

Effect of Fluoride Varnish on Improvement of Surface Decalcifications after Fixed Orthodontic Treatment

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ABSTRACT

Statement of the problem: Enamel white spot lesions are one of the problems associated with fixed orthodontic treatment that compromise esthetics.

porpuse: The aim of this study was to evaluate the effect of fluoride varnish on the improvement of white spot lesions after fixed orthodontic treatment.

Materials and Methods: In this randomized clinical trial, 20 patients with at least two white spot lesions after fixed orthodontic treatment were selected and randomly divided into two groups. In the test group patients, VOCO fluoride varnish was applied to the buccal surface of all the teeth monthly for 4 months. Control group patients only received dental prophylaxis monthly for 4 months. At baseline, three photographs were taken from the frontal, right and left views of occlusion and repeated after 4 months. Pre- and post-treatment photos were superimposed using Photoshop 6.0 software and the area of demineralized white spot lesions was measured pre- and post-treatment. The measurements were compared with repeated measures ANOVA.

Results: Thirty-three teeth in the test group and 32 teeth in the control group were evaluated. Oral hygiene was good in both groups. The mean size of lesions in the test group was $8.3\% \pm 3.07$ before treatment, decreasing to $5.9\% \pm 2.9$ after treatment ($P=0.009$). The mean size of lesions in the control group was $7.7\% \pm 4.2$ before treatment, decreasing to $5.9\% \pm 3.6$ after treatment ($P=0.001$). No statistically significant differences were detected between the two groups ($P=0.307$).

Conclusion: According to the results, use of fluoride varnish has no superiority over natural remineralization by saliva in decreasing white spot lesions in patients with good oral hygiene.

Keywords: Orthodontics, Fluorides, Tooth Demineralization, Oral Hygiene.

INTRODUCTION

White spot lesions are one of the

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complications of fixed orthodontic treatments. Despite the advancements in orthodontic materials and techniques, development of carious lesions around orthodontic brackets is still a problem in orthodontic treatments.⁽¹⁾ Presence of these

lesions in the maxillary anterior teeth is a major problem compromising patients' esthetics.^(2,3)

Development of white spot lesions depends on plaque retention, oral hygiene status and host susceptibility.⁽⁴⁾ The frequency of enamel white spot lesions in orthodontic patients has been reported to be 16%⁽⁵⁾ to 89%⁽⁶⁾ in some studies. Oral hygiene status is believed to be mainly responsible for such different prevalence rates.⁽⁷⁾ Several factors have been suggested to reduce the prevalence of white spot lesions, including the improvement of oral hygiene status,⁽⁷⁾ changing nutritional habits and reduced consumption of fermentable carbohydrates⁽⁸⁾ and topical application of fluoride.⁽¹⁾ Topical fluoride regimens such as fluoride-containing toothpastes (1100 ppm fluoride) and mouthwashes (0.05% sodium fluoride) have been demonstrated to prevent or reduce the occurrence of enamel white spot lesions in orthodontic patients.^(9,10) Fluoride varnish was first introduced more than 30 years ago to increase contact with enamel surface and enhance fluoride ion uptake.⁽⁵⁾ This product can result in 33% reduction of caries.⁽¹¹⁾ In comparison to other topical fluoride products, fluoride varnish has the ability to adhere to enamel surfaces for a longer period of time (the surface should be dry) and consequently, allows the uptake of higher amounts of fluoride ions.⁽¹²⁾ Fluoride varnish is effective if it is applied to tooth surfaces 2 to 4 times a year and therefore, it

is economically more cost-effective than fluoride gel. Another advantage of fluoride varnish is its easy and fast application.⁽¹²⁾

Furthermore, its application does not require patient compliance.⁽¹¹⁾

Previous in vitro studies and clinical trials have demonstrated that fluoride varnish reduces enamel demineralization. Regular use of fluoride is important for prevention of dental caries and monthly application of fluoride varnish is indicated in patients with enamel white spot lesions or individuals at risk.⁽¹²⁾

As mentioned earlier, oral hygiene is an important factor in prevention of enamel white spot lesions and various indexes have been proposed for its assessment. Plaque index (PI) is an accurate tool for this purpose among the described oral hygiene indexes because it disregards the coronal extension of plaque on the tooth surface and scoring is made based on plaque thickness at the gingival areas of teeth. PI scoring is carried out on the distofacial, facial, mesiofacial and lingual surfaces and a dental mirror and an explorer are used for plaque detection after drying the tooth. In contrast to other indexes, PI does not exclude crowned teeth or those with gingival restorations from the assessment. PI of a tooth is calculated by adding up the scores of the 4 tooth surfaces and dividing the value by 4. PI of a patient is calculated by summing up the PI of all the teeth and dividing the value by the total number of teeth. The main characteristic of PI is that it

can be used in longitudinal studies as well as clinical trials.⁽¹³⁾

Considering the fact that use of fluoride-containing compounds is effective for preventing and improving white spot lesions, the present in vivo study evaluated the effect of fluoride varnish on enamel white spot lesions following fixed orthodontic treatment.

MATERIALS AND METHODS

In this clinical trial, the study population consisted of orthodontic patients with at least two chalky white demineralized lesions that were non-existent before treatment. Based on the results of similar studies for determination of the size of lesions and considering the type one error=0.05 and type two error=0.10, our sample size was calculated at 20 patients. After selection of 20 patients, 10 were allocated to the test (fluoride varnish) and the remaining 10 to the control group using the random numbers table. The procedure was explained to all the patients and informed consent was obtained.

Treatment group patients underwent dental prophylaxis of the labial surfaces of their teeth and after the placement of a dental mouth opener and drying the teeth, fluoride varnish was applied to tooth surfaces with small pieces of sponge and allowed to dry for 5 minutes. The patients were asked not to eat or drink for the next 2–4 hours and refrain from tooth brushing for 24 hours. This procedure was repeated monthly for 4 months in the test group patients. The

fluoride varnish used in this study contained 6% sodium fluoride and 6% calcium fluoride in a fast-drying varnish.

The control group subjects underwent only monthly dental prophylaxis for 4 months.

PI was used to assess patients' oral hygiene status and calculated and recorded in each session. PI scoring system was as follows:

0: No plaque in the gingival area

1: A film of plaque adhering to the free gingival margin and the area adjacent to the tooth. The plaque might be detected only by running a probe across the tooth surface

2: Moderate accumulation of soft deposits within the gingival pocket and on the gingival margin and/or adjacent tooth surface that can be seen by the naked eye.

3: Abundance of soft matter within the gingival pocket and/or on the gingival margin adjacent to tooth surface.

In all the patients, the teeth were dried before the initiation of intervention to the level that no more change was observed in the size of the lesions. Then, 3 photographs were taken from the frontal and the right and left view of patients' occlusion. After the completion of the 4-month period, the teeth were completely dried and the 3 photographs mentioned above were repeated.

Using Photoshop 6.0 software, image brightness was first adjusted to allow optimal observation of the lesions. Afterwards, the pre- and post-intervention images were superimposed using tooth

sizes in a way that the respective teeth exactly matched in the two images.

The labial surface and the pre- and post-treatment lesion margins were specified

with “Magic Wand” tool and the lesion borders before and after treatment were marked with black and red lines, respectively (Figure 1).

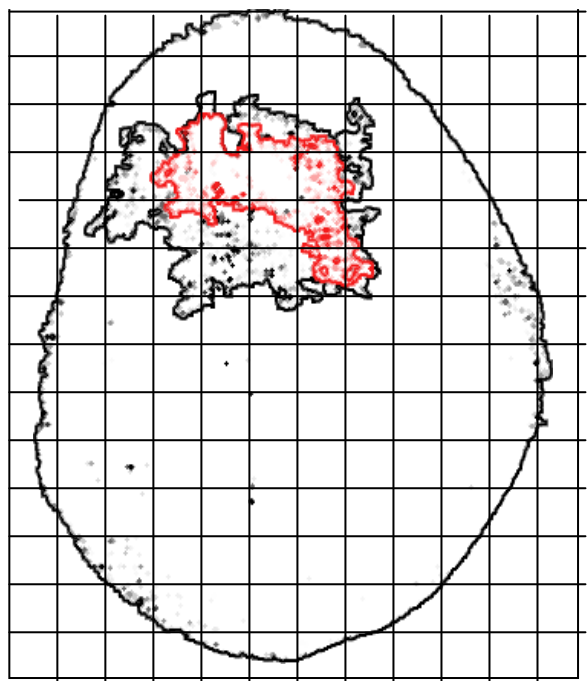


Figure 1. Superimposed pre- and post-intervention images in Photoshop software. Black line is before and red line is after intervention.

The superimposed images were gridded in a way that the tooth width occupied 10 pixels. The ratio of lesion/tooth area based on the number of pixels was calculated using the following formula:

$WSA\% = \frac{\text{Number of pixels occupied by the lesion}}{\text{Number of pixels in the labial tooth surface}} \times 100$

WSA= White Spot Area

WSA area was calculated before and after treatment. Since the ratio of lesion-to-labial surface area was calculated and the pre- and post-treatment tooth dimensions were

superimposed, the magnification factor had no effect on measurements.

In each patient, one to a maximum of 4 teeth were measured. Overall, 33 teeth in the fluoride varnish group and 32 controls were evaluated.

SPSS 16 was used for statistical analysis and the results were compared with repeated measures ANOVA.

Oral hygiene was compared by Mann-Whitney U test between the two groups.

RESULTS

Of all the patients, 4 were male and the remaining were female. Of 4 males, 3 were

in the control and one was in the test group. In total, 33 teeth were in the test and 32 in the control group and the lesion size was measured before and after the intervention. There were no significant difference between the two groups in terms of age ($P=0.461$) or duration of fixed orthodontic treatment ($P=0.107$). In all the patients, the mean PI was in the range of 0–1 except for one subject who had a PI of 1–2 in one

session. The oral hygiene index between the two groups was not significantly different ($P=0.705$) as shown in Table 1.

The mean area of white spot lesions significantly decreased in both groups as observed in Table 2.

Figure 2 graphically shows comparison of mean lesion sizes in the two groups before and after the intervention.

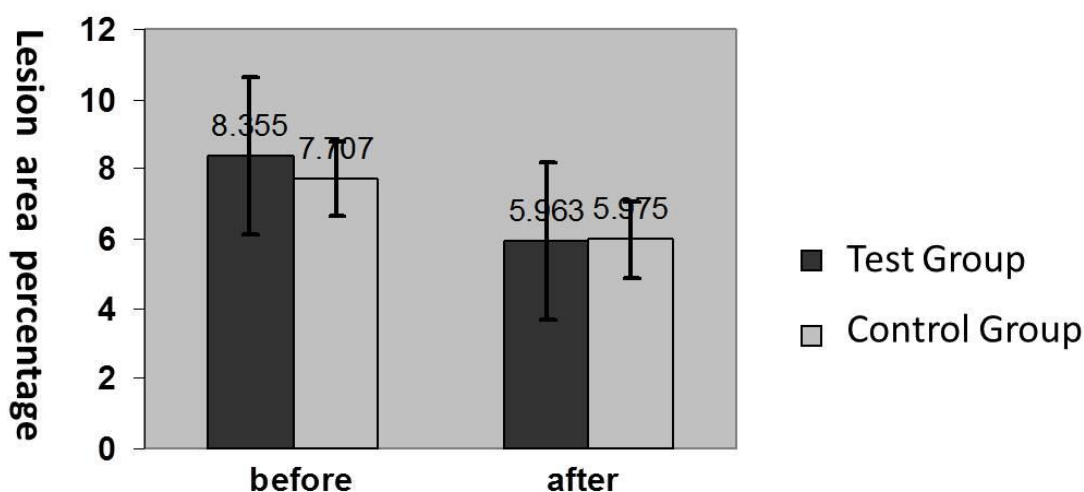


Figure 2. Comparison of mean size of lesions in the two groups before and after the intervention.

The teeth in the two groups were compared as well (Table 2).

As observed in Table 2, the duration of time (time factor) had a statistically significant effect on lesion sizes regardless of the case

or control group but the difference between the two groups (group*time factor) in terms of change in lesion sizes was not statistically significant.

Table 1. Comparison of oral hygiene between two group with Mann-Whitney test

Group	N	Mean rank	Level of significance
Flouride varnish	10	10	0.705
Control	10	11	

Statistical analysis showed no significant differences between the two groups.

Table 2. The results of repeated measurement ANOVA for studied groups

Error in	Sum of squares	Degree of freedom	Mean squares	F	Level of significance
Group	12.419	1	12.419	1.052	0.307
Patient	762.053	9	84.673	7.173	0.000
Time	160.638	1	160.638	13.608	0.000
Group*Time	7.284	1	7.284	0.617	0.434
Error	1381.162	117	11.805		
Corrected total	2341.240	129			

Statistical analysis showed a significant effect between patient and time factors, but Group*Time factor showed no significant effect between the wo groups.

DISCUSSION

The present study evaluated the size of white spot lesions after fixed orthodontic treatment.

One research revealed that the primary white spots are mostly superficial, smooth and chalky lesions on the enamel and the subsurface carious lesions with an intact surface layer are less frequent. The former rapidly remineralize under in-vivo conditions; however, in case of subsurface lesions, fluoride ions may penetrate into the surface layer and cease the process of demineralization or remineralization.⁽⁶⁾

Schmit in his study concluded that application of fluoride varnish might be beneficial in patients with white spot lesions or susceptible subjects.⁽¹²⁾ Furthermore, another study found that fluoride uptake in demineralized enamel following the application of fluoride varnish is much greater compared to using

NaF and monofluorophosphate (MFP) toothpastes.⁽¹⁴⁾

However, clinical studies on patients' compliance showed that rate of demineralization increases by reduced patient compliance in using topical fluoride regimens and one study showed that only 13% of patients (total: 206, 27) fully complied with the use of fluoride regimens prescribed for caries prevention.⁽⁴⁾

Considering the above-mentioned issues, it seems that preventive measures adopted by dentists and not requiring patient compliance are more suitable for patients. Application of fluoride varnish is among the most important preventive measures that can be adopted by dentists.

In this study, 20 patients were evaluated for 4 months after the completion of their orthodontic treatment course. In 10 patients, fluoride varnish was applied to tooth surfaces. No specific recommendations were given to patients regarding the type of

toothpaste. Patients' compliance without oral hygiene instructions was very good. There were no differences between the two groups in terms of age, duration of fixed appliance therapy and oral hygiene status. The mean size of lesions before treatment was 7.7% in the control group, which decreased to 5.9% after treatment. In the treatment group, the mean size of lesions before the treatment was 8.3%, decreased to 5.9% after treatment. Size of white spot lesions in both groups decreased during the 4-month study period and no significant differences were noted in this respect between the case and control groups.

Willmot in 2004 conducted a study on 21 patients with a mouthrinse/toothpaste treatment regimen and reported similar results.⁽¹⁵⁾ However, he took his photographic images under polarized light. Polarized light eliminates excess light in the room and results in better and clearer observation of lesions. However, we did not use polarized light in the present study because the important issue was the clinical pattern of the lesions. The important goal in the present study was to evaluate what was clinically present and to accurately measure the lesion size.

In another in vitro study conducted on 45 premolar teeth in Isfahan, the efficacy of fluoride varnish and fluoride gel was compared in protecting the prepared enamel surfaces. Based on the results, both fluoride varnish and gel significantly decreased the depth of demineralized lesions.⁽¹⁶⁾ One in

vitro study concluded that fluoride varnish could result in a 50% reduction in the size of demineralized enamel lesions in comparison to the control group.⁽¹⁷⁾ Another in vitro study showed that low-concentration fluoride solutions (50 ppm) were more efficacious in remineralization than those with higher fluoride concentrations (225 ppm).⁽¹⁸⁾

It appears that under in vitro conditions, fluoride varnish or gel have a significant effect on reducing the size or depth of white spot lesions; whereas, under in vivo conditions only the surface extension of lesions is evaluated and there might not be a significant difference due to the presence of natural saliva and its mineral content. In the oral environment, natural saliva alone may play an important role in remineralization of these lesions, provided a good oral hygiene status is maintained. Optimal oral hygiene status and probably the fluoride content of toothpastes played a significant role in improving lesions in the two groups.

It has been demonstrated that fluoride varnish can significantly reduce demineralization but cannot completely prevent the development of enamel white spot lesions.⁽¹⁹⁾ Koch et al reported that the highest fluoride uptake in enamel occurred after the application of fluoride varnish and in the outermost enamel layers.⁽²⁰⁾ Thus, application of fluoride varnish has no advantages over the natural compensatory mechanisms of saliva in patients with post-

treatment white spot lesions, given an optimal oral hygiene status.

Stafford et al, in a randomized clinical trial in 2011, evaluated the efficacy of fluoride varnish in improving post-treatment white spot lesions. They assessed the status of white spot lesions using a DIAGNOdent pen. They showed that monthly topical fluoride varnish application for 6 months is a good method for treatment of white spot lesions and must be advocated for patients as a routine measure after the completion of orthodontic treatment.⁽²¹⁾

In 2012, Du assessed the efficacy of fluoride varnish in the treatment of white lesions using a DIAGNOdent pen after completion of orthodontic treatment. He also concluded that fluoride varnish application is a suitable method for treatment of enamel white spot lesions after debonding.⁽²²⁾

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Comparison of the two afore-mentioned studies and ours reveals that fluoride varnish application has no effect on the size (area) of lesions but may prevent or treat their extension into deep layers, which is better detected by DIAGNO dent laser pen. Staining of teeth was among the disadvantages of fluoride varnish application in this study and compromised patients' esthetics. It was corrected by tooth cleaning and prophylaxis at the end of treatment.

CONCLUSION

Based on the results, application of fluoride varnish has no superiority over the natural remineralization process by saliva in reducing enamel white spot lesion sizes in patients with good oral hygiene.

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