ORIGINAL ARTICLE

Effect of brushing simulation on the surface roughness of soft-tissue liners: An *in vitro* study

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ABSTRACT

Soft denture liners evenly distribute functional loads over denture-bearing tissues. The liners aid in more evenly distributing the pressures of mastication to the underlying tissues by absorbing some of the masticatory forces. The study aimed to evaluate the brushing simulation influence on the surface roughness property of soft-tissue liners. A total of eight samples of Avue brand soft-tissue liners with the composition of varnish base and varnish catalyst were suspended into a standard template extracted and numbered sequentially and surface roughness was calculated using a stylus profilometer. A total of 30,000 cycles brushing were done, where the first group samples were brushed with Colgate toothpaste and the second group brushed with Dabur Red toothpaste using a toothbrush simulator (ZM3.8 SD Mechatronik). The data of both pre- and postbrushing values were recorded manually and statistically uploaded on SPSS software version 22 and values were represented in clustered bar graph forms. The significance value of Ra was 0.321. The significance value of Rq was 0.211. The significance value of Rz was 0.354, hence statistically, insignificant. In the present study, the surface roughness of soft-tissue liners is reduced to a minimal extent after brushing simulation.

Key words: Brushing simulation, innovative measurement, profilometer, soft liners, surface roughness, toothpaste

INTRODUCTION

A denture is a removable dental appliance that replaces lost teeth and soft tissues. Two types of dentures are available: complete and partial dentures. When all of the teeth are lost, complete dentures are utilized, while partial dentures are used when some natural teeth remain. The precision of dentures is a crucial aspect in denture retention. The resilient lining materials are important in removable prosthodontics because they have the potential to restore health to inflamed mucosa, resulting in a more even distribution of functional load on the denture foundation region, as well as improved denture fit and retention.[1] Soft denture lining materials were first used in clinical settings in 1943. Soft liners have grown increasingly popular as a means of offering comfort to denture users since then. Soft liners are frequently utilized by people who are unable to tolerate a traditional hard denture base.[2,3]

The success of dentures composed of distinct materials is dependent on the components ability to bond together.

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As a result, structural discrepancies between the materials are the cause of soft lining denture failure. Denture liner's hardness is the most essential factor, as it affects malleability, ductility, and abrasion resistance. A denture liner's surface roughness is also crucial, as a rough denture surface promotes biofilm production and *Candida albicans* colonization. Routine denture cleaning removes plaque, calculus, food debris, and external discoloration, as well as preventing re-accumulation of plaque.

There are two primary varieties of soft liners: plasticized acrylics and silicone elastomers, both of which are available in auto polymerized and heat polymerized forms. Surface roughness, on the other hand, is thought to be an essential element in the adhesion and retention of microbes on surfaces, with greater surface roughness, leading to increased microbial cell retention.[4,5] The roughness of the surface is measured using three different values: Ra, which stands for roughness average. Rq is for root mean square roughness and Rz is peak and depth average value[6] The study aimed to evaluate the brushing simulation influence on the surface roughness property of soft-tissue liners.

MATERIALS AND METHODS

The sample size consists of eight soft-tissue liners. Avue brand soft-tissue liners with composition of varnish base and varnish catalyst were suspended into a standard template and extracted. The surface roughness was measured using stylus profilometer consisting of tip 2 μ and 60° angulated. Before brushing simulation, the surface of the liners was evaluated [Figure 1]. The soft-tissue liners samples were mounted over die stone to ensure better retention, while brushing with a toothbrush using a toothbrush simulator ZM3.8 SD Mechatronik with a minimum pressure of 3N [Figure 2]. The first group samples were brushed with Colgate toothpaste and the second group samples were brushed with Dabur red toothpaste. There were a total of 30,000 cycles of brushing, 10,000 times in x-axis direction, 10,000 times y-axis direction, 5000 times clockwise and contraclockwise direction. The surface roughness was evaluated again post brushing simulation and the values were compared. The data of both pre- and postbrushing values were recorded manually and statistically uploaded on SPSS software version 22 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) and values were represented in clustered bar graph forms.

Figure 1: Representation of stylus profilometer to measure the surface roughness of soft-tissue liners

RESULTS

Independent sample *t*-test was done. Mean and standard deviation values for the Ra parameter were 0.0043 ± 0.0042 in colgate group and 0.00064 ± 0.00064 in dabur red group. The significance value of Ra was 0.321. The significance value of Rq was 0.211. The significance value of Rz was found to be 0.354, hence statistically, insignificant [Table 1]. The bar graph infers that the surface roughness of soft-tissue liners is slightly reduced after brushing simulation [Figure 3].

DISCUSSION

The present study demonstrated that brushing simulation of soft lining materials reduced the mean surface roughness in an *in vitro* environment. Although other factors such as the presence of saliva during polymerization, tissue surface imperfections, and microbial contaminants may have an effect on the values obtained, polishing is likely to have a similar effect clinically.[7] The wet environment of the oral cavity changes often, exposing denture materials to a risk of degradation.

Denture area surface roughness grants to tissue damage in an indirect way.[8] Higher the surface roughness, the more

Figure 2: Representation of brushing of soft-tissue liners in brushing simulator

Table 1: Significance testing between the groups

Parameter	Groups	Mean	SD	Significance
Ra	Colgate toothpaste group samples	0.0043	0.00064	0.321
	Dabur toothpaste group samples	0.0042	0.00064	
Rq	Colgate toothpaste group samples	0.0055	0.00078	0.211
	Dabur toothpaste group samples	0.0053	0.00076	
Rz	Colgate toothpaste group samples	0.044	0.00063	0.354
	Dabur toothpaste group samples	0.045	0.00067	

Ra: Roughness average, Rq: Root mean square roughness, Rz: Peak and depth average value, SD: Standard deviation

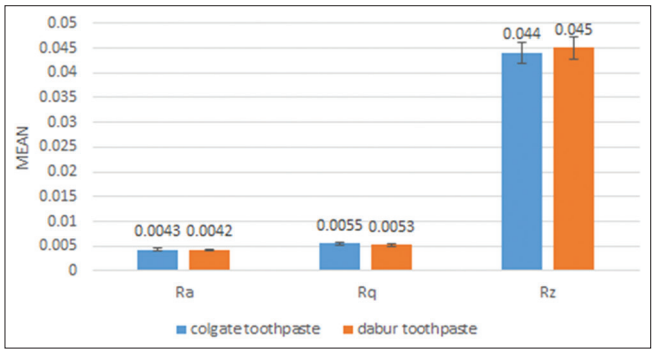

Figure 3: The bar graph above shows the surface roughness values of soft liner material before and after brushing simulation. Blue color represents the mean difference of Ra, Rq, Rz of colgate toothpaste and orange color denotes the mean difference of Ra, Rq, Rz of dabur toothpaste. This graph infers that the surface roughness of soft tissue liners is slightly reduced after brushing simulation

surface contortion, stain, calculus precipitation, and certain bacterial adherence, all of which can damage the health of oral tissues, directly or indirectly, and hence reduce the longevity of robust relining.[9] Our team has substantial research and knowledge, which has resulted in high-quality publication papers.[10-29] Gad MM conducted a pilot study in 2008 to examine and compare the adhesive qualities of oral microbiota onto four soft liner materials and acrylic resin material. Soft liner materials had the highest concentration of microorganisms and were shown to have higher oral bacterial and Candida adhesion than acrylic resin.[30] The solubility and absorption characteristics of soft liners in artificial saliva and distilled water were experimented in a study. They concluded that, with the exception of heat cure type silicone material, all of the tested soft liners had lower solubility and absorption rates in artificial saliva medium. As a result, it is assumed that artificial saliva would show clinically meaningful findings over distilled water. The study has a sample size constraint due to the small sample size. More varieties of toothpastes may be employed in the future to assess the change in surface roughness of different liners.

CONCLUSION

In the present study, the surface roughness of soft-tissue liners is reduced to a minimal extent after brushing simulation. Thus brushing simulation with fluoridated and herbal toothpaste did not influence the important surface roughness property of soft-tissue liners.

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Conflicts of interest

There are no conflicts of interest.

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