

Effect of Two Disinfectant Solutions on Wettability of Flexible Denture Base Material

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الخلاصة

الاهداف: تهدف الدراسة تقييم خاصية ترطيب مادة الطقم المرنة بعد تخزينها لمدة (٧) أيام في اللعاب، اللعاب المصنع، الكلور هكسدين ومادة القاصر. تم تحضير (٦٠) عينة مستطيلة الشكل، احد السطحين تم صقله والأخر ترك بدون صقل. قسمت العينات الى خمس مجاميع حسب نوع محاليل الغمر انفة الذكر فضلا عن مجموعة السيطرة (الماء المقطر). تم قياس زاوية المماس للقطرة على سطحي العينة بعد مرور يوم على عملية الغمر وقراءة أخرى بعد مرور (٧) أيام. اظهرت النتائج ان خاصية ترطيب السطوح الخشنة للعينة اعلى بفرق معنوي من السطوح المصقولة. اظهرت مادة القاصر فقط (من بين محاليل الغمر المستعملة) تأثير سلبي على خاصية ترطيب السطوح المصقولة. اظهرت خاصية ترطيب السطوح المصقولة فقط تأثيرا معنوي بين فترتي الغمر، يمكن الاستنتاج ان السطح الخشن لمادة الطقم المرنة تمتلك خاصية ترطيب أفضل من السطوح المصقولة ولم يكن لفترتي التخزين تأثيرا عليها. مواد التطهير ذات الفاعلية المؤكسدة يمكن ان يكون لها تأثير سلبي على خاصية ترطيب مادة الطقم المرنة.

ABSTRACT

Aims: To evaluate wettability of flexible denture base material after immersion in saliva, artificial saliva, chlorhexidine and sodium hypochlorite for 7 days period of time. **Materials and methods:** sixty rectangular shape sample of flexible denture base material were prepared with one surface polished and another surface unpolished. These samples were stored in the previously mentioned four solutions in addition to the distilled water as a control group for 1 day and 7 days. Contact angle (parameter of wettability) were measured on both surfaces after each storage periods (1- day and 7 days). The statistical analysis to the data was performed using ANOVA and Duncan Multiple Range Test. **Results:** The results revealed that the wettability of unpolished flexible denture base material is significantly more than the polished surface. Sodium hypochlorite had significantly decrease the wettability of polished surfaces. Periods of storage had significant effect only on the wettability of polished surfaces rather than unpolished surfaces. **Conclusions:** Wettability of unpolished surface of flexible material is better than the wettability of the polished surface. The storage periods have no effect on the wettability of unpolished surface. Disinfectant solutions that have oxidizing effect (sodium hypochlorite) has a worsening effect on the wettability of flexible denture base materials.

Key words: Wettability, Flexible, Chlorhexidine, Sodium Hypochlorite

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INTRODUCTION

Nylon is a generic name for certain types of thermoplastic polymers. The use of nylon as a denture base material has been described in the literatures in the 1950's^(1,2). It can be used for the fabrication of temporary partial dentures or small to medium size full removable dentures as well as occlusal splint and night guards.⁽³⁾ For good adhesion of the denture to the supporting tissues, the saliva or saliva substitute must flow easily over the entire surface. The ability of a denture material to be wetted gives an indication of the degree to which the lubricating effect of saliva will be enhanced, thereby promoting denture retention and patient comfort⁽⁴⁾

Wettability of denture base and denture relining materials is one of the most important properties for denture retention because it provides a condition in which saliva will

spread over the surfaces with ease. Contact angle has been highlighted as the most important parameter concerning wettability of denture base materials.^(5,6)

It has been reported that the tissue surfaces of dentures should not be polished⁽⁷⁾.

This is probably because the fit the dentures to the alveolar ridge mucosa in the defective area is thought to deteriorate due to the polishing of the tissue surface. However, it has been reported that the wettability of a solid material is influenced by the surface roughness of the solid material.⁽⁸⁾

Chemical cleansing is recommended for denture plaque control.^(9,10) Chlorhexidine is recommended as a chemical cleansing agent to reduce the pathogenicity of the micro-organisms present on the surface of complete denture resulting in clinical improvement of the denture stomatitis lesions and in

controlling *Candida* species and streptococcus of the denture plaque.⁽¹⁰⁾ Sodium hypochlorite is one of the earliest and most widely used disinfectant.⁽¹¹⁾ It can be a bactericidal and fungicidal, because it acts directly on the organic matrix of the plaque resulting in dissolution of the polymer's structures.⁽¹²⁾

In spite of that, some denture cleaners may have harmful effects on the plastic and metallic components of the denture and it may in turn have an effect on wettability of denture base material.^(3,13,14) Contact angles are the characteristic constant of liquid/Solid system and provide valuable information on the surface energies of solids.⁽¹⁵⁾ The degree of wetting corresponds to the surface energy of the material, and the drop contact angle varies inversely with its wetting capability.⁽¹⁶⁾

The aims of the present study are to evaluate the wettability of flexible denture base material both polished, and unpolished surfaces after two periods of immersions (1 day and 7 days) in saliva, artificial saliva, chlorhexidine and sodium hypochlorite.

MATERIALS AND METHODS

The samples prepared from flexible denture base material (Valplast thermoplastic Nylon, China) were rectangular in shape (30*20*3± 0.03 mm) length, width and thickness respectively. Sixty samples were prepared; and were incubated in distilled water at 37±1°C for two days for conditioning (ADA specification No.12)⁽¹⁷⁾ The samples were grouped according to type of immersing solution (each group 12 samples), as follow:

Group I: The samples were stored in distilled water (for 7 days).

Group II: The samples were stored in human saliva (for 7days). Unstimulated saliva that was collected from a healthy donor, it was clarified by centrifugation at 10,000 cycle for 10 min.⁽¹⁸⁾

Group III: The samples were stored in fusayama artificial saliva (for 7 days). The solution of artificial saliva was prepared by mixing: NaCl2 (0.4g); KCl2 (0.4g); CaCl2H2O (0.795g); NaH2Po4 (0.6g) and Na2S.9H2O (0.005g) and urea (1.0g) in distilled water(1000ml).⁽¹⁹⁾

Group IV: The samples were stored in 0.5% sodium hypochlorite (for 7 days).

Group V: The samples were stored in 0.2% chlorhexidine glucuronate (for 7 days).

This long period of immersion (particularly for sodium hypochlorite and chlorhexidine) represents the cumulative effect of repeated short immersion of the dental prosthesis during its life service.⁽²⁰⁾

Flexible (valplast) samples preparation

Flexible resin samples were prepared in mold made by investing a hard elastic foil (30*20*3±0.03mm) length, width and thickness respectively, in dental stone(Whip-mix corporation, Louisville, USA). AL-Tahho⁽²¹⁾ method for packing and curing of flexible denture base samples were followed to prepare the samples of this study. After deflasking, the sprues were cut by metal disks, then any irregularities were smoothed by titanium bur (small gage) then by rubber bur and finally by water prove sand paper (400). One surface of the sample was polished (to simulate the polished surface of the denture) by brush and pumice then by cotton wheel and rouge.⁽²¹⁾

Contact angle measurement

Contact angle (CA) measurement were performed after storing the samples for 1-day and then the same measurement was repeated after 7 days immersion. Contact angle was measured on both surfaces of each samples, the polished surface and unpolished surface (represent the tissue surface). The measurement of the contact angle was performed by a sessile drop method,^(5,6) contact angle measurement was calculated by dropping 15µl of deionized water applied with micropipette (TopPette Single Channel Pipetto DRACON MED DS8I873, China) on sample surface 2 cm above the surface, the images of 3 drops on polished surface were captured and the images of another 3 drops on the unpolished surface of each sample were also captured using a digital camera 18.2 Mega pixel (DSC- HX200 V Sony Japan) situated at distance of 20 cm from pipette tip. Contact angle (CA) degree Figure (1), was measured using Auto CAD 2008.18. CA measurement was recorded between the tangent line and the resin surface.⁽⁵⁾ Each CA degree of each surface represents the mean of 3 angles.

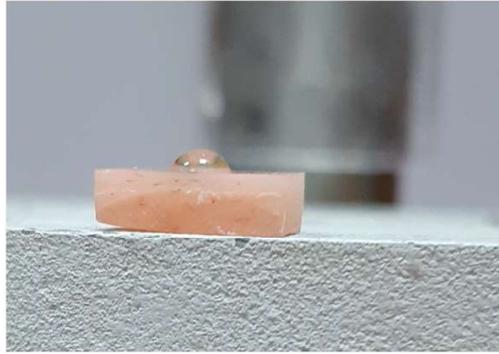


Figure (1): Drop of deionized water on flexible denture base sample

Statistical analysis to the data was performed by the use of one Way Analysis of Variance, Duncan Multiple Analysis Range Test and T test.

RESULTS

One Way Analysis of Variance was carried out between the mean CA values of samples stored for I day to evaluate the significance of differences as shown in Table(1).

Table (1) : ANOVA of mean contact angle of 1-day storage

	Sun of squares	df	Mean square	f	Sig.
Between group	8156.342	9	906.260	19.893	0.000
Within group	5011.250.	110	45.557		
Total	13167.592	119			

The result of ANOVA test showed that there were significant differences between them. One Way Analysis of Variance was also carried out between the mean CA values

of samples stored for 7 days to evaluate the significance of differences as shown in Table (2).

Table (2) : ANOVA of mean contact angle of 7-day storage

	Sun of squares	df	Mean square	f	Sig.
Between group	6243.008	9	693.668	9.968	0.000
Within group	4452.917	110	40.481		
Total	10695.925	119			

The result of ANOVA test showed that there were significant differences between them. Duncan Multiple Analysis Range Test was carried out to study the differences in wettability between the polished and unpolished surfaces for groups that were stored for I day. The results of this test as shown in Figure (2) revealed that the mean CA values of the unpolished surfaces of groups stored in the immersion solutions (distilled

water, saliva, artificial saliva, chlorhexidine and sodium hypochlorite) were (67.3, 53.3, 61.00, 47.8 ,54.1 respectively) while the mean CA values of the polished surfaces of groups stored in the immersion solutions were (71.7, 67.3, 63.7, 69,00, 74.00 respectively), which were significant to all groups except group of distilled water and artificial saliva which were insignificant.

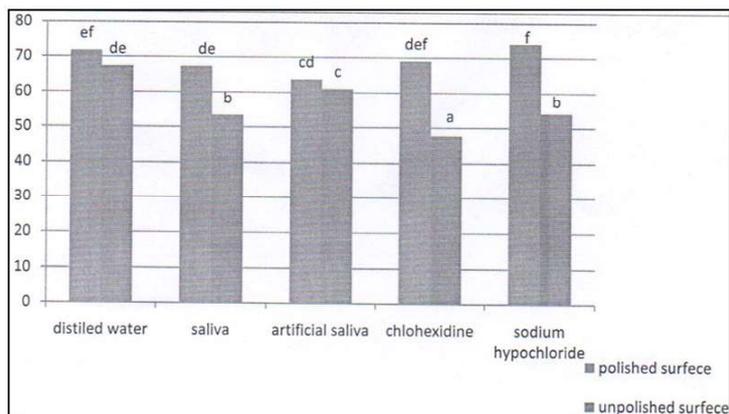


Figure (2): Differences of contact angle values between polished and unpolished groups stored for 1 day

Duncan Multiple Analysis Range Test was carried out to study the differences in wettability between the polished and unpolished surfaces for groups that were stored for 7 days. The result of this test as shown in Figure (3) revealed that the mean CA values of the unpolished surface of groups stored in the immersion solutions were (59.4, 55.3, 53.9, 49.9, 55.1 respectively), which was significant in sodium hypochlorite group only. In the same Fig there were significant

differences between mean CA values of samples stored in artificial saliva, chlorhexidine and sodium hypochlorite when compared with the control group (distilled water). This means that the wettability of polished surface of the samples stored in artificial saliva and the wettability of both polished and unpolished surfaces stored in chlorhexidine showed improvement; while the wettability of the polished surface of samples stored in sodium hypochlorite showed worsening.

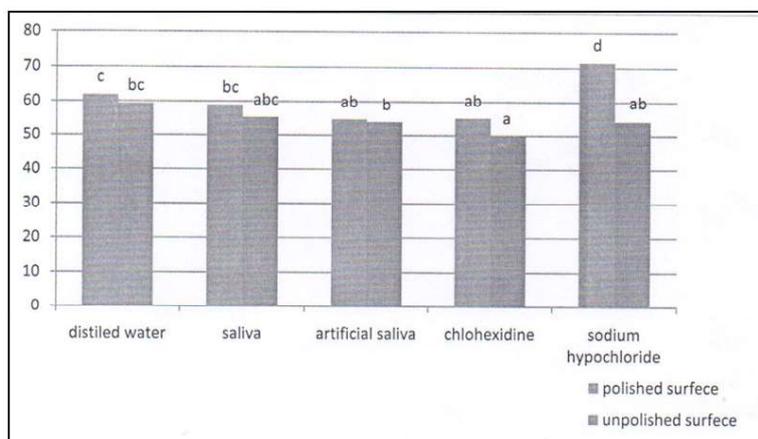


Figure (3): Differences of contact angle values between polished and unpolished groups stored for 1 week.

The highest mean CA value was observed in polished surfaces of the samples stored in sodium hypochlorite for 1 day (74.00) while the lowest mean CA value was observed in unpolished surfaces of samples stored in chlorhexidine for 1 day (47.8); as shown in Fig (2).

T-test was carried out to study the mean of storage periods on the wettability of polished and unpolished surfaces. Table (3) revealed significant differences in the mean CA values of polished surfaces between both storage periods.

Table (3) : T-test of mean contact angle values of polished surfaces of all groups stored for both storage periods

Mean CA * values	t-value	df	Sig.	
1day-7days	-8.75000	-7.570	59	0.000

* Means contact angle.

Table (4) showed insignificant differences in mean CA values of unpolished

samples between both storage periods.

Table (4) : T-test of mean contact angle values of un polished surfaces of all groups stored for both storage periods

Mean CA * values	t-value	df	Sig.	
1day-7days	-0.93333	-0.662	59	0.511

* Means contact angle.

DISCUSSION

Wettability of the denture base materials are important, because it is suggested that the saliva will spread over their surfaces, forming a lubricant layer for extra comfort. Reduced wettability has disadvantages in terms of comfort and retention.⁽¹⁵⁾ The results of this study showed that the wettability of the tissue surface (unpolished) was significantly more than the wettability of the polished surfaces as shown in Figure (2 and 3), these results agree with Nishioka et al⁽²³⁾ and DeZhou and Hosson.⁽²⁴⁾ Increases in the surface roughness of solids increases the surface area, and the affinity of solids with liquid is enhanced⁽²⁵⁾ De zhou and Hosson⁽²⁴⁾ also concluded that increases surface roughness of AL203 has significant decreasing in CA values.

The lowest mean value was observed in unpolished surfaces of samples stored in chlorhexidine for 1-day Figure (2). While the highest mean contact angle values were observed in polished surfaces of samples stored in sodium hypochlorite for 1- day too Figure (2). When compared this result with results of AL-Nema⁽²⁶⁾ we can find that (with in the limit of this study) the wettability of flexible denture base material was better than the wettability of visible light cured resin and it was less than the wettability of heat cured resin denture base material.

The effectiveness of sodium hypochlorite and chlorhexidine as denture cleansers and anti-fungal agents were studied by many researchers.^(9,10,14,27) Storing the flexible denture base samples in chlorhexidine and artificial saliva results in improving in the wettability Figure (3). These results agree with the results of AL-Nema⁽²⁶⁾ and Sharma and Vidya.⁽²⁸⁾

Sodium hypochlorite causes worsening effect on the wettability especially the polished surface Figure (3). This may be attributed to the differences in their effect on the surface of the samples. Sodium hypochlorite has a strong oxidizing property,^(17,29) the elaborated oxygen causing bubble entrapment the fluid drops lead to increasing in CA values.

the effect of storage time on wettability was significant on polished surface only, Table (3 and 4). Accordingly, the wettability of the tissue surface of flexible denture base was not affected.

CONCLUSION

Within the limits of this study we can conclude that:

- The wettability of unpolished surfaces (tissue surface) were better than the wettability of the polished surfaces.
- Polishing the tissue surface of the denture may has worsening effect on the wettability and then the retention of the denture.
- The oxidizing solution (sodium hypochlorite) has a worsening effect on the wettability of the flexible resin denture base material.
- Storage period have no significant effect on the wettability of the tissue surface of flexible denture base.

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Wettability of flexible denture base material

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