Effect of brushing simulation using remineralizing toothpaste on microhardness of anterior teeth - An in vitro study

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Abstract

Introduction: Brushing simulator machines are capable of running programmable three-dimensional brushing patterns. In microhardness testing, an indentation is made on the specimen by a diamond indenter through the application of a load. The aim of the study is to evaluate the effect of brushing simulation using remineralizing toothpaste on microhardness of anterior teeth.

Materials and methods: For this study, 8 maxillary central incisors teeth samples were obtained. They were divided into 3 groups, as pre test, demineralising solution group (de - min) and post test group. Once, the pre test hardness was measured. The samples were immersed in demineralising solution for 48 hours after immersion period again, vickers microhardness was measured. Then the samples were mounted in die stone. The anterior teeth samples were placed on the machine and were subjected to brushing simulation. The brushing simulator samples were subjected to brushing with two different remineralizing toothpastes (Enafix and GC Tooth Mousse Plus). Microhardness was checked using an instrument named SHIMADZU HMV-G31D Microhardness Tester. The microhardness was checked on three different sessions, pretest (pre-brushing), post demineralization, and post brushing (24 hours).

Results : Paired T test was done. The Pre test group mean value is 385.88, the pre test group standard deviation is 46.008, the de-min group mean value is 346.13, de-min group standard deviation is 53.153, the post test mean group value is 263.13 and the post test group standard deviation is 104.450. The pre and post group significance value is 0.009. The de-min and post group significance value is 0.035. Hence statistically significant. **Conclusion:** Within the limitations of the study, it can be concluded that microhardness of anterior teeth was decreased after brushing simulation using remineralizing toothpastes for 5000 cycles.

Keywords : Microhardness, Brushing, Teeth, Innovative measurement, Demineralizing solution, Remineralizing toothpaste

Introduction

In a technical sense, the term "hardness" is used to represent five concepts: a material's resistance to scratching, indentation, elastic impact, cutting, and permanent deformation. As a basic principle, the many types of hardness-testing devices use one of these attributes or a combination of these qualities; thus, the enormous number and variety of these instruments (1)). A comparison of different commercial hard-ness tests as applied to tooth tissues has just been verified with various materials. Despite the fact that these devices were based on various concepts and had variable degrees of delicacy, they demonstrated qualitative agreement in terms of enamel and dentin relative hardness (2). Because of the small size of the teeth and the abrupt gradients in hardness, it was determined that a more delicate tool is needed for hardness examinations of these tissues (3).

Since the discovery of therapeutic agents to prevent dental caries, fluoride has been widely used in different sources (gels, varnishes, toothpastes and mouthwashes) in dentistry (4). Fluoride, which is incorporated in various brands of toothpaste, can increase resistance to demineralization and reduce microbial activity, thus also reducing the occurrence of secondary caries, which is well known in current dentistry (5). The activity of bacteria in the biofilm formed by carbohydrate metabolism causes demineralization and remineralization in the tooth enamel, resulting in the creation of incipient carious lesions (6). In addition, the presence of fluoride in saliva and other remineralizing substances allows previously demineralized enamel to be remineralized.

Brushing simulator machines are capable of running programmable three-dimensional brushing patterns. In microhardness testing, an indentation is made on the specimen by a diamond indenter through the application of a load. The size of the resultant indentation is measured with the help of a calibrated optical microscope, and the hardness is evaluated as the mean stress applied underneath the indenter. The Vickers hardness test method consists of indenting the test material with a diamond indenter, in the form of a pyramid with a square base (7). The aim of the study is to evaluate the effect of brushing simulation using remineralizing toothpaste on microhardness of anterior teeth.

Materials and Methods

This in vitro study was done in white lab, Saveetha Dental College and Hospital, Chennai, India. For this study, 8 maxillary central incisors teeth samples were obtained. Non carious teeth were selected. 2*2 mm middle third part of the teeth were selected. They were divided into 3 groups, as pre test, demineralising solution group (de - min) and post test group. Pre test indicates before and post test indicates after the samples exposed to brushing simulation. They were mounted in acrylic resin and blocks were obtained. Then Vickers microhardness was measured. Once, the pre test hardness was measured. The samples were immersed in demineralising solution for 48 hours after immersion period again, vickers microhardness was measured. Then the samples were mounted in die stone. Brushing simulator (ZM3.8 SD Mechatronik) was used in this study. The anterior teeth

samples were placed on the machine and were subjected to brushing simulation for 5000 cycles. The brushing simulator samples were subjected to brushing with two different remineralizing toothpastes (Enafix and GC Tooth Mousse Plus). Microhardness was checked using an instrument named SHIMADZU HMV-G31D Microhardness Tester. The microhardness was checked on three different sessions, pretest (pre-brushing), post demineralization, and post brushing (24 hours).

Figure 1: Brushing simulation samples

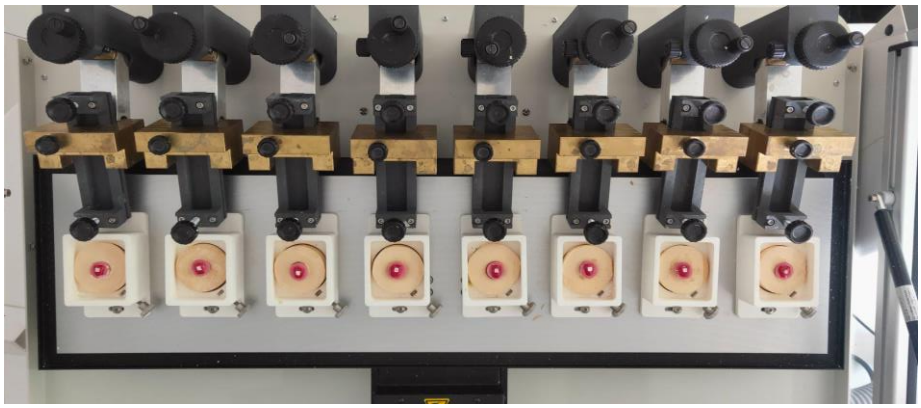

Figure 2: Samples loaded in brushing simulator

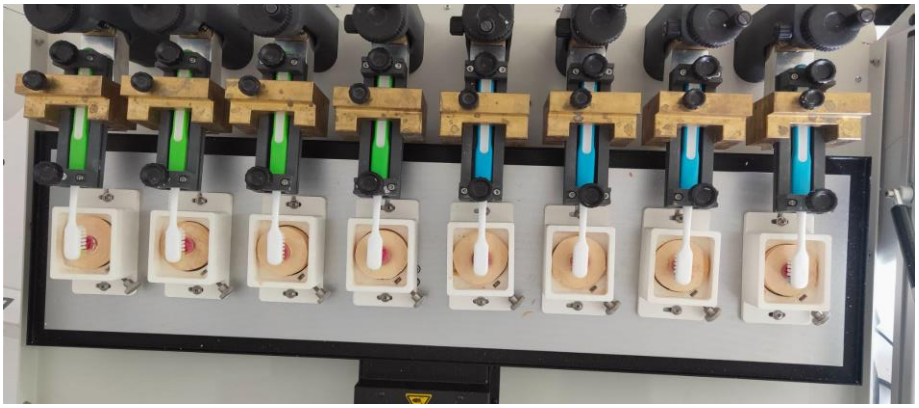

Figure 3: Brushing simulation done for 8 samples

Results

In this study we have calculated the effects of brushing simulation on micro hardness of anterior teeth with two different toothpaste (Colgate and GC Tooth Mousse Plus). Paired T test was done. The Pre test group mean value is 385.88, the pre test group standard deviation is 46.008, the de-min group mean value is 346.13, de-min group standard deviation is 53.153, the post test mean group value is 263.13 and the post test group standard deviation is 104.450. (Tabe 1) The pre and post group significance value is 0.009. The de-min and post group significance value is 0.035. (Table 2, Figure 4) Hence statistically significant.

Table 1: Mean and standard deviation values of groups

GROUPS	MEAN VALUE	STD. DEVIATION
PRE TEST	385.88	46.008
DE-MIN	346.13	53.153
POST TEST	263.13	104.450

Table 2: Significance testing among the groups

GROUPS	SIGNIFICANCE VALUE
PRE - POST	0.009
DE MIN - POST	0.035

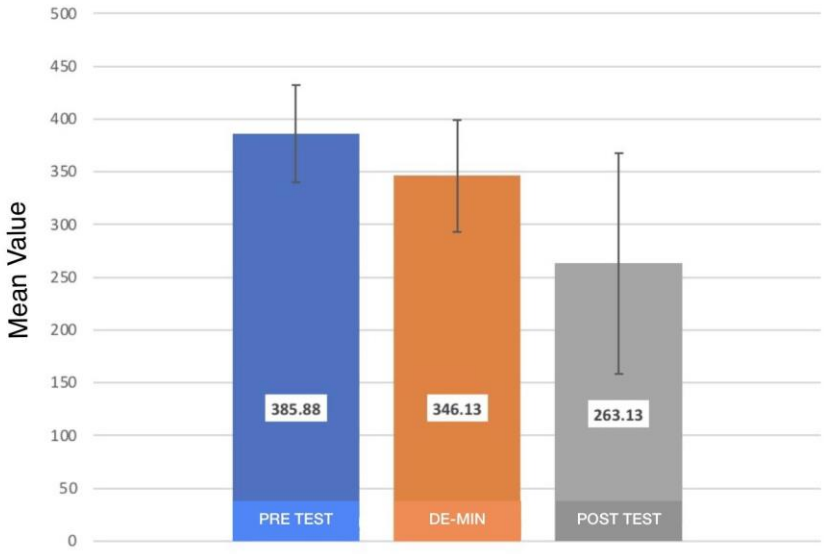

Figure 4: The graph represents the mean micro hardness values of pre test, de min and post test groups. x axis represents the pre test, de-min and post test groups and y axis represents the mean value. Blue represents the pre test group, orange represents the de-min value group and grey represents the post test group. There was a decreasing trend in the microhardness values.

Discussion

Our team has extensive knowledge and research experience that has translated into high quality publications (8–17),(18–21),(22–26),(27). The control group had the highest microhardness. The brushing-treated group, on the other hand, had a mean value that was lower than the control group and de min group. This might be because the brushing force, which is a tiny frictional force, alters the wear behaviour of infiltrating teeth's surfaces. The speed, pressure, abrasive size, and coolant all affect this energy.

The influence of an extended use of desensitizing toothpastes (DTs) on dentin bonding, microhardness and roughness was evaluated in a study. 120 incisor teeth were randomly divided into four groups: distilled water, Colgate Total, Colgate Sensitive Pro-Relief, Sensodyne Repair. 2 years of simulated tooth brushing (20,000 cycles) was performed on their surfaces. Knoop microhardness and surface roughness were performed before and after the simulated tooth brushing. The extended use of both dentifrices (conventional and for sensitive teeth) did not affect the bond strength and produced a significant increase in microhardness and roughness of the dentin. The simulated tooth brushing technique with water produced an increase in roughness, without significantly reducing the dentin microhardness (28). In another study, Vickers microhardness value was obtained at baseline, post demineralisation and post treatment with NovaMin, Bio Min and Remin Pro toothpastes. The microhardness of artificial carious like lesions increased significantly with NovaMin, Bio Min and Remin Pro containing toothpastes(29). The current study had limitations of less sample size and future studies which compare and analyse the surface roughness, studies which deal with multiple parameters in different types of restorative materials are also required.

Conclusion: Within the limitations of the study, it can be concluded that microhardness of anterior teeth was decreased after brushing simulation using remineralizing toothpastes for 5000 cycles.

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