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COMPARISON OF THREE REMINERALIZING AGENTS AROUND ORTHODONTIC BRACKETS- AN INVITRO STUDY

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ABSTRACT

Aim: To compare the enamel demineralization around orthodontic brackets while using three remineralizing agents. **Materials and Methods:** Forty eight extracted maxillary premolars were divided into four groups of 12 each with application of CPP-ACPF, CaSP, Fluoride Varnish and Control. The samples were immersed in demineralizing solution and artificial saliva solution for 15 days alternatively. The samples were evaluated for Vickers micro-hardness test at three depth of 40µm, 70µm, 90µm. **Results:** The results revealed that varnish group showed highest micro-hardness value compared to other groups at every depth and was statistically significant. This was followed by CaSP group, tooth mousse group and control group. The control group showed the least microhardness value compared to the other groups. **Conclusion:** Fluoride Varnish can be considered as an effective method to prevent or reduce enamel demineralization during orthodontic treatment.

INTRODUCTION

Oral hygiene maintenance has become progressively difficult to maintain over the plaque and calculus with the current dietary habits. Caries is caused by organic acids produced by bacteria when they adhere onto the plaque.Early carious lesions in the enamel are observed clinically as a white opaque spot.[1]

orthodontic appliance cause increased risk of caries formed around orthodontic brackets and below the bands. The carious lesions developed on the buccal surfaces of teeth show an un-aesthetic drawback of orthodontic treatment that may hide the beneficial results from orthodontic treatment.[2]

Various methods like application of casein phospho peptide – amorphous calcium phosphate, calcium sucrose phosphate, use of sodium fluoride varnish , fluoride gel and mouth washes have been used for minimizing enamel demineralization around orthodontic brackets.[3,4]

Previous studies have focused on plaque accumulation and the prevention of enamel demineralization around orthodontic brackets with the focus mainly on either CPP-ACPF gel or mouth washes but very few on fluoride varnishes and CaSP. Currently, there is a lacuna in literature on studies that evaluate and compare the effectiveness of CPP-ACPF, CaSP and Fluoride varnish in preventing white spot lesions (WSLs) around orthodontic brackets. Therefore, the purpose of the study was to evaluate and compare the effectiveness of these three remineralizing agents in preventing white spot lesions (WSLs) around orthodontic brackets.

MATERIALS AND METHODS

This experimental, in-vitro study involves the use of forty eight extracted maxillary premolar tooth samples that were collected after obtaining informed consent from orthodontic patients who were subjected to an extraction treatment plan. The samples were collected from the "Department of Oral and Maxillofacial Surgery, SRM Dental College, Ramapuram". The samples were washed, cleaned and kept in distilled water in a closed container at room temperature. Teeth with surface cracks, active carious lesions, attrited and abraded surfaces, flurosed enamel, presence of white Spot Lesions and arrested caries were excluded from the study. Preparation of Demineralizing solution and artificial saliva were done in the Department of Biochemistry at SRM Dental Faculty, Ramapuram. The vickers microhardness testing was done at Chennai Metex lab, guindy, Chennai.

The collected and stored extracted maxillary premolars were taken and the enamel surfaces were polished with a non-fluoridated pumice and water, rinsed with deionized water and dried with compressed air. The buccal surfaces of the teeth were conditioned with 37% phosphoric acid (EAZETECH, Anabond Stedman) for 30 seconds followed by thorough washing and drying. The Primer (ORTHOFIX, Anabond Stedman) was applied on the etched enamel and cured for 20 seconds after which 3M- Universal Gemini premolar brackets were placed on the middle third of the enamel parallel to the long axis with the composite resin (ORTHOFIX, Anabond Stedman). After removing the residual resin around the brackets, the specimens were light cured with "BLUEPHASE LED" light curing unit for 40 seconds.

The collected forty eight teeth were divided into four groups, three study groups and one control group with 12 teeth in each group. All the teeth in Group A were painted with CPP-ACFP (GC Tooth Mousse

plus) around the brackets and were allowed to dry for 3 minutes and washed with deionized water. All the teeth in Group B were applied with CaSP + inorganic amorphous calcium phosphate (ENAFIX Tooth paste) around the brackets and were allowed to dry for 4 minutes and washed with deionized water. All the teeth in Group C were applied with sodium fluoride varnish (Duraflor - Medicom) around the brackets and were allowed to dry for 5 minutes. All the teeth in Group D (control) were not applied with any agents. This procedure was repeated everyday for a period of 15 days. All specimens were immersed in a demineralising solution (0.4723 g – calcium nitrate; 0.2722 g - potassium dihydrogen phosphate; 4.5083 g – acetic acid) for 8 hours/ day at 370c for 15 days. The specimens were then rinsed with tap water and kept in a artificial saliva solution (0.75 g – sodium azide; 0.804 g – potassium monohydrogen phosphate; 1.02 g – sodium chloride; 0.166 g – calcium chloride; 0.059 g – magnesium chloride) for 30 minutes. Each specimens were cleaned with dental brush and cavity protection tooth paste (COLGATE 1450 ppm F) for 2 seconds and again rinsed with water and placed in artificial saliva solution for 15 hours daily for 15 days.[5]

After 15 days procedures the crowns were separated from the roots and hemi-sectioned vertically in the bucco – palatal direction, through the centre of the bracket base with a 15 HC waffering blade. The half crown sections were embedded in acrylic resin and polished with abrasive paper discs so that the cut surface were exposed. Throughout the study, the samples were kept in humid conditions to avoid drying. After polishing the samples demineralization lesions were assessed by micro-hardness profiles across the micro-hardness tester with a load of 100 g was exerted on the cervical surface of the specimens for 10 seconds and three indentations were made at 40, 70, 90 µm from the external surface of the enamel using Vickers elongated diamond pyramid indenter. (Fig: 1) The micro-hardness values were tabulated and statistical analysis was done.[6]

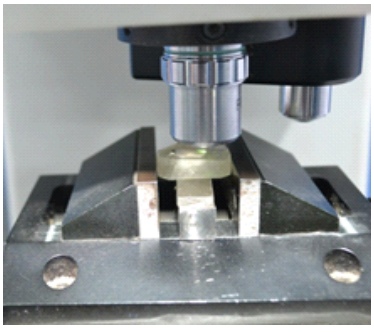

Figure : 1 Vickers microhardness testing machine

RESULTS

The collected data were analyzed with IBM.SPSS statistics software 23.0 version. The data was described using descriptive mean and standard deviation and 95% confidence interval. The variation between the groups in the multi-variant analysis was found using one-way ANOVA and post-hoc Tukey test. In both the above statistical tools the probability value of 0.05 is considered as a significant level.

Comparison between three different groups was done using one-way ANOVA and statistically significant level was done using post-hoc Tukey test. At 40µm, the mean micro-hardness value of groups A,B,C and D was found to be 263.26, 267.03, 287.12 and 211.13 respectively. At 70µm, the mean micro-hardness value of groups A,B,C and D was found to be 239.29, 272.02, 273.01 and 199.43 respectively. At 90µm, the mean micro-hardness value of groups A,B,C and D was found to be 251.24, 269.23, 286.56, and 221.63 respectively. (Table 1) One way ANOVA was done between four groups and was found to be statistically significant (p value = 0.05) and post hoc Tukey test was done and the results showed statistically significant (p value = 0.05). (Table 2)

Table 1: Descriptive data showing mean, standard deviation of different groups at different variable depths

Depth (µm)	Groups	N	Mean	Standard Deviation
40	Tooth Mousse	12	263.36	6.49
	Tooth Paste	12	267.03	9.29
	Varnish	12	287.12	9.13
	Control	12	211.13	6.88
	Total	48	257.16	29.42
70	Tooth Mousse	12	239.29	3.92
	Tooth Paste	12	272.02	4.74
	Varnish	12	273.01	3.51
	Control	12	199.43	5.55
	Total	48	245.63	30.44
90	Tooth Mousse	12	251.24	4.96
	Tooth Paste	12	269.23	4.69
	Varnish	12	286.56	4.55
	Control	12	221.63	5.29
	Total	48	257.16	24.73

Table 2: Analysis of variance done between different groups at different variable depths.

Depth	Groups	Sum of Squares	Df	Mean Square	F	Significance
40	Between Groups	37828.327	3	12609.442	194.678	0.05
	Within Groups	2849.911	44	64.771		
	Total	40678.238	47			
70	Between Groups	42669.186	3	14223.062	702.675	0.05
	Within Groups	890.617	44	20.241		
	Total	43559.803	47			
90	Between Groups	27691.069	3	9230.356	387.474	0.05
	Within Groups	1048.163	44	23.822		
	Total	28739.233	47			

DISCUSSION

The oral flora provides an ideal condition for the colonization of a complex microbiota. Dental plaque is a bio-film complex which was organized for providing protection and nutrients for the pathogenic bacteria. The accumulation of plaque in the oral cavity increases the colonization of periodontal pathogenic bacteria.

Studies by Nasarin Fahradin and Meryvin. H Chin prove that orthodontic brackets form a new location for plaque to be retained,[7,8] thereby, increasing plaque adhesion and inflammatory response. The amount of enamel demineralization during orthodontic treatment depends upon the mineral content of the enamel, bacterial plaque accumulation, diet of the patient and the bracket characteristics like bracket design, bracket material, type of ligation, etc., Demineralization can be reduced or prevented by reducing the effects of these causes by preventive methods like fluoride tooth paste, oral washes and tooth mousse which have been tried but they had not been completely successful since they depend on patient compliance. Therefore during the last year studies are being made to develop methods that do not need patient compliance.[9] Previous studies have focused on plaque accumulation and the prevention of enamel demineralization around orthodontic brackets with the focus mainly on either CPP-ACPF gel or mouth washes but very few on fluoride varnishes and CaSP. Currently, there is a lacuna in literature on studies that compare the effectiveness of CPP-ACPF, CaSP and Fluoride varnish in preventing white spot lesions around orthodontic brackets.

Hence, the purpose of the study was to compare the effectiveness of these three remineralizing agents in preventing white spot lesions around orthodontic brackets. At 40µm, 70µm, 90µm depth, the result of this study showed that the Group C (Varnish) had the highest micro-hardness value followed by Group B (CaSP), Group A (CPP-ACPF) and Group D (Control). The Control group showed the least micro-hardness value and was found statistically significant (P value = 0.05). A similar study was conducted by Ferial AM et al where they compared Sodium fluoride varnish, Sodium fluoride varnish-ACP, fluoride resin, CPP-ACP, CPP-ACPF and control group by Laser Fluorescence. They concluded that Sodium fluoride varnish had statistically significant reduction in enamel demineralization. But they had not used CaSP as part of their study.[5] Compared to 40µm and 70µm depth results in 90µm was more striking. Though the order of highest Vickers micro-hardness number (Varnish, CaSP, CPP-ACPF and least with control group) was similar to 40µm and 70µm. the difference between groups was marked and highly statistically significant in 90µm depth. This study conclusively proves that there is significance in enamel demineralization with all the three methods. The highest was seen in Varnish followed by CaSP, CPP-ACPF and the last was Control group. Thus, the Null hypothesis was rejected because there was a statistical difference between the control and the other study groups. This study reveals the importance of the regular use of remineralizing agents during orthodontic treatment in preventing iatrogenic damage to the enamel.

LIMITATIONS

- This study was an in-vitro study and future in-vivo studies have to be done comparing these products with patients undergoing orthodontic therapy to draw further conclusions. Other remineralizing agents can also be included and compared.
- Patients with a known allergy to milk protein should avoid products containing CPP-ACP because they will be allergic to the casein protein from which CPP-ACP is derived.

FUTURE SCOPE

- This study has raised new questions including comparison of the relative benefits of other remineralizing agents, when used individually or in combination, in preventing white spot lesions.
- Long term In-vivo studies with a large sample size can also be done.
- Other methods like Trans-illumination, Diagnodent, Quantitative light fluorescence test can be used to detect white spot lesions.

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