

ORIGINAL ARTICLES

Reducing white spot lesions in orthodontic populations with fluoride rinsing

Arnold M. Geiger,^a Leonard Gorelick,^b A. John Gwinnett,^c and Barbara J. Benson^d

New York City, New Hyde Park, Stony Brook, N.Y., and Skillman, N.J.

A clinical study was conducted to determine if rinsing frequency with a neutral 0.05% sodium fluoride rinse influenced white spot lesion formation associated with orthodontic brackets. Patients from two private orthodontic practices participated. Each received home-care instructions and were told to use 10 ml of sodium fluoride rinse daily before bedtime. The rinse was supplied free of charge to determine if this affected compliance with its prescribed use. Compliance was measured by recording the number of bottles used by each patient. An assessment of oral hygiene status was conducted, and at the time of debonding, white spot lesions were recorded. Only 13% of the 206 participants fully complied with the rinse protocol; 42% of the subjects used 10 ml approximately every other day; and 45% used the rinse less frequently. A significant dose response relationship was noted in which those who rinsed at least once every other day had fewer lesions (21%) than those who rinsed less frequently (49%). It was concluded that a significant reduction in enamel white spot lesions can be achieved during orthodontic therapy through the use of a 10 ml neutral sodium fluoride rinse. The more closely patients complied with the prescribed use, the more likely they could expect a decrease in the occurrence of lesions. (*AM J ORTHOD DENTOFAC ORTHOP* 1992; 101:403-7.)

White spot formation on the labial surface of bonded or banded teeth during orthodontic treatment has long been recognized as a problem.^{1,2} Clinical observation and quantitative studies of the incidence, areas of susceptibility, and prevention of decalcification have been reported.^{1,4} Retention of plaque,⁵ oral hygiene efficiency, and varied resistance levels of the patient have been identified as related to white spot experience during orthodontic treatment.^{5,6}

The beneficial effect of preventive fluoride programs has been reported for banded and bonded appliances in office-applied or self-administered regimens.^{4,7-11} In self-administered fluoride programs, compliance has been identified as a significant problem.⁴

This study was designed to identify the effect of a self-administered fluoride rinse and to evaluate the effect of procedures designed to influence patient compliance with the rinsing regimen.

MATERIAL AND METHOD

The fluoride rinsing program was initiated for all patients starting treatment in two private orthodontic practices (A.M.G., L.G.). All teeth were bonded with a sealant-composite combination (Concise, 3M Dental Products Division, St. Paul, Minn.) according to conventional bonding procedures. Dates of the bonding and debonding of each tooth were recorded.

The fluoride rinse, a neutral 0.05% sodium fluoride (ACT, Johnson and Johnson Consumer Products, Inc., Skillman, N.J.), was given to each patient with instructions to use a measured quantity (10 ml accurately dispensed from the bottle dosimeter) daily before bedtime. Rinsing was done immediately after brushing with a fluoride-containing toothpaste. Eating and drinking was prohibited for 30 minutes after this regimen. A new bottle of fluoride rinse was given to each patient who either returned an empty bottle or lacking a return gave assurance that the bottle had been used up. Each time the patient received a replacement bottle, the date was recorded.

The following educational efforts were employed for each patient:

1. Instructions urging careful hygiene, fluoride toothpaste, and fluoride rinse as prescribed.
2. An instruction book that graphically demonstrated good hygiene procedures and photographically showed white spot formation was read by each patient.
3. Patients demonstrating poor hygiene or compliance were given special instruction.

In one office (L.G.) an additional effort was made to enhance compliance for a group of patients by having each

^aClinical Professor, School of Dental and Oral Surgery, Columbia University, New York, N.Y.

^bStaff Orthodontist, Long Island Jewish/Hillside Medical Center, Associate Clinical Professor, Department of Children's Dentistry, School of Dental Medicine, SUNY at Stony Brook, N.Y.

^cProfessor, Department of Oral Biology and Pathology School of Dental Medicine, SUNY at Stony Brook, N.Y.

^dSenior Clinical Research Associate, Johnson and Johnson Consumer Products, Skillman, N.J.

8/1/29010

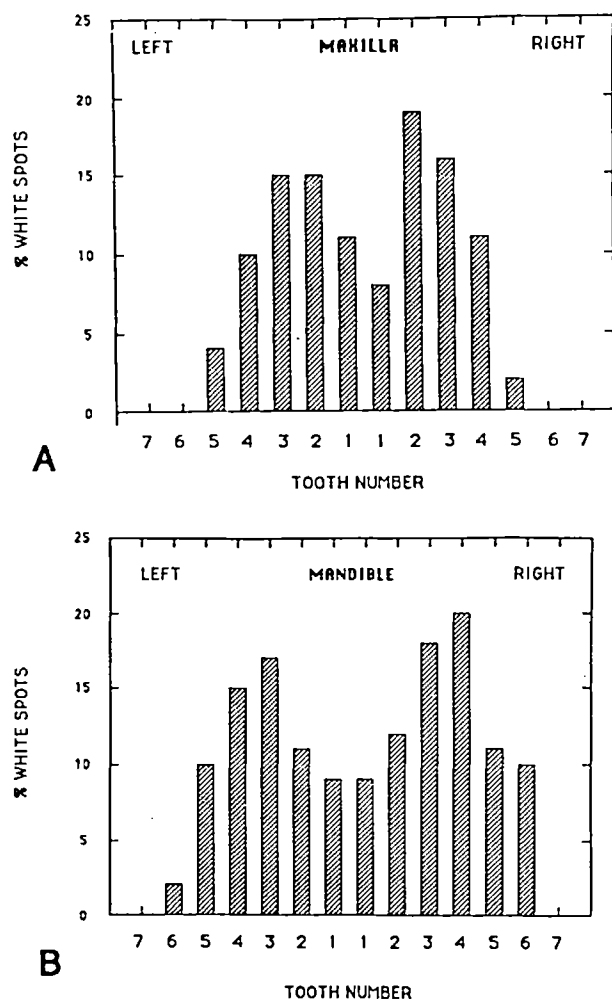


Fig. 1. A and B, Bar graphs represent percentage incidence of white spots according to tooth position in maxillary and mandibular arches, respectively.

child read and sign a brief "contract" letter in the presence of the parent. The contract letter stated:

"I understand that if I use my fluoride rinse as directed my teeth will have greater protection. I agree to use it and know that I will be given a fresh bottle when I bring in an empty one."

Secondly, if the patient neglected to bring in an empty bottle, no effort was made to remind him or her unless oral hygiene was considered poor. The objective was to determine if these efforts at behavior modification would affect the compliance.

The date each tooth was debonded was recorded, and the labial enamel surface was visually examined in an illuminated and relatively dry field. White spot formation, as reported previously, was scored according to the following numeric scale:

1. No white spot formation.
2. Slight white spot formation.

Table 1. Incidence of white spots related to duration of bond

Duration of bond (mo.)	Teeth with white spots	Percent of total teeth
9-14	11	3.0
15-24	37	9.9
25+	334	7.1
Totals	382	

3. Severe white spot formation.

4. Cavitation.

For purposes of simplicity, the data were analyzed according to the absence versus presence of white spots. At the termination of active treatment and debonding of remaining brackets, an evaluation of oral hygiene status was recorded for each patient as poor, acceptable, or excellent on the basis of the treatment record.

The data were subjected to statistical analysis with chi-square and log-linear models for multiway contingency evaluation. Data from the practices were not combined for overall analysis if significant differences between them were noted. However, if nonsignificant differences were identified, then practice data were combined and overall effects were analyzed for significance with the chi-square method.

RESULTS

There were 206 patients in the study sample; 87 were from one office, and 119 were from the other. Of the total, 89 were male patients and 117 were female patients whose ages ranged from 7 to 60 years old with a median age of 30 years. A total of 3133 teeth were followed from the time of bracket placement to debonding. Of the 209 patients 3.4% were bonded for less than 9 months, 22.3% from 10 to 19 months, 59% from 20 to 34 months, and 14.6% from 35 to 49 months.

Among the 206 participants, 69 (33.5%) exhibited one or more teeth with white spot lesions. Of the bonded teeth 11.9% showed white spot formation.

The bar graphs for the maxilla and the mandible indicate a bilateral symmetry of white spot occurrence and indicates the relative susceptibility of individual teeth (Fig. 1). As noted in the table, the greatest number of white spots occurred in patients treated for more than 24 months (Table I).

Compliance and white spot formation

The number of bottles of fluoride rinse was dated and recorded for each patient. The bottle comes with a dosimeter and can only be dispensed in 10 ml doses. Therefore the average daily dose could be based on the number of bottles used and the duration of use. The ideal would have been for each patient to have used 10 ml per day. Approximately 42% (41.7%) rinsed with

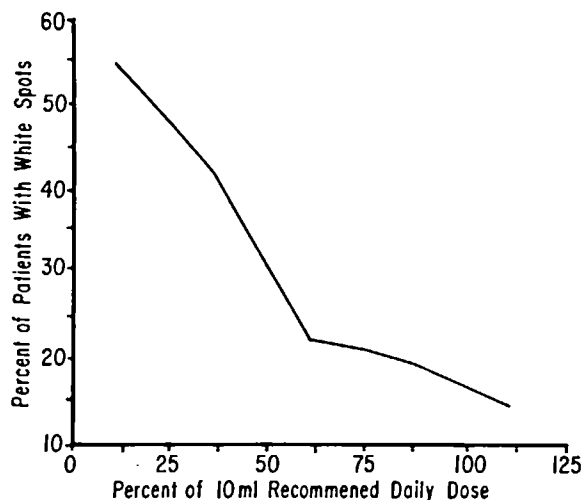


Fig. 2. Graph shows decrease in incidence of white spot lesions as a percent of the daily recommended dose, i.e., 10 ml.

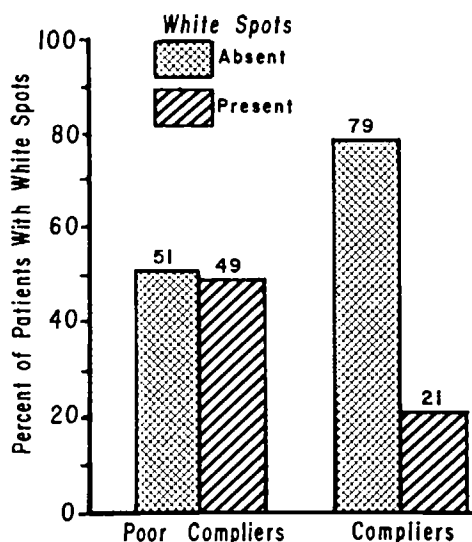


Fig. 3. Bar graph shows percentage of patients with white spot lesions according to rinsing compliance.

Table II. Number of patients classified by study site; incidence of white spots and dosage level

Dose	White spots Geiger		White spots Gorelick	
	Absent	Present	Absent	Present
Up to 10 ml every other day	23 (34%)	12 (63%)	25 (36%)	34 (68%)
More than 10 ml every other day	45 (66%)	7 (37%)	44 (64%)	16 (32%)
Total patients	68 (100%)	19 (100%)	69 (100%)	50 (100%)

at least 10 ml once every other day, and these were identified as compliers. A small number of patients overcomplied as shown in Fig. 2. The remainder (45.6%) rinsed less than once every other day and were identified as noncompliers.

Analysis of the data on the basis of a usage level of 10 ml every other day shows a clear association ($p < 0.0001$) in which a decrease in white spot incidence occurred with increasing dose (Table II). This is expressed as a graph (Fig. 2).

Those patients who rinsed at least once every other day had significantly ($p < 0.0001$) fewer lesions (21%) than those who rinsed less frequently (49%). In the compliant group, 79% had no white spot lesions compared with 51% in the noncompliant group (Fig. 3).

Oral hygiene and white spot formation

From the treatment record, oral hygiene status during treatment was recorded at the time of debonding.

Of the sample, 72 patients (35%) were evaluated as having excellent hygiene, 102 patients (49.5%) were judged as acceptable, and 32 patients (15.5%) had consistently poor hygiene.

The analysis of the incidence of white spots showed a clear association ($p < 0.0001$) between the presence of white spots and the standard of oral hygiene (Table III). To evaluate the effect of rinsing and the hygiene on white spots, the analysis was performed by dosage.

The percentage of patients with white spots relative to oral hygiene and modified in accordance with compliance is expressed in a histogram (Fig. 4). Of the noncompliant patient with poor oral hygiene, 91% exhibited white spot lesions compared with 49% who had acceptable oral hygiene and 15% rated excellent. The compliant patients showed 50%, 26%, and 7% poor, acceptable, and excellent oral hygiene, respectively. However, the dose-dependent relationship was evident regardless of hygiene status.

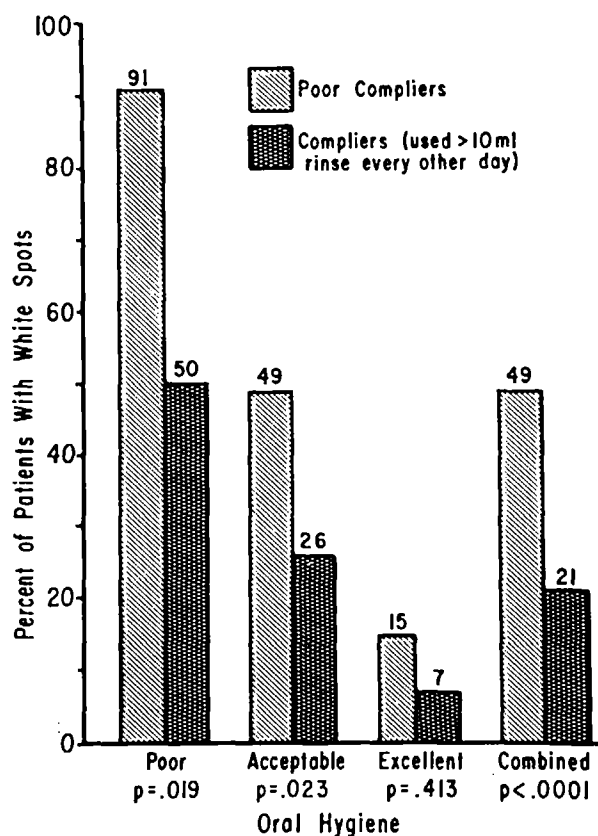


Fig. 4. Bar graph shows percentage of patients with white spot lesions according to oral hygiene status.

DISCUSSION

The objective of this project was to study the effect of a preventive fluoride rinsing on white spot formation.

In a previous study,⁴ it was reported that 49.6% of patients experienced some degree of white spot formation. This was consistent with the findings of Stratemann and Shannon,¹² and Magness, Shannon, and West⁸ who reported decalcification in their control group of orthodontic patients to be 58% and 64% respectively. Geiger et al.⁴ reported on the effect of a fluoride rinse program (Fluoriguard, Colgate-Palmolive Co., Piscataway, N.J.) in a private orthodontic practice setting. There was a 25% reduction in the number of patients exhibiting white spot lesions.

This positive result occurred although only 12% of patients were judged excellent compliers, and more than 50% complied very little or not at all.

In the present study, efforts were made to encourage compliance with the rinse program. Distributing the fluoride rinse free of charge permitted a reasonable quantification of its use. The efforts to improve compliance with the rinse protocol were, however, unwarded. The data confirmed our previous report⁴ and

Table III. Number of patients classified by hygiene and status of white spots

Hygiene	White spots		Row total
	Absent	Present	
Poor	7 (5%)	25 (36%)	32 (15%)
Acceptable	65* (47%)	37* (54%)	102 (50%)
Excellent	65 (47%)	7 (10%)	72 (35%)
Total patients	137 (100%)	69 (100%)	206 (100%)

*Median, $p < 0.0001$.

those of others⁷ as to the susceptibility of certain teeth, symmetry of occurrence, and the benefit of sustained exposure to fluoride rinse on the incidence and severity of white spots.

Recording the date each bottle of rinse was given during treatment provided a reasonable measure of its use over time. Since the bottle has a dosimeter that only permits a 10 ml dose at a time, the amount used could be quantified. Patients who used the rinse at least every other night or more demonstrated a significant reduction in white spots. The data further showed that poor hygiene was a contributor to the decalcification process. Future studies should address the use of an index for scoring oral hygiene quantitatively in a manner suggested by Ciancio et al.¹³

It is interesting to note that in those patients who complied with the rinse regimen but demonstrated poor oral hygiene did manifest a significant reduction ($p < 0.019$) in the incidence of white spots. This may be explained by the mechanism of action of fluoride. Although fluoride is known to reduce solubility of enamel and to play a role in remineralization,^{14,15} it has also been shown to influence plaque composition, growth, and metabolism.¹⁶ Fluoride accumulates in plaque in much higher concentration than in saliva. It is therefore available to assist in remineralization. An alteration in plaque metabolism, particularly related to the acidogenicity, may account for the observation that white spot incidence was significantly reduced in those patients with poor oral hygiene, yet were compliant with fluoride use, i.e., rinsing with 10 ml every other day.

CONCLUSIONS

The use of a 0.05% sodium fluoride rinse during orthodontic treatment resulted in a statistically significant reduction of enamel white spot lesions.

The more closely patients adhered to the daily use of the sodium fluoride rinse, the more likely they exhibited a decrease in the occurrence of white spot lesions.

The dose response effect between the frequency of rinsing and the incidence of white spots was evident regardless of oral hygiene status.

Despite educational efforts and supply of rinse free of charge, only 13% of the patients complied fully with its use, thus suggesting further investigation into methods to improve motivation and compliance.

We wish to acknowledge the Johnson and Johnson Consumer Products, Inc. for its financial support of this project.

REFERENCES

1. Mizrahi E. Surface distribution of enamel opacities following orthodontic treatment. *AM J ORTHOD* 1983;84:323-31.
2. Gorelick L, Geiger AM, Gwinnett AJ. Incidence of white spot formation after banding and bonding. *AM J ORTHOD* 1982;81:93-8.
3. Zachrisson BU, Zachrisson S. Caries incidence and orthodontic treatment with fixed appliances. *Scand J Dent Res* 1971;79:183-92.
4. Geiger AM, Gorelick L, Gwinnett AJ, Griswold PG. The effect of a fluoride provide program on white spot formation during orthodontic treatment. *AM J ORTHOD DENTOFAC ORTHOP* 1988;93:92-38.
5. Ceen RF, Gwinnett AJ. Plaque patterns and crevicular fluid flow related to orthodontic bracket bonding. *J Prev Dent* 1980;6:229-33.
6. Zachrisson BU, Zachrisson S. Caries incidence and oral hygiene during orthodontic treatment. *Scand J Dent Res* 1971;79:394-401.
7. Hirschfield RE. Control of decalcification by use of fluoride mouth rinse. *J Dent Child* 1978;42:26-8.
8. Magness WS, Shannon IL, and West DC. Office applied fluoride treatments for orthodontic patients. *J Dent Res* 1979;58:1427.
9. Corbett JA, and Shannon IL. Prevention of decalcification in orthodontic patients; a preliminary clinical trial with a mixture of fluorides. *J Colo Dent Assoc* 1980;58:16-7.
10. O'Reilly MM, Featherstone JDB. Demineralization and remineralization around orthodontic appliances: an in vivo study. *AM J ORTHOD DENTOFAC ORTHOP* 1987;92:33-40.
11. Ogaard B, Rolla G, Arends J, ten Cate JM. Orthodontic appliances and enamel demineralization. 2. Prevention and treatment of lesions. *AM J ORTHOD DENTOFAC ORTHOP* 1988;94:123-8.
12. Stratmann NW, Shannon IL. Control of decalcification in orthodontic patients by daily self-administered application of a water free 0.4 percent stannous fluoride gel. *AM J ORTHOD* 1974;66:273-9.
13. Ciancio SF, Curat JJ, Mather ML, Harvey DH. A comparison of plaque accumulation in bonded vs. banded teeth. *J Dent Res* 1985;64:359.
14. Featherstone JDB, Glens R, Shariati M, Shields CP. Dependence of in vitro demineralization of apatite and remineralization of dental enamel on fluoride concentration. *J Dent Res* 1990;69:620-5.
15. Wefel JS. Effects of fluoride on caries development and progression using intra-oral models. *J Dent Res* 1990;69:626-33.
16. Tatevossian A. Fluoride in dental plaque and its effects. *J Dent Res* 1990;69:645-52.

Reprint requests to:
Dr. A. M. Geiger
30 East 40th St.
New York, NY 10016