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The Effect of Denture Base Surface Treatments on Microlekage of Soft Lining Materials

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ABSTRACT

Aims: To evaluate the effect of two acrylic resin denture base surface trearments on microleakage of 4 soft denture lining materials (Tru–soft, Bony plus, UfiGel–P and Molloplast–B after 2 periods of storage and thermalcycling. **Materials and methods:** One hundred eighty specimens for microleakage were prepared in a disc shape 30 mm diameter and 4 mm thickness (2 mm for acrylic resin part and 2 mm for soft lining material part). Soft lining materials were bonded to three different groups of acrylic resin surface pretreatments (untreated, sandblasted and monomer treated denture base). These specimens underwent two aging procedures: Storage with two periods (one week and one month), and 500 cycles of thermalcycling inside **2**% methylene blue dye. **Results:** Statistical analysis showed that treating the acrylic resin denture base by sandblasting increased microleakage of silicone–based linings (UfiGel–P and Molloplast–B)and decreased microleakage of acrylic–based linings (Tru–soft and Bony plus) in comparison to untreated denture base, while treating the denture base with MMA monomer positively decreased microleakage for all tested soft lining materials in relation to untreated and sandblasted denture base at one week storage, one month storage and at thermalcycling. **Conclusions:** For all types of denture base surface treatments, microleakage was inevitable, however, wetting the acrylic resin denture base with MMA monomer was more effective in reducing microkeakage than sandblasted and untreated denture bases.

Key Words: Microleakage, surface treatments, soft lining materials.

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INTRODUCTION

The use of soft denture lining materials is helpful in fabricating removable complete and partial dentures because of their ability to alleviate inflamed mucosa, resulting in a more equal distribution of functional load on denture–bearing tissues and improving the retention of the prosthesis [(1)], but these materials fail for many reasons, one of them is de–bonding of the lining material from the denture base which may be attributed to the microleakage between them [(2)].

Microleakage defined as: The clinically undetectable passage of bacteria, fluids, molecules and even air between a cavity wall and a restorative material applied to it, this occurs because of a microscopic gap at the interface between the two different materials [(3)]. The longevity of soft denture lining materials is a major problem since these materials are highly sensitive to oral fluids, therefore; Effective bonding of these materials to the denture base is important for their success [(4)].

As the microleakage is the early sign of a weakened bond [(5)], the bonded surface of the denture base appears to be the most important predictive variable of bond strength and microleakage inhibition [(6)]. A roughened acrylic resin denture base by sandblasting was preferred by some investigators to improve the adhesion to a soft lining material [(7 and 8)], while methyl methacrylate monomer treatment of the acrylic resin denture base was preferred by others as such pretreatment dissolves some of the outer poly methyl methacrylate network and helps to allow a soft lining material to penetrate deeper into the denture base and produce a more intimate contact and reduction of microleakage [(5, 9)].

MATERIALS AND METHODS

Four soft denture lining materials (Bony plus, self cured acrylic based, Lietchtenstein, Switzerland), (Tru–soft, self cured acrylic based, Bosworth, USA), (UfiGel–P, self cured silicone based, VOCO, Germany) and (Molloplast–B,heat cured silicone based, Detax Gmbh, Germany) were used, micro-leakage specimens consisted of 180 speci-mens bonded in butt–joint design to the acr-ylic resin denture base, each specimen was a disc shape 30 mm diameter and 4 mm thickness (2 mm acrylic resin part and 2 mm soft lining material part). A clear heat cured acrylic resin (Quayle Dental, England) was prepared by packing a dough acrylic into a stone mold that was previously prepared after removal of a spacer, Figure (1). Processing was carried out in a water bath at 70°C for 30 minutes and rised to 100 °C for 30 minutes according to manufacturers instr-uctions.

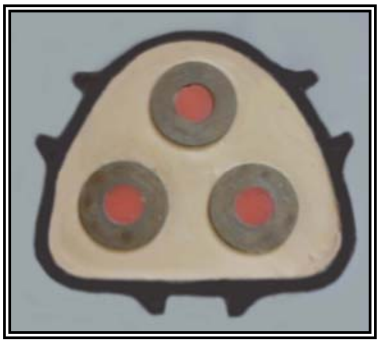

Figure (1): Stone mould for acrylic resin denture base preparation

Two groups of acrylic resin denture base surface treatments were choosen besi-des untreated denture base, these were: Sandblasting group in which the acrylic res-in denture base specimens were abraded in a sandblasting machine (Gerdent, Syria) using 250 μm aluminium oxide particles at a pressure of 6 bar and a monomer treated group in which the specimens of denture base were wetted by a cotton tipped appli-cator saturated with MMA monomer three times for 180 seconds.

Tru–soft and Bony plus (self–cured soft lining materials) were applied by using a split mold (4 mm thickness and 30 mm diameter), Figure (2).

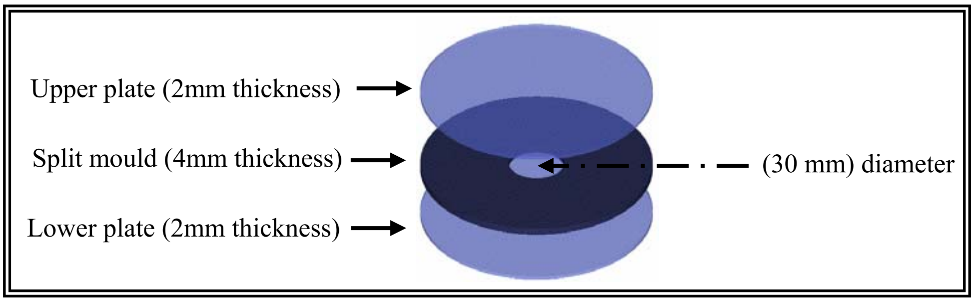

Figure (2): Split mould for microleakage specimen preparation

Pre–cured denture base was placed in the mold occuping 2 mm of it's thickness, the remaining 2 mm was filled with Tru–soft and Bony plus materials that were applied by mixing the powder and the liquid according to manufacturers instruct-tion, the split mold was placed between two plates to extrude excessive material. Ufi Gel–P lining material was applied to a stone mold in a denture flask after removal of spacers, Ufi Gel–P adhesive was app-lied with a brush to the bonded surface of the denture base and erated for 1 minute, then bubble free equal lengths of the base and catalyst were mixed for 30 seconds and applied on the denture base, after setting of the lining material, Ufi Gel–P sealer was applied on the surface of the lining material according to manufacturers instruction.The flasks were pressed and placed in a water bath at 45 °C for 15 minutes, then they were bench cooled and opened, any excessive material was trimed by a surgical blade.

Molloplast–B lining material was applied also to a stone mold in a dental flask after removal of the spacer by the aid of a clean wax knife and disposable gloves that were worn during the whole procedure. The flasks were placed in the water bath which was heated up slowly to 100°C. Polymerization in boiling water at 100°C for two hours was performed according to manufacturers instructions, after bench cooling the flasks and the specimens were removed, any excessive material was trimmed by a surgical blade.

In this study 2% methylene blue dye was used as a medium for the microleakage determination. Microleakage specimens were divided into two groups: One group immersed in the dye in an incubator (Memmert, Germany) at 37 ± 1°C to simulate the temperature of the oral cavity and this group subdivided into two storage periods (one week and one month). The other group was thermalcycled by subjectting the specimens in 2 isolated containers to 5 ± 1ºC and 55 ± 1ºC for 30 seconds in each container and the number of cycles employed was 500 cycles.

After thermalcycling and storage, the specimens were removed from the dye, washed thoroughly and dried, each specimen was divided by 4 diameters into 8 equal pieces, so it yeilds 8 areas of microleakage readings per specimen. The division of the specimens was marked by drawing lines with a permanent ink inorder to section them according to these lines using a slow speed hand piece (W& H Dental Werk, Austria) with a diamond sectioning disc and water cooling by the aid of a disposable needle.

Microleakage values were measured by linear penetration of methylene blue dye from the edge of the soft lining material/ denture base interface toward the point of dye fading by the aid of a stereoscopic microscope (Carl Zeiss, Germany) at 40 X magnification, Figure (3); and the microleakage value was recorded in millimeter. Eight readings were viewed on each specimen, this was undertaken because the accuracy of microleakage based on a single section may be negligible [10].

Figure (3): Steroscopic microscope at 40X magnification

RESULTS

Microleakage values of the tested soft lining materials that were bonded to three denture base surface treatments were analyzed at each aging group separately (one week storage, one month storage and thermalcycling). At one week storage and at one month storage, the microleakage values were given in Figures (4 & 5). The 2–way ANOVA (Tables 1 & 2) indicated insignificant differences between groups, but lower microleakage values occured in the monomer treated group, and the Molloplast–B had the lowest values at one week and one month storage respectively. The highest microleakage values occurred in untreated group of Tru–soft at one week and one month storage respectively. In thermalcycling group, the mean microleakage values were given in Figure (6), and 2–way ANOVA (Table 3) indicated a significant difference ($P \leq 0.001$), there was an increase in microleakage than one week and one month storage, but again the lowest values of microleakage occurred in monomer treated group for all the tested soft lining materials and the highest one occurred in untreated group of Tru–soft.

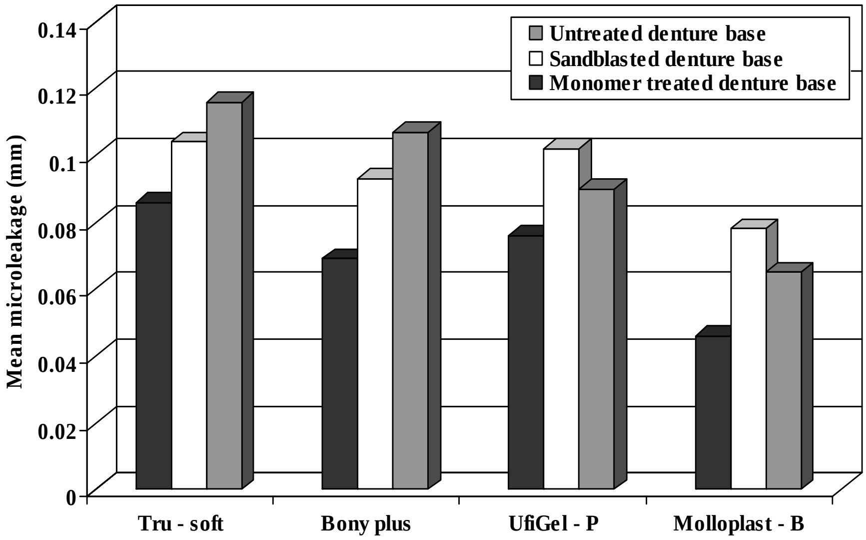

Figure (4): Mean microleakage after one week storage.

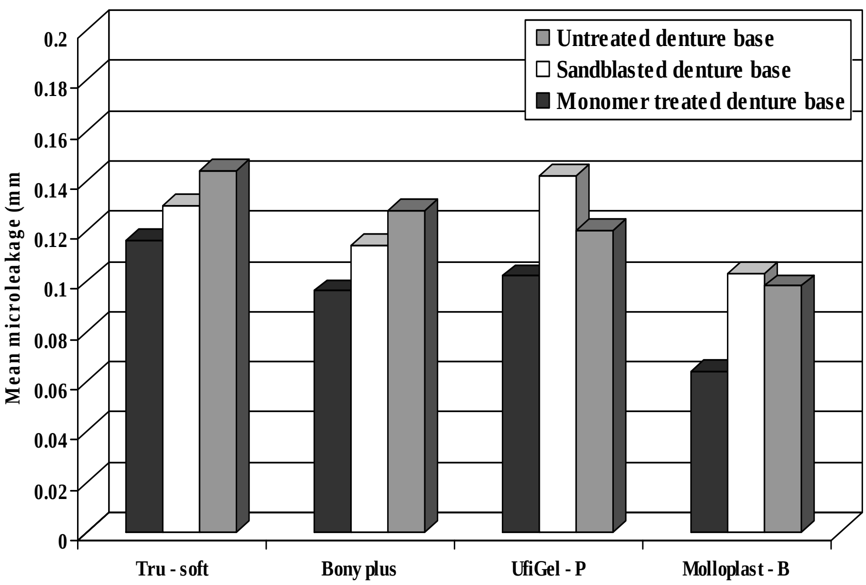

Figure (5): Mean microleakage after one month storage.

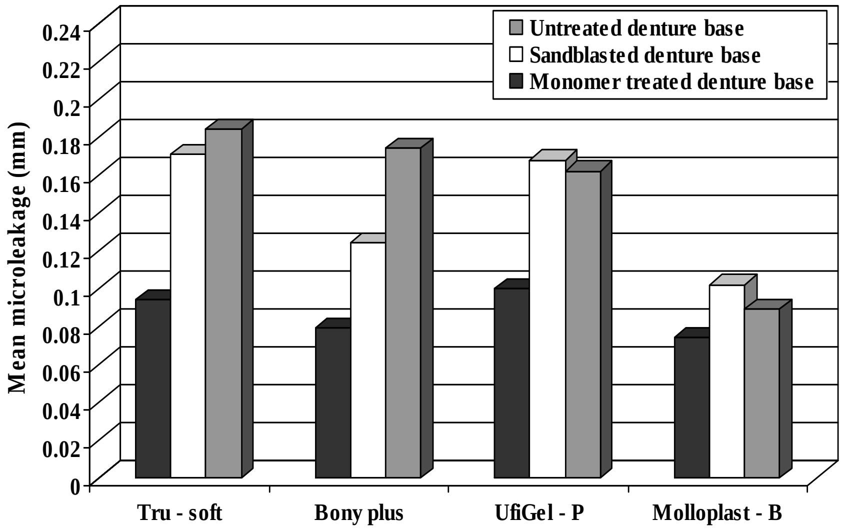

Figure (6): Mean microleakage after 500 cycles of thermal cycling.

Table (1): ANOVA of microleakage after one week storage.

Source of variation	Sum of square	df	Mean square	F-value	*P*-value
Between groups	0.045	11	0.004	1.08	0.39
Within groups	0.408	108	0.004	.	.
Total	0.45	119	.	.	.

df = Degree of freedom.

Table (2): ANOVA for microleakage after one month storage.

Source of variation	Sum of square	df	Mean square	F-value	*P*-value
Between groups	0.054	11	0.005	0.99	0.46
Within groups	0.541	108	0.005	.	.
Total	0.595	119	.	.	.

df= Degree of freedom.

Table (3): ANOVA for microleakage after thermal cycling.

Source of variation	Sum of square	df	Mean square	F-value	*P*-value
Between groups	0.194	11	0.018	5.35	<0.001*
Within groups	0.356	108	0.003	.	.
Total	0.550	119	.	.	.

df= degree of freedom; * = significant difference.

DISCUSSION

It is believed that treating the bonded surface of the acrylic resin denture base mechanically and chemically is clinically a practical step preceding the application of soft lining materials to remove contaminants which may weaken the bond of the lining material to the denture base [(11)], and lead to microleakage.

In the present study, roughening the denture base by sandblasting reduced microleakage for acrylic–based linings (Tru–soft and Bony plus) in all aging processes, this can be attributed to the similarity of their chemical structure with that of the acrylic resin denture base and the high flow of these lining materials allows the material to readily adapt to the prepared surface creating an intimate union and a chemical bond between them [(12)], while for the silicone–based linings (Ufi Gel–P and Molloplast–B), sandblasting showed an increase in microleakage in all aging processes, these results were in agreement with some investigators[(5,13)] who revealed that the roughened acrylic resin denture base may have pits, cracks, crevices, discontinuities with sharp corners and projections. Furthermore, these irregularities may not allow a complete flow of a viscous lining to penetrate into them and may result in voids formation, therfore, oral fluids may enter more easily than if materials were applied to untreated denture base.

The results also showed that the monomer wetting of the denture base was beneficial because it resulted in microleakage lower than sandblasted and untreated denture bases [5, 9], where complete prevention of microleakage was not possible. However, lowest microleakage values resulted. The explanation was that the denture base mononmer or the lining's liquid washes away microdebris producing a cleaner surface for bonding and the swelling and porosities of the denture base enhance the penetratrion of soft lining material or it's adhesive to these porosities, thus a type of interlocking was created [14 -16].

Because microleakage is an obvious pre–stage of de–bonding, the lower microleakage value seen in monomer treated group may result in slower de–bonding of soft lining material from the denture base, thus providing a longer clinical life for the prosthesis.

CONCLUSIONS

Within the scope of this study, it can be concluded that none of the tested soft lining materials showed a complete cessation of microleakage. Wetting the PMMA denture base with it's monomer was more effective in reducing microleakage than either sandblasting or leaving the surface of the denture base untreated and the heat–cured silicone–based lining (Molloplast–B) would perform better in terms of serviceability as it had the lowest microleakage than the other tested soft lining materials.

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