**EVALUATION OF SURFACE ROUGHNESS OF SOFT TISSUE LINER BEFORE AND AFTER IMMERSION WITH CARBONATED DRINKS - AN IN VITRO STUDY****Vikraman K S**

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ABSTRACT:**INTRODUCTION:**

Surface roughness is a surface irregularity of the material. Resilient soft lining materials are helpful for the management of patients with removable prosthesis who are unable to withstand the hard denture base with thin underlying mucosa, resorption of the residual ridge, severe undercuts and heavy and unequal distribution of occlusal loads. Use of soft liners employed as tissue conditioners, functional impression materials and temporary reliners of ill-fitting removable dentures. These materials can be used as interim liners within the healing periods after implant placement. The aim of the study is to determine the surface roughness of soft tissue liner before and after immersion with carbonated drinks.

MATERIALS AND METHODS:

10 samples of soft tissue liners discs were made with a diameter of 10mm and thickness of 4mm. a 2µm/60 stylus was used to measure the surface roughness. Pre immersion surface roughness was measured for 10 samples using Mitutoyo SJ-310 Stylus profilometer. All the data were tabulated. Using the "SPSS software", values were presented in the form of bar charts.

RESULTS:

Carbonated beverages like coke and sprite influenced the surface roughness property of soft tissue liners, by increasing the roughness parameters post immersion for 24 hours. When compared with coke, sprite drink shows a more significant increase in surface roughness. P value obtained using chi square test was greater than 0.05, hence it is statistically not significant.

CONCLUSION:

Within the limitations of study, it is concluded that there was an increase in the surface roughness of the soft tissue liner when immersed in carbonated beverages like coke and sprite. Surface roughness of soft tissue liner material immersed in sprite drink showed increased roughness values when compared to the material in coke drink.

KEYWORDS: Surface roughness, soft liners, Carbonated drinks, Profilometer

RUNNING TITLE: Evaluation of surface roughness of soft tissue liner before and after immersion with carbonated drinks.

INTRODUCTION:

Surface roughness is a surface irregularity of the material. Resilient soft lining materials are helpful for the management of patients with removable prosthesis who are unable to withstand the hard denture base with thin underlying mucosa, resorption of the residual ridge, severe undercuts and heavy and unequal distribution of occlusal loads(1) . Short-term-use of soft liners employed as tissue conditioners, functional impression materials and temporary reliners of ill-fitting removable dentures. These materials can be used as interim liners within the healing periods after implant placement. Soft liners are either heat-polymerized or auto-polymerized. They are usually provided as powder and liquid(2). The powder consists of polymethylmethacrylate (PEMA) and therefore the liquid contains ethyl alcohol (as solvent) and an aromatic ester (di-butylphtha-late) the plasticizer agent which maintains material softness.(3)

The efficiency of those materials relies on their cushioning effect and that they lose their resiliency and become harder after clinical use. The temporary nature of those sorts of materials is because, in their clinical use, the alcohol and plasticizer leach out from their structure and water or saliva is absorbed by them which eventually causes the loss of viscoelasticity and their compliance. These soft materials have a massaging effect on irritated mucosa and since they are soft, occlusal forces are probably more evenly distributed(4). The tissue conditioner is soft high-molecular material which is applied to the surface of the denture base that comes in contact with the mucosa under the denture base which varies its state following the displacement of the mucosa(5). The tissue conditioner is employed within the sort of a paste formed by mulling a powder and a liquid material together. As ulcer and inflammation of oral mucosa gradually diminish the state of the oral mucosa recovers with the passage of time to resume initial state(6,7). Here the tissue conditioner must undergo plastic deformation to fulfill the change within the state of the oral mucosa(8). This is often because when no deformation occurs because the oral mucosa recovers it'll cause pain again. Several studies have been done before about the consequences of water and denture cleansers on the properties of soft lining materials. But there are few published articles in reference to the effect of carbonated beverages on the hardness and bond strength of resilient soft-liner materials(9). Therefore, the aim of this study was to evaluate the surface roughness of soft tissue liner material before and after immersion with carbonated drinks.

MATERIALS AND METHODS:

This in-vitro study was done at White lab, material research centre at Saveetha dental college, Chennai. Before scheduling of the in-vitro study, the official permission was obtained from the institutional ethical committee. 10 samples of soft tissue liners discs were made with a diameter of 10mm and thickness of 4mm (Fig 1). A $2\mu\text{m}/60$ stylus was used to measure the surface roughness (Fig 3). Pre immersion surface roughness was measured for 10 samples using Mitutoyo SJ-310 Stylus profilometer (Fig 4). All the data are tabulated. Then samples are divided into two groups. The group-1 samples are immersed in coca cola drink and group-2 samples are immersed in sprite drink for 1 day (Fig 5). Then post immersion surface roughness was taken. All the data were tabulated. Comparison of pre and post immersion surface roughness was done using the SPSS software and result values were presented in the form of bar charts.

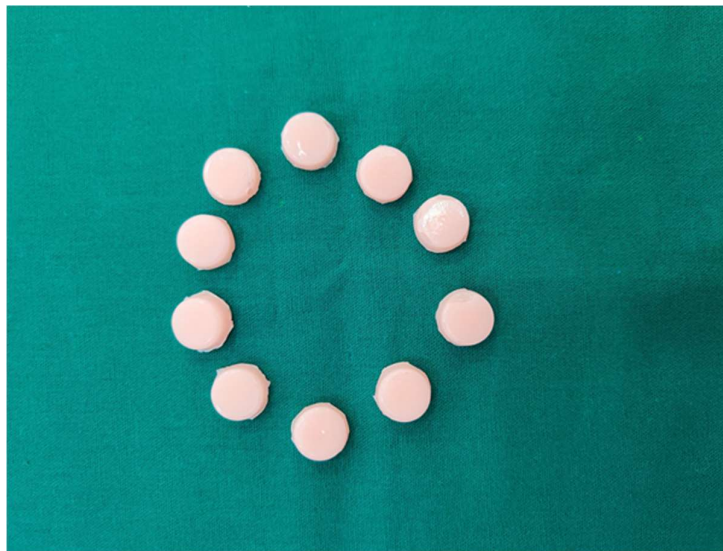


Figure 1: Prepared soft-liner samples



Figure 2: MITUTOYO SJ-310 Stylus Profilometer



Figure-3 Stylus-2µm/60



Figure 4: MEASURING SURFACE ROUGHNESS OF SAMPLE USING STYLUS - 2µm/60

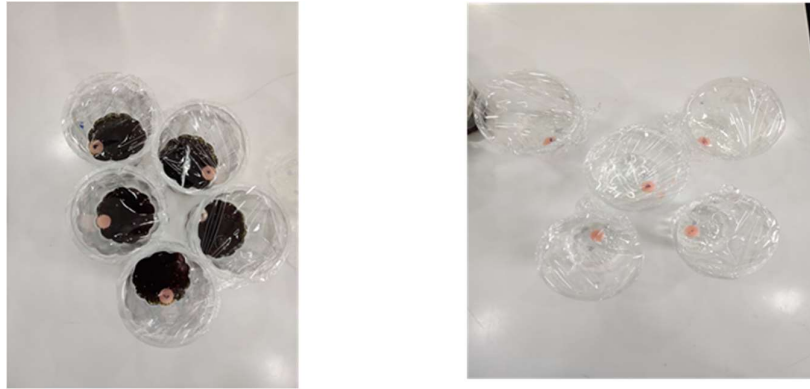


Figure :5 Samples immersed in coke and sprite drink

RESULTS:

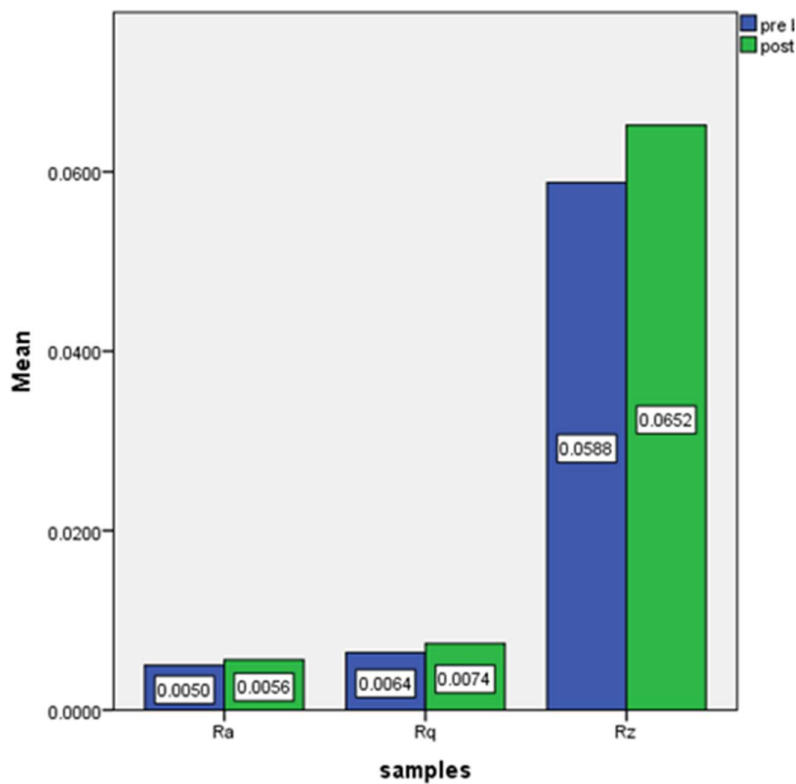
TABLE 1:Pre and post immersion surface roughness parameters(Ra-Roughness average, Rq-Root mean square roughness, Rz-Arithmetic mean) of soft tissue liners (coke group)

SAMPLES	Pre Ra	Pre Rq	Pre Rz	Post Ra	Post Rq	Post Rz
1	0.005	0.006	0.062	0.006	0.008	0.069
2	0.005	0.006	0.056	0.005	0.006	0.054
3	0.005	0.006	0.056	0.005	0.007	0.063
4	0.005	0.007	0.063	0.006	0.008	0.067
5	0.005	0.007	0.057	0.006	0.008	0.073
AVERAGE	0.0050	0.0064	0.0588	0.0056	0.074	0.0652

TABLE 2: Pre and post immersion surface roughness parameters Ra-Roughness average,Rq-Root mean square roughness, Rz-Arithmetic mean) of soft tissue liners (sprite group)

SAMPLES	Pre Ra	Pre Rq	Pre Rz	Post Ra	Post Rq	Post Rz
1	0.005	0.007	0.062	0.006	0.008	0.072

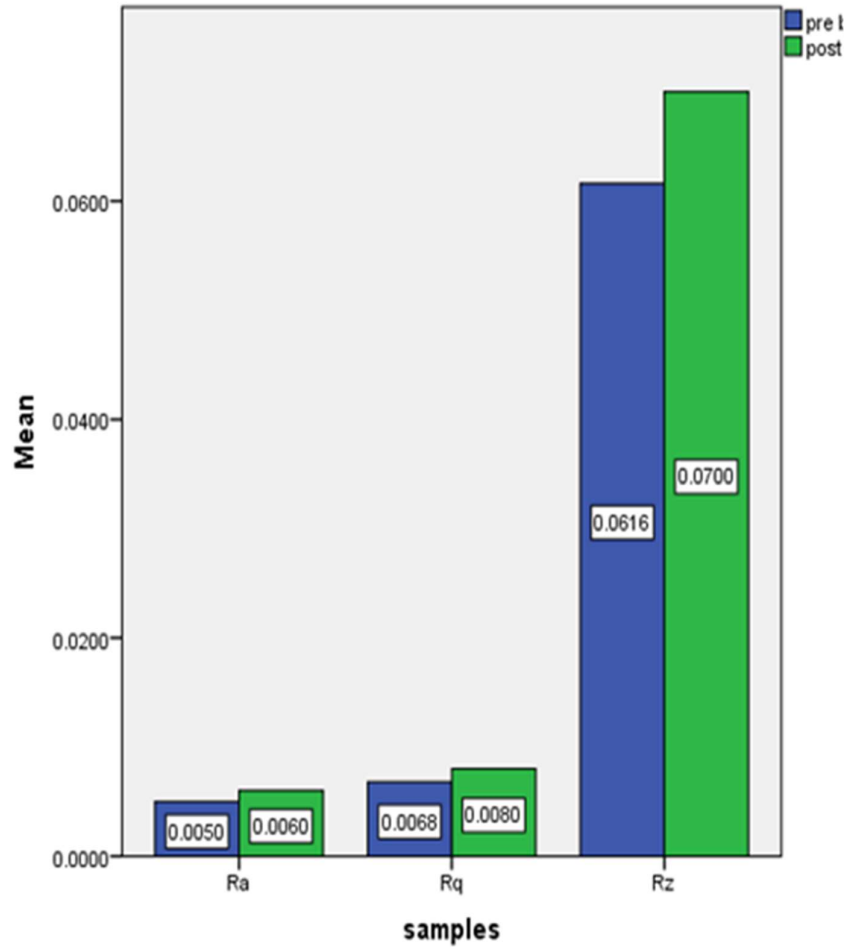
2	0.005	0.007	0.064	0.006	0.008	0.069
3	0.005	0.006	0.056	0.006	0.008	0.068
4	0.005	0.007	0.063	0.006	0.008	0.069
5	0.005	0.007	0.063	0.006	0.008	0.072
AVERAGE	0.0050	0.0068	0.0616	0.0060	0.0080	0.0700



GRAPH 1:

This bar graph depicts the association between pre and post surface roughness of Ra,Rq,Rz of soft tissue liners after immersion in coke for a duration of 24 hours.X axis represents the soft liner samples and Y axis represents the mean surface roughness value. Blue colour represents the surface roughness of samples before immersion, Green colour represents the surface roughness of samples after immersion. In comparison with pre immersion surface roughness,

the soft liner samples showed increase in surface roughness after immersion in coke drink. P value obtained using chi square test was $0.241 > 0.05$, hence it is statistically not significant.



GRAPH 2: This bar graph represents the association between pre and post surface roughness of Ra,Rq,Rz of soft tissue liners after immersion in sprite for a duration of 24 hours. X axis represents the soft-liner samples and Y axis represents the mean surface roughness value. Blue colour represents the surface roughness of samples before immersion, Green colour represents the surface roughness of samples after immersion. On comparison with pre immersion surface roughness, the soft-liner samples showed increase in surface roughness after immersion in sprite drink. P value obtained using chi square test was $0.329 > 0.05$, hence it is statistically not significant.

This study was done to evaluate the surface roughness of soft tissue liner material before and after immersion with carbonated drinks. SPSS software was used for statistical analysis and p value was calculated. In the coke group, in comparison with surface roughness of pre immersion Ra(0.0050), the surface roughness of post immersion Ra(0.0056) has been increased. In comparison with pre immersion Rq(0.0064) the surface roughness of post immersion Rq(0.074) has been increased. In comparison with pre immersion Rz(0.0588), the surface roughness of post immersion Rz(0.0652) has been increased. On comparison with pre

immersion surface roughness, the soft liner samples showed increase in surface roughness after immersion in coke drink (Table 1) In the sprite group, on comparison with roughness of pre immersion Ra(0.0050), the surface roughness of post immersion Ra(0.0060) has been increased. On comparing with pre immersion Rq(0.0068) the surface roughness of post immersion Rq(0.0080) has been increased. On comparing with pre immersion Rz(0.0616), the surface roughness of post immersion Rz(0.0700) has been increased. On comparison with pre immersion surface roughness, the soft liner samples showed increase in surface roughness after immersion in sprite drink.(Table 2).P value obtained using chi square test was greater than 0.05,hence it is statistically not significant

DISCUSSION:

Surface roughness is a surface irregularity of the material. Resilient soft lining materials are helpful for the management of patients with removable prosthesis who are unable to withstand the hard denture base with thin underlying mucosa, resorption of the residual ridge, severe undercuts and heavy and unequal distribution of occlusal loads. In this study, from (graph 1), This bar graph represents the association between pre and post surface roughness of soft tissue liners after immersion in coke for a duration of 24 hours. On comparing with surface roughness of pre Ra, the surface roughness of post Ra has been increased and on comparing with pre Rq the surface roughness of post Rq has been increased and on comparing with pre Rz, the surface roughness of post Rz has been increased. On comparison with pre immersion surface roughness the soft liner samples showed increase in surface roughness after immersion in coke drink .The p value is $(p)=0.290 > 0.05$ is not statistically significant.

In this study, From (graph 2), This bar graph represents the association between pre and post roughness of soft tissue liners after immersion in coke for a duration of 24 hours.On comparing with surface roughness of pre Ra, the surface roughness of post Ra has been increased and on comparing with pre Rq the surface roughness of post Rq has been increased and on comparing with pre Rz, the surface roughness of post Rz has been increased. On comparison with pre immersion surface roughness the soft liner samples showed increase in surface roughness after immersion in sprite drink .The p value is $(p)=0.284 > 0.05$ is not statistically significant.

In a similar study, storage in Coca-Cola, 50% ethanol and 8% ethanol decreased the hardness of the resilient lining materials in comparison to the control group. In that study 50% of ethanol and 8% of ethanol decreased the hardness more than Coca-Cola. This may be related to the presence of ethanol. It is known that ethanol acts as a plasticizer. In one study, it was shown that a large amount of ethanol may accelerate degradation of a photo-activated soft lining material(9). This deteriorating effect of ethanol on hardness is in agreement with other studies. This might indicate that the patients' alcohol consumption could cause damage to soft lining materials(10). Storage in water did not affect the bonding of denture liners to PMMA. By roughening the PMMA surface before bonding; it would approximately double the adhesion values of resilient liners(11). There was no significant interaction between the soft liners and the drinks for both hardness ($p=0.748$) and bond strength ($p= 0.902$).

Brushing with only toothpaste and water increased the roughness of silicone liner, since

toothpaste is composed of sodium carbonate, an abrasive agent.(12). The increase in roughness of the soft liner is due to porosities formed from the release of residual monomers and plasticizers and from the increase in temperature during disinfection with microwaves. The increase in roughness was observed when organic solvents such as MMA were applied on PMMA as an attempt to improve adhesiveness to silicone-based liners, because these solvents degrade the surface and alter its morphology.(13). The results demonstrated that the type of liquid simulating foods or artificial saliva, and immersion time significantly influenced the behaviour of the commercial denture soft lining materials and the experimental elastomer during in vitro testing. The two groups of materials behaviour were different. The two methacrylate-based denture soft lining materials showed marked absorption and solubility which may be associated with the loss of plasticisers. The two silicone-based denture soft lining materials showed much less absorption and solubility under the same conditions. The experimental elastomer showed marked swelling in oils, which was not expected, its chemical structure being similar to a methacrylate. Increased surface roughness was also demonstrated with the two methacrylate-based materials, and decreased contact angle was found with the two silicone-based materials(14). Only a small number of soft-liner samples were used in our study and in future it should be done by comparing with different kinds of cold and hot beverages commonly consumed by the patients.

CONCLUSION:

From the above study, it is concluded that there was an increase in the surface roughness of the soft tissue liner when immersed in carbonated beverages like coke and sprite. Surface roughness of soft tissue liner material immersed in sprite drink showed increased roughness values when compared to the material in coke drink. Further in vivo clinical investigations on the soft lining materials are required to determine the level of bond strength, hardness and other properties which are indispensable for effectiveness of these materials.

CONFLICT OF INTEREST: NIL

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