Control of decalcification in orthodontic patients by daily self-administered application of a water-free 0.4 per cent stannous fluoride gel


Any successful program of preventive dentistry for orthodontic patients must be based upon the realization that these patients represent an advanced caries risk. One may argue at length as to the specific causes of decalcification frequently encountered in patients over long periods of banding, and there are differences of opinion as to the progression or regression of these lesions after the bands are removed. The disturbing and unequivocal fact remains, however, that decalcification under and around orthodontic bands is a problem of significance.

Past work in this laboratory has pointed out that, while both stannous fluoride (SnF₂) and acidulated phosphate fluoride (APF) treatments produce relatively high initial solubility reduction on enamel surfaces, a large amount of this protection is removed from the surface with relative ease. Recent clinical research has also pointed out that a very low concentration of SnF₂ (0.1 per cent) is highly effective in reducing dental caries, even in a population of schoolchildren who are already receiving maximal protection from lifelong exposure to appropriately fluoridated water.

The foregoing suggests that frequent applications of low concentrations of stannous fluoride might be effective in reducing decalcification in orthodontic patients by rendering the enamel surfaces less susceptible. This suggestion was confirmed in a short-term study recently conducted in thirty children over a 7-week period.

The present study was designed with a twofold purpose. One was the mea-
asurement of the customary incidence of decalcification in orthodontic patients. The second was an investigation of the effectiveness of the daily use of a 0.4 per cent SnF₂ gel in the reduction of mineral loss from enamel in these patients with banded teeth.

Materials and methods

A total of 209 patients were studied—99 on the test program and 110 controls. Oral hygiene instruction and supervision were the same for all patients and were of a relatively high order, since the patients were seen frequently by their graduate student orthodontists and were treated under the stringent requirements that would be expected in a graduate division of orthodontics.

The control group (N = 110) included fifty-one boys and fifty-nine girls. Eight patients were less than 11 years old, eighty-eight were between 12 and 14, and fourteen were 15 or older. In the ninety-nine test patients, 12 were less than 11 years old, seventy-seven were between 12 and 14, and ten were 15 or above. This group included forty-two boys and fifty-seven girls.

The program for test patients differed from that for the controls in that it included the daily use of a water-free 0.4 per cent SnF₂ gel each day at bedtime. After the evening brushing of the teeth (the third of the day), the patient rinsed his mouth well and flushed his toothbrush thoroughly with water. He then placed about 3/4 of an inch of gel on the bristles and brushed the gel onto all of the tooth surfaces. The patient then attempted by oral movements, to “force the gel into the spaces between the teeth.” He then expectorated but did not rinse. No food or drink was allowed after application of the gel.

In both control and test patients an evaluation of decalcification present was made from chart records, including the report of clinical examinations, roentgenograms, black and white photographs, and color transparencies and prints. Both pretreatment and posttreatment evaluations were carried out. Completion of treatment and full band removal was not accomplished in all patients within the time limitations of this study. In all patients however, teeth were banded for at least 18 and not more than 24 months.

Decalcification was classified as localized or generalized according to the number of surfaces involved. Extent of decalcification was recorded as none; mild, with only a slight change in the enamel color; moderate, with a definite color change and increase in surface area involved; or severe, with frank enamel loss and dentinal involvement. The exact location of the decalcification on the crown was also recorded.

Each patient using the gel was required to maintain a record authenticating the frequency of its use. Every effort was made to assure daily application. At each appointment the patient was questioned as to actual frequency of use, and this was recorded to serve as a criterion for later group consideration.

Results

Of the 110 control patients, 58 per cent presented areas of decalcification at the posttreatment evaluation. Of the ninety-nine test patients, 27 per cent had
decalcified areas either under or around the bands. At the time of this evaluation in the test patients, treatment was completed and bands were removed in thirty-six patients, and sixty-three were evaluated with the bands remaining in the mouth. Typical decalcification is shown in Figs. 1 and 2.

The amount of protection provided the enamel surfaces appeared to be a direct function of the degree of cooperation shown by the patient. Table I points out that, of twenty-nine patients who used the gel once weekly or less, 66 per cent showed decalcification. In the nineteen patients using the gel two to three times weekly, 26 per cent had decalcified areas. The incidence of decalcification decreased to only 2 per cent in the fifty-one patients who employed the gel daily as directed. This 2 per cent figure can be seen as a remarkable decrease when it is compared to the 58 per cent decalcification shown in the control group.
Table I. Incidence of posttreatment decalcification as a function of frequency of gel use (ninety-nine patients)

<table>
<thead>
<tr>
<th>Frequency of gel use</th>
<th>No. of patients</th>
<th>No. of patients (per cent)</th>
<th>Decalcification (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once weekly or less</td>
<td>29</td>
<td>34</td>
<td>66</td>
</tr>
<tr>
<td>Two to three times weekly</td>
<td>19</td>
<td>74</td>
<td>26</td>
</tr>
<tr>
<td>Daily as directed</td>
<td>51</td>
<td>98</td>
<td>2</td>
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</tbody>
</table>

Discussion

While orthodontic treatment is immeasurably beneficial in both the functional and esthetic senses, the fact that there is a concurrent increase in caries risk should be squarely faced. Two factors have received primary incrimination for this increased risk: the acidic nature of orthodontic cement (orthophosphoric acid) and the added oral hygiene problem associated with the presence of appliances in the mouth.

Any program for the prevention of decalcification in orthodontic patients must be directed toward one or more of the following factors: (1) alteration of the oral flora, (2) decrease in frequency and quantity of fermentable carbohydrate intake, and (3) increase in resistance of the tooth surface to demineralization. A great deal of research, past and present, is concerned with the latter factor—decreasing surface solubility.

It has long been known that SnF₂ has a remarkable ability to reduce the incidence of dental caries. Since previously recommended concentrations for topical treatment have been needlessly high (8 to 10 per cent), there have been significant clinical problems associated with its use. Some of these have been the staining of teeth, inability to treat in the presence of inflammation of the soft tissues, blanching of gingival tissues, and a remarkably unpleasant taste. Another serious deficiency was the inability to prepare SnF₂ in gel form.

Thus, there were valid criticisms voiced against the use of SnF₂ as it was previously offered to the clinician. All were a result of either the high SnF₂ concentration employed or the fact that SnF₂ is unstable in aqueous solution.

Several reports from this laboratory have established that very low concentrations of SnF₂ are remarkably effective in reducing the acid solubility of enamel, root surfaces, and cavity preparations. These findings suggested the possibility of home use of low concentrations of SnF₂ in frequently administered patient-applied treatments. Significant problems in establishing such a program were the hydrolytic and oxidative changes taking place when SnF₂ is dissolved in water. This was surmounted by our development of a method for forcing SnF₂ into solution in glycerine. This provides a crystal-clear, water-free solution with indefinite shelf life which serves as the basis for the chemical program of preventive dentistry as practiced throughout the dental services of the Veterans Administration.

It is now well established, from both clinical and laboratory studies, that frequent applications of low concentrations of SnF₂ provide a very high level of protection. Radiké and associates found that use of a 0.1
per cent SnF₂ mouth rinse on school days, in an optimal water fluoride area, induced an additional decrease in caries of about 38 per cent.

Landry and Shannon⁶ studied thirty orthodontic patients who used the 0.4 per cent SnF₂ gel daily at bedtime. Premolars extracted from these patients indicated that using the gel for only 1 week reduced enamel solubility by 12.1 per cent and that self-treatment for 6 to 7 weeks brought this figure to 35.5 per cent. Significantly, this reduction in solubility was induced with no oral hygiene intervention. In a similar study, Chambles²⁹ found that self-treatment with the gel for 3 weeks reduced enamel solubility by about 10 per cent and that the protective layer was highly resistant to removal by successive exposures to acid.

The present clinical study is based upon these experiments of Landry and Shannon⁶ and Chambles²⁹ and the clinical results support their conclusions.

Evaluation of the 110 control patients revealed that at the posttreatment interval sixty-four (58 per cent) of these patients presented areas of decalcification around or under the orthodontic bands. This decalcification was classified mainly (forty-four of sixty-four patients) as localized mild and was characteristically found (sixty of sixty-four patients) in the gingival area.

Results for the patients using the 0.4 per cent SnF₂ gel demonstrate unequivocally that frequency of application is an overwhelmingly important factor. Of the ninety-nine patients placed on the gel initially, twenty-nine used the gel only once a week or less, and the incidence of decalcification was 66 per cent in this group. This figure is comparable to the 58 per cent incidence of decalcification found in our 110 control patients and indicates that this low degree of cooperation and infrequent use (there is no assurance that these patients used the gel at all) negates the value of the gel. Nineteen patients reported that they applied the gel two to three times weekly, and for this group the decalcification incidence was 26 per cent. Of greatest importance was the finding that, in the fifty-one patients who applied the gel daily as directed, the incidence of decalcification was only 2 per cent. This is a highly gratifying reduction in this very troublesome aspect of orthodontic treatment and validates, we believe, the concept that frequent self-applications of low concentrations of stannous fluoride offer a high degree of protection to populations either at advanced caries risk or demonstrating a propensity for caries.

Summary

Self-application of a water-free 0.4 per cent SnF₂ gel, daily at bedtime, was practiced by ninety-nine orthodontic patients over a treatment period of 18 to 24 months. Incidence of decalcification in these patients was compared to that found for 110 control patients who were managed in the same fashion but did not use the gel.

Incidence of decalcification in the control group was 58 per cent, with the bulk of the lesions being classified as localized mild and located in the gingival area. Decalcification was found in only 2 per cent of the fifty-one patients who applied the gel as directed on a daily basis. Those who used the gel less regularly experienced higher degrees of decalcification.
These results suggest that frequent self-applications of low concentrations of SnF₂ provide very high levels of protection. It is also clear that "frequent" in this sense, means daily treatment.

REFERENCES

THE JOURNAL 50 YEARS AGO
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In 1536, on his return to Louvain, Vesalius, with Gemma's assistance, secretly procured a human skeleton. "The treasure, however, was not complete: One finger, a patella, and a foot were missing. To this extent was Vesalius the owner of a human skeleton. In supplying the missing parts he was obliged to incur new dangers. He stole out of the city in the nighttime, climbed gallows unaided, searched through the mass of decaying bodies, and having found the coveted bones, he stole into the city by another gate." (Ball.) In 1542, in describing the mandible, he showed that it did not consist of two pieces, as taught by Galen, and accepted for twelve centuries. Three hundred and eighty-two years have elapsed since then, but the modifications of the mandible are not yet fully understood, nor will they ever be, if we remain anchored in the haven of occlusion. (Lischer, B. E.: New Methods of Diagnosing Dentofacial Deformities, p. 533.)