

Efficacy of a Fluoride Varnish in Preventing White-Spot Lesions as Measured with Laser Fluorescence

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The tendency of plaque to accumulate around fixed orthodontic appliances can result in rapid demineralization,¹⁻⁷ sometimes within only a few weeks after bracket placement.¹⁻³ Vigilant home hygiene, including the use of a fluoride mouthwash, is effective in preventing white spots,⁶⁻⁹ but requires unusual patient compliance. Periodic application of fluoride varnish is much more efficient, reducing demineralization around brackets by as much as 50%.⁹⁻¹⁵

In this study, we evaluated the in vivo effectiveness of a fluoride varnish in preventing demineralization of the enamel surrounding orthodontic brackets, as measured with a laser fluorescence monitoring device.

Methodology

Fifteen patients (six female, nine male, age

12-18), all of whom had sought treatment at the orthodontic clinic of the State University of Maringá, Brazil, were selected for the study. Screening determined that the patients had no buccal caries or visible demineralization. After approval for the research project was granted by the university ethics committee, written informed consent was obtained from each patient's parent or legal guardian.

Metal brackets were bonded using a light-cured composite resin and adhesive (Transbond XT*) in accordance with the manufacturer's instructions. Each patient was given the same oral-hygiene instructions. One week after bracket placement, the patient received a thorough prophylaxis. The dental arches were then isolated using cheek

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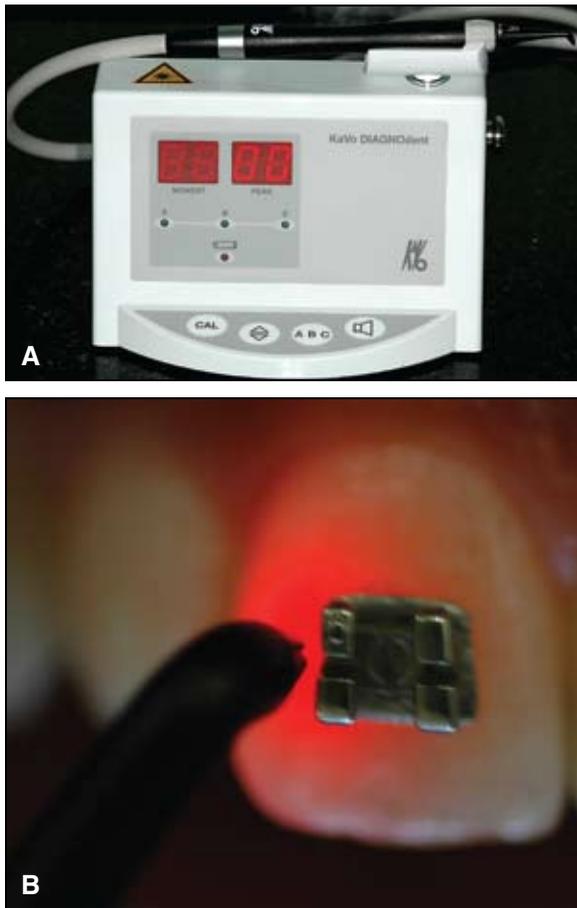


Fig. 1 A. DIAGNOdent laser fluorescence device used to measure enamel demineralization. B. Reading of reflection of laser fluorescence from tip of handpiece indicates mineralized content of enamel.

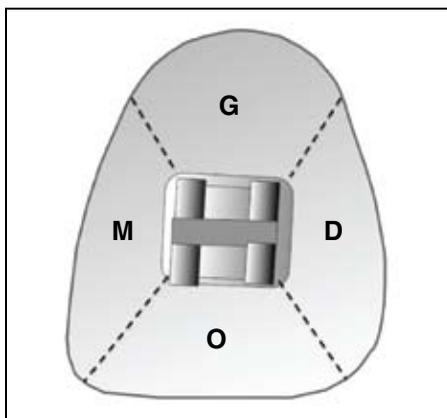


Fig. 2 Division of tooth surface proposed by Banks and Richmond to calculate level of enamel decalcification.²²

retractors, and the buccal surfaces were carefully dried.

Baseline measurements of the enamel mineralization of each tooth, from second premolar to second premolar in both arches, were made with a laser fluorescence device (DIAGNOdent,** Fig. 1). This unit uses a 655-nanometer diode laser to identify non-cavitated, occlusal pit-and-fissure caries and smooth-surface caries before they are detectable by visualization, radiography, or probing.¹⁶⁻²⁰ Laser fluorescence from the wand tip is reflected off the tooth surface to measure the mineralized content of the enamel; higher readings indicate greater demineralization. Although the scale runs from 0 to 99, the levels found in normal patient groups are: 0-10 = healthy tooth structure; 11-20 = outer-half enamel caries; 21-30 = inner-half enamel caries; 30+ = dentinal caries.²¹ Any measurements from 2 to 9 can signify incipient decalcification.¹⁸

The laser device was calibrated for each patient by pointing the beam at an area of apparently healthy enamel (normally the incisal edge, as recommended by the manufacturer) and resetting the digital display to zero. For purposes of this study, the buccal surface of each tooth was divided into four quadrants—mesial, distal, gingival, and occlusal (Fig. 2)—as recommended by Banks and Richmond.²² The peak fluorescence measurement shown on the display was recorded for each quadrant.

After the baseline recording, we applied a fluoride varnish (Duraphat***) around the brackets with a microbrush (Cavibrush†), using a split-mouth technique (Fig. 3). In each patient, half of the maxillary teeth and the contralateral half of the mandibular teeth were varnished; the unvarnished teeth served as the control group. The patients were instructed to wait 12 hours before brushing their teeth.

Laser fluorescence readings were recorded

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†FGM Produtos Odontológicos, Av. Edgar Nelson Meister, 474, 89219-501 Joinville - SC, Brazil; www.fgm.ind.br.

TABLE 1
AVERAGE MEASUREMENTS OVER SIX-MONTH PERIOD

Varnish Applied (137 teeth)			No Varnish Applied (137 teeth)		
Baseline	3 Months	6 Months	Baseline	3 Months	6 Months
0.58 ± 0.64	0.59 ± 0.70	1.09 ± 0.89*	0.73 ± 0.97	0.80 ± 0.98	1.40 ± 1.48*

*Differences between these readings and the baseline within each group are statistically significant at the .05 level (ANOVA for repeated measurements, with post hoc Bonferroni test).

again at three months and six months after the baseline application,^{13,15} and varnish was reapplied to the same teeth.

Decalcification was calculated for each tooth by averaging the values from the four quadrants. Each quadrant (gingival, occlusal, mesial, and distal) was also appraised individually. Intragroup evaluation was performed by ANOVA for repeated measurements, with post hoc Bonferroni tests. Comparisons between the increases in decalcification from baseline to six months were assessed with Student's *t*-test.

Results

Baseline laser fluorescence readings did not differ significantly between the varnished and unvarnished teeth (Table 1). At three months, the unvarnished group showed a tendency toward greater demineralization than in the varnished group. At six months, demineralization had increased significantly in both groups compared with the baseline readings. The unvarnished group showed 32% more demineralization progression than the varnished group at six months, although the difference was not statistically significant when the four quadrants were combined. In the gingival quadrant, however, demineralization was significantly less in the varnished group (Table 2); the gingival quadrants of the varnished teeth showed only about half as many readings greater than or equal to 3 on the laser fluorescence scale at the end of six months (Fig. 4).

Overall, the greatest amount of demineralization occurred in the gingival quadrant, which also showed the most significant benefit from the application of fluoride varnish (Table 2). The distal quadrant also displayed a substantial difference in demineralization between groups, but with much more variable results. Both groups showed

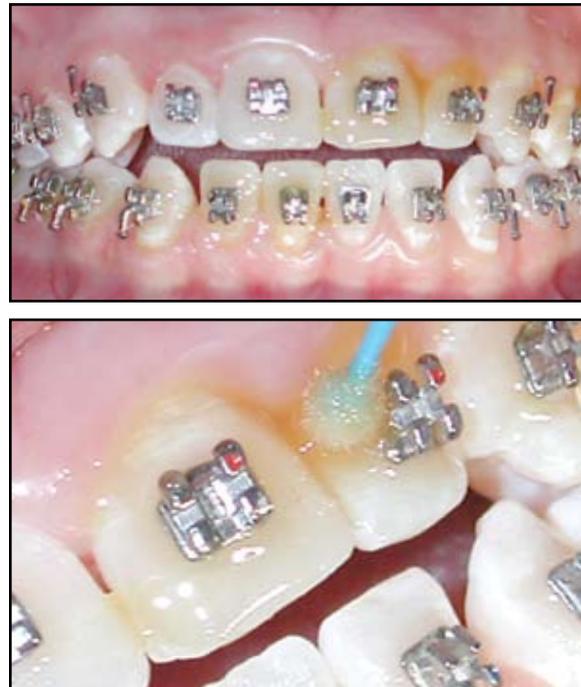


Fig. 3 Examples of varnish application using split-mouth technique.

TABLE 2
INCREASE IN DECALCIFICATION FROM BASELINE TO SIX MONTHS

	Varnish Applied (137 teeth)	No Varnish Applied (137 teeth)
Overall	0.51 ± 1.14	0.67 ± 1.60
Gingival quadrant	0.53 ± 1.33	0.89 ± 1.94*
Occlusal quadrant	0.32 ± 0.93	0.20 ± 1.20
Mesial quadrant	0.75 ± 1.62	0.67 ± 2.23
Distal quadrant	0.54 ± 2.25	0.88 ± 3.59

*Differences between these groups are statistically significant at the .05 level (Student's *t*-test).

Efficacy of a Fluoride Varnish in Preventing White-Spot Lesions

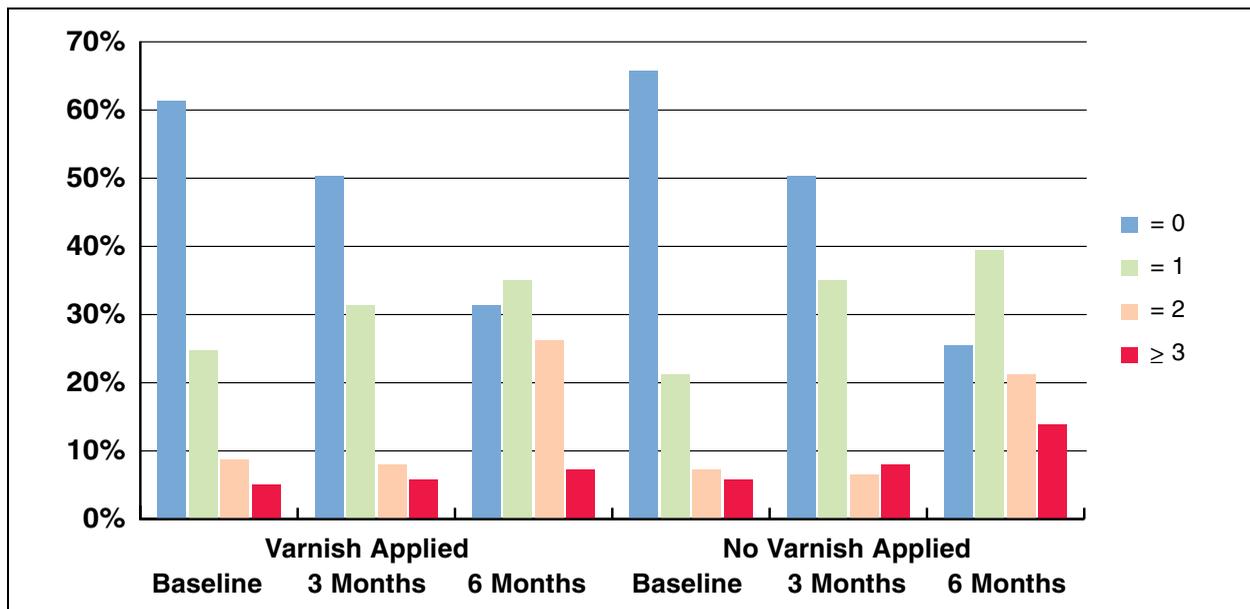


Fig. 4 Distribution of average laser fluorescence readings in gingival quadrant with and without fluoride varnish.

only minor increases in demineralization in the occlusal quadrant.

Discussion

The clinical appearance of enamel decalcification may not accurately indicate the depth of white-spot lesions.²³ Considering how quickly these lesions can develop and become irreversible, early diagnosis is of critical importance.^{19,22} Our study showed significant decalcification within only six months after orthodontic bonding—an effect that was reduced only slightly by the application of fluoride varnish.

The gingival subface, the area most prone to white-spot lesions, did exhibit a significant benefit from fluoride varnish. The quadrants most affected by the development of lesions in our study were, in decreasing order, the gingival, distal, mesial, and occlusal areas, as in a previous report²²—a pattern that probably reflects the relative difficulty of cleaning these regions.

The positive effects of fluoride varnish noted in the current study corroborate the findings of previous reports.^{11,14,15} Two of these investigations^{11,15} used Duraflo[‡] varnish, which contains

[‡]Registered trademark of Medicom, Inc., 295 Firetower Road, Tonawanda, NY 14150; www.medicom.com.

the same 5% concentration of sodium fluoride as in Duraphat. Daily rinsing with a solution of .05% sodium fluoride has also been shown to reduce the severity of white-spot lesions, while not preventing them completely.⁶⁻⁹ Of course, the efficacy of this method depends on patient compliance, which has generally been found to be lacking (13% in one study⁷). Patients who do not practice proper oral hygiene are particularly unlikely to cooperate with the use of mouthrinses.^{3,13}

Enamel sealants, with and without fluoride release, have shown varying levels of success in preventing white-spot lesions.^{9,22,24,25} In one study, a highly filled pit-and-fissure resin applied just before placement of orthodontic appliances showed significant effectiveness in reducing demineralization.²⁵ In another study, however, a polymeric tooth coating around brackets appeared to be ineffective.⁹ Given the concern that acidic beverages might penetrate the enamel-sealant junction at the margins, possibly causing enamel damage, sealants deserve further evaluation.

Anderson and colleagues reported a 94% reduction in average lesion area and depth when teeth were irradiated for 60 seconds with a 325mW argon laser.²⁶ Noel and colleagues demonstrated a 22% reduction when an argon laser was used to cure the bonding adhesive for 10 seconds per

tooth.²³ Unfortunately, because argon-laser units are not cost-effective curing lights, they have disappeared from the dental marketplace. Other types of lasers may help prevent dental caries in the future, perhaps in combination with fluoride treatments and sealants.

Conclusion

Even though studies have unanimously reported 30-50% reductions in incipient enamel lesions following the application of fluoride varnish,⁹⁻¹⁵ a recent survey of 229 orthodontists found that only .6% of the respondents routinely applied fluoride varnish.²⁴ Fluoride varnishes are less expensive and easier to apply than fluoride gels and, unlike home rinses, require no patient compliance.^{14,15} Disadvantages include the need to wait an hour before eating or drinking and 12 hours before brushing, a brownish-yellow discoloration of the enamel for about three days, and the need to reapply the varnish at least every 12 weeks to maintain its effectiveness. On balance, however, compared with other alternatives for reducing enamel decalcification, fluoride varnishes would seem to be the first choice.

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