

Comparative evaluation of two different remineralizing agents on the microhardness of bleached enamel surface: Results of an *in vitro* study

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ABSTRACT

Context: Various agents are studied for their remineralization potential.

Aim: To evaluate the effect of GC Tooth Mousse and Toothmin Tooth Cream on microhardness of bleached enamel.

Settings and Design: *In vitro*- study.

Methods and Material: Twenty freshly extracted anterior teeth were cut sagittally and impregnated in cold cure acrylic resin. Specimens were kept in artificial saliva to prevent from dehydration. After measuring baseline hardness, teeth were randomly divided into two groups. Everbrite In - Office Tooth whitening kit (Dentamerica) was used to demineralize the teeth following which hardness was measured again. Teeth in group one ($n=10$) and group two ($n=10$) were treated with GC tooth mousse (Recaldent) and Toothmin tooth cream (Abbott Healthcare Pvt.Ltd) daily for seven days and microhardness of enamel surface was measured.

Statistical Analysis Used: Mean, SD, and percentage change in the microhardness were calculated. Student's paired t-test was used to evaluate the significance of change from initial, after bleaching for 5 min and after 1-week remineralization Unpaired 't' test was used to compare difference between groups.

Results: Microhardness significantly decreased in both groups after bleaching (% change group one: 3.24% group two: 3.26% in group; $P<0.01$ in both groups). Both products significantly increased mineralization after seven days of treatment ($P<0.01$). Remineralization was numerically better in Toothmin group (Abbott Healthcare Pvt.Ltd) compared to GC Mousse(Recaldent) (% change 3.27% vs 6.34%). However, difference was not significant ($P > 0.05$).

Conclusion: Both GC Tooth Mousse (Recaldent) and Toothmin Tooth cream (Abbott Healthcare Pvt.Ltd) increase the microhardness of bleached enamel. Toothmin tooth cream is a better agent for increasing microhardness, although difference is not significant.

Key words: Bleaching, remineralization, enamel, microhardness

Received : 04-09-14

Review completed : 06-10-14

Accepted : 17-04-15

Bleaching is a popular and simple method of treating tooth discoloration.^[1] However, it can cause some adverse effects to because of inadvertent contact with dentine in carious lesions or enamel defects. Increased acidic exposure in bleaching

can alter the total demineralization/remineralization causing significant mineral loss.^[2] Remineralization treatment is well-recognized and received lot of attention by both clinicians and researchers.^[3] Preparations like GC Tooth Mousse (Recaldent) and Toothmin Tooth cream (Abbott Healthcare Pvt Ltd) are being used as remineralizing agents for increasing microhardness of bleached enamel surface. However, direct comparative studies showing their effect on remineralization are not available.

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| Access this article online | |
|---|--|
| Quick Response Code: | Website: www.ijdr.in |
|  | DOI: 10.4103/0970-9290.159154 |

SUBJECTS AND METHODS

Twenty freshly extracted anterior teeth were selected. The teeth were cut sagittally, using the diamond disc (Horico-horico-PFINGST New jersey USA) and were impregnated in the cold-cure acrylic resin.

Enamel specimens were mounted on a resin block with the labial surface of the crown facing upwards upon which a 3 mm × 3 mm surface was marked and subjected to the application of bleaching agent and remineralizing agents.

The specimens were then kept in artificial saliva to prevent dehydration. Artificial saliva was prepared in Department of Oral Pathology, Dr. D. Y. Patil Dental College, Pune by using calcium chloride 0.22 g/l, sodium phosphate 1.07 g/l, sodium bicarbonate 1.68 g/l, sodium azide 2 g/l and 1l distilled water. The samples were rinsed in water and dabbed dry before subjecting them for baseline hardness test.

Procedure for microhardness test

Microhardness was tested using Vickers microhardness tester (Reichert Austria). The tests were carried out according to the manufacturer's instructions. The test specimens were placed on the stage of the tester and stabilized. Then area to indent was selected by focusing with 10× objective lens. After this, the test was carried out

where the indentations were made with a rate of 100 g load for 30 s. The indentation formed was viewed and measured on the display monitor with 10× objective lens [Figure 1]. The average microhardness of the specimen was determined from two indentations to avoid any discrepancy. The procedure was repeated for all the twenty specimens.

Preparation of bleaching agent

Everbrite in office tooth whitening (Dentamerica) kit was used to demineralize the teeth. The kit contains 35% hydrogen peroxide and a photo activator mixed together with a spatula for approximately 1 min till the mixture becomes gel-like. The syringe is filled with the gel-like mixture using a spatula. The prepared bleaching agent was applied to the enamel surface using a syringe. The arch whitening key on the LITEX 685 whitening system was selected. It has an in built whitening program which runs 15 bleaching cycles for 30 s each and 4 such cycles are done over a total of 10 min. It was then washed under distilled water, and then subjected for microhardness test. After this, the samples were stored in artificial saliva.

Remineralization procedure

The teeth were divided into two groups [Figures 2 and 3].

GC Tooth Mousse and Toothmin tooth cream (Abbott Healthcare Pvt Ltd) were applied on enamel surface of samples in group one and two respectively with cotton applicator for 3 min immediately after demineralization and washed with distilled water and stored in artificial saliva every day for 7 days. The details of these products are given in Table 1. According to the manufacturer, Toothmin is recommended to be used as a toothpaste and rinsed with water

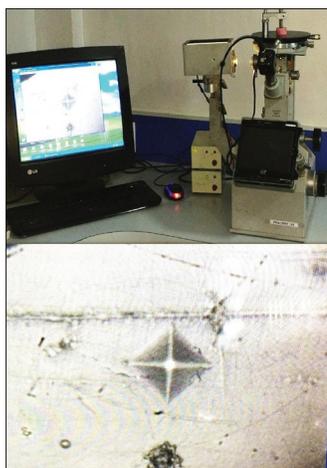


Figure 1: Viewing and measuring of the indentation formed



Figure 2: Teeth treated with GC Tooth Mousse (group 1)



Figure 3: Teeth treated with Toothmin tooth cream (group 2)

Table 1: Study product details

| Product | Toothmin | GC Tooth Mousse |
|-----------------------|--|--|
| Manufacturing company | Abbott | Recaldent |
| Composition | Silica Glycerine Calcium sucrose phosphate Cocamidopropylbetaine Sorbitol Sodium carboxyl methyl cellulose Titanium dioxide Methyl hydroxyl benzoate Sodium saccharine Propyl hydroxyl benzoate Flavours Purified water | Glycerol Propylene glycol CPP ACP D-glucitol Colloidal silica Sodium carboxyl methyl cellulose Titanium dioxide Xylitol Phosphoric acid Guar gum Sodium saccharine Magnesium oxide Zinc oxide Ethyl 4-hydroxy benzoate Propyl 4-hydroxy benzoate Butyl para-hydroxy benzoate Flavor Distilled water |

CPP=Casein phosphopeptide, ACP=Amorphous calcium phosphate

Table 2: Microhardness in HV (100 g load)

| Microhardness | Group 1 (GC Tooth Mousse) mean (\pm SD) | | | Group 2 (Toothmin tooth cream) mean (\pm SD) | | |
|---------------|--|------------------------|------------------------|---|-----------------------|-----------------------|
| | Initial | After 5 min | After 1-week | Initial | After 5 min | After 1-week |
| | 301.45 (\pm 39.74) | 291.80 (\pm 41.84)* | 301.26 (\pm 43.01)* | 298.2 (\pm 25.18) | 288.3 (\pm 23.13)* | 306.1 (\pm 20.46)* |
| % change | 3.24 | | 3.27 | 3.26 | | 6.34 |

* $P < 0.01$ (student's paired *t*-test). SD=Standard deviation, HV=Hardness values

after use whereas GC Tooth Mousse is recommended to be applied topically on the teeth and avoid rinsing with water for at least 3 min. However to standardize the procedure both the products were applied on enamel surface for 3 min followed by rinsing with water as followed in a published study.^[4]

At the end of 7 days, the samples were washed with distilled water and blotted dry. Again the microhardness of the enamel surfaces was measured with the Vickers indenter as previously.

Statistical analysis

Statistical analysis was done by applying descriptive statistics as mean, standard deviation, proportions and percentages, etc. Student's paired *t*-test was used to evaluate the significance of change from initial, after bleaching for 5 min and after 1-week remineralization. Unpaired *t*-test was used for comparing the difference between two groups. $P = 0.05$ or less was considered for statistical significance.

RESULTS

A significant decrease in the mean values of microhardness in hardness values (HV) (100 g Load) from initial to after bleaching 5 min was seen in both groups [Table 2; $P < 0.01$]. There was no significant difference in the mean values of microhardness in HV (100 g Load) after bleaching 5 min between two groups (Unpaired *t*-test $P > 0.05$).

Both groups showed a significant increase in the mean values of microhardness from after bleaching for 5 min to after 1-week remineralization [Table 2; $P < 0.01$].

In group one, 3.27% increase was observed from after bleaching 5 min to after 1-week remineralization. While in group two the increase was 6.34%. Thus, the increase was numerically higher in group two [Figure 4]. However, the difference in the mean values of microhardness in HV (100 g load) after 1-week remineralization in group one and group two was not significant (Unpaired *t*-test $P > 0.05$).

DISCUSSION

Bleaching procedure has been known to alter the enamel matrix because of the pH and strong oxidizing effect of hydrogen peroxide.^[5,6] Hydrogen peroxide causes the release of free radicals, and the effect can be intensified by a reduction in pH of the bleaching agents, thus changing the microhardness of enamel and dentin.^[7] During last few

years, there has been a great development in tooth bleaching and efforts to improve the remineralization.

In vitro studies have evaluated remineralization potential of different preparations on the bleached enamel hardness.^[4,3] The results have been encouraging. GC Tooth Mousse has been shown to increase the microhardness of the bleached enamel.^[4] Casein phosphopeptide amorphous calcium phosphate (CPP-ACP) nano complexes, have been shown to prevent demineralization and promote remineralization of enamel subsurface lesions *in situ* caries models.^[8]

Incorporation of CPP-ACP into the glass-ionomer cement results in improvement of microtensile bond strength and compressive strength. It also significantly improves the release of calcium, phosphate, and fluoride ions at neutral and acidic pH.^[2] The CPP stabilizes calcium phosphate in a solution which helps to maintain high-concentration gradients of calcium and phosphate ions into the subsurface lesion.^[9] Remineralized enamel by CCP-ACP is comparatively more resistant to acid than normal enamel.^[10]

Toothmin tooth cream is a newly introduced remineralizing agent that is based on Anticay Technology.^[11] This unique technology has been commercialized by Biodental Remin, an Australia based biotechnology company. Anticay is a mixture of calcium sucrose phosphates and inorganic calcium phosphates consisting of 10–12% calcium and 8–10% phosphorous by weight.^[12]

Calcium sucrose phosphate decreases tooth enamel demineralization and promotes enamel remineralization. It also inhibits the formation of plaque.^[13] Its effective remineralizing action is because of its solubility in water providing high concentrations of free calcium and phosphate ions several times higher than normally present in saliva.

However, comparative studies between Toothmin and GC Tooth Mousse are lacking, hence we compared these two preparations for evaluating their remineralization potential.

Microhardness of enamel was significantly and similarly reduced after bleaching for 5 min in both groups. After bleaching the test products were applied and remineralizing effects of GC Tooth Mousse versus Toothmin tooth cream were compared. Significant improvement in the microhardness was seen after 1-week remineralization in both the groups, confirming usefulness of both agents.

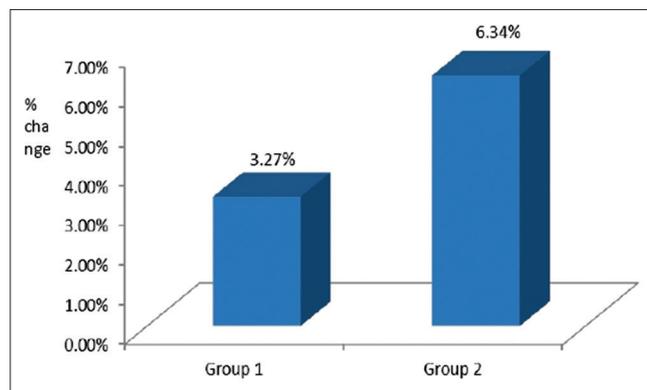


Figure 4: Percentage change in microhardness in hardness value (100 g load) after 1-week remineralization

GC Tooth Mousse showed a numerically lower increase in remineralization after 1-week remineralization compared to Toothmin tooth cream.

The calcium and phosphate ions rapidly adsorb onto the enamel surface and due to the common ion effect, rate of acid solubility of enamel decreases with increase in rate of remineralization. In addition, sucrose phosphate ions adsorb onto the enamel surface and cause decrease in the rate of acid dissolution. Similarly, in the presence of anticay, drop in pH at the enamel surface due to acid formation is less. Anticay also acts as a complement to fluoride.^[14]

In finding of this *in vitro* study, it encourages the use of Toothmin tooth cream and GC Tooth Mousse after the bleaching procedure. Tooth Mousse is a remineralizing cream, hence when applied on the teeth, only excess needs to be expectorated and rinsing with water is avoided. As a part of the study protocol, both products were applied for 3 min and then rinsed with water. This might be the reason of reduced remineralization with GC Tooth Mousse in this study.

Toothmin tooth cream is an additional option for improving remineralization in the patients undergoing bleaching.

According to our knowledge, this is the first study comparing remineralizing potential of GC Tooth Mousse versus Toothmin tooth cream. Our study has some limitations. First it is an *in vitro* study. Remineralization in the oral cavity is a complex procedure involving a change in pH and replenishment of calcium and phosphate elements. This may not be achieved in the *in vitro* conditions. We recommend further studies using these products in *in vivo* conditions.

Secondly, scanning electron microscopy of enamel surface might add more value to the results.

ACKNOWLEDGMENT

Authors of this study would to thank Dr. Anant D Patil, Dr. Shambhu Mandal and Dr. Manoj Naik for assistance in writing the manuscript.

REFERENCES

1. Rajesh AG, Ranganath LM, Kumar KS, Rao BS. Surface morphological changes in human enamel following bleaching: An *in vitro* scanning electron microscopic study. *J Contemp Dent Pract* 2012;13:405-15.
2. Mazzaoui SA, Burrow MF, Tyas MJ, Dashper SG, Eakins D, Reynolds EC. Incorporation of casein phosphopeptide-amorphous calcium phosphate into a glass-ionomer cement. *J Dent Res* 2003;82:914-8.
3. Kamath U, Sheth H, Mullur D, Soubhagya M. The effect of Remin Pro® on bleached enamel hardness: An *in-vitro* study. *Indian J Dent Res* 2013;24:690-3.
4. Darshan HE, Shashikiran ND. The effect of McInnes solution on enamel and the effect of Tooth mousse on bleached enamel: An *in vitro* study. *J Conserv Dent* 2008;11:86-91.
5. Seghi RR, Denry I. Effects of external bleaching on indentation and abrasion characteristics of human enamel *in vitro*. *J Dent Res* 1992;71:1340-4.
6. Pinto CF, Oliveira Rd, Cavalli V, Giannini M. Peroxide bleaching agent effects on enamel surface microhardness, roughness and morphology. *Braz Oral Res* 2004;18:306-11.
7. Borges AB, Yui KC, D'Avila TC, Takahashi CL, Torres CR, Borges AL. Influence of remineralizing gels on bleached enamel microhardness in different time intervals. *Oper Dent* 2010;35:180-6.
8. Hegde MN, Shetty N, Pardal D. Remineralization of enamel sub-surface lesion using casein phosphopeptide amorphous calcium phosphate (CPP-ACP) - A quantitative energy dispersive X-ray analysis (EDAX). *J Conserv Dent* 2007;10:19-25.
9. Reynolds EC. Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions. *J Dent Res* 1997;76:1587-95.
10. Iijima Y, Cai F, Shen P, Walker G, Reynolds C, Reynolds EC. Acid resistance of enamel subsurface lesions remineralized by a sugar-free chewing gum containing casein phosphopeptide-amorphous calcium phosphate. *Caries Res* 2004;38:551-6.
11. Craig GG. The use of a calcium sucrose phosphates-calcium orthophosphate complex as a cariostatic agent. *Br Dent J* 1975;138:25-8.
12. Available from: <http://www.biodentalremin.com/#!/about2/caj8>. [Last accessed on 2014 Oct 17].
13. Reema SD, Lahiri PK, Roy SS. Review of casein phosphopeptides-amorphous calcium phosphate. *Chin J Dent Res* 2014;17:7-14.
14. Rogerson MJ. The role of a calcium sucrose phosphate-calcium orthophosphate complex in the reduction of dental caries. *Aust Dent J* 1973;18:160-6.

How to cite this article: Kaur G, Sanap AU, Aggarwal SD, Kumar T. Comparative evaluation of two different remineralizing agents on the microhardness of bleached enamel surface: Results of an *in vitro* study. *Indian J Dent Res* 2015;26:176-9.

Source of Support: Nil, **Conflict of Interest:** None declared.