

## Studying the Effect of Different Separating Medium on the Roughness of the tissue surface of Acrylic Denture Base (In Vitro Study)

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### المستخلص

**الهدف:** من اجل تقويم تأثير المواد العازلة المستخدمة اثناء تحضير مادة الطقم الاكليري على خشونة السطح النسيجي لقاعدة الطقم الاكليري.  
**المنهجية:** تم اختيار ثلاث مواد عازلة مختلفة (أتين فويل)، (ب-ديتيري)، (ج-كولد مولد سيل)..حيث تم تحضير ثلاثين عينة من مادة الطقم الاكليري باستخدام المواد العازلة، عشرة عينات لكل مادة عازلة. بعد الانتهاء تم قياس خشونة سطح مادة لطقم الاكليري باستخدام جهاز (بروفايلوميتر) لكل عينة ضمن المجاميع الثلاثة.

**النتائج:** اظهرت النتائج ان الفارق بين جميع المجموعات كان محسوس جدا . بالرغم من ان المادة العازلة (أ) كانت اقل هذه المواد تأثيرا على خشونة السطح بينما المادة (ب) اعطت نتائج مقبولة. اما المادة العازلة (ج) اعطت نتائج غير جيدة بالنسبة الى خشونة سطح مادة الطقم الاكليري.  
**التوصيات:** اجراء فحوصات اخرى حول تأثير المواد العازلة المختلفة على صفات سطح مادة الطقم الاكليري مثل الصلادة.

### Abstract:

**Objective:** In order to evaluate the effect of different typed of Separating Medium on the roughness of the fitted tissue surface of acrylic denture base.

**Methodology:** Chosen three types of separating medium (Group A Tin foil), (Group B Detery Isolant),(Group C Cold Mould Seal),used 30 samples of hot cure acrylic resin ,10 samples for each group, after complete curing of these samples , Profilometer device was used to measure the surface roughness of each sample in all groups.

**Results:** Using One Way ANOVA Test and LSD test, the results were highly significant in differences among all groups. Although (Group A) showing lest roughness, (Group B) showing a satisfactory result of roughness, While (Group C) Showing the highest unsatisfactory surface roughness of acrylic denture base.

**Recommendations:** make other studies on the effect of different separating medium on other properties of the fitted tissue surface of acrylic denture base such as hardness.

**Key Word:** Separating Medium, Surface roughness of acrylic denture

## Introduction:

**P**oly (methyl methacrylate) resin has been widely used as a denture base material due to its desirable properties of excellent aesthetics, low water sorption and solubility, relative lack of toxicity, ability to repair, and simple processing techniques<sup>(1,2)</sup>. During prosthodontic steps of processing of acrylic denture base material a separating medium must be used to prevent direct contact between the denture base material and mold surface<sup>(3, 4)</sup>.

Separating medium can be defined as a coating applied to a surface and serving to prevent a second surface from adhering to the first<sup>(2)</sup>, also it is a medium overlying the surface of the material such as plaster, metal, or wax to prevent adhesion between the denture and the other material<sup>(4)</sup>. Also it is used to seal all the pores in the stone model without adding any additional bulk<sup>(5)</sup>.

Separating medium should have qualities of applying in an extremely thin layer as well as not modify the surface to which it was applied<sup>(5)</sup>. Also when separating medium dries it should present a smooth, glazed surface so as to impart a corresponding smooth surface to the tissue surface of the denture base<sup>(3, 4)</sup>, finally it should adhere and dry quickly to the surface which it was applied<sup>(2)</sup>.

A large number of materials used as a separating medium, Tin foil was the first material; it is most effective as a separating medium<sup>(2)</sup>. With time, more materials have been developed to include materials such as alginate solution, sodium silicate (water glass), this material is used only on a plaster surface; it undergoes a chemical reaction

## Materials & Methods:

### *Wax preparations:*

Used base plate wax in order to prepare 30 samples cubic in shape 1cm in dimension,

with plaster but it simply dries to form a shiny surface<sup>(3,6)</sup>. Detergent isolate is another separating medium used in the dental process of acrylic resin only<sup>(4)</sup>. Cold mould seal is another material used as a separating material; it is suitable for both packing, pressing technique and cast moulding, making a tough elastic film which is unbreakable under pressure<sup>(6)</sup>.

Separating medium will prevent water passing from the mold surfaces into the denture base resin, and also prevents free monomer soaking from denture base resin into the mold portion; otherwise this will lead to a compromise in the physical properties, strength, porosity and surface roughness of the processed denture base material<sup>(6, 7)</sup>.

The tissue surface properties of any denture base material is of particular concern as studies of denture base materials have shown a direct link between surface roughness, patient discomfort and the accumulation of plaque and the adherence of *Candida albicans*<sup>(8,9)</sup>. Increased presence of *Candida* species are reported in denture related stomatitis<sup>(8)</sup>. A clinically acceptable threshold level of denture base tissue surface roughness (Ra) is 0.2  $\mu\text{m}$  where no further reduction in plaque accumulation is expected in prosthetic and dental restorative materials need<sup>(6,7,10,11)</sup>.

The surface roughness of dental materials including acrylic denture base materials is influenced by either mechanical polishing techniques for the outer surface of the denture<sup>(12,13,14)</sup> or the quality of separating medium for the tissue surface of the denture<sup>(4,5,6)</sup>.

divided into 3 equal groups according to the separating medium which was used during packing, Group (A) used Tin Foil separating medium, Group (B) used Detergent Isolate separating medium, Group (C) used Cold Mould Seal separating medium.

**Flasking:**

Each samples was put inside the lower half of medium size flask, dental stone (elite stone/Italy) mixed according to the manufacturing instruction, then poured in the lower half in which the level of the stone with the level of the base plate wax samples. After hardening of the first layer of the dental stone the second half of the flask position on the first one and then poured by the second mixed of dental stone.

Wax elimination was done after complete setting of dental stone by placing the flask in boiling water for 20 minutes, then removed from water, open the flask, washing the excess of wax by boiling water, be sure the created mold became clearly clean from any remnants of wax.

**Packing:**

In order to use a standard amount of separating medium inside the created mold in the lower half of the flask (which represents the tissue surface of the denture base) ,0.4 ml of separating medium was used to cover the mold surfaces by a single coated layer for each flask.

- Group A 0.4ml (Tin Foil substitute) coated each mold /10 molds.
- Group B 0.4ml (Detery Isolant) coated each mold /10 molds.
- Group C 0.4ml (Cold Mould Seal) coated each mold / 10 molds.

Poly methyl methacrylate (QD), powder & liquid were mixed together according to manufacturing instruction, till reaching dough stage (when mixture separate from the wall of the container) ADA specification no.12 for denture base resin.

The mixture inserted (packed) into the mold, covered with polyethylene sheet , the two half of the flask closed together& allowed to stand for 5 minutes under hydraulic pressure press 20 bars applied incrementally to allow dough resin to flow evenly throughout the mold, the flask was open , the over flow material with polyethylene sheet were removed, the two halves of the flask closed together & clamped.

Curing done using rapid cycle (90min. at 56C ,then 60min. at 100C° ) by using a thermo-electrically controlled water bath(W&H England) (2).

The samples were removed from the flask and cleaned from stones remnants, Any irregularities , spurs and sharp edge were removed with a tungsten carbide bur (Cross-cut, coarse -ISO No. 5034, Bredent GmbH & Co KG) at 18,000 rpm. All samples were placed and sealed in bags containing 10 ml distilled water.

**Measuring surface roughness:**

The surface roughness values were measured using a profilometer (Stylus Profiler XP-2,) which can measure small surface variations by moving a diamond electronic probe in contact with the surface while moving laterally across the sample. The vertical displacement of the electronic probe is measured as the surface variations.

The Profilometer generated the Ra values for the selected areas of samples in angstroms which were converted into  $\mu\text{m}$  unit. All measurements were carried out by the same researcher.

**Results:**

**Table 1.** representing the roughness ( $\mu\text{m}$ ) of the tissue surface of each samples measured by profilometer.

Table 1. Surface roughness ( $\mu\text{m}$ )

Group A	Group B	Group C
0.187	0.201	0.209
0.186	0.198	0.207
0.185	0.201	0.207
0.185	0.198	0.208
0.188	0.2	0.209
0.187	0.199	0.207
0.185	0.201	0.208
0.187	0.198	0.207
0.186	0.198	0.209
0.187	0.201	0.206

**Table 2.** Descriptive Statistic representing the lowest value (Min), the highest value (Max), the mean values and the Standard Deviation (S.D.) of each group.

Table 2. Descriptive Statistics

Group	No.	Min.	Max.	Mean	S.D.
A	10	0.158	0.188	0.1863	0.001059
B	10	0.198	0.201	0.1995	0.001434
C	10	0.206	0.209	0.2077	0.001059

SD: Standard Deviation, No.=Number, Min=Minimum, Max=Maximum

**Table 3.** One way ANOVA representing the differences between the groups and the differences within the groups.

Table3. One Way ANOVA

	sum of squares	Mean square	Sig.
Between Groups	0.002	0.001	0.000
Within Group	0.000	0.000	0.000

Sig. =level of significance

**Table 4.** representing Post Hoc Test showing the least significant differences (LSD) between the groups.

Table 4. Least Significant Difference

LSD	Mean Difference	Std. Error	Sig.
A	-.013200	.0005353	.000
B	-.021400		.000
A	.013200	.0005353	.000
C	-.008200		.000
B	.021400	.0005353	.000
C	.008200		.000

Std. Error =Standard Error, Sig.= level of significance

### Discussion:

Separating medium can be define as a coating applied to a surface and serving to prevent a second surface from adhering to the first one, Separating mediums are consists of Oil that dispersed in water and their action (separation between different materials ) depends on the high interfacial tension of the medium that separates between the two different matrix<sup>(2)</sup>.

According to the descriptive statistic concerning the mean of each group it can reveal that both( tin foil substitute and detery isolant) can be used as a separating medium during processing and curing of acrylic denture base, while (cold mould seal) failed to act as an acceptable separating medium in relation to the surface roughness of fitted tissue acrylic denture base that became more than 0.2 $\mu$ m which is the highest acceptable clinical level of roughness need no further smoothness<sup>(6,7,10,11)</sup>. These findings have an agreements with (Raja Mahdi Al musawi, 2005) which used Glycerin as a separating medium and compared it with ordinary types of other separating medium, also agree with (Ahklas Zaid Al taie, 2006) which compared olive oil as a separating medium with other types. Both these two researchers found

that cold mould seal offer highest value in relation to surface roughness of acrylic denture base.

According to the inferential statistic that used One Way ANOVE & LSD test to compare between groups found that the comparisim among all groups related to the surface roughness were highly significant in difference, In which (Group A tin foil) provide the best smooth surface (lowest surface roughness) of acrylic after curing these finding agree with (Ahklas Zaid Al taie 2006) ,Although the result between (Group A&B)was highly significant but (Group B,detery isolant) offer a satisfactory result concerning the surface roughness , While the comparisim was highly significant between(Group A&C) AND (GroupB&C).

These findings may be related to three reasons, first one is the viscosity of the separating medium, each material with low viscosity permit to close any voids or porosity found due to the high coefficient of penetration of this material that permit the material to penetrate and close any porous found, the second reasons may be due to good wet ability of the material that permit the separating medium to flow readily along the surface of the gypsum product which demonstrate by the

contact angle of the molecule of separating medium on the stone surface, the third reasons may be due to surface tension of the separating medium after setting which occur due to the adhesion force that found between its

**Recommendations:** make other studies on the effect of different separating medium on

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molecules, high surface tension of separating medium the high sealing and separation between dental stone and acrylic denture base<sup>(2,6,7)</sup>.

other properties of the fitted tissue surface of acrylic denture base such as hardness.

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