة عشر نوع لكل مجموعة فرعية) كانت كما يلي:

- المجموعة (C.M.S): أنواع مبطنه بوسيط عازل ( Cold mold seal ) .
- المجموعة (T.F): أنواع مبطنه بوسيط عازل (Tin foil).
- المجموعة (G): أنواع مبطنه بوسيط عازل (Glycerin).

نتائج هذه الدراسة كشفت بأن هناك اختلافات مهمة جداً على القوة الضاغطة للأكريليك البارد المعالج والوسيط العازل (Tin Foil) مع الوسيط العازل (Cold Mold Seal) .

### **INTRODUCTION**

Acrylic plastic have been the most widely used and accepted among all denture base materials and it was estimated that they represent 95% of the plastics prosthodontics<sup>(1,2)</sup>. The cold cure acrylic resin Poly Methyl Methacrylate (PMMA) is one of very important material in dentistry which is referred to as acrylic resin has been introduced for using in dentistry in the early 1930.

Acrylic resin become the most reliable material for denture construction (denture base, relined, rebase, orthodontic appliance and crown and bridge work as maxillofacial prosthesis) so that it is necessary to know it is properties, characterized effects and all factors which effect these material to produce the accepted results (prosthesis)<sup>(3,4)</sup>.

Separating media are materials used for filling porous Surface to effect easy separation of other materials which are later poured against them <sup>(5,6,7)</sup>. Therefore the resin must be carefully protected during processing from the gypsum surfaces in the mould spaces two reasons:

- 1- Any water in corporate in to the resin from the gypsum during processing will defined affect the polymerization rate and the cold of the resin, the denture procedure will craze readily of water after the processing, particularly if the resin is not cross-linked.
- 2- Dissolved polymer and free monomer must be prevented from soaking in to the investing medium, portions of gypsum material will be joined to the denture after polymerization, with the result that it will be virtually impossible to separate the investing material from the resin <sup>(8,9,10)</sup>.

The compressive strength is defined as , the internal induced force, that opposes the shortening of a material in a direction parallel to the direction of the stresses , any induced force per unit area that resists deformation caused by a load that tend to compress or shorten a body <sup>(11,12)</sup>.

Compressive stress. If a body is placed under a load that tends to compress or shorten it , the internal resistance to such a load is called a compresses stress. A compressive stress is associated with a compressive strain. To calculate either tensile stress or compressive stress, the applied force is divided by the cross-sectional area perpendicular to the force direction. <sup>(13,14,15)</sup>.

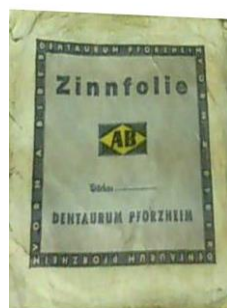
## **Materials and Methods**

### **A-Instrument and Equipment :**

- 1- Wax Knife .
- 2- Sand paper .
- 3- Finishing burs (acrylic ; stone ; fissure and sand paper burs) .
- 4- Prosthetic hand Piece (wand Heleo , Austria) .
- 5- Metal mold .
- 6- Compression Machine (made in England) .



**A**



**B**



**C**

**Figure (1): Types of separating medium used in this study that A- Cold mold seal ; B- Tin foil; C-Glycerin .**

**B- Materials used in this study :**

**Table (1): Show some materials used in these study.**

No.	Type of material	Treat name	Manufacture	Batch number
1	Cold cure acrylic resin	Major 2	India	RRL 051
2	Cold mould seal	P.D Pink color	India	LOT 117
3	Glycerin	Glycerin pure	Syria	158/ lb
3	Metallic	Tia foil	Italy	Products Dentaires
4	Pumice	Grad CL 125	U.S.A	Corporation 361 Louis Ville
5	Distilled water	Al- Mansore	Iraqi	----

**Methods :**

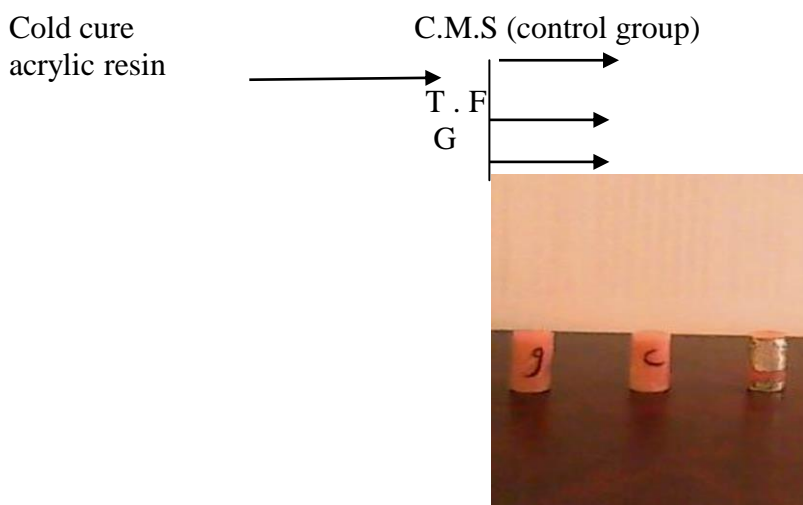
45 specimens were prepared in College of Health and Medical Technology / Prosthetic Dental Technology Department and tested in University of Technology in Practical Physics Department in February- May 2010. The specimens were prepared from pink cold cure acrylic resin . The study includes three groups of specimens depending on the type of separating medium that used in curing process. Each group of them contains fifteen specimens as shown in **Figure (2)**

These 45 specimens were divided into three sub group according to the type of separating medium used (fifteen specimen for each sub group) : were as follows:

Group of Cold Mould Seal (C.M.S): specimens lining with cold mold seal separating medium (control group).

Group of Tin Foil (T.F): specimens lining with tinfoil separating medium.

Group of Glycerin (G.): specimens lining with glycerin separating medium.



**Figure (2) : (Cylinder cold cure acrylic)**

Cold cure acrylic was mixed according to manufacturer's instruction (2.5:1) by volume. The liquid was placed in a clear and dry mixing vessel followed by slow of powder the mixture was then stirred with wax knife and left to stand in closed container at room temperature ( $23^{\circ}\text{C} + 5^{\circ}\text{C}$ ) until reach the dough stage . The two plates were closed to gather and placed in hydraulic press , and allow oven flow of the dough through out the mold space .

The pressure was then released , The plates was removed and the over flowed material surrounding the mold space was removed with sharp knife .

The Mold that contained the acrylic resin dough to prepare the first group of samples (group A) or (group used with cold mold seal) and (group B) or (group)used with tin foil) and (group C) or (group used with glycerin) .

The mold was allowed to cool slowly at room temperature ( $37 + 1^{\circ}\text{C}$ ) for (30)minutes following by complete cooling with water for (15) minutes . The acrylic patterns was then removed from metal mould .

All the acrylic resin specimens were finished with an acrylic and stone bur followed by (120-grain) size sand paper with continues water-cooling (to prevent over heating) in order to get smooth surface .

Polishing was accomplished using bristle brush and pumice with dental lath polishing machine (using low speed , 1500 rpm) till glossy surface was obtained using the micrometer and vernier . Acrylic resin specimens were prepared in cylinder design with the dimensions (22 x 11 mm) length and width respectively according the dimensions accepted by the tester device.

The mold is local manufacture by using cylinder of metal with dimensions (22 x 11 mm) length and width respectively according to dimension accepted by tester device as in **Figure (3, 4)**

American Dental Association (ADA) Specification No.8, 1978 , all the tested specimens were conditioned in distilled water at ( $37^{\circ}\text{C} + 1^{\circ}\text{C}$  ) for 3 days before testing All prepared specimens were examined by using (compression). each tested specimen have cylinder in shape measured (22 x 11mm), See **Figure (5)**.



**Figure (3)**



**Figure (4)**



**(Figure 5): Specimens under test**

### **Statistical Analysis:**

Statistic methods used to analyze assess the result study were :

- 1- Descriptive statistic .
  - A- Mathematic mean .
  - B- Standard deviation.
- 2- T- test to find significant deference between test groups and the control group .

### **Results**

The results show that the highest mean value of degree of compressive strength was to Cold Mould Seal (C.M.S) was (7366.67) and the lowest (glycerin) mean value was (5606.67) and for the Tin Foil (T.F) was (5560.00) as shown in **table (1)** .

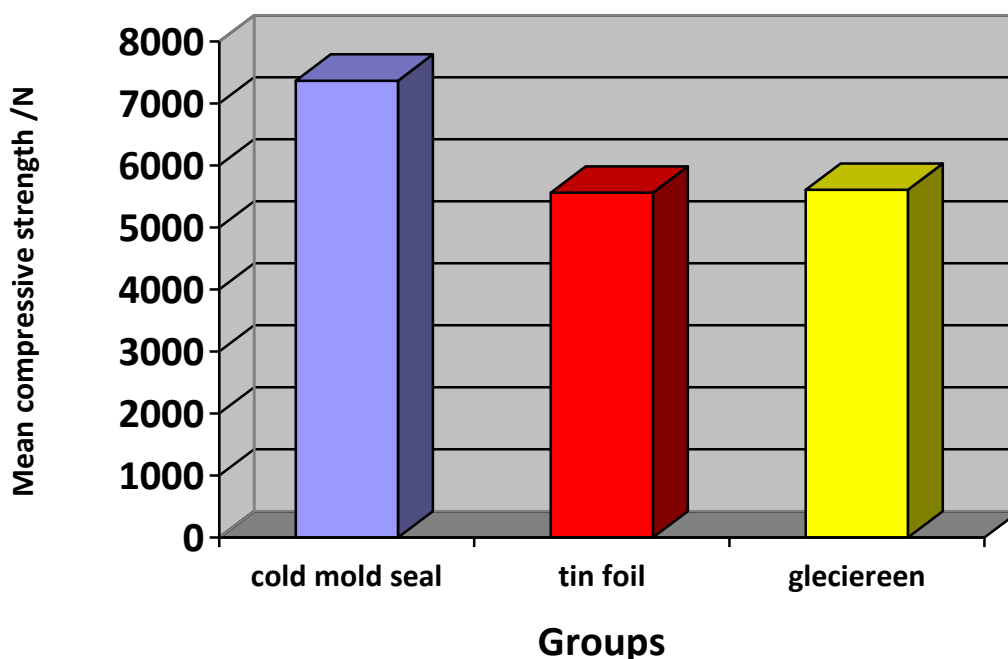
**Table (1): mean distribution compressive strength according to studies groups.**

Groups	N	Mean	Std. deviation	Std. error	Range		ANOVA test (f-test) p-value	Sig
					Min	Max		
<b>Cold mold seal</b>	<b>15</b>	<b>73366.67</b>	<b>783.23</b>	<b>202.23</b>	<b>5000</b>	<b>8000</b>	<b>.000</b>	<b>HS</b>
<b>Tin foil</b>	<b>15</b>	<b>5560.00</b>	<b>877.33</b>	<b>226.53</b>	<b>4500</b>	<b>7000</b>		
<b>Glycerin</b>	<b>15</b>	<b>5606.67</b>	<b>1001.05</b>	<b>258.47</b>	<b>4000</b>	<b>8000</b>		
<b>Total</b>	<b>45</b>							

Applying the student test to verify the statistical significant between (cold mold seal) , (tin foil) and (glycerin) separating medium we showed high significant differences in the degree of compressive strength for cold cure acrylic resin specimens as shown in **table (2) and Figure (1).**

**Table (2) :less significant differences of compressive strength.**

Groups		LSD test (f-test)	
		P-value	Sig.
Cold mold seal	Tin foil	.000	HS
	Glycerin	.000	HS
Tin foil	Glycerin	.887	NS



**Figure(1): Represent the compression between tested groups.**

## **Discussion**

By comparing the cold mold seal, tin foil and glycerin separating medium utilized in this study we showed that there was highly significant differences in the degree of compressive strength of cold cure acrylic resin specimens with metal mold lined by the three types of separating medium. This is may be related to residual monomer in cold-cured materials. Which is affected adversely with compressive strength .

So that tin foil and glycerin separating medium show decrease in the compressive strength of cold cure acrylic resin in comparison with cold mold seal. This is may be related to high water sorption of the acrylic denture base material and differences in the properties of these materials and different techniques when used with acrylic resin materials (**Watanabe, M. et al ; 2007**). If can be concluded from these results obtained that tin foil and glycerin can not used as separating medium as cold mold seal for processing cold cure acrylic resin material because of decrease the compressive strength of cold cure acrylic resin material. This disagreement with (**Naval, 1950**) ; Who said that "Tin foil the most ideal type of separating medium for lining molds during the processing of acrylic resin". And agreement with (**Phillips, 1973; Prombonass A. and Vlissidis D., 1994**) they mentioned that "the most popular types of separating agents are water-soluble alginates which produce a very fine film on the applied surface(**Yazdani S.S. and R. Gonzalez ;2007**) .

## **Conclusions :**

From this present study the following are concluded:

1. Generally the cold mould seal material as separating medium revealed highly effect on the compressive strength of cold cure acrylic resin denture base material.
2. The using of tin foil and Glycerin separating medium appear to have less effect on the compressive strength of cold cure acrylic resin denture base material.
3. Glycerin material as separating medium showed lower effect on the compressive strength of cold cure acrylic resin denture base material than that of tin foil separating medium.

## **References:**

1. Greig R.G.; O'Brein W.J.; and Powers J.M.: Dental materials properties and manipulation. (1996); 6<sup>th</sup> Ed. St. Louis. The C.V. Mosby Company, PP. 242-264.
2. Greig R.G.; and Powers J.M.: Restorative dental materials. (2002); 11<sup>th</sup> Ed. St. Louis: Mosby.
3. American Dental Association: Guide to Dental materials and Device (1980).
4. Prombonass A. and Vlissidis D.: Compressive strength and setting tempreture of mixes with various proportion of plaster to stone . J prosth et Dent. (1994) ; 72 (1) : 95 – 100 .
5. Anderson JN.: Applied dental materials 4<sup>th</sup> ed. Black well. Scientific publications(1972). London.
6. Naval US.: Dental Prosthodontic Technician , Flasking and tin foiling. (1950) 2<sup>nd</sup> Ed : 143-157 , national naval medical center, Maryland for publication by bureau of Naval personnel.
7. Phillips RW.: Skinners science of dental materials (1973); 7<sup>th</sup> Ed: Saunders Co. Philadelphia.
8. Callister W.D. Jr., John Wiley & Sons: Materials Science & Engineering an Introduction (2003). USA; ISBN 0-471-22471-5 .

9. Glossary of Prosthodontic Terminologies. Journal of Prosthetic Dentistry (2005). The Academy of Prosthodontics. J Prosthetic Dentistry, Mosby.
10. Mikell P.Groover, John Wiley & Sons: Fundamentals of Modern Manufacturing (2002). U.S.A, ISBN 0-471-40051-3
11. Glossary of Prosthodontic Terminologies. Journal of Prosthetic Dentistry, (1999). The Academy of Prosthodontics, Mosby.
12. Greig R.G., O'Brien W.J., powers J.M, (1997). Dental materials, properties and manipulation, Mosby company .
13. Watanabe, M. et al . " Acroline syntheses from glycerol in hot compressed water " . Bioresource technology (2007); 98:1285-1290 doi:10 1016/ J. Biortech 2006.05.007 .
14. Yazdani S.S. and R. Gonzalez " Anaerobic fermentation of glycerol : a path to economic viability for the biofuels industry " Current Opinion in Biotechnology (2007) ; 18 (3): 213-219 doi: 10. 1016/ J. Copbio. 2007 .05. 005 .
15. Phillips R.W.:Skinner's science of Dental materials. (1996) Saunders company .