

INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN
CHEMISTRY AND PHARMACEUTICAL SCIENCES

(p-ISSN: 2348-5213; e-ISSN: 2348-5221)

www.ijrcrps.com

Coden: IJCROO(USA)

Volume 3, Issue 7 - 2016

Research Article



SOI: <http://s-o-i.org/1.15/ijrcrps-2016-3-7-3>

Effect of Three Mouthrinses: Chlorhexidine, Irsha, and Epimax on the Color Stability of Acrylic- Based Liners and Silicone- Based Denture Liners: An *In Vitro* Investigation

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Abstract

Background and Objective: an important feature of denture liners is maintaining its original color and assessment of staining is a challenging aspect of dentistry. The study aimed to investigate the effect of three mouthrinses: chlorhexidine, Irsha, and Epimax on the color stability of acrylic- based liners and silicone- based denture liners. **Materials and Methods:** at first, 120 discs (two types of silicone-based liner and three types of acrylic-based liner) were prepared and immersed in distilled water, and random samples were selected from each group and immersed in three liquid mouthwashes for a 24- hour color measurement. Then, before and after immersion in distilled water and mouthwashes, the primary color of the samples was recorded using a spectrophotometer device based on the CIELAB system. **Results:** the most staining was in the Dura-liner with the liner (E = 12.0070) after immersion in the Irsha mouthwash. The minimum staining was in Ufi permanent gel liner with E = 0.00193 and after immersion in distilled water. **Conclusions:** the color stability of silicone- based liners is higher than acrylic-based liners. Irsha mouthwash more than Epimax and Chlorhexidine, causes staining of liners. Chlorhexidine creates the lowest staining of the soft liner samples.

Keywords: Color stability; Liners; Mouthwash.

Introduction

Relining means a replacing or lining the denture impression with new material for better compliance of the prosthesis. Over time, the tissues of the mouth of a person without teeth will experience regressive changes and jaw bones will be atrophied. Therefore, denture compliance will be decreased and the mobility of dentures will be appeared and this issue is uncomfortable for the patient. At this time, the best

solution is relining denture. Generally, every two to five years, dentures need for relining. The denture is relined by two techniques: chairside reline and laboratory reline. Chairside technique is faster than laboratory technique and a patient can use his or her denture by this method unlike the laboratory technique that patients are deprived of having denture in all the stages. There are various lining materials that in terms of its application and needs

of patients generally are divided into three categories: hard lining materials, soft liner material, and improvement material of the tissue.

Today, soft liner materials are commonly used that some of their advantages are: pain reduction, better adaptation of the prosthesis with underlying mucosa, uniform distribution of functional forces in stressable areas and the increased chewing efficiency. These soft materials, based on the duration of use are divided into two groups: *Provisional* and *Permanent* and based on the constructive materials are divided into two groups: silicone and acrylic. Substances that lose their elasticity properties after a month are temporary and those that maintain this property for over a month, are permanent. Silicone liners have hydrophobic properties and do not absorb water but do not have a good consistency and adhesion with mucosa. Unlike silicone-based liners, acrylic-based liners are plasticizer and also hydrophilic. So when they lose their plasticizer properties in the oral environment, they absorb water and eventually their original physical and mechanical properties will be lost. Color stability of all restorative material is very important and an index for their optimal use. Staining of dental materials causes a dissatisfaction of the patient and spending more time and cost for its replacement. One of the problems of the soft denture liners is cleaning them. Some of the liners assume the color of the denture cleaners, liquid and foods. Color stability can be measured visually or instrumentally. Visual assessment changes due to uncontrolled factors such as fatigue, age and individual emotions, light conditions, and metamerism. Due to the objectivity, the ability to measure and speed of achieving, instrumental analysis of staining is preferred on the visual observation. In evaluating color differences, generally two systems are used: Munsell's color sphere and color system of * C I E L * A * B (Commission International de l'Eclairage). Unlike the Munsell's color sphere system, in this system, color is expressed quantitatively. L* indicates luminosity, a * represents the rate of greenness-redness and b * represents the rate of blueness-yellowness. One important aspect of this system is that the difference between one of colors with another color is measured with E .

Since the use of mouthwashes is common in Iran and some of them are made in the country, and on the other side, no report has been provided by the effects of Chlorhexidine, Irsha, and Epimax mouthwashes on soft denture liners, the study was conducted.

Materials and Methods

This study was in-vitro and therefore, did not have certain ethical considerations. Based on previous studies 26, and the availability of materials, five liner types were prepared as follows: acrylic-based liners: Gc tissue conditioner (GC Corporation, Japan), Dura-Liner II (Dental Mfg. Co, Illinois, America), Ufi gel hard (Voco,

Cuxhaven, Germany) and silicon-based liners: Molloplast B (Detax, Ettlinggen, Germany), and Ufi gel permanent (Voco, Cuxhaven, Germany). One hundred twenty discs of 10 mm in the length and a height of 2 mm were obtained from any of the liners. At the end, 24 discs were prepared from any liners that 12 samples were considered as the control group and 12 other samples as the study group. To make the baking process, Teflon generators, with 1 mm in the length of and a height of 2 mm, were prepared. The amount of powder required for each type of liners of Dura-Liner II, GC hard tissue conditioner and Ufi gel, in an amount as recommended by the manufacturer, was weighted by a digital scale (AsDHL-400, A&D, Tokyo, Japan) with a precision of the 1.0 g carefully, and mixed with liquid at a specified size, and then was ready for baking. In the case of Molloplast liner B, an adequate amount of material to build a disc with a diameter of 10 mm and a thickness of 2 mm, was isolated to perform its baking process. Base and Catalyst liner tubes of Ufi Gel Permanent, of equal length, according to the manufacturer's instructions, were used to perform the baking process.

All levels of liners of Dura-Liner II, GC tissue conditioner and Ufi gel hard were polished using sandpaper 600 grit carbide and fine and super fine discs, and liners of Molloplast B and Ufi gel permanent were polished with the help of special discs provided by the manufacturer, by the handpiece at low speed. After the completion of the polymerization and polishing, the final thickness of discs was 2 mm.

After this stage, samples were cleaned by an ultrasound machine (Sonica 1200 M, Soltic. Italy) at 30 ° c for 6 minutes with distilled water and then were dried with compressed air. Furthermore, three types of mouthwashes were prepared: Irsha (Afragostar Co, Tehran, Iran), 2.0% Chlorhexidine (Behsa pharmaceutical company, Tehran, Iran), and Epimax (Emad pharmaceutical company, Tehran, Iran).

Prior to any action, the color of the prepared samples was evaluated by reflectance spectrophotometer device (model Gretage Macbeth Color-Eye® 7000A Switzerland) under a light source D65 and in the white light field and then, the data were recorded. Then, all the samples were immersed in the distilled water of 37 ° c for 12 hours. Also, in this step the color of the samples was measured using the spectrophotometer device based on the CIELAB system and recorded in three parameters: L * luminance, a * redness-greenness and * B blue – yellow. In the next step, 12 samples were selected randomly from each group, and each of them was immersed in 20 ml of each mouthwash for 24 hours before measuring color. After leaving the solutions, the samples were cleaned using distilled water in an ultrasonic device for five minutes and rinsed under the tap for 30 seconds, and cleaned gently with a soft toothbrush in order to remove any debris stuck to the of

samples by immersion. Then, the amount of staining was assessed using the spectrophotometer device based on the CIELAB system.

Results

Mean and standard deviation of E or the amount of their color changes, for each of the five types of liners after immersion in distilled water and mouthwash are

registered by a spectrophotometer (tables 1 and 2). These results show that in all scenarios (before and after immersion in distilled water and after immersion in mouthwash), most color change is in the Dura-liner with E = 12.0070 and after immersion in the Irsha mouthwash (table 2), while the minimum color change can be seen in Ufi gel permanent liner with E = 0.0193 and is related to after immersion in distilled water (table 1).

Table 1. Mean and standard deviation of E after immersion in distilled water

E	Soft liner	Ufi permanent	Molloplast B	Ufi gel hard	Dura-liner	GC tissue conditioner
Mean (M)		0.0193	0.0363	0.0349	0.0851	0.0363
Standard deviation (SD)		0.00440	0.00313	0.00634	0.01224	0.00393

In addition, overall silicon-based liners have exhibited more color stability after immersion in distilled water than acrylic-based liners. After immersion of all the samples (all five types of soft liner) in distilled water, it became clear that Dura-liner with E = 0.0851 has had the most color change, that is, it has exhibited less color stability. However, Ufi gel permanent liner with E = 0.0193 has had the lowest color change and the maximum color stability (table 1). In addition, it became clear that after immersion in the distilled water, silicon-based liners have exhibited more color stability than acrylic-based liners. After immersion of all the samples (all five types of soft liner) in all three types of mouthwash: Chlorhexidine, Irsha, and Epimax, it became clear that Dura-liner with E =

12.0070 and after immersion in the Irsha mouthwash, has the highest color change and lowest color stability. However, Ufi gel permanent with E = 0.2820 and after immersion in the Chlorhexidine mouthwash have exhibited the lowest color change and maximum color stability. In addition, it became clear that after immersion in mouthwashes, silicon-based liners have exhibited, on average, more color stability than acrylic-based liners. In addition, the results show that the Irsha mouthwash with an average change of E = 6.4065 causes the greatest color changes on the samples; and Chlorhexidine mouthwash with an average change E = 3.7790 has created the lowest color change on the samples (table 2).

Table 2. Mean and standard deviation of E after immersion in mouthwashes

Soft liner	Mouthwash		EChlorhexidine		EEpimax	
	Irsha					
	M	SD	M	SD	M	SD
Ufi gel permanent	3.2296	0.08338	0.2820	0.09637	0.4788	0.10883
Molloplast B	3.4139	0.29749	2.6719	0.17196	3.1247	0.15128
Ufi gel hard	6.5749	8.52421	0.5337	0.22921	0.5503	0.22175
Dura-liner	12.0070	0.25393	11.1312	0.30721	11.5254	0.18592
GC tissue conditioner	6.8073	0.27052	4.2763	0.30721	4.3894	0.18592
Total	6.4065	4.88699	3.7790	0.99649	4.0137	4.08392

For comparisons between indices of L*, a*, and b*, in each liner after 24 hours of immersion in distilled water the Robust anova welch test was used, and after doing this test, statistically significant differences could be seen between the samples (p < 0.05). However, to do a comparison of the amount of color differences (E) in liners after 24 hours of immersion in distilled water the Post hoc tamhance test was used, and after doing this test and statistical

computing, statistically significant color differences could be seen between liners (p < 0.05).

A two-way analysis of variance (ANOVA) revealed that the impact of the mouthwashes and mutual impact of liner materials in the mouthwashes have been significant in the E index (p < 0.05). After 12 hours of immersion of five types of liners in mouthwashes, statistically significant differences could be seen

between the extent of the color changes of each liner in the three mouthwashes and control group ($p < 0.05$). In addition, after doing a paired comparison between every three types of mouthwash and the control group, a statistically significant difference was seen ($p < 0.05$). A comparison between the three types of mouthwash and the control group, except a comparison between Irsha and Chlorhexidine, showed that the amount of color difference is not significant ($p < 0.05$); in other cases, a statistically significant difference can be seen in the amount of color ($p < 0.05$).

Figure 1 shows that after immersion, the index L Dura-liner has increased in all three mouthwashes compared to the control group, which indicates it has

lost its color sample and became clearer. The color of the Ufi gel permanent liner compared to the control group, and after immersion in Irsha mouthwash, became clearer, but in the two other mouthwashes, this index has not been changed. After immersion in Irsha mouthwash, the color of the Molloplast B liner has become clearer and lost its color samples, but in the other two mouthwashes it has attracted the color sample and became darker. In the case of GC tissue conditioner liner, after immersion in all three mouthwashes the index L has increased that shows it has lost its color example and became brighter. Finally, after immersion in two mouthwashes of Irsha and Epimax, Ufi gel liner hard has attracted color sample and became darker, but in Chlorhexidine mouthwash the color sample became brighter.

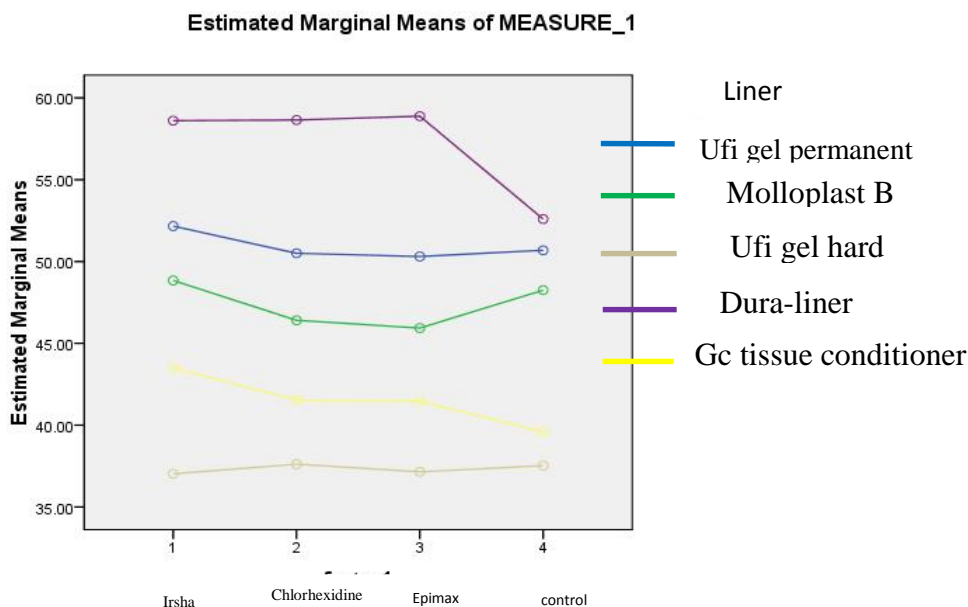


Figure 1. A comparison of the extent of the changes in index L * for each liner in three mouthwashes and control ($p = 0.05$)

According to the figure 2 about three liners: Dura liner, GC tissue conditioner, and Molloplast B, the index *a* (red-green) in all three mouthwashes had increased compared with the control group and their color has a tendency towards redness, but in two other liners, i.e. Ufi gel hard and Ufi gel permanent after 12 hours of immersion in the Irsha mouthwash the index a* (red-green) had increased in comparison with the control group, and has a tendency towards redness. But in the two other mouthwashes, this index was almost constant and did not change.

As seen in figure 3, in all three mouthwashes, three liners: Dura liner, GC tissue conditioner, and Molloplast B, the index b* (yellow-blue) increased in comparison with the control group and has a tendency towards yellow color, but in two other liners, i.e. Ufi gel hard and Ufi gel permanent and after 12 hours of immersion in the Irsha mouthwash the index b* (yellow-blue) increased in comparison with the control group and its tendency was towards yellow color. But in the two other mouthwashes this index remained almost constant and without change.

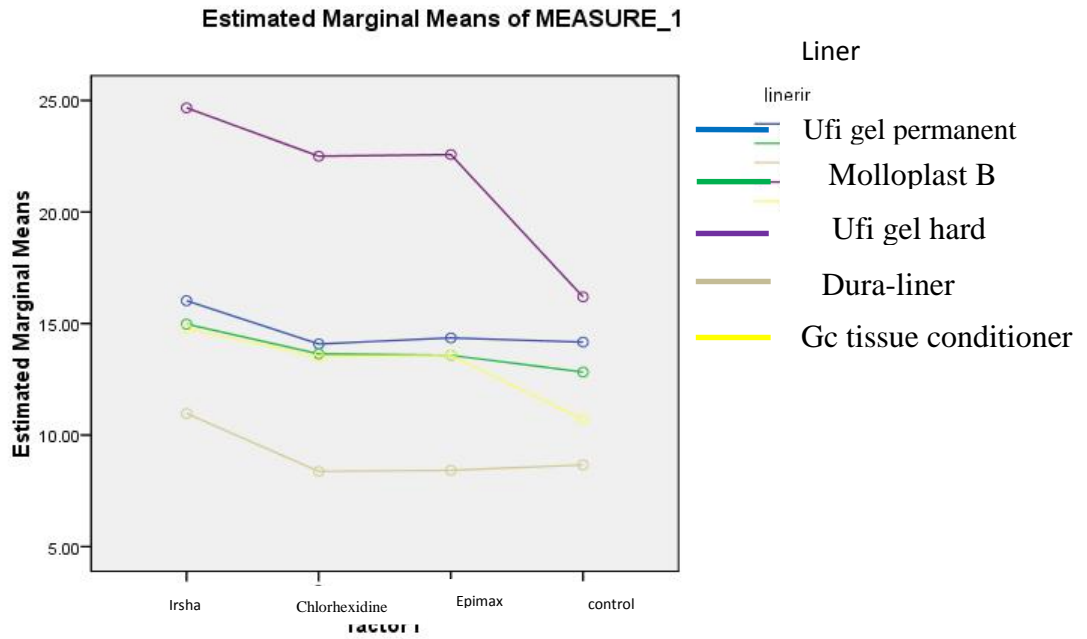


Figure 2. A comparison of the extent of the changes in the index a * for each liner in each three mouthwashes and control group (p = 0.05)

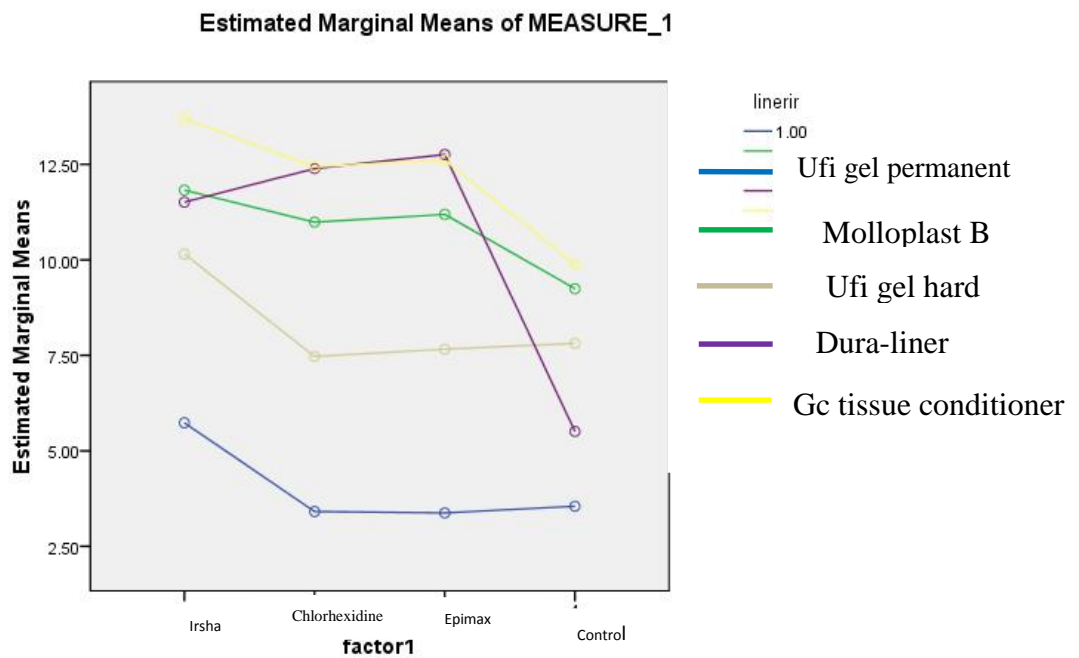


Figure 3. A comparison of the extent of the changes in index b * for each liner in three mouthwashes and control group (p = 0.05)

Discussion

Color stability of lining materials can have an impact on the apparent acceptance of the prosthesis. Despite the progress and improvement of the lining material quality, clinical studies have shown that they still need to be improved in the water absorption, solubility, and color changes. The CIELAB color system is used to assess tooth color. Based on this system, the letter L * represents the material luminance, graded from zero (black) to 100 (white). A red a * represents the positive direction and the green a * indicates the negative direction. The blue b * is a negative parameter and low and the yellow b * is positive and above.

In this study the index a * of the tested materials, after immersion in distilled water, showed that changes in all these liners have been very slight. In the study by Gulfem Ergun *et al.*, these changes have been slight, but slightly more than our study. In that study similar to our study, index L * has increased to cases of Ufi gel hard and Molloplast B, but unlike our study, the reduced luminance can be seen in the liners of the Dura-liner and Tukiso rebase. In the study conducted by Gulfem Ergun *et al.*, after immersing in distilled water, the index b * increased in all samples except for the Dura-liner. However, in our study this index increased for all liners and had a tendency towards yellowness. In this study, the lowest was related to the Ufi gel permanent liner, which represents most of color stability the liner is more; therefore, this study is consistent with the Gulfem Ergun *et al.*'s study. This is a great advantage for long-term maintenance of this liner.

After immersing all the samples (five types of soft liners) in all three types of mouthwashes: Irsha, chlorhexidine and Epimax, it became clear that Dura-liner with $\Delta E = 12.0070$ and after immersion in Irsha mouthwash, has highest color change and least stable color. The color changes of the liner were obvious in other mouthwashes (Epimax $\Delta E = 11.5254$) and (chlorhexidine $\Delta E = 11.1312$), but Ufi gel permanent liner with $\Delta E = 0.2820$ and after immersion in chlorhexidine mouthwash has had least color change and maximum color stability. These findings are consistent with results of Serra Oguz *et al.*'s study of most resistance to staining among the acrylic-based liners gained than silicon-based liners.

In a comparison between heat-cured and cold-cured silicones, the findings have shown that the cold-cured silicone-based liner tested of Ufi gel permanent had color stability more than heat-cured Molloplast B. In the study by Serra Oguz *et al.*, exact findings have been opposite to our study. The cold-cured silicone-based liners tested in two studies are different.

In the study by Gulfem Ergun *et al.*, also in terms of color stability the Molloplast B and Ufi gel permanent

have been presented as the ideal lining materials, so these findings are consistent with our finding.

Conclusion

Given the limitations of this study, it seems:

- mouthwashes cause discoloration of liners.
- Studies show that color stability of silicone-based liners is more than acrylic-based liners.
- Irsha, more than other mouthwashes, will cause discoloration of liners.
- Chlorhexidine mouthwash creates fewer color changes on soft liner samples.

Suggestions

- More research must be done concerning the impact of denture mouthwashes on other properties of soft liner materials.
- The more detailed assessments must be done for finding the relationship between color stability and composition of denture bases to better understand the mechanism of the color change.

Conflict of Interest statement

The authors declare that there is no conflict of Interest.

Acknowledgments

This paper is issued from the thesis of Heydar Savari. This project was conducted with financial support from the Vice-Chancellor for Research Affairs of Ahvaz Jundishapur University of Medical Sciences; thereby authors express thanks for the financial support.

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How to cite this article:

Asadollah Ahmadzade, Hoda Erfanimajd, Ali Rohani, Parisa Boostanifard, Heydar Savari. (2016). Effect of Three Mouthrinses: Chlorhexidine, Irsha, and Epimax on the Color Stability of Acrylic- Based Liners and Silicone- Based Denture Liners: An *In Vitro* Investigation. Int. J. Curr. Res. Chem. Pharm. Sci. 3(7):12-18.