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The effect of chemical disinfection on the compressive strength of heat-cure and cold-cure acrylic denture base resin.

تأثير المعقمات الكيمائية على القوة الضاغطة لقاعدة الطقم الاكريلكي الحار والبارد

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Abstract

Background: Prostheses have been identified as a source of cross contamination between patient and dental personnel. Although aseptic guide lines were established to minimize the potential for disease transmission by prostheses, many laboratories and dental offices have failed to follow these procedures. Dental personnel have an increased risk of infection through constant exposure to debris, plaque and saliva, which harbor pathogenic organisms and adhere to prostheses. Dental personnel also may transmit potentially harmful organisms to patients.

الخلاصة :

التعويضات السنية قد تكون مصدر مباشر لانتقال العدوى من خلال تكوين تجمعات بكتيرية وفطريات متراكمة والتي تكون مصدرا رئيسيا لانتشارالامراضية بين العاملين في مجال طب الأسنان تم استحداث عملية التعقيم لتكون المجال المساعد للتقليل من هده الإصابات في الدراسة الحالية تم استخدام 60 عينة من الالكريلك(30 عينةللاكريلك الحار و 30 عينةللاكريلك البارد) ذات الإبعاد الاسطوانية الشكل (12ملم الطول و6 ملم العرض) و قسمت العينات بالتالي إلى ثلاث مجموعات المجموعة الأولى وهي المجموعة القياسية غمرت العينات بالماء المقطر والمجموعة الثانية غمرت بمحلول الصوديوم هايبو كلوريت بنسبة2.5% والمجموعة الثالثة غمرت بمحلول الفلوكونزول بنسبة 1% ولمدة 60 دقيقة وهو وقت ثابت للغمر كل العينات بعد فحص العينات أكدت النتائج إن القوة الضاغطة للاكريلك الحراري المغمور بمحلول الصوديوم هايبوكلوريت بنسبة 2.5 % سجل أعلى نسبة قياسية للقوة الضاغطة ($P< 0.01$) بالمقارنة مع المجموعات الأخرى و يمكن الاستنتاج من هده الدراسة بان الغمر العينات الاكريلكية النوع الحار والبارد بالمحاليل المعقمة لكلا النوعين المستخدمين ودلك بعدم تأثيرهما على القوة الضاغطة من خلال زيادة متانة الطقم وبوقت الغمر المستخدم وهو الستون دقيقة لهدا يجب استخدام هده المحاليل المعقمة للتخلص من العدوى ومن البكتريا الملتصقة والفطريات المتراكمة على سطح الطقم الاكريلكي

Methods:

Sixty acrylic resin specimens cylinder in shape have size (12mm * 6 mm) (12mm) height and (6mm) diameter, (30) cold- cure acrylic resin and (30) hot- cure acrylic resin that immersed for (60) minutes in either 2.5% sodium hypochlorite and 1% fluconzal solution, control specimens were immersed only in distilled water. The compressive strength (N/mm^2) was tested for failure in instron machine set at cross- sectional area head speed of (2mm/min) with chart speed (20 mm/min).

Result:

Data were statistically analyzed using t-test statistical analysis, the result indicated there was highly significant differences among these groups (control group) and (experimental group). also showed that the compressive strength for hot- cure acrylic immersed in sodium hypochlorite have a highly significant difference ($P< 0.01$) than control group and other tested groups.

Conclusion:

From this study we can concluded that the compressive strength was not affected after immersion in these disinfectants solution for the immersion period tested at (60 minutes).

Key words: acrylic resin ;sodium hypochlorite ;fluconzal agent solution .

Introduction

One of the primary uses of self- cures acrylic has been used in the construction of prosthetic appliances such as denture bases. However, it has been used for highly important application such as artificial teeth, tooth restoratives, orthodontic space maintainer, crown and bridge facing, obturators for cleft palates.(1,2,3) Also have routinely been used as materials for temporary crowns or repairing fractured dentures in dentistry. (4,5)The Candida-associated denture stomatitis is a common condition characterized by generalized inflammation of the palatal mucosa covered by the denture. (6,7,8)It is a harmless form of oral candidiasis and is associated with a quantitative increase of yeasts on the mucosa and the denture's fit surface. Although denture induced candidosis could be treated by methods targeted towards the oral mucosa, other treatment modalities are directed toward the denture base. (9,10)A number of effective antifungal agents have been administered, either topically or systemically, for management of oral candidacies. Amphotricin B and nystatin are common topical antifungal agents, where as azoles such as fluconazole and ketoconazole are available as systemic antifungal treatment. Significant resistance in yeasts has been reported in isolates from patients with prolonged neutropenia, and in HIV patients. Dentists, auxiliary personnel, and dental laboratory technicians may be exposed to a wide variety of harmful microorganisms daily, potential sources of transmission of infections diseases from patients of dental technicians include impressions, impression trays and gypsum casts. Like wise, prostheses in contact with oral tissues, saliva and blood, when removed from patient's mouths at the various stage of trial and insertion, may contaminated by pathogenic organisms, which can be transmitted through direct contact or through the aerosol raised during training, finishing, and/ or polishing procedures, opportunistic bacteria with varying levels of pathogen city may be spread and disseminated in the air leading to cross- inflection and exposing professionals and patients to disease. (11,12,13,14)To eliminate cross- contamination all prostheses and dental appliances should be properly disinfected in both the dental office and laboratory and before being inserted intraorally. Chemical disinfectants are recommended method to prevent cross contamination when used after removal and before insertion of a prostheses into the mouth. (16,20,15,17)In this study evaluated immersion the acrylic denture base resin in different chemical solutions for disinfecting prostheses than can effect the compressive strength of acrylic denture base resins, that 1% fluconozale solution and 2.5% sodium hypochlorite was used as disinfection solution for 60 minutes that times for immersion for all specimens.

Materials and Methods:

The materials were used in the present study are shown in Table (1) and Figure (1.A.B).this study was done in the College of Health and Medical Technology/Baghdad ; in the dental department for the study years (2010-2011).

Table (1): The materials were used in the present study.

Type of materials	Trade name	Manufacturer	Batch number
Pink self- cure acrylic resin	Heroes Kulzer	Germany	Lot… RR 142, B
Pink hot- cure acrylic resin	Heroes Kulzer	Germany	Lot … RR 142, B
Distilled water	Al- Mansoor Company	Iraq	
Sodium hypochlorite solution	Rirex;Lndustria Farmaceutica	Brazil	Sao Jose
Fluconzole solution	Candistan	Cairo-A.R.G	

A- some of materials used in these study. B-hot and cold - cure acrylic resin .

Figure (1 A;B):The materials were used in the present study .

Methods

(60) samples were prepared of self- cure acrylic resin denture base materials and hot- cure acrylic resin denture base materials.

They were divided into (3) groups (10)samples for each group. figure (2).

The tested groups are used in these study:

Group A: hot- cure acrylic immersed in distilled water for (60) minutes (control group).
Croup B: hot- cure acrylic immersed in fluconzole solution for (60) minutes.
Croup C: hot- cure acrylic immersed in sodium hypochlorite for (60) minutes.
Croup D: cold- cure acrylic immersed in distilled water for (60) minutes.
Croup E: cold- cure acrylic immersed in fluconzole solution for (60) minutes.
Croup F: cold- cure acrylic immersed in sodium hypochlorite for (60) minutes.

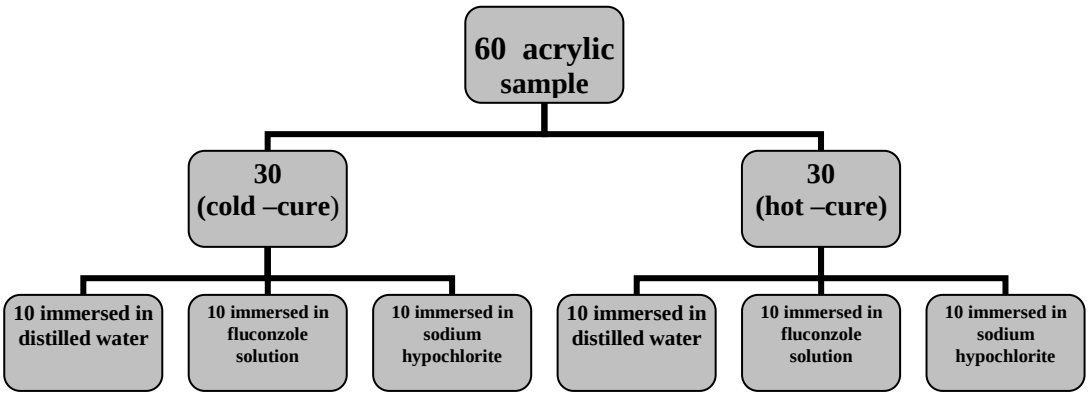


Figure (2):Diagram represent disruption of the specimens used in these study.

Metal Pattern preparation

According to American dental association specification no.12 (1975, 1999), and Astern D256, (1985, 1988) and B5 specification 2482 (1989).

The metal pattern was constructed with a metal steel split cylinder of (12 mm * 6mm) length, diameter was constructed to be used for compressive strength as shown in figure(3).

Figure (3):metal pattern for compressive strength.

Specimens preparation

Coating the metal pattern with the separating medium (to easy removal from the metal pattern) a layer of melted wax mix then inserted on metal pattern after hardening the wax patterns remove it and started using a conventional denture flasking technique, the lower portion of the dental flask was filled with dental plaster mixed according to manufacturer instruction (i.e. 50 ml \ 100 gm) than placed these wax patterns on the dental plaster ; after setting of the plaster (30 mn), both the plaster and wax patterns were coated with separating medium, and another layer of plaster was poured into the upper half of the flask with vibration to get rid of the trapped air. plaster was allowed to be harden for (60 minutes) then the flask was processing for wax elimination process about (10 mn) than open the flask and cleaning the mould from any residual wax leaving it for a little time for drying to be ready for packing procedures.(16)

Curing for cold-cure acrylic resin specimens

Pink cold-cured acrylic was 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 in a closed container at room temperature (23C°± 5C°), so the self - cure acrylic procedure is same as the hot - cure acrylic resin procedure.

Packing

Acrylic resin dough was used (when it doesn't stick to the vessel wall) as recommended by the American dental association specification NO. 12 (1975). It was packed in the mould which had been painted with separating medium with the aid of nylon sheet the two halves of the flask were closed together and placed under hydraulic press (1200 pound per square inch). Pressure was slowly applied to allow even flow of the dough stage acrylic through out the mould space. The pressure was then released, flask was opened and the over flowed
material surrounding the mould was removed and the flow material around the
specimen was cut by a sharp knife. A second trail closure was performed then the two halves of the flask were finally closed until metal to metal contact had been established and left under the press (1200 pound per square inch) for(5) minutes.(19)

Curing for hot- cure acrylic resin specimens

Curing was done in a thermostatically controlled water bath temperature at (74C°) for (8) hours) Jorge et al, (2003). After completing the curing, the flask was allowed to cool slowly at room temperature for (30) minutes, followed by another cooling of the flask with tap water for (15) minutes. Deflasking was done and acrylic patterns were then removed from the stone mould.

However, curing the pink cold-cure acrylic was carried by placing the flask in the Ivomat machine processed by heating at (80C°) for (15) minutes under experimental pressure (50 pound per square inch). (22)

Finishing and polishing

All the acrylic resin specimens were finished by sand paper sheet and continuous water-cooling (to avoid over heating).While polishing was accomplished by using bristle brush and pumice with dental lathe polishing machine using law speed (1500 rotation per minute). The final glossy surface was obtained with wool brush and polishing soap on dental lathe, the specimens were continuously cooled with water to avoid over heating during finishing and polishing to prevent distortion of the specimens according by the American Dental Association specification NO. 12 (1975).

Disinfection Method For Acrylic Specimens

To determine the effect of chemical disinfectants on the compressive strength, specimens (n= 40) from each resin brand that cold- cure and hot- cure acrylic resin were immersed in one of the following chemical disinfectants:

{2.5% sodium hypochlorite} (Rirex; Industrial pharmaceutical Rioquimica, Sao Jose, Brazil) or in { 1 % fluconzole solution }(candistan ;cario A-R-G).

The rationale for selecting these agents was based on the fact sodium hypochlorite is accepted by the American dental association for the cleansing and disinfection of the complete and non metal partial removable denture.

The specimens of each brand of resin were immersed in the chemical disinfectant solution for 60 minutes.(13).

After immersion, the resin specimens were removed from the chemical solutions, thoroughly washed in running water, dried with absorbent paper, and tested for compressive strength. Control specimens from each resin brand (n =20) were submitted to immersed just in distilled water and kept in it until compressive strength testing figure (4;5).

Figure (4): hot -cure samples.

Figure (5): cold- cure samples.

Compressive strength

Testing Procedure:

According to American Stander Tests of material, E6, (1986) compressive strength is calculated from the maximum load during a compression test and the original cross-sectional area of the specimen. The compressive strength was measured by using instron machine especially equipped with grips suitable for holding the test specimen set at cross- sectional area head speed of 2mm/min with a chart speed 20 mm/min.the load was measured by a compressive load with a maximum capacity (2500 kg) the force at failure was measured (kg) which converted into (N). (31)

The values of compressive strength were calculated by the following Formula according to Craig and Power, (2002).

$C.S. = F/ \pi d h$

C.S. =Compressive strength (N/mm^2).

h = Height of the specimen (mm).

F = Force at failure (N).

d = Diameter of the specimen (mm).

Result

The effect of immersion in different disinfectant solutions on the compressive strength of hot-cure acrylic and cold- cure acrylic denture base resin were statically analyzed in order to asses and analyze the results.

The mean, standard deviation and range of all measurements of the tested groups used in this study as shown in table (2).

The highest mean value was record for group (C) that hot – cure acrylic immersed in sodium hypochlorite for (60 minutes) was (27.08) while the lowest mean value that for group (E) that cold-cure acrylic immersed in fluconzole solution for (60 minutes) was (18.20).as shown in figure (6). Through the application of t-test between each two groups of hot- cure acrylic and cold- cure acrylic

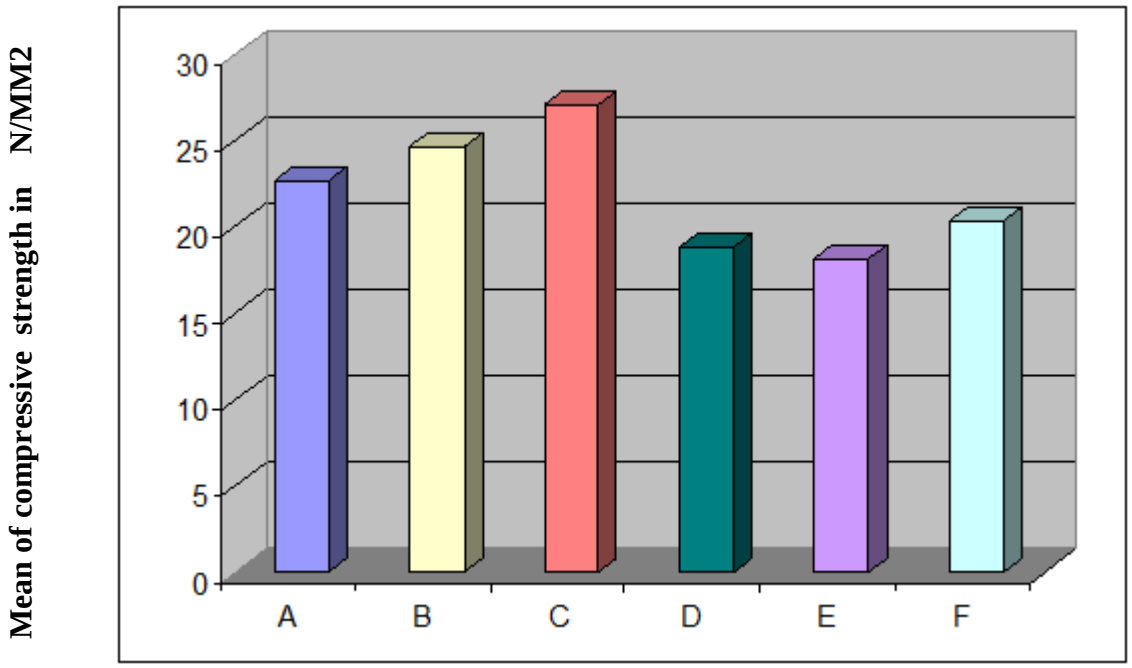
that all groups of tested specimens have highly significant differences (P< 0.01) as shown in table (3).

Statistics	Hot- cure acrylic			Cold –cure acrylic		
	Group A (control group) Distill water	Group B 1% Fluconzole solution	Group C 2.5% sodium hypochlorite	Group D Distill water	Group E 1% Fluconzole solution	Group F 2.5% sodium hypochlorite
Mean	22.67	24.70	27.08	18.82	18.20	20.41
SD	0.5553	0.38526	0.36224	0.2272	0.35159	0.28251
Max.	23.42	25.18	27.390	19.00	18.560	20.770
Min.	22.09	24.30	26.510	18.56	17.670	19.880
ANOVA test	.000 HS highly significant differences P<0.01 between &within groups					

Table(2):Comparison between of compressive strength (N/MM^2) of hot-cure and cold –cure acrylic groups immersion with different disinfectant solution.

Table(3): t- Test between Hot-Cure acrylic & Cold -Cure acrylic

Groups	T	P-value	C.S
Grouop A-D	21.882	P<0.01	HS
Group B-E	43.877	P<0.01	HS
Group C-F	43.356	P<0.01	HS



(hot- cure acrylic groups) (cold- cure acrylic groups)

Figure(6):Bar –chart showing the mean of compressive strength (N/MM^2) of hot-cure and cold – cure acrylic groups after immersion with different disinfectant solution.

In table (4) represent the t-test for all groups that used in this study also the comparison between each group with other tested groups using coefficient of correlation test that represent the highly significant differences that ($P< 0.01$).

Table(4): t- Test with coefficient of correlation test for all samples groups.

Groups	t-Test	P-value	C.S
Group (A) HOCADW-HOCAFS (B)	10.756	P<0.01	HS
Group (A) HOCADW-HOCASHCS (C)	22.306	P<0.01	HS
Group (A) HOCADW-COCAFS (E)	24.624	P<0.01	HS
Group (A) HOCADW-COCASHCS (F)	11.711	P<0.01	HS
Group (B) HOCAFW-HOCASHCS (C)	13.557	P<0.01	HS
Group (B) HOCAFS-COCASW (D)	39.838	P<0.01	HS
Group (B) HOCAFS-COCAFS (E)	43.877	P<0.01	HS
Group (B) HOCAFS-COCASHCS (F)	22.872	P<0.01	HS
Group (C) HOCASHCS-COCADW (D)	72.091	P<0.01	HS
Group (C) HOCASHCS-COCAFS (E)	85.927	P<0.01	HS
Group (C) HOCASHCS-COCASHCS (F)	43.356	P<0.01	HS
Group (D) COCADW-COCAFS (E)	5.234	P<0.01	HS
Group (D) COCADW- COCASHCS (F)	13.420	P<0.01	HS
Group (E) COCAFS- COCASHCS (F)	12.546	P<0.01	HS

Discussion

Contaminated prostheses provided a source for cross contamination between patient and dental personnel when aseptic techniques are not followed according to (1;2;3) often, short appointments scheduled for prostheses manipulation leave inadequate time for proper cleaning and disinfection of a prostheses. Organic material remaining on the prostheses before they are disinfected may inhibit the effectiveness of the disinfecting solution. Therefore, the selection of a disinfectant should be based on its biocides effectiveness in the presence of organic material and on the time required for it to achieve disinfection (4;5;6;10;11) .

This study stressed the importance of testing the disinfectants solution under conditions the disinfectants solution under conditions that simulate prostheses in the mouth.

The present study compared mean compressive strengths recorded for heat- polymerized resin and cold- cure acrylic resin specimens subjected to immersion in different chemical disinfectants for (60) minutes. The experimental group or distilled water (control).

Lower compressive strength values were reported for cold- cure acrylic specimens immersed in fluconzole solution, whereas hot- acrylic immersed in sodium hypochlorite demonstrated significantly higher compressive strengths, emphasizing the observation that chemical cure acrylic resin may adversely affect resin strength after immersion in these disinfectant solution. these result agreement with(13;14) These may be due to differences in the properties of heat- cure acrylic and cold- cure acrylic and method of polymerization for each type, Also that due to residual monomer in cold- cure much more in cold- cure that hot- cure causes that decrees the strength of cold- cure acrylic, these result agreement with (15;16;17; 18) and also due to immersion in the disinfectants for these time may have reasons for increasing the compressive strength of acrylic denture base resin in comparison to the control group that immersed just distill water (23;25,34,35,).

the type of material and the amount of source exposed to the disinfectant are the third factor that affect the length of time required for complete disinfection. it is evident that the concentration of the disinfectant on inculum;the type and concentration of organic material used; and the materials disinfected will have an effect on the biocides activity of the disinfectant(36).

Conclusions:

1-From this study we can concluded that the compressive strength for acrylic resin samples was not affected after immersion in these disinfectants solution for the immersion period tested at (60 minutes).

2- Disinfection solution that 1% fluconozale solution and 2.5% sodium hypochlorite was used as antiseptic solution in these study that not effected the compressive strength for hot and cold cure acrylic resin specimens.

3-Immersion in 2.5% sodium hypochlorite gives the highly mean value of compressive strength for hot -cure acrylic resin than other tested groups.

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