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THE EFFECTIVENESS OF A FLUORIDE VARNISH IN PREVENTING THE DEVELOPMENT OF WHITE SPOT LESIONS

*A prospective examination of 10 consecutively treated orthodontic patients was undertaken to examine the effectiveness of fluoride varnish in reducing enamel demineralization. Pairs of dental quadrants for each patient's mouth (ie, maxillary right and mandibular left; maxillary left and mandibular right) were randomly assigned to an experimental or control group. After placement of resin-bonded orthodontic brackets, fluoride varnish was applied to the 2 experimental dental quadrants for each patient. Subsequent applications were done every 3 months during 12 months of orthodontic treatment. A double-blinded examination of intraoral photographs of the 100 experimental and 100 control teeth was done. The presence of white spot lesions was registered using the enamel decalcification index and the 2 groups were compared using paired Student t tests with a significance level of 5% (*P < .05*). There was no statistically significant difference between the mean enamel decalcification index for the control and experimental groups before or after treatment, since demineralization increased for both groups. Most importantly, the change in mean enamel decalcification index was significantly smaller for the experimental group (0.34), compared to the control group (0.51). In other words, there was 44.3% (*P < .05*) less demineralization noted for teeth that had been treated with fluoride varnish during orthodontic treatment.* World J Orthod 2006;7:xx–xx.

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It is accepted knowledge that orthodontic treatment with fixed appliances predisposes patients to a larger accumulation of bacterial plaque and, therefore, to enamel demineralization lesions. This is due to the mechanical interference imposed by the orthodontic appliances, making adequate oral hygiene more difficult. Consequently, enamel demineralization lesions, resulting from the dissolution of the enamel, can appear within only a few weeks after appliance placement.[1–3] These enamel scars can vary from microscopic alterations to visible "white spot lesions" that may reach cavitation.[2] The presence of these lesions is not typically noted until the removal of orthodontic appliances and has been reported to be a frequent event.[4,5] As a consequence, these scars present a discouraging result for a specialty whose objectives are to improve facial and dental esthetics.

Several authors have suggested preventive methods to combat these dental scars. For example, patient motivation and oral hygiene instruction, as well as home use of fluoride supplements have been demonstrated to be effective.[6,7] The prescription of a 0.05% solution of

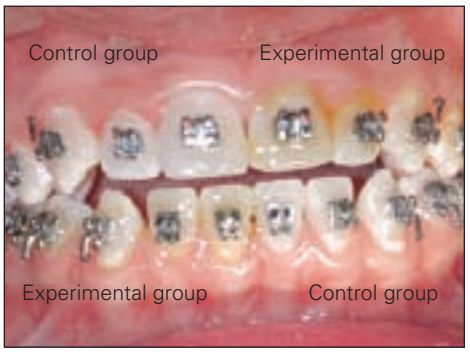

Fig 1 Example of the crossover design.

sodium fluoride for home use has been proven to reduce white spot development.[6–8] Unfortunately, this approach is totally dependent upon unpredictable patient compliance.[7,8] Therefore, patients who demonstrate poor oral hygiene often do not comply with prescribed methods of prevention, such as the use of fluoride rinses or gels.

In an attempt to provide the necessary protection, independent from patient compliance, fluoride-release bonding agents have been suggested. Although glass ionomer cement does reduce enamel demineralization, concerns regarding handling difficulties, limited protective coverage area, and bond strength have somewhat curbed its appeal as a bracket adhesive.[9–11]

Some researchers have demonstrated a decrease in the incidence of white spots when using fluoride-release resin-bonding materials,[12,13] while others have found no improvement.[14–16] Similarly, enamel sealants were reported to yield a 13% reduction in the white spot lesion incidence; however, Wenderoth et al[17] and Frazier et al[18] demonstrated the presence of breaks and faults in the sealant, leaving niches that could lead to carious lesions underneath this material. Periodic application of an antimicrobial varnish with chlorhexidine was also suggested to diminish Streptococcus mutans colonization.[19,20] Jenatschke et al[21] found that these varnishes were not efficient in preventing the appearance of white spot formation.

Fluoride varnish, applied around orthodontic appliances, has been proven to diminish the incidence of white spot lesions. For instance, fluoride varnish, composed of 5% sodium fluoride in a resin base, has shown a reduction in white spot incidence of about 50%.[10,20–22] Therefore, periodic fluoride application, independent of patient compliance, may provide a clinically effective solution, yet it has also been observed that such material cannot completely prevent white spots.[10,21]

Fortunately, applying fluoride varnish on existing lesions does prevent their progression[20] and may potentially help remineralization. The application of these varnishes was studied by Petersson et al,[23] who concluded that an application every 90 days (tri-monthly) would be sufficient to promote adequate protection. Todd et al[11] pointed out that because of the easy application of fluoride varnish, this procedure could be done by auxiliary personnel in the orthodontic office.

In an attempt to confirm these findings, the present prospective study was conducted to investigate the clinical effectiveness of a tri-monthly application of a fluoride varnish (Duraflor, Pharmascience, Montreal, Quebec, Canada) in preventing enamel demineralization (ie, white spot lesions) around orthodontic brackets during the course of 1-year of treatment.

MATERIAL AND METHODS

This prospective research evaluated 10 consecutive patients who sought corrective orthodontic treatment at the dental clinic of the State University of Maringá–UEM (Maringá, Paraná, Brazil). The patients ranged from 10 to 14 years of age (5 boys and 5 girls). A crossover design was used (Fig 1), in which one pair of crossed quadrants of each patient's mouth (eg, maxillary left and mandibular right; maxillary right and mandibular left) were designated at random as the experimental group and the contralateral quadrants assigned as the control group. Therefore, the sample featured a total of 200 teeth, with 100 in the experimental group and 100 controls.

The University of Maringá's Ethics Committee approved the study protocol under identification number 73/2002. The patients and their parents gave informed consent for participation in this study. A full series of intraoral photographs, including all labial and buccal surfaces from the second premolar to the contralateral second premolar of both maxillary and mandibular arches, were taken using a Nikon Coolpix 4500 digital camera (Nikon, Tokyo, Japan) prior to the placement of orthodontic appliances. All photographs were taken with a dry and well-illuminated enamel surface, and the unaltered images were stored on a computer. Subsequently, an oral hygiene demonstration was given to each patient.

After prophylaxis of the enamel surface, the teeth were isolated with cheek retractors, etched for 20 seconds with a 37% phosphoric acid gel, rinsed for 20 seconds, and air-dried with compressed air. Fixed orthodontic appliances (Monoblock, Morelli, São Paulo, Brazil) were bonded using a chemically-cured resin (Concise, 3M Unitek, Monrovia, USA), according to the manufacturer's directions. Specifically, the resin was applied to the bracket base and the bracket was placed on the tooth. A dental scaler was used to remove any residual resin from around the bracket after placement. Immediately after the placement of all brackets and initial polymerization of the bonding adhesive, the randomized experimental quadrants were assigned for that patient.

With cheek retractors in place, the fluoride varnish was applied for the first of 4 applications during the experimental period of 1 year. A thin coat of Duraflor was applied with a microbrush to the dry enamel around the orthodontic appliances as described by Bowman.[24] No drying time was required as the varnish is activated by saliva. The patients were instructed not to brush for 12 hours, with the intent of prolonging the contact time of the fluoride on the enamel surface. It is important to note that no fluoride varnish was ever applied to the control quadrants during that 1 year of treatment.

Varnish applications were repeated every 3 months to the experimental quadrants of each patient over the first year of orthodontic treatment. At each application (AU: edit okay?), a new series of digital photographs were taken. Prior to those subsequent applications of varnish, gross plaque was removed and the teeth were isolated using cheek retractors. The teeth were then air-dried and varnish was once again applied around the orthodontic appliances. (Figs 2a, 2b, 3a, 3b, 4).

Two calibrated examiners performed a double-blinded examination of the photographs taken before and after 12 months of orthodontic treatment and the tri-monthly applications of fluoride varnish to the experimental quadrants. The presence of "white spot lesions" was registered following the methods proposed by Banks and Richmond[25] (Figs 5 to 8). The groups were then statistically compared by paired Student *t* tests with significance level of 5%.

RESULTS

The mean enamel decalcification index significantly increased for both groups after 12 months of treatment (Table 1). There was no significant statistical difference between the mean index for the control and experimental groups either before or after 12 months of treatment; however, the change in the mean index during treatment was significantly smaller in the experimental group (Table 2). In other words, there was 44.3% ($P < .05$) less demineralization noted for teeth that had been treated with fluoride varnish during orthodontic treatment.

DISCUSSION

White spots are incipient carious lesions, arising from the demineralization process of the tooth enamel, produced by bacterial acids in a cariogenic environment. The clinical characteristic of a white spot occurs because of the mineral dissolution of the enamel; turning it from translucent to opaque. These lesions create an esthetic problem because they do not spontaneously disappear.

Fig 2 Example of the varnish application after the appliance placement, prior to contact with the saliva.

Fig 3 Appearance of the varnish after it has been in contact with the saliva, forming a white water-resistant plaque.

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Fig 4 *(left)* Fluoride varnish Duraflor with 5% sodium fluoride.

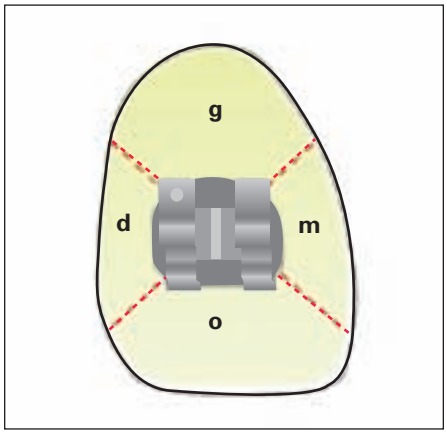

Fig 5 *(right)* Enamel decalcification index proposed by Banks and Richmond.[25] The tooth is divided into 4 areas: g, gingival; m, mesial; d, distal; o, occlusal. A score was allocated for each area of each tooth: 0, no decalcification; 1, decalcification covering less than 50% of the area; 2, decalcification covering more than 50% of the area; and 3, decalcification covering 100% of the area, or severe decalcification with cavitation. Total score per tooth calculated by summation of the individual areas scores for each tooth.

In general, orthodontic brackets increase bacterial plaque retention, which increases the chance of decalcification, and the appearance of such lesions in patients undergoing orthodontic treatment with fixed appliances has been reported to be between 11% and 96%.[3,5,25] The present study corroborated these findings; the incidence of white spot lesions increased 31.19% in the experimental group and 50.83% in the control group. Due to the rapid development of these lesions (around 4 weeks from the date of bracket placement),[1] orthodontists should be highly concerned.

The present study confirms that periodic application of fluoride varnish during orthodontic treatment can help to reduce the incidence of white spot lesions by 44.3% ($P < .05$), a finding similar to the 48% reduction obtained by Ogaard et al[19] (see Table 2). Although fluoride varnish can decrease the incidence of enamel scars, it cannot completely prevent their appearance.[10,21] Consequently, it is important to emphasize that methods for early diagnosis be developed, perhaps through the use of fluorescence light iridescence (eg, KaVo DIAGNOdent, KaVo America, Lake Zurich, USA) to objectively measure the status of the enamel during the course of treatment. If the start of these lesions could be determined at an early stage then they may be more easily treated by

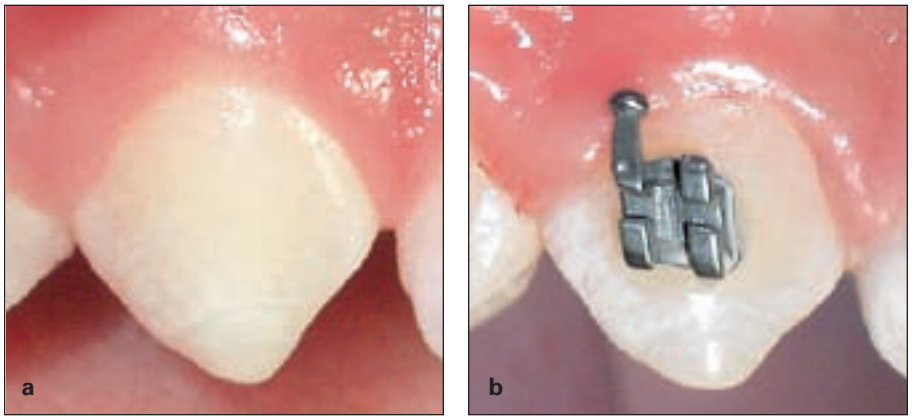

Fig 6 Example of white spot lesion development on a maxillary canine of the control group. **(a)** Before treatment. **(b)** After 10 months of treatment. Brackets were removed after 12 months of treatment.

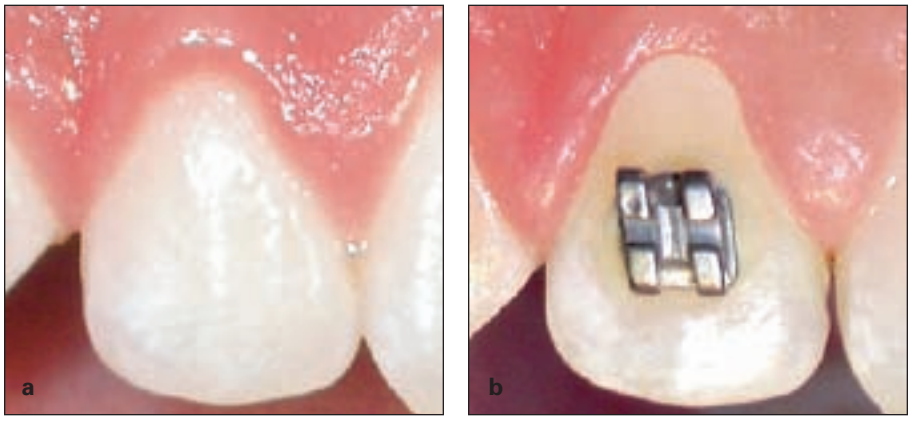

Fig 7 Example of the white spot lesion development on a maxillary lateral incisor in the control group. **(a)** Before treatment. **(b)** After 10 months of treatment. Brackets were removed after 12 months of treatment.

Fig 8 Example of the white spot lesion development on the maxillary incisors of the control group. **(a)** Before treatment. **(b)** After 12 months of treatment.

Table 1 Descriptive statistics and Student *t* test comparison of the decalcification index between the experimental and control groups before and after 12 months of treatment

Stage	Experimental group (mean ± SD)	Control group (mean ± SD)	*P*
Pretreatment	1.09 ± 1.26	1.20 ± 1.51	NS
After 12 months	1.43 ± 1.50	1.81 ± 1.86	NS

NS, not significant.

Table 2 Descriptive statistics and Student *t* test comparison of the decalcification index between the experimental and control groups after 12 months of treatment

Stage	Increment in the experimental group index mean ± SD	Increment in the control group index mean ± SD	*P*
After 12 months	0.34 ± 0.64	0.61 ± 1.15	.035*

*Significant at the level of 5% ($P < .05$).

aggressive preventive methods and/or by the stimulation of remineralization.

The crossover model utilized in this study seems to have adequately demonstrated some favorable clinical benefits from fluoride varnish; this despite confounding factors, such as each individual's salivary composition and oral hygiene compliance and capabilities. However, as fluoride varnish releases fluoride ions into the oral environment, it may have also inadvertently provided some level of "protection" for teeth in the control quadrants in the same patient. Consequently, the fluoride varnish may have been demonstrated to be even more effective for the experiment quadrants if the control quadrants in each individual could have been completely isolated from any unintentional contact with fluoride ions in the saliva.

Most of the patients in this study had some areas of decalcification prior to the initiation of orthodontic treatment (see Table 1). The resemblance between the white spot lesions caused by fluorosis and the ones caused by bacterial plaque may have interfered in the initial readings and in the evaluation of the new lesions. For instance, lesions caused by fluorosis could have masked the appearance of new enamel decalcification lesions during treatment. Despite those possible errors of detection, treatment with fluoride varnish was demonstrated to help reduce the incidence of enamel scars.

CONCLUSION

The results of this prospective evaluation of tri-monthly fluoride varnish application have demonstrated that this is an effective auxiliary method to reduce white spot lesions during treatment with fixed orthodontic appliances. During a 12-month observation period, a 44.3% reduction in the mean enamel demineralization index was found for teeth that had been treated with fluoride varnish compared to controls. Although fluoride varnish does not completely prevent the development of enamel scars, the reduction in incidence and depth of lesions warrants clinical consideration. Routine, periodic application of fluoride varnish for patients undergoing orthodontic treatment may be eventually accepted as a contemporary standard of care for limiting enamel scars.

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