

Evaluation of Microleakage of Soft Liners to Highly Impact Acrylic Resin

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الخلاصة

الأهداف: تهدف هذه الدراسة لتقييم التسرب الدقيق لأربع أنواع من المادة الطرية المبطنة (فيرتكس , مولوبلاست ب, بوني بلاس , سيليكون بروميديكا) بمعاملات سطحية مختلفة (اسيتون و مونومير وليزر) لافترات عديدة. **المواد وطريقة العمل:** تم تحضير مئتان واربعون عينة للتسرب الدقيق متكونة من جزئين :جزء الراءتج الاكريلي المقاوم للكسر قطر (30) سم ويتخن (2) ملم ومن المادة الطرية قطر (30) سم ويتخن (2) ملم العينات للتسرب الدقيق غمست بالخلول خزنت لثلاث فترات لمدة اسبوع ولشهر وبدورات التخزين الحراري بداخل صبغة الميثيلين الأزرق 2% في 600 دورة. **النتائج:** أظهرت النتائج هذا البحث عند (المولوبلاست ب و فيرتكس) اقل المواد تسربا خلال الاسبوع وخلال الشهر بدون دورات حرارية و (فيرتكس) اقلها خلال الشهر الاول ومعاملة سطح قاعدة الطخم بالاسيتون والمونومير اعلى قيمة من باقي معاملات السطوح بالاسبوع بينما في الشهر و بدون دورات حرارية وبدورات حرارية لا يوجد فرق معنوي **الخلاصة:**المادة المبطنة (فيرتكس) له اوطا قيمة بعد فترات مختلفة من التخزين .

ABSTRACT

Aims: To evaluate the microleakage of four types of soft Liners materials (Vertex, Molloplast B, Bony plus and Silicon promedica) with different surface treatment: acetone, monomer, and laser at different period of storage to highly impact acrylic resin. **Materials and Methods:** Two hundred and forty specimens for microleakage have been prepared, each specimens consists of two parts: acrylic resin denture base part (30mm) diameter, (2mm) thickness of acrylic resin and (30mm) diameter, (2mm) thickness of soft liners. Soft denture liners bonded to three different groups of surface treatment: acetone, monomer, laser treated to denture base resin. Microleakage specimens underwent three aging procedures: storage at one week, one month without thermocycling and one month with thermocycling inside 2% methylen blue dye in 600 cycles. **Results:** The results showed that microleakage of Vertex and Molloplast_B in one week and in one month without thermocycling were the lowest value from the other types, in one month with thermocycling the vertex was the lowest of microleakage than others. Treating the surface of denture bases with acetone and monomer had the highest value of microleakage from other types of surface treatment in one week, while in one month without thermocycling and one month with thermocycle, there were no significant difference in microleakage among the different types of surface treatment of acrylic resin. **Conclusions:** Permanent soft liner of acrylic type (vertex) had the lowest values of microleakage after different periods of storage and thermocycling.

Key words: soft liner, microleakage, acetone.

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INTRODUCTION

Soft liners defined as soft, resilient materials forming a cushioned layer between the hard denture base and the oral mucosa⁽¹⁾. Microleakage is a major factor effect the bond of a materials and microbial accumulation. The success of the materials depends on the ability to prevent leakage^(2,3). Thermal cycling promotes leaching out of unpolymerized ingredient components and cause leakage of materials.⁽⁴⁾

Polymethylmethacrylate used in dental

prosthetic device for almost 70 years. Three fundamental feature have contributed for its success

- A . Excellent appearance
- B . Easiness of repair
- C . Simple processing.⁽⁵⁾

Because of the risk of fracture if patients drop their dentures, high impact strength is a desirable property. Given the function of a denture base in a removable prosthesis, high flexural strength, flexural modulus, and a large yield point distance

would help resist torsional forces in function, leading to a longer clinical service life for the prosthesis.⁽⁶⁾ The elastomers added to PMMA act as a plastifying agent, the addition of elastomers to the material increase the ability of absorb-energy and over come the possibility of resin fracture.^(7,8)

Anil *et al.*,⁽⁹⁾ carried out a study involved the specimens prepared from (Molloplast –B, Mucopren, Ufigel P, Flexor, Tokuyama, Simapa) and stored in accelerated weathering tester and immersed in radioisotope solution (⁴⁵Ca). The microleakage properties of Molloplast –B, Mucopren and Ufigel P decrease after aging, but not affected on microleakage properties of Flexor, Tokuyama, Simapa.

This research was aimed to evaluate the microleakage of four types of soft liners (Vertex, Molloplast B, Bony plus and Silicon promedica) to highly impact acrylic resin with different surface treatment at different periods of storage.

MATERIALS AND METHODS

In this research we used four types of soft liners Vertex (Heat-curing acrylic type soft liner, Netherlands), Molloplast-B (Heat-cured silicon type soft liner, Dentax, Germany), Bony plus (self-curing soft liner, Switzerland), Silicon Promedica (self-curing soft liner, Germany) and High impact Acryl (Heat-curing resin, Netherlands).

The total number of specimens were two hundred and forty, sixty specimens of each type of soft liners materials were prepared and divided into four basic groups; according to the type of denture base surface treatment (untreated (control), acetone, monomer and laser), the total number of specimens of each group n= 15, A 2% methylen blue dye was used as medium for microleakage indication. After preparation of specimens the acrylic specimen design 30mm in diameter, 2mm in thickness of acrylic specimens and 2mm in thickness of soft liners for microleakage test shown in Figure (1).

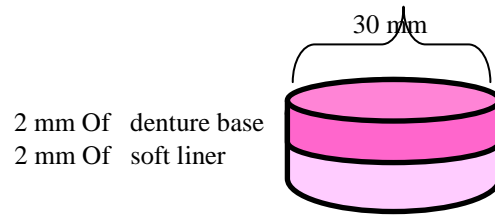


Figure (1): Specimen of microleakage test.

There were three types of denture base surface treatment in this study including: surface treatment with acetone, monomer (methylmethacrylate) and laser, acetone was performed by fine brush saturated with (acetone) for 60 second.⁽¹⁰⁾ Another group of surface treatment was performed by fine brush saturated with monomer for 180 second^(11, 12, 13) and the last group of surface treatment was the CO₂ laser (laser machining, Inc, China.) which had a continuous plus with a wave length 10.6 mm for 15 seconds on the surface of the denture base⁽¹⁴⁾ user wear of eye glass to protect the eyes from light hazard and made a fine holes on the surface of denture base by a metal mesh.

Specimens were immersed in methylen blue dye in plastic containers inside an incubator (Memmert, Germany) at 37±1°C. The stored specimens were divided into three groups (one week, one month without thermocycling and one month with thermocycling). This procedure was performed by subjecting the specimens into two isolated containers to 5±1°C and 55±1°C for thirty seconds and the number of the cycles employed were 600 cycles.

At the end of thermocycling procedure and storage periods. The specimens were removed from the dye, washed thoroughly with water and dried. The specimen divided by four diameters into eight equal pieces, after fixing each specimen by a special bench fixing device, it was sectioned according to the drawing lines by a slow speed, portable engine hand piece (W&H Dental, Austria) using a diamonds sectioning disc with water cooling using a disposable needles.

The microleakage value was measured by linear penetration of methylen blue dye from the edge of soft denture liner/denture base interface toward the point of dye pe-

netration by the aid of a stereoscopic microscope (Hamilton, ENGLAND) at a magnification of 80X.(Figure 2)



Figure(2): Stereoscope microscope

Then capture a picture by a digital camera (12 Mega pixel) and then dye penetration evaluated by Auto-CAD soft ware, and measured in millimeter Figure(3).

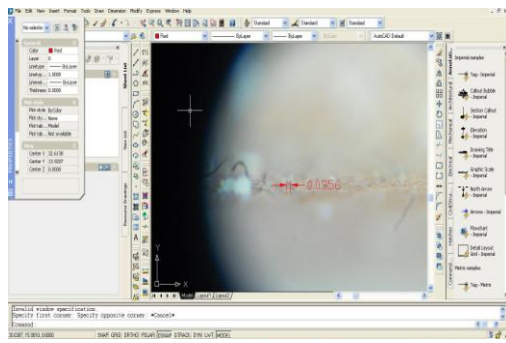


Figure (3): Auto-cad copmertrized soft ware

The sections were identified, fixing on microscope slides and examined for microleakage separately. Eighty readings were reviewed on each specimens per

group, yielding forty points per groups. This is was undertaken because the accuracy of leakage study based on a single section may be negligible.⁽¹²⁾

Statistically: the results were analyzed by descriptive analysis, One way analysis of variance (ANOVA) test, Duncan's multiple range test.

RESULTS

Linear microleakage evaluation of four types of soft liners (Vertex Molloplast-B, Bony plus and Silicone promedica) bond to highly impact acrylic denture base material stored after one week, one month without thermocycling and one month with thermocycling in Figures (4, 5 and 6) demonstrated the Mean \pm standard deviation in millimeter of microleakage values for each soft liner to denture base after one week,one month without thermocycling and one month with thermocycling.

One way analysis of variance (ANOVA) test was shown in Tables (1, 2and3) and Duncan's multiple range test Figures (4, 5 and 6) demonstrated that there was a significant difference at $p \leq 0.05$ in the microleakage for the four types of soft liners (Vertex, Molloplast_B, Bony plus and Silicone promedica) after one week, one month without thermocycling and one month with thermocycling.

Table (1): (ANOVA) of microleakage in (mm) of four types of soft liners after one week storage.

SOV	SS	Df	MS	F-value	p-value
Between Groups	22.113	3	7.371	31.987	0.000*
Within Groups	17.513	76	0.230		
Total	39.627	79			

Table (2): (ANOVA) of microleakage in (mm) of four types of soft liners after one month storage without thermocycling.

SOV	SS	Df	MS	F-value	p-value
Between Groups	11.766	3	3.992	30.123	0.000*
Within Groups	9.895	76	0.130		
Total	21.661	79			

Table (3): (ANOVA) microleakage in(mm) of four types of soft liners after one month storage with thermocycling.

SOV	SS	Df	MS	F-value	p-value
Between Groups	7.351	3	2.510	13.474	0.000*
Within Groups	14.158	76	0.186		
Total	21.689	79			

In Figures (4) showed that the Vertex and Molloplast-B soft liners had significant lowest mean value of microleakage

while the Bony plus and Silicone promedica had significant highest mean value of microleakage.

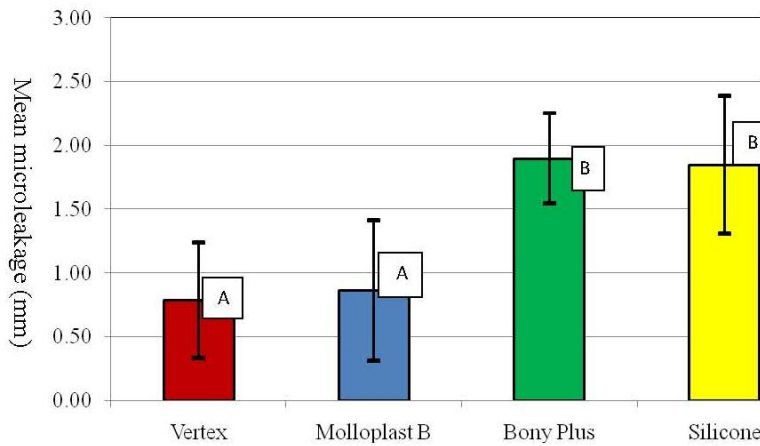


Figure (4): Mean ± standard deviation and Duncan's multiple range test of microleakage values in (mm)for comparison of different types of soft liners after one week storage

In Figures (5) showed that the Vertex and Molloplast-B soft liners had significant lowest mean value of microleakage

while the bony plus had the highest mean value of microleakage.

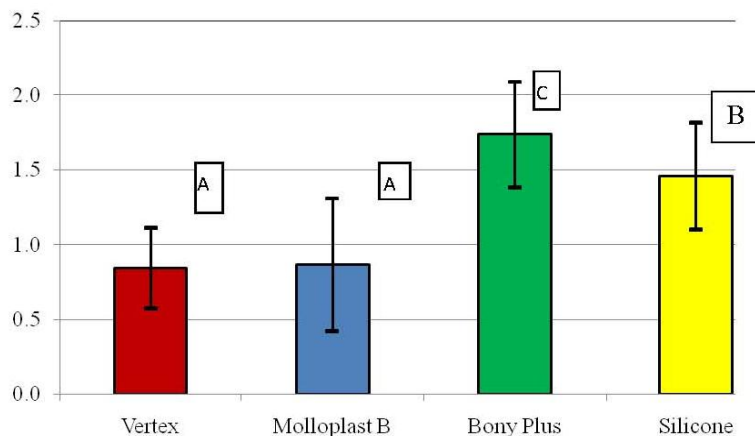


Figure (5): Mean ± standard deviation and Duncan's multiple range test of microleakage values in(mm) for comparison of different types of soft liners after one month storage without thermocycling .

In Figures (6) showed that the Vertex soft liners had significant lowest mean value of microleakage while the Mollop-

last-B , Bony plus and Silicone promedica had the highest mean value of microleakage.

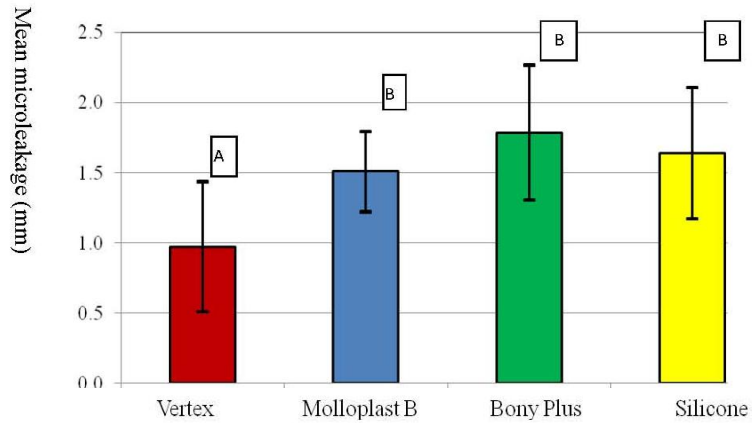


Figure (6): Mean \pm standard deviation and Duncan's multiple range test of microleakage values in(mm) for comparison of different types of soft liners after one month storage with thermocycling

One way analysis of variance (ANOVA) test as shown in Tables (4 and 6) and Duncan's multiple range test (Figures 7 and 8) demonstrated that there was a sig-

nificant difference at $p \leq 0.05$ of microleakage for the four types of surface treatment after one week and one month with thermocycling.

Table (4): (ANOVA) of microleakage in(mm) of four types of surface treatment after one week storage.

SOV	SS	df	MS	F-value	p-value
Between Groups	4.388	3	1.463	3.155	0.030*
Within Groups	35.238	76	0.464		
Total	39.627	79			

Table (6): (ANOVA) of microleakage in(mm) of four types of surface treatment after one month storage with thermocycling.

SOV	SS	df	MS	F-value	p-value
Between Groups	3.889	3	1.296	5.535	0.002*
Within Groups	17.800	76	0.234		
Total	21.689	79			

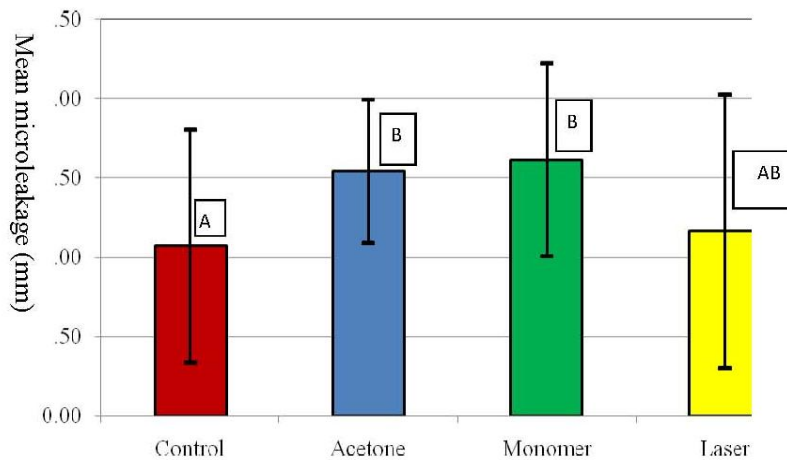


Figure (7): Mean \pm standard deviation and Duncan's multiple range test of microleakage values in (mm) for comparison of different types of surface treatment after one week storage .

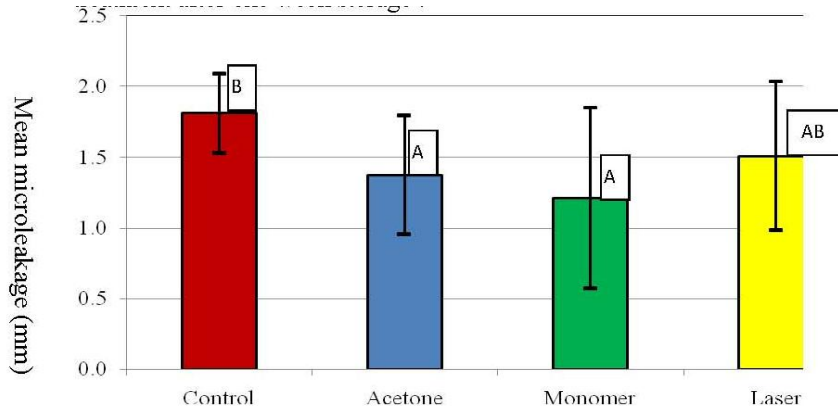


Figure (8): Mean \pm standard deviation and Duncan's multiple range test of microleakage values in(mm) for comparison of different types of surface treatment after one month storage with thermocycling

One way analysis of variance (ANOVA) test as shown in Tables (5) demonstrated that there was no significant differ-

ence at $p \leq 0.05$ of four types of surface treatment.

Table (5):(ANOVA) of microleakage in (mm) of four types of surface treatment after one month storage without thermocycling.

SOV	SS	df	MS	F-value	p-value
Between Groups	0.583	3	0.194	0.701	0.555
Within Groups	21.078	76	0.277		
Total	21.661	79			

Table (4) and Figure (7) showed that the control (untreated surface) has significant lower mean value than acetone and monomer surface treatment. In Table (6) and Figure (8) demonstrated that the control (untreated surface) had significant highest mean values of microleakage.

DISCUSSION

In this research a highly impact acrylic was used ,the presence of the woven fibers in high impact acryl and the solvent based bonding enhance the bond strength by swelling of the surface and improving wet-tability, solvents clean the surface from environmental pollutants and disperse loose particles covering the substrate surface⁽¹⁵⁾.

In Tables (1, 2and 3) and Figures (4,5 and 6) ,the heat cured soft liners (Vertex and Molloplast-B) showed the lowest microleakage values than other soft liners.

An explanation was that due to the increased polymerization of these soft liners which was thought to provide an increasing the resistance to debonding and improved mechanical and physical properties.^(16,17)

Bony plus soft liner showed the highest microleakage and that related to the fact that the self cured acrylic resin soft liner was leach out of plasticizer and the loss of ethanol was thought to be the cause of water sorption, solubility and microleakage behavior. This results came in agreement with other studies.⁽¹⁸⁻²²⁾

Microleakage values after thermocycling showed Molloplast-B and self curing soft liners had significant of greatest microleakage, due to the effect of the temperature changes in properties of the silicon-based liners and self curing soft liners, these soft liners showed an increased f microleakage value.^(19,23) In Table(4) and Figure (7)

showed significantly highest microleakage of the acetone and monomer surface treatment. A possible explanation was that during the immersion in the dye, the acetone and monomer would exhibit out from the surface of denture base and enter the dye between the junction liner, the effect of the polarity of the two solution increased the microleakage.⁽²³⁾ Also the lower bond strength between the denture base and soft liners after treatment might due to stress occurring at interface of PMMA/soft liners junction by surface treatment which increased the microleakage.^(24,25)

In Table (6) and Figure (8) showed significantly lowest microleakage of the surface treated group. A possible explanation is that after a period of storage the presence of woven fiber in the acrylic resin enhance the bond strength between the soft liners and surface treated denture base⁽¹⁵⁾, this result is an agreement with other studies.⁽¹¹⁻¹³⁾

CONCLUSIONS

Treating the surface of denture bases with acetone and monomer had the highest value of microleakage from other types of surface treatment in one week. For all types of soft liners the Vertex and Molloplast-B were the best soft liners for reducing of microleakage in one week and the Vertex had the lowest microleakage in one month without thermocycling and in one month with thermocycling. The surfaces treatment varying in affected in microleakage value. The surface treatment of denture base with acetone and monomer were highest values of microleakage than other surface treatment at one week while untreated (control) and laser surface treatment were the lowest value than others at one week.

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