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EFFECT OF AGING AND IMMERSION IN DIFFERENT SOLUTIONS ON SURFACE PROPERTIES OF DENTURE LINING MATERIAL

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ABSTRACT

Background: Adequate softness and surface integrity are the most important clinical features of soft lining materials. This study was conducted to estimate the effect of aging process and immersion in different solutions on surface hardness and roughness of tissue conditioner material. **Materials and Methods:** One hundred and fifty-four acrylic disc specimens with diameter of 20 mm and 3mm in thickness were prepared. To the acrylic discs the same dimensions of temporary soft lining material (tissue conditioner) were bonded, the specimens divided to two equal groups containing 77 specimen for each test and then subdivided to five groups involving [baseline, aging, distilled water, immersion, aging and immersion groups including (corega, Alum+ soda, citric acid+ soda, lemongrass)], 7 specimens for each group, immersion cycle continue for 15 day. After cycle surface hardness and roughness were carried out. **Results:** the result showed that the hardness highly affected in all procedures, while surface roughness is not affected by aging, but highly affected by immersion and aging+ immersion procedures. **Conclusion:** the Surface properties of tissue conditioner material effected by experimental solutions and the lemongrass was the least effected solution.

KEYWORDS: Tissue conditioner, surface properties, immersion solutions, aging.

INTRODUCTION

The accuracy of denture fit is an essential point in the retention of the denture. However, alveolar resorption is irreversible process and may result in an inadequate fit of the prosthesis,[1] and the gradual changes of the oral tissue requires that prosthesis be relined to

get better adaptation to supporting tissue.[2] So use soft denture lining materials is useful in removable prosthesis, because of their ability to restoring health of abuse mucosa.[3] Soft lining materials are classified into temporary and permanent.[4] Permanent soft liners are either acrylic resins or silicone materials.[5] Dental tissue conditioners are temporary, viscoelastic materials and are primarily used to create a soft cushion between the tissue side of hard denture base and oral mucosa, so it aids in redistributing the force equally on the oral mucosa, during the healing phase after implant placement and also use as functional impression materials.[6,7] Tissue conditioners have problems associated with their physical characteristics and response to microorganisms and colonization by *candida albicans* and associated candida species. Efficient denture plaque control is essential for soft lining since bacteria and plaque are essential etiological factors of denture stomatitis.[8] In addition fungal growth may diminish the intraoral longevity of such resilient lining by deteriorate material surface quality and irritate oral tissue.[9,10] Denture cleanses are a common utilized by denture wearer for cleansing.[11] However, daily use of denture cleansers can influence the characteristics of denture resin base and resilient liner,[8] in addition when the dental prostheses are in use, they expose to firm clinical conditions and PH alteration, saliva flow and temperature.[12] Therefore to simulate clinical condition of various materials in laboratory studies, several methods such as thermal cycling, storage in distilled water, materials exposure to UV light, heat and water spray broadly utilized in dental research to simulate materials affected due to aging.[13]

This study was conducted to estimate the effect of aging by thermal cycling and immersion in different solutions on surface hardness and roughness of acrylic-based temporary soft lining material.

METHODES MATERIAL

One hundred and fifty-four heat cured acrylic specimen were constructed by using circular metal discs with a diameter 20 mm and 3 mm thickness.[14] One surface of all acrylic specimens was coated by coating agent that supplied with the tissue conditioner material and left to dry for 5 minutes, then the acrylic specimens were positioned inside a split metal molds, the base of the molds were placed on a glass slab, the acrylic specimens were positioned in a way that the coating surfaces faced a space about 3 mm to receive the tissue conditioner material.[15] The tissue conditioner material was mixed according to the manufacturer's instructions (p/L ratio 2.4g/2ml) by using special plastic spatula and rubber

bowl, the liquid was put into clean, dry rubber bowl and the powder was added to the liquid, then they mixed gently for 30 second, and the mixture was applied inside the space. The mold was then covered from the top by another glass slap and was pressed tightly against the mold to remove excess material and to shape the specimens according to the dimensions of the mold. Once the material was set, the specimens were removed from the mold, the excess material was trimmed by a sharp blade. Then specimens were divided into five groups

Group 1: Specimens were tested immediately after preparation (baseline)

Group 2: Specimens were aging by submitted to thermal cycling

Group 3: Specimens were kept in distilled water (control group)

Group 4: Specimens were immersed in different solutions

Group 5: Specimens were aging and immersed in different solutions.

Aging procedure

Specimens were aging by thermal cycled between (5 °C±1°C to 55 °C ±1°C) for (45) cycle which correspond to 15 days of clinical usage.[16,17] With an immersion time of 60 second at each temperature and 5 second as a transitional time, and the total cycle time of two minutes.

Immersion procedure

The immersion groups were immersed in different experimental prepared solutions (Corega, Alum +Soda, Citric acid+ Soda, Lemongrass extract) at room temperature for 8 hours and then washed by distilled water after that kept for 16 hour in distilled water at 37°C for 15 days. Control group were immersed in distilled water at 37°C for period 15 day. The distal water was changed daily; also the four experimental solutions were changed every day by fresh one.

Aging + immersion procedure

After submission to 45 thermal cycle, specimens then immersed in different prepared solutions at room temperature for 8 hours and then wash by distilled water after that kept for 16 hour in distilled water at 37°C for period 15 days, this simulated the daily usage of denture by the patient.

The surface hardness property of tissue conditioner was evaluated by using shore A durometer with scale (0-100), zero represent absolute softness while 100 represent absolute hardness. The testing procedure was performed immediately after polymerization, after aging by 45 thermal cycles and after 15 day of daily immersion and after aging and immersion in

different solutions. For the surface roughness of each specimen was measured also after polymerization, after aging, after immersion and after aging and immersion in different solutions by using surface roughness profilometer.

RESULTS

Table (1) LSD test among all groups for both immersion and aging and immersion, shows high significant difference in surface hardness test result when comparing with base line.

Table (1): LSD of shore A hardness test results.

		Mean Differences	P-Value
Baseline	Distilled water	22.04	0.0001 HS
	immersion Corega	13.82	0.0001 HS
	Aging+ Immersion Corega	24.51	0.0001 HS
	immersion Alum+ soda	16.94	0.0001 HS
	Aging+ Immersion Alum+ soda	22.88	0.0001 HS
	immersion Citric+ soda	17.5	0.0001 HS
	Aging +Immersion Citric+ soda	24.84	0.0001 HS
	immersion Lemon grass	12.2	0.0001 HS
	Aging+ Immersion Lemon grass	15.85	0.0001 HS

LSD test among all groups relative to distilled water for both immersion and aging and immersion, all group shows high significant difference when comparing with distilled water except three group which include aging +immersion (corega, alum + soda, citric acid +soda), since they giving non-significant difference. Table (2)

Table (2): LSD of shore A hardness test results.

		Mean Differences	P-Value
Distilled water	immersion Corega	8.21	0.0001 HS
	Aging+ Immersion Corega	2.47	0.09 NS
	immersion Alum+ soda	5.1	0.001 HS
	Aging+ Immersion Alum+ soda	0.84	0.558 NS
	immersion Citric+ soda	4.54	0.002 HS
	Aging+ Immersion Citric+ soda	2.8	0.055 NS
	immersion Lemongrass	9.84	0.0001 HS
	Aging+ Immersion Lemon grass	6.2	0.0001 HS

Table (3) (4) show the LSD test of surface roughness one comparing with baseline and the other with distilled water. result show significant difference in surface roughness between baseline and distilled water groups and high significant difference with all experimental solutions groups except for (alum + soda) group which show non-significant different in both procedures (immersion and aging and immersion). Table (4) shows high significant different

in immersion and aging + immersion (corega, and citric acid+ soda) and non-significant difference for immersion and aging + immersion (alum+ soda, lemongrass) groups when comparing with distilled water.

Table (3): LSD of surface roughness test results.

		Mean Differences	P-Value
Baseline	Distilled water	0.2514	0.037 S
	immersion Corega	0.9174	0.0001 HS
	Aging+ Immersion Corega	0.9765	0.0001 HS
	immersion Alum+ soda	0.1181	0.245 NS
	Aging+ Immersion Alum+ soda	0.1382	0.319 NS
	immersion Citric+ soda	0.8980	0.0001 HS
	Aging+ Immersion Citric+ soda	0.8908	0.0001 HS
	immersion Lemongrass	0.4298	0.0001 HS
	Aging+ Immersion Lemongrass	0.4727	0.0001 HS

Table (4): LSD of surface roughness test result.

		Mean Differences	P-Value
Distilled water	immersion Corega	0.666	0.0001 HS
	Aging+ Immersion Corega	0.725	0.0001 HS
	immersion Alum+ soda	0.133	0.365 NS
	Aging+ Immersion Alum+ soda	0.113	0.286 NS
	immersion Citric+ soda	0.646	0.0001 HS
	Aging+ Immersion Citric+ +soda	0.639	0.0001 HS
	immersion lemongrass	0.178	0.079 NS
	Aging+ Immersion Lemongrass	0.221	0.155 NS

DISCUSSION

Resilient lining materials are broadly used in prosthetic dentistry for their ability to restore the health to the inflamed and distorted denture-supporting tissue. Due to their viscoelastic properties soft lining materials are reduce and redistribute the functional load over the denture bearing area.[8,18]

Colonization may diminished the intraoral life of the soft lining material,[9] and the fungal growth deteriorate the surface quality of the material and irritant the oral tissue through a combination of surface roughness and concentration of exotoxins and metabolic products of the fungal colonies.[10]

Decontamination process by using chemical solutions as denture cleansers may produce an alteration in the surface morphology, and any change in hardness or roughness can cause failure of the soft lining materials,[19,20] on the other hand, denture resins prosthesis is

routinely exposed to thermal stress in the oral cavity, particularly during the ingestion of hot and cold food and beverages.[21]

After thermalcycling and after immersion in different solutions tissue conditioner displayed significantly changes in hardness property. Tissue conditioner is poly ethyl methacrylate acrylic polymer, so the hydrophilic character of polymer may promote hardening through loss of ethanol, water absorption, and plasticizer loss.[22,23] Plasticizers decrease the amount of water sorption due to the hydrophobic nature and ability to fill micro-voids in the polymer.[24] In addition temperature cycling may also influence the water sorption, which is a temperature-dependent process.[21]

Result showed that the surface roughness of tissue conditioner not significantly affected after aging, and this result disagreement with Tari and Nalbant,[25] and with Hahnel et al,[26] this is may be due to difference in number of thermalcycling. Nikawa et al.[18] demonstrates that a large number of thermal cycles could promote the leaching out of the inhibitory components from soft lining materials to the growth medium and these antifungal effects are significantly decrease with increasing times of thermal cycling. Also may due to the temperature, Goll et al.[27] suggest that elevated temperature of water might produce an accelerated deterioration of the soft lining materials. The results showed that corega solution was the greatest effect on surface roughness when compared with distilled water; this is may be due to the presence of peroxide and this result agreement with Shay,[28] Murata et al,[29] and Moussa et al.[30]

Citric acid with sodium bicarbonate solution caused high increase in surface roughness when compared with distilled water, this is may be due to the high acidity of solution, Constantinescu et al,[31] concluded that salivary acidity increase the surface roughness of acrylic resin. Also may due to CO2 that released from the reaction Mohialdeen et aI.[32] concluded the release of CO2 from denture cleanser effect surface roughness of acrylic resin denture base.

Result showed non-significant different of material surface roughness for both immersion and aging+ immersion(alum+ soda) although the acidity of alum +sod solution and the release of CO2 from the reaction, this may be attributed to the gelatinous aluminum hydroxide precipitate (AL(OH)3) which is forming when add any base to the aqueous solution of aluminum salt Taqa et al,[33] this gelatinous may precipitate on the surface of tissue

conditioner material and fill the porosities, irregularities and depressions formed on surface and result in lower roughness mean values.

Lemongrass solutions also cause highly significant increase in surface roughness of tissue conditioner in compare with base line while it give non-significant different in relation to the distilled water since the distilled water cause significant increase in surface roughness; this increase probably resulted from presence of phenolic compound. Ma et al,[34] demonstrate that the phenolic based disinfectant caused surface damage of denture resins materials.

CONCLUSION

1. In general the aging (thermal cycling) process leads to increase the surface hardness of tissue conditioner, but did not affect the surface roughness of material.
2. The aging and immersion procedure was the greatest effect on the studies properties.
3. The period used (15 day) resulted in changes in the mean surface hardness and roughness of tissue conditioner material.
4. Surface hardness of all samples was significantly higher after immersion in all solutions, and the highest value was in distilled water followed by solutions with highly acidity.
5. The highest roughness mean values were observed for corega commercial denture cleanser followed by a citric acid+ sodium bicarbonate solution.

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