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The effect of aging on some physical properties of temporary soft denture liners

Running title: aging effects on softness and roughness of soft liners

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Abstract

Aims of the study: To evaluate the effect of aging on softness of two temporary soft denture liners after immersion in different solutions and the effect of this immersion on the surface roughness of these materials.

Materials and methods: Fifty circular acrylic disk specimens were prepared of dimension 20 mm and 3 mm in thickness. These disks were bonded to same dimensions of soft denture liners. 25 acrylic specimens were bonded with COE-SOFT, the other 25 were bonded with COE-COMFORT. Each group were subdivided into five groups according to the immersion solutions used (Control, Artificial saliva, hydrogen peroxide, sodium hypochlorite and acid denture cleanser) and for four storages (1, 2, 3 and 4 weeks). The softness measurement carried out using Shore Adurometer. The roughness of the surface was measured using Profilometer. Statistical analysis was performed using descriptive statistic and two way analysis of variance at p= 0.05

Results: the results reveled significant shore A hardness difference (p=0.05) for the material tested and the interaction effects between aging and immersion solutions also between the first and fourth weeks. For the roughness test, the results showed slight increase in roughness in the acidic media and a decrease (Ra) in the alkaline media for the COE-SOFT liner; however it showed no significant difference. For the COE-COMFORT tissue conditioner, the result revealed slight increase in (Ra) values during immersion in the hypochlorite media; however no significant difference were found.

Conclusion: within the limitation of this study, significant differences were found in shore A hardness with the aging for the COE-SOFT and COE-COMFORT. Roughness test (Ra) showed little differences in the immersion solutions and storage intervals although statistically not significant.

Key words: Temporary soft liner, Softness, Roughness, Aging

Introduction:

Resilient or soft liners are usually used in dentistry to reduce the masticatory forces transmitted by the prosthetic appliance to the underlying tissue on which these appliances rest.

When soft liner material are employed, some of the load applied to the prosthetic appliance during the masticatory process is stored and released in the form of elastic recoil as the appliance comes out of occlusion (1,2). This material gives comfort to the patient and in certain cases is expected to have a healing effect to the mucosa (3, 4, and 5)

For patient who cannot tolerate a hard denture base, soft liners are an important adjunct treatment to help the patients adapt to the new dentures (4). An investigation performed byAttard et al (6) indicated that some of 75% of patients needed relining of the implant supported over denture after an average of 7 to 8 months.

Although these materials has many indications and advantages to the patients but still they have several problems associated with their use such as, loss of softness, water absorption, bonding failure, changes in dimension after storage, porosity and increased roughness after aging (7, 8).

The adhesion of microorganism to the surface exposed to the flushing action of fluids is a prerequisite to the colonization and the development of pathogenesis and infection, some authors have shown that soft lining materials present a greater retention of candida albicans than denture acrylic resin and the high values for surface roughness can also enhance adhesion- retention (9, 10 and 11).

In a comparative study (12) great variability in the surface roughness values among the denture material was detected, most of them above the threshold of 0.2 Mm (Ra) which could increase plaque accumulation (13, 14)

Softness test has been used to evaluate the effect of aging on soft liners by many investigators (15, 16) on soft lining material but their relation to the surface roughness have not been fully covered.

(17)Stated that the roughness of the soft liner didn't affect after 28 days of immersion

The purpose of this study was to evaluate Shore A hardness with aging and to investigate the co-relation between this effect after storage in artificial saliva and chemical denture cleansers. In addition to that to investigate the effect with the same parameters on surface roughness on temporary soft liners

Materialand methods:

Tow commercially available temporary soft denture liner were examined in this study they were COE-SOFT soft liner and COE-COMFORT tissue conditioner (GC-America INC) selected of the bases of the variety of chemical composition and clinical use.

Four immersion solutions were employed for the storage of the specimens of soft liner and tissue conditioner. They were prepared according to their manufacture instructions or commercial use namely, Sodium hypochlorite, Hydrogen peroxide, Citric acid and Artificial saliva.

Fifty circular acrylic disk specimens were prepared of dimension 20 mm and 3 mm in thickness. These disks were bonded to same dimensions of soft denture liners using split metal molds. 25 acrylic specimens were bonded with COE-SOFT, the other 25 were bonded with COE-COMFORT. Each group were subdivided into five groups according to the immersion solutions used (Control, Artificial saliva, hydrogen peroxide, sodium hypochlorite and acid denture cleanser) and for four storages (1, 2, 3 and 4 weeks). The softness measurement carried out using Shore Adurometer.

All samples were stored in distilled water container at 37C for 24 hours in a thermostatically controlled incubator before testing. Then all the specimens were aged by thermo cycling for 120 cycle, this was done by

soaking the specimens alternatively in to (5C and 55C)-+2C In water bath chambers with 14 seconds dwelling time at each temperature and 1 second transition time.

The softness property of the liner and the conditioner was evaluated by using shore Adurometer with scale (0-100)USA.Zerorepresents absolute softness while 100 represent absolute hardness. After a period of storage namely one week, two weeks, three weeks and four weeks. A comparison was made between the softness readings by comparing them with the readings of the control

This test was carried out to measure the surface roughness of soft liner and tissue conditioner at base line and after four storage periods of the four immersion solutions used in the study (artificial saliva, Sodium hypochlorite, Hydrogen peroxide and acidic denture cleanser).

The effect of aging of soft liner and tissue conditioner on surface roughness of these materials was evaluated on surface roughness of dental stone used as a replica of the surface of soft liner and tissue conditioner by comparing it with the control specimens.

The surface roughness values of the dental stone cast were measured by a profilometer (Taylor- Hobson Ltd, UK).Fifty specimens of stone casts from the both materials tested were prepared after each immersion.

The roughness of the surface was measured using Profilometer. Statistical analysis was performed using descriptive statistic and two way analysis of variance at p= 0.05.

Results:

The descriptive analysis and two way analysis of variance of softness test (shore a degrees) reveled a significant difference in increasing of the shore A hardness measurement for all of immersion solutions and for the four weeks intervals (P=0.05). Results are presented in table (1& 2) andfigure (1&2)

Table (1): Descriptive statistic for COE-SOFT soft denture liner for the immersion solutions and storage time

		Water	Saliva	Hypochlorite	Peroxide	Acid
N	Valid	25	25	25	25	25
	Missing	25	25	25	25	25
Meanfor 4 weeks		32.6400	32.1467	38.3333	35.7467	33.4133
Median		35.0000	31.3333	40.0000	38.0000	33.3333
Std. Deviation		7.55530	9.11454	12.45362	9.71076	9.11414
Variance		57.083	83.075	155.093	94.299	83.067
Minimum		16.33	14.67	17.67	17.33	17.00
Maximum		43.67	45.33	63.33	47.67	51.67

95% Confidence interval

Table (2): Descriptive statistic for COE-COMFORT tissue conditioner for the immersion solutions and storage time

		Water	Saliva	Hypochlorite	Peroxide	Acid
N	Valid	25	25	25	25	25
	Missing	25	25	25	25	25
Mean for 4 weeks		27.9867	25.0400	27.1333	27.8000	28.2667
Median		29.6667	26.6667	29.0000	29.6667	29.6667
Std. Deviation		7.68987	7.10590	7.41246	9.86061	8.67894
Variance		59.134	50.494	54.945	97.232	75.324
Minimum		12.33	12.00	13.00	11.33	10.67
Maximum		36.00	34.67	36.67	45.00	44.00

95% Confidence interval

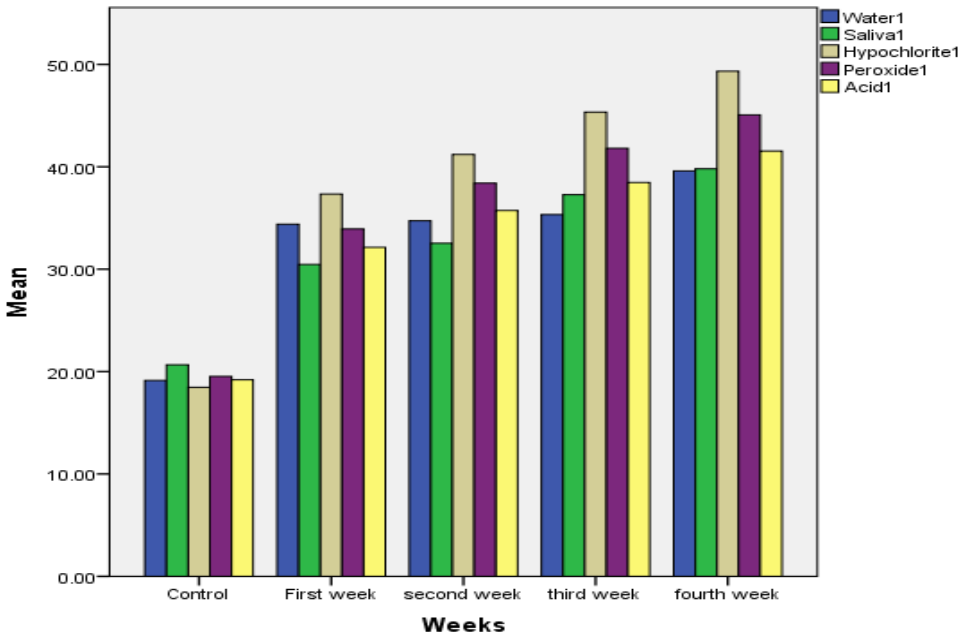

Figure (1)COE-SOFT, mean shore A hardness versus time intervals and the four immersion with control groups

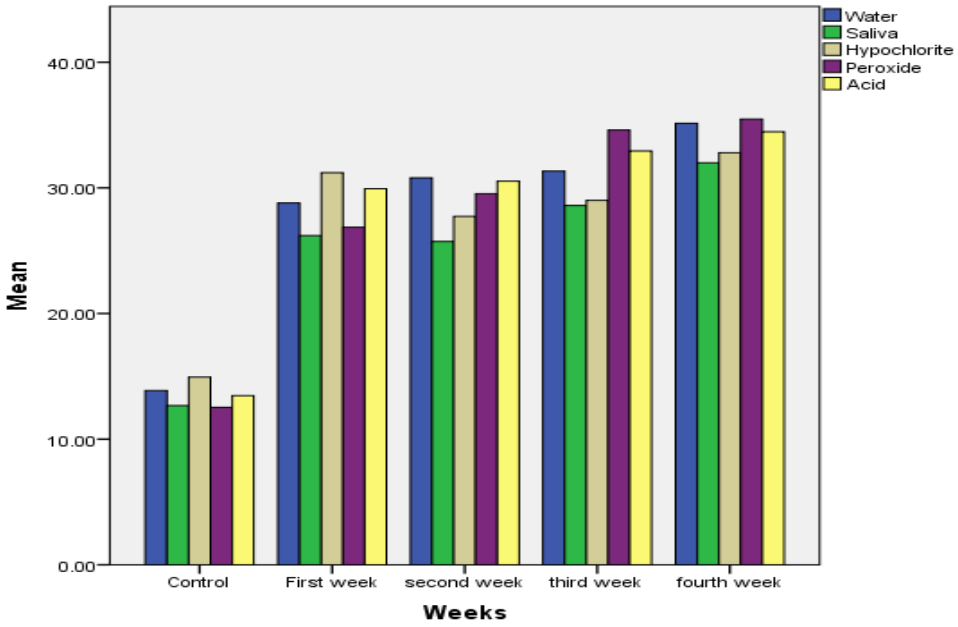

Figure (2) COE-COMFORT mean shore A hardness versus time intervals for the four immersion and control groups

The result of the roughness test revealed slight changes in (Ra) values for both materials, although statistically non-significant.

Table (3&4) and figure (3&4) showedthe descriptive analysis and two way analysis of variance of roughness test (Ra) for both materials and for one week & four week intervals

Table (3): Descriptive statistic for surface roughness (COE-SOFT)

		Control	Sodium hypochlorite	Acid	Hydrogen peroxide	Saliva
N	Valid	6	6	6	6	6
	Missing	34	34	34	34	34
Mean		2.4167	2.3083	2.6250	1.9333	2.3333
Std. Deviation		.37506	.20351	.45908	.33116	.11690
Variance		.141	.041	.211	.110	.014
Minimum		2.15	2.05	2.00	1.65	2.20
Maximum		2.90	2.65	3.15	2.40	2.45

Table (4): Descriptive statistic for surface roughness (COE-COMFORT)

		Control	Sodium hypochlorite	Acid	Hydrogen Peroxide	Saliva
N	Valid	6	6	6	6	6
	Missing	34	34	34	34	34
Mean		2.3500	3.2250	2.2583	2.2250	2.8167
Std. Error of Mean		.22435	.22463	.09523	.10704	.04944
Std. Deviation		.54955	.55023	.23327	.26220	.12111
Variance		.302	.303	.054	.069	.015
Minimum		1.90	2.25	1.90	1.90	2.65
Maximum		3.05	3.80	2.50	2.60	3.00

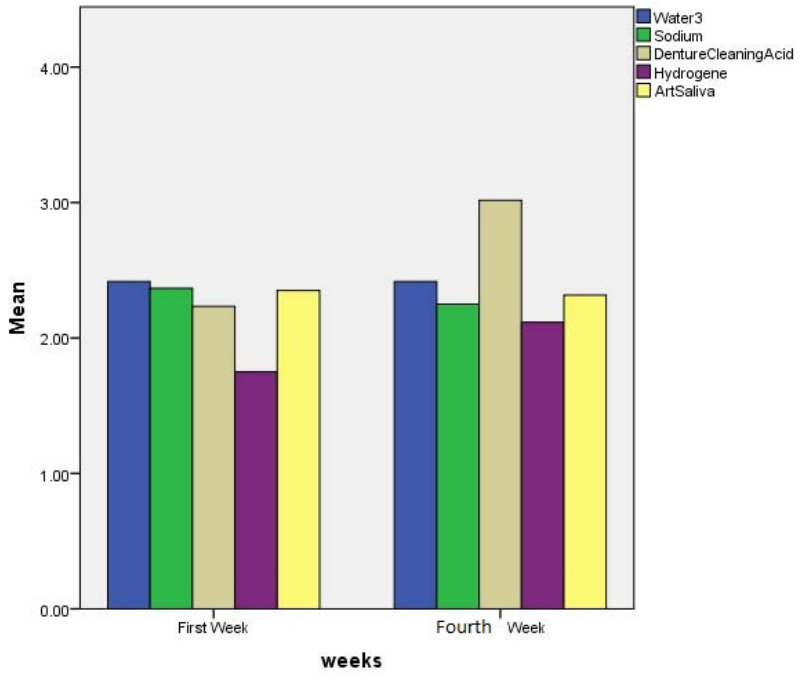

Figure (3) mean roughness (Ra) in Mm for COE-SOFT for the all solutions versus storage intervals

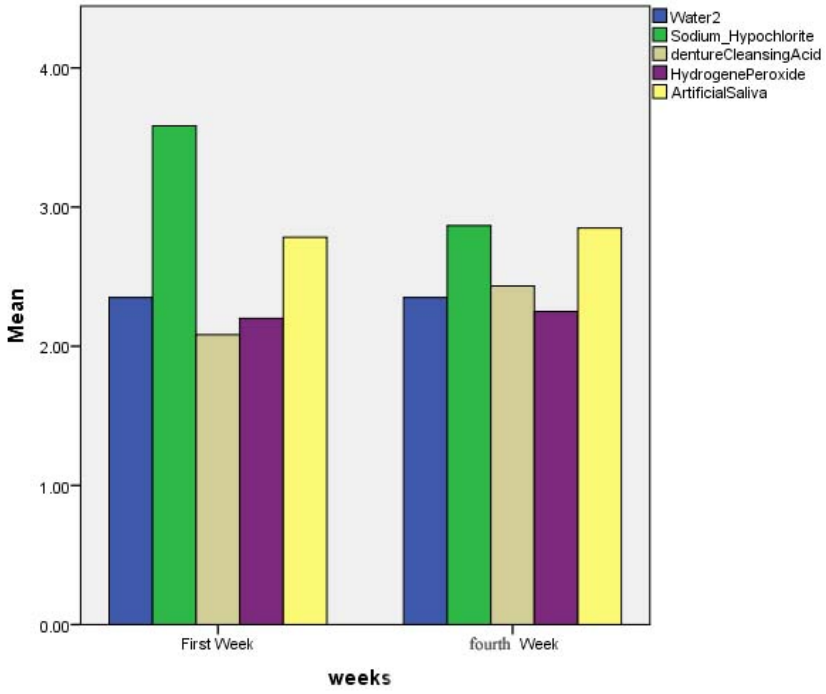

Figure (4) mean roughness (Ra) in Mm for COE-COMFORT for the all solutions versus storage intervals

the histogram in figure (3) showed a slight decrease in the mean (Ra) value for the peroxide media in first week of storage and an increase in the (Ra) value for the COE-SOFT samples in the fourth interval of the acidic media although the result were non-significant.

The histogram in figure (4) showed a significant increase in mean roughness values (Ra)for the samples of COE-COMFORT immersed in hypochlorite media for the 1st week of storage; however the results for the other solutions were found non-significant.

Discussion:

The results on this study revealed that COE-COMFORT tissue conditioner is significantly softerthan COE-SOFT (meancontrol COE-COMFORT=27.96)temporary soft liner (meancontrol COE-SOFT= 32.64) and this softness decreased with the time of the storage being used. This finding supports the evidence of (18). Who found that shore a hardness degrees of plasticized soft liners stored in water for different period of times was increased (i.e.) the liner become harder

This results also matches COE-SOFT which becomes significantly harder after immersion in different time intervals

It has been stated that the chemical composition of this liner are different from the acrylic resin materials, in which they contain plasticizers and ethanol in their liquid and this materials are responsible for maintain softness(19). It is possible that leaching out of plasticizer from these is responsible for the acrylic based soft denture liner becoming harder in storage this supports the finding of (1) and this might be due to absorption of water by the fillers.

The range of variations in softness for the two soft liners could be attributed to the chemical composition. This is in agreement with (20, 21) whom reported the presence of different components as cross linking agent in the auto polymerized materials.

The softness property will be changed with storage time which is mostly due to leaching out of plasticizers (22). This is in agreement with (23).

In addition to that these controversial changes could be attributed to either absorption of water or leaching out of plasticizer, since absorption of water may act as additional plasticizer that enhance material softness or resiliency, in the opposite leaching out of plasticizer will reduce material elasticity (7, 22).

It has been observed that the acrylic based soft denture liners becomes less elastic on storage for up to 28 days (17) and this matches the results with the current study, in addition to that the results comes in agreement with(16).

There are only few studies evaluating the roughness of soft liner after immersion in denture cleansers and artificial saliva (24, 25).

In the current study, The immersion in artificial saliva for the COE-COMFORT leads to some increase in surface roughness mean (Ra) value for the artificial saliva=2.8 while for control (Ra) =2.35 although statistically found not significant, This could be due to ionic exchange between the solution of artificial saliva and COE-COMFORT soft denture liner which attributed to this increase in surface roughness and this matches the work of (26).

For the peroxide immersion solution the result showed that there was a lower mean value for the COE-SOFT after 1st week immersion, Mean (Ra) for alkaline peroxide=1.93 in comparison with control =2.41 although the statistical result reviled non-significant.

This decrease in surface roughness values can be attributed to alkaline PH of the solutions which could be responsible for the chemical polishing in the material surface.

For the COE-SOFT the acidic denture cleanser showed little higher mean value (2.62 Mm compared with the control mean =2.41 Mm) however, it founded to be non-significant

For the COE-COMFORT in hypochlorite media resulted in a significant increase in surface roughness value mean (Ra) for the hypochlorite =3.25 while for the control 2.35 this could be attributed to the effect of alkaline PH on the surface roughness and this come in line with (27)

The effect of immersion intervals up to 28 days in this study also showed non-significant difference regarding roughness of the surface, this finding come in line with (24).

It was concluded that the soft liners tested in this study decreased in softness with aging and during immersion in different solution while the surface roughness was not significantly affected

Clinicians should be aware of the changes in softness with the aging of soft denture liners intra orally during usage and needs to select appropriate materials for specific clinical purposes, because the shore A hardness and (Ra) roughness values vary widely among commercial temporary soft denture liners which have been tested by many researchers.

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