ORIGINAL RESEARCH

Effect of Fluoridated Varnishes on surface micro-hardness of Enamel

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ABSTRACT

Introduction: Fluoride varnish is one of the professionally applied topical fluoride agents. The ease of application of fluoride varnishes has led to its popularity in dentistry. **Aim:** To evaluate the surface micro-hardness of enamel following application of two commercially available fluoridated varnishes. **Materials and methods:** Enamel blocks were cut from the 60 primary teeth samples. The initial surface micro-hardness was assessed using tester machine. The teeth samples were divided into two groups (A and B) consisting of 30 blocks each. Enamel samples of group A and B received varnish application, Fluorprotector® and BiFlourid10®, respectively. After varnish application, these samples were subjected to pH cycling. Following, final (a second) surface micro-hardness was assessed. **Results:** The mean surface micro-hardness of group A samples were found to be 258.99±4.81 VHN whereas group B showed 210.47±7.37VHN. **Conclusion:** Fluorprotector® showed statistically significant increase in the surface micro-hardness of enamel than BiFlourid10®.

KEYWORDS: Varnish, Surface Micro-Hardness, Fluor Protector®, BiFlourid10®

INTRODUCTION

Fluoride varnishes are fast becoming an integral component of prevention based programs along with patient and parent education. In many nations topical gel treatment has been replaced by fluoride varnishes.[1] Fluoride varnish application is effective in reversing and arresting active enamel lesions and therefore reduces the need for restorative intervention.[2]

Fluoride varnishes are used as an effective anti-caries agent. The use of varnishes has reduced the caries incidence by 40-56%.[2-4] Fluoride varnish is a professionally applied adherent material which consists of a high concentration of fluoride as a salt or silane preparation in fast drying, alcohol based solutions of natural varnishes. They are coated on to enamel or cementum. The main objective of the fluoride varnish is that, the fluoride is in close contact with the enamel or cementum surface for a prolong period of time.

Fluoride varnish covers the enamel and/ or cementum surface with an adherent film that lasts for up to 24 hours. This long period of time enhances the uptake of fluoride ions into the tooth surface. The fluoride is deposited as calcium fluoride, creating a reservoir of fluoride ions, which are slowly released. [5] The fluoride ion has the ability to improve the crystallinity of enamel apatite. Improved crystallinity denotes that the apatite structure is more stable, and that there may be fewer imperfections and dislocations within the crystals. The net result is that even low concentrations of fluoride may result in an increased stability of the substituted lattice structure of enamel. The enamel treated with fluoride is more resistant to acid solubility, reduced carious lesion depth[5] and has increased rates of remineralization and decreased demineralization. [6] The aim of the present study was to assess the effect of the application of the fluoridated varnishes on enamel solubility. This was assessed by evaluating the surface micro-hardness of enamel following application of two commercially available fluoridated varnishes.

MATERIALS AND METHODS

Sixty primary teeth extracted or exfoliated were collected from healthy children aged 6-10 years. Informed consent was obtained from patients as well as parents for the use of these teeth for the research purpose. Teeth with intact enamel surfaces and without white spot lesions or signs of decalcification or fluorosis were included in the study. Teeth with caries or developmental defects or fractured teeth were excluded. A total of 60 teeth were collected. All soft tissue deposits and calculus was removed from the teeth with a periodontal scaler. Teeth were cleaned using a slurry of pumice and autoclaved. All teeth were then stored in distilled water containing 0.2% thymol at 4° C to inhibit the microbial growth until the study was carried out.

All the 60 teeth samples were sectioned using Silverstone–Taylor hard tissue microtome (Scientific Fabrications, Littleton, CO, USA) to obtain enamel blocks (5X5 mm) from the most prominent portion of the buccal surface of the crown. The blocks were serially polished and flattened using polishing grits no. 800, 1000 and 1200. These blocks were embedded in acrylic blocks and smoothened to achieve a flat surface.[5]

Initial surface micro-hardness (SMH) of each sample was

How to cite this article:
Doddamani GM, Girish Babu KL. Effect of Fluoridated Varnishes on surface micro-hardness of Enamel. Int J Oral Health Med Res 2017;4(2):1-3.

assessed using the micro-hardness tester machine.

(Shimadzu HMV-2000/Shimadzu Corporation, Kyoto, Japan). SMH was assessed by making an indentation on enamel by applying 25mg of the load for 10 seconds.[5,7] The value displayed on the machine was noted. Five such indentations (spaced 100 µm from each other) were made on left upper, left lower, central, right upper and right lower part of the enamel block. The average SMH of 5 indents was calculated for each sample.[8] The values were expressed in VHN. Following, all the enamel blocks were randomly distributed into 2 groups (Group A and Group B) consisting of 30 samples each.

A thin layer of Fluorprotector® (Ivoclar Vivadent, Amherst, N.J, USA) varnish was applied according to manufacturer's instructions using a soft bristled applicator tip provided by them on the enamel blocks of group A, and enamel blocks of group B received Biflourid 10®(VOCO, Cuxhaven, Germany) varnish application. The varnish was removed carefully from enamel blocks of groups A and B after 24 hours. The varnish was completely removed using cotton swabs soaked in acetone. Then, the blocks were washed with deionized water for 1 minute. All the samples from each group were subjected to a demineralization-remineralization cycle simulating a high caries challenge.[9]

The enamel blocks were immersed in the demineralizing solution for 3 h (35.5 mL per block). After 3 hours, all the samples were removed from demineralization solution and dried using a blotting paper. Following, all the samples were immersed in remineralization solution for 21 h (17.75 mL per block). This cycle was repeated every day for 7 days. On the 8th day, all the samples were taken out of the solution and dried using blotting paper.[5] A second reading (final) of surface micro-hardness of the each enamel sample was measured as described earlier.

The data collected was statistically analyzed using One-Way ANOVA and Tukey's Multiple Post Hoc test.

RESULTS

The mean surface micro-hardness of group A samples were found to be 258.99±4.81 VHN whereas Group B showed 210.47±7.37 VHN. Both the groups showed an increase in surface micro-hardness compared to initial surface micro-hardness. However, the difference was significant (p-value 0.00001) only with enamel samples of group A. (Table1)

Groups	Surface Microhardness(VHN)		Difference	P value*
	Initial	Final		
Group A	208.32±13.63	258.99±4.81	50.67±15.05	0.00001*
Group B	206.37±13.85	210.47±7.37	4.1±17.21	

Table 1: Mean surface microhardness of enamel of groups A and B

DISCUSSION

Fluoride varnish increases the concentration of fluoride ions on the enamel surface of teeth. The concentrated fluoride ions in fluoride varnish form globules of calcium fluoride-like material to form on the tooth surface. These globules are stabilized by protein phosphate in the mouth, at neutral p^H. When there is a cariogenic challenge, the p^H is lowered and the dissolution rate of these globules increases. This response lowers the solubility constant of calcium and phosphate ions, releasing fluoride and increasing the saturation of calcium and phosphate ions in plaque fluid. This reaction helps to prevent the dissolution of calcium and phosphate from the tooth mineral and/or increases the rate of remineralization or reprecipitation of the lost minerals thereby acting as a slow releasing reservoir of fluoride which is released during early stages of demineralization. [10,11]

The pH cycling protocol followed in the present study was as described by Featherstone et al. This protocol is most commonly used for human enamel, which is a modification of protocol proposed by Ten Cate and Duijsters. This model simulates in-vivo high caries risk condition. Simultaneously this model measures the net result of the inhibition of demineralization and the enhancement of remineralization. In this model, the dynamic cycles of de- and remineralization are simulated by sequentially immersing enamel specimens in acidic (demineralizing) and supersaturated (remineralizing) buffer solutions. These de- and remineralization solutions approximate the mineral ion composition and supersaturation of saliva as originally reported by ten Cate and Duijsters.[12,13]

Various studies have used different methods to assess the surface micro-hardness of enamel. The commonly used micro-hardness tests are Vickers micro-hardness test and Knoop micro-hardness test. The instrument used in Vickers micro-hardness test is designed for rapid micro-hardness tests of all types and shapes of metallic and nonmetallic materials. The diagonal measurements of the indentations and resultant hardness values is provided by the diamond indentor.[7] The Vickers indenter does not penetrate as deeply into the enamel relative to the Knoop indenter, and therefore helps to reduce the risk of enamel cracking.[14] As this study focused on the evaluation of surface micro-hardness of enamel, Vickers surface micro-hardness test was used.

Fluoride varnishes harden on enamel to form a reservoir and act by a slow release of fluoride ions to the underlying apatite crystallites to form a more stable complex which hampers crystalline dissolution. This reduces the rate of demineralization and enhances mineral deposition by forming deposits of calcium fluoride.[15] The present study results showed that the enamel blocks treated with Fluorprotector® showed an increased SMH compared to Biflourid 10®. The difference may be due to the amount and the type of fluoride compound formed on the surface. Fluor Protector® contains 0.9% difluorsilane in a polyurethane varnish base with ethyl acetate and isoamyl propionate solvents. The fluoride content is equivalent to 0.1%, or 1000 parts per million (ppm) in solution. As the solvents evaporate, the fluoride concentration at the tooth surface increases to a much

higher value (nearly 10 times higher). It gains access even to the proximal surfaces, due to its low viscosity. Fluorprotector® forms a thin transparent film which readily adheres to the tooth surface.[16] The varnish hardens to a clear transparent film on the tooth surface, providing a highly aesthetic result.[17] Delbem et al. suggested that the fluoride released by varnish has greater interaction with sound enamel and provides less mineral loss.[5]

The Biflourid 10® varnish showed a lower SHM after pH cycling, despite the high release of fluoride. Biflourid® has a higher viscosity than Fluorprotector® which adheres better on demineralized areas, fissures, open dentinal tubules and cervical areas more when compared to the smooth enamel surfaces.[16] As the varnishes were applied to intact enamel surfaces, the penetration of calcium fluoride and sodium fluoride from Biflourid 10® would haves hampered leading to increased mineral loss from the subsurface during the remineralization-demineralization cycle.

Even though Biflourid 10® provides more soluble fluoride (23.6%) in comparison with Fluorprotector® varnish, the results suggested that higher amounts of fluoride are formed and retained on the enamel treated with Fluorprotector®. This retained fluoride may be released during the cariogenic challenge and may spread into the enamel and reduce the caries lesion progress, propitiate the reprecipitation of less soluble calcium phosphate.

As this study was carried out under *in-vitro* conditions hence, the results may not be transferred completely to an in vivo situation. Further, in-vivo studies have to be carried out in order to evaluate the effectiveness of these fluoridated varnishes.

CONCLUSION

Fluorprotector® showed statistically significant increase in the surface microhardness of enamel than BiFlourid10®.

REFERENCES

1. Vaikuntam J. Fluoride varnishes: should we be using them?. Pediatr dent. 1999;22(6):513-6.
2. Lam A, Chu CH, A. L, C.H. C. Caries management with fluoride varnish of children in U.S. N Y State Dent J. 2011;77(4):38–42.
3. Weinstein P, Domoto P, Koday M, Leroux B. Results of a promising open trial to prevent baby bottle tooth decay: a fluoride varnish study. J Dent Child. 1994;61(5):338–41.
4. Holm AK. Effect of a fluoride varnish (Duraphat®) in preschool children. Comm dent and oral epidemol. 1979;7(5):241-5.
5. Delbem ACB, Bergamaschi M, Sassaki KT, Cunha RF. Effect of fluoridated varnish and silver diamine fluoride solution on enamel demineralization: pH-cycling study. J Appl Oral Sci. 2006;14(2):88–92.
6. Beltrán-Aguilar ED, Goldstein JW, Lockwood SA. Fluoride varnishes. A review of their clinical use, cariostatic mechanism, efficacy and safety. J Am Dent Assoc. 2000;131(5):589–96.
7. Lata S, Varghese NO, Varughese JM. Remineralization potential of fluoride and amorphous calcium phosphate-casein phospho peptide on enamel lesions: An in vitro comparative evaluation. J Conserv Dent. 2010;13(1):42–6.
8. Zhang Q, Zou J, Yang R, Zhou X. Remineralization effects of casein phosphopeptide-amorphous calcium phosphate creme on artificial early enamel lesions of primary teeth. Int J Paediatr Dent. 2011;21(5):374–81.
9. Rodrigues E, Delbem ACB, Pedrini D, de Oliveira MSR. PH-cycling model to verify the efficacy of fluoride-releasing materials in enamel demineralization. Oper Dent. 2008;33(4):658–65.
10. Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR. Early childhood caries and quality of life: child and parent perspectives. Pediatr Dent;25(5):431–40.
11. Cury JA, Tenuta LMA. Enamel remineralization: controlling the caries disease or treating early caries lesions? Braz Oral Res. 2009;23(1):23–30.
12. Rirattanapong P, Vongsavan K, Saengsirinavin C, Pornmahala T. Effect of fluoride varnishes containing tri-calcium phosphate sources on remineralization of initial primary enamel lesions. Southeast Asian J Trop Med Public Health. 2014;45(2):499–504.
13. Queiroz CS, Hara AT, Paes Leme AF, Cury JA. pH-Cycling models to evaluate the effect of low fluoride dentifrice on enamel De- and remineralization. Braz Dent J. 2008;19(1):21–7.
14. Karlinsey RL, Mackey AC, Walker TJ, Frederick KE, Blanken DD, Flaig SM, et al. In vitro remineralization of human and bovine white-spot enamel lesions by NaF dentifrices: A pilot study. J Dent Oral Hyg.2011;3(2):22–9.
15. Marya C, Dahiya V. Fluoride Varnish: A Useful Dental Public Health Tool. The Internet Journal of Dental Science. 2006 Volume 4 Number 2.
16. Pinar Erdem A, Sepet E, Kulekci G, Trosola SC, Guven Y Effects of two fluoride varnishes and one fluoride varnish on biofilm formation in vitro Int J Med Sci. 2012;9(2):129-36.
17. de Bruyn H, Buskes JA, Jongebloed W, Arends J. Fluoride uptake and inhibition of intra-oral demineralization, following the application of varnishes with different concentrations of fluoride. J Biol Buccale;16(2):81–7.

Source of Support: Nil
Conflict of Interest: Nil