

## Comparative Evaluation Of Remineralisation Potential Of Fluoridated Toothpaste And Toothpaste Containing Blue Covarine - An Invitro Study

Research Article

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### Abstract

**Introduction:** An Ideal toothpaste is the one that causes minimal abrasion and surface roughness on tooth and restorative materials. Hence, the aim of the current study was to evaluate the remineralization potential of fluoridated toothpaste and toothpaste containing blue covarine .

**Materials and Methods:** This in vitro study involves 12 enamel samples divided into two groups of 6 samples each. The remineralizing agents included were Pepsodent Whitening toothpaste and Colgate Maxfresh toothpaste. The two groups were subjected to demineralization following which the groups were remineralized with their respective remineralizing toothpastes. Statistical Analysis: Paired t-test was used for intragroup comparison and independent t-test was used for intergroup comparison.

**Results:** On intragroup comparison, the mean values of microhardness in group Pepsodent Whitening toothpaste at baseline and after remineralization were 474.36+ \_29.26 and 479.93+ \_29.19 respectively.

Similarly, the mean values of microhardness in group Colgate Maxfresh toothpaste at baseline and after remineralization were 490.51+\_18.55 and 501.5+\_18.75 respectively and was statistically significant with p=0.000.

On intergroup comparison, the mean values of microhardness in group Pepsodent Whitening toothpaste and Colgate Maxfresh post remineralization were 479.93+\_29.19 and 501.50+\_18.75 respectively and the difference was not statistically significant with p=0.315. As per statistical analysis, there was an improved enamel remineralization in Colgate Maxfresh toothpaste group as compared to Pepsodent Whitening toothpaste group

**Conclusion:** The results of this in vitro study showed that Colgate Maxfresh is likely to yield higher microhardness when compared to Pepsodent Whitening toothpaste.

**Keywords:** Blue Covarine Toothpaste; Fluoridated Toothpaste; Early Enamel Lesions; pH Cycling; Surface Microhardness.

### Introduction

Caries is a highly prevalent multifactorial disease [1]. The carious lesion is initiated by demineralization favouring factors such as fermentable carbohydrates, cariogenic bacteria and salivary dysfunctions. These pathological factors gradually win over protective factors such as remineralizing ions present in saliva [2]. Dental caries is a public health concern that can be minimized in the ini-

tial stages of demineralisation through remineralisation [3, 4]. As a result, dental professionals have shifted to the noninvasive management of carious lesions using remineralizing toothpastes [5]. Remineralizing toothpastes serve as an interventional approach for the management of early enamel lesion [6].

Till date, the researches in the literature reinforce that fluoride treatment remains the potent remineralizing method for early

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enamel caries. There is evidence based literature on the remineralisation potential of agents like Novamin, tricalciumphosphate, Nano-hydroxyapatite [7], casein phosphopeptide amorphous calcium phosphate (CPP-ACP), casein phosphopeptide amorphous calcium phosphate with fluoride (CPP-ACPF) [8-11]. Since the 1950s, fluoride has been considered the gold standard in caries prevention. According to several epidemiological data, caries rate is either stagnating or notwithstanding the regular use of fluoride toothpastes [12]. In the era of holistic dentistry and after fluoride has been categorized as a chemical neurotoxicant, major thriving concerns arise regarding the exposure of fluoride to children from multiple sources accelerating the risk of developing dental fluorosis [13].

It is well known that toothpaste is an important vehicle for delivering therapeutic agents to the oral cavity during the daily brushing routine. Many types of toothpaste ingredients have been described in the literature for removing plaque, extrinsic stains and teeth whitening. However, these include abrasives, calcium chelators and surfactants which are known to cause surface hardness and roughness on tooth [14]. According to studies, silica based blue covarine toothpastes have shown minimal undue degree of abrasivity to enamel or dentin compared to other relevant commercially available products [15].

Predominantly, silica based blue covarine toothpastes are advocated for teeth whitening where it changes the optical properties of teeth [16]. Despite abundant literature on teeth whitening of Blue covarine, its effect on remineralization potential is limited and none of the studies have compared its efficacy with fluoride. Hence, the study aimed at quantitatively evaluating remineralization potential of fluoridated toothpaste and a toothpaste containing blue covarine.

## Materials And Methods

This *in vitro* study was conducted in the Laboratory (White lab), Saveetha Dental College, Chennai. Vickers microhardness values were analyzed in Mettix Laboratories Pvt Ltd, Guindy, Chennai.

### Inclusion criteria

Permanent maxillary premolars extracted for orthodontic purposes were selected for the study. The teeth selected were non carious, with an intact surface, no visible cracks and were unrestored.

### Exclusion criteria

Any tooth with visible cracks, hypoplasia, enamel white spot lesions or caries on any surface and restored teeth.

### Sample preparation

12 freshly extracted human maxillary premolars were used in the study. After thorough scaling with an ultrasonic scaler and polishing with a pumice paste and a rubber cup, the teeth were examined for visible cracks under microscope at 10 magnification. The radicular part of each of the teeth was horizontally sectioned at a level of 1mm apical to cemento-enamel junction with the help of a diamond disc at 15000rpm with constant coolant.

Enamel samples of 2mm thickness were prepared on the lingual surfaces of the teeth using a double faced diamond disc mounted on a contra angle handpiece (Fig.1). Following sample preparation, windows were created with a dimension of 5mm X 5mm using adhesive tape (Fig.2). And now, the samples were coated with a nail varnish to make them acid resistant.

After drying, the adhesive tape was removed from the enamel using a sharp tipped instrument exhibiting a rectangular area on the enamel surface [17].

### Groups

A total of 12 enamel slabs were randomly divided into two groups of 6 samples each based on the type of remineralizing agent used. Now, the specimens were mounted in acrylic resin moulds by pouring self-cure acrylic resin in the preformed mould of 2cm X 2cm (Fig.3). Following this, all the samples were tested for baseline surface microhardness measurement by Vickers Hardness Tester (Leco model M-400)

### Slurry preparation

The remineralizing agent slurry was prepared by manually mixing peanut sized toothpaste to the distilled water (three times the volume of toothpaste) with a plastic spatula at a speed of 30 rotations in 30s.

### pH cycling model

This was adopted to simulate the dynamic process of demineralisation and remineralisation process that occurs in the oral cavity. Each of the twelve samples were treated with the respective remineralizing agents Pepsodent whitening-blue covarine containing toothpaste and Colgate maxfresh-standard fluoridated toothpaste for 2 min, following which the samples were immersed separately in 20 ml of demineralizing solution (calcium 2.0 mMol/L, phosphate 2.0 mMol/L, acetic acid 75.0 mMol/L, adjusted to pH 4.4) for a period of 3 h. This was followed-up with treatment of the samples again with remineralizing agents for 2 min. The remineralizing solution was replaced every 48 h and the demineralizing agent replaced every 5 days. The pH cycling was carried out for a period of 28 days. After the completion of the process of pH cycling, all the groups of samples were assessed for surface microhardness using Vickers hardness test.

### Microhardness testing

The specimen surfaces were assessed for microhardness using Vickers microhardness testing machine (Fig.4). A load of 100 g was exercised steadily to the surface of specimens for 10 s using Vickers elongated diamond pyramid indenter under a  $\times 40$  objective lens (Fig.5). The Vickers Indenter Test was performed, with indentations at least 120  $\mu$ m apart, and the average of the 3 indentations was measured as the average value. Accuracy of values of diagonal length of indentation was determined under high magnification of  $\times 400$ . The Vickers values were converted into microhardness values.

The results were analyzed by Paired t test that compared the baseline and post remineralisation values. Independent t test that compared values between two toothpaste groups.

Figure 1. Enamel specimens of 2mm thickness.



Figure 2. Windows with a dimension of 5mmX5mm and covered using an adhesive tape.



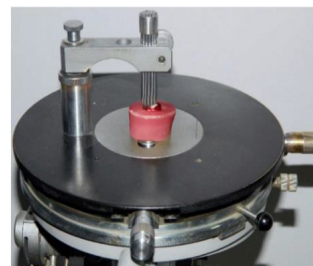
Figure 3. The specimens are mounted on acrylic blocks.



Figure 4. Vickers Hardness Tester (Leco model M-400).



Figure 5. Acrylic blocks subjected to load.



## Results

The data were processed through SPSS software version 23. The Kolmogorov-Smirnov test was used to test the normality of the data. Paired t-test was used for intragroup comparison and independent t-test was used for intergroup comparison.

Table 1. shows intragroup comparison; the mean values of microhardness in group Pepsodent Whitening toothpaste at baseline and after remineralization were  $474.36 \pm 29.26$  and  $479.93 \pm 29.19$  respectively.

Similarly, the mean values of microhardness in group Colgate Maxfresh toothpaste at baseline and after remineralization were  $490.51 \pm 18.55$  and  $501.5 \pm 18.75$  respectively and was statistically significant with  $p=0.000$ .

Table 2. shows intergroup comparison, the mean values of microhardness in group Pepsodent Whitening toothpaste and Colgate Maxfresh at baseline were  $474.36 \pm 29.26$  and  $490.51 \pm 18.55$  respectively and the difference was not statistically significant with  $p=0.282$

**Table 1. Intragroup comparison of microhardness values.**

	N	Mean+_SD	P
Pepsodent Whitening Baseline Microhardness	6	474.36±29.26	0.000
Microhardness after remineralization	6	479.93±29.19	
Colgate Maxfresh Baseline Microhardness	6	490.51±18.55	0.000
Microhardness after remineralization	6	501.5±18.75	

**Table 2. Intergroup comparison of microhardness value.**

	N	Mean+_SD	P
Microhardness difference at baseline Pepsodent Whitening	6	474.36 +_29.26	0.282
Colgate Maxfresh	6	490.51 +_18.55	
Microhardness difference after remineralization Pepsodent Whitening	6	479.93+_29.19	0.315
Colgate Maxfresh	6	501.5+_18.75	

The results showed that both toothpastes were able to produce similar levels of microhardness following remineralization procedures. However, the amount of microhardness was considerably high with Colgate Maxfresh toothpaste than Pepsodent Whitening toothpaste. This signifies that Colgate Maxfresh possesses improved remineralization than Pepsodent Whitening toothpaste although it was not statistically significant.

**Discussion**

The equilibrium between demineralization and remineralization is largely intervened by the acidic environment produced by the bacteria and the buffering capacity of saliva intraorally(16,18).A fall in pH of the oral cavity results in tooth demineralization. On the contrary, a rise in pH results in the deposition of calcium, phosphate and fluoride.

Studies have shown that SMH measurement is a convenient technique that can be used to determine enamel surface hardness [19]. It is a functional method to detect fine microstructure, non homogenous areas prone to cracking in dental enamel.

Blue covarine was a new silica based whitening component. The idea behind blue covarine formulation was contemplated to provide teeth whitening.

The present study was undertaken to evaluate the remineralization outcome associated with two remineralizing agents in an early enamel demineralization in vitro models using Pepsodent whitening toothpaste and Colgate Maxfresh toothpaste. The results showed that both toothpastes were able to yield similar levels of microhardness following remineralization procedures. However, Colgate Maxfresh showed a slightly higher level in microhardness in comparison with Pepsodent Whitening toothpaste although the results were not statistically significant.

The values of surface microhardness indicate that remineralization of enamel is more with Colgate Maxfresh toothpaste. This high remineralizing capacity of Colgate Maxfresh may be attributable to its high calcium and phosphate level content or its particle

size which can enter the enamel surfaces.

The silica based whitening toothpaste containing blue covarine has been formulated for an effective extrinsic stain removal. However, the increase in stain removal efficacy did not give a collateral increase in abrasion as demonstrated using in vitro model [16]. However, in the current study this toothpaste has not reported an adequate remineralization of enamel or dentine.

Results of the present study are in accordance with studies conducted by Vahid Golpayegani et al and Karlinsey et al [20] for evaluating the remineralization efficacy. Chintan Joshi et al summarized effectively that Fluoride which was employed as a positive control group resulted in increased microhardness values of lesions by inhibiting the additional demineralization of existing carious lesions.

According to studies, the presence of small and intercrystalline spaces, enamel cracks, rod sheaths and other defects in enamel structures allows the partial penetration of certain ions and molecules through it. In the current study, both Colgate Maxfresh and Pepsodent Whitening yielded predominant results after remineralization although there was a statistically significant difference between the remineralisation efficacy between the two groups of toothpastes.

Since the present study was conducted in an in vitro setting, the oral environment could not be simulated to match the exact in vivo conditions. Hence, more translational research on dental tissues remineralization is required to identify potential therapeutic remineralizing properties of blue covarine.

With this basis, we can confirm that Colgate Maxfresh is an excellent material for remineralization of white spot or initial enamel caries as compared to Pepsodent Whitening toothpaste.

**Conclusion**

Under the condition of this study, these conclusions can be derived. Conventional fluoridated toothpastes effectively remineral-

izes initial enamel caries when compared to toothpastes containing blue covarine.

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