



Predicting improvement of postorthodontic white spot lesions

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Introduction: Patients undergoing orthodontic treatment are at greater risk for developing white spot lesions (WSLs). Although prevention is always the goal, WSLs continue to be a common sequela. For this reason, understanding the patterns of WSL improvement, if any, has great importance. Previous studies have shown that some lesions exhibit significant improvement, whereas others have limited or no improvement. Our aim was to identify specific patient-related and tooth-related factors that are most predictive of improvement with treatment.

Methods: Patients aged 12 to 20 years with at least 1 WSL that developed during orthodontic treatment were recruited from private dental and orthodontic offices. They had their fixed appliances removed 2 months or less before enrollment. Photographs were taken at enrollment and 8 weeks later. Paired photographs of the maxillary incisors, taken at each time point, were blindly assessed for changes in surface area and appearance at the individual tooth level using visual inspection. **Results:** One hundred one subjects were included in this study. Patient age, brushing frequency, and greater percentage of surface area affected were associated with increased improvement. Central incisors exhibited greater improvements than lateral incisors. Longer time since appliance removal and longer length of orthodontic treatment were associated with decreased levels of improvement. Sex, oral hygiene status, retainer type, location of the lesion (gingival, middle, incisal), staining, and lesion diffuseness were not found to be predictive of improvement. **Conclusions:** Of the various patient-related and tooth-related factors examined, age, time since appliance removal, length of orthodontic treatment, tooth type (central or lateral incisor), WSL surface area, and brushing frequency had significant associations with WSL improvement. (Am J Orthod Dentofacial Orthop 2016;149:625-33)

Orthodontic treatment has long served as a means for providing patients with improved esthetic, functional, and psychological benefits. Unfortunately, white spot lesions (WSLs) are a common and undesirable side effect that can diminish the satisfaction that a patient experiences after orthodontic treatment.

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

Submitted on behalf of the Northwest PRECEDENT network, with support from National Institute of Dental and Craniofacial Research grants DE016750 and DE016752.

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Submitted, April 2015; revised and accepted, October 2015.

0889-5406/\$36.00

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<http://dx.doi.org/10.1016/j.ajodo.2015.10.025>

Some studies have shown that the prevalence of WSLs is as high as 97% among orthodontic populations.¹

WSLs are characterized by their greater opacity than healthy enamel. They have a whiter appearance as a result of mineral loss in the surface layers; this alters the refractory index and increases the scattering of light in the affected area because of damaged surface roughness.² The appearance of the lesion can vary from minor surface change to cavitation.³ In some instances, stains can be incorporated into a lesion and lead to the formation of brown spots during the remineralization process, worsening the esthetic problem.⁴ Prevention and treatment of WSLs are important for the integrity of the teeth, as well as for esthetics, since they often affect the maxillary incisors.

Several options have been proposed to address these lesions, depending on their nature and severity. The recommended treatments range from as simple as improved home care with fluoride toothpaste to more invasive options involving composite restorations. There is still a lack of strong evidence in the literature, however, regarding the most effective treatment protocol and the ideal timing for maximizing improvement.⁵

In addition to the abundance of available treatment options, the unpredictable patterns and degrees of improvement add to the complexity of WSL treatment. There is a wide range of improvement in lesions from one patient to the next. Lesions can vary in size, shape, and location and are as unique as the oral environment of the patients in whom they are found. Results from a previous randomized control trial by Huang et al⁶ found no significant differences in subjective or objective improvement in the appearance of the WSLs among those who received MI Paste Plus, PreviDent fluoride varnish, or normal home care during an 8-week period. Although some WSLs exhibited little or no improvement, some did show considerable improvement. Since the treatment arm did not appear to have a large role in the improvement of WSLs, investigation of other possible factors associated with WSL improvement seemed warranted.

The first aim of this study was to determine whether the following patient factors are predictive of the overall improvement of WSLs: age, sex, time since appliance removal, length of orthodontic treatment, self-reported tooth brushing, oral hygiene, or retainer type. Each patient factor was analyzed with the null hypothesis of no difference in WSL improvement for both subjective and objective measures.

The second aim was to compare the following tooth-related factors with the amount of WSL improvement: proportion of tooth surface area affected, tooth type (central or lateral incisor), staining, location (gingival, middle, incisal), and lesion diffuseness. The null hypothesis was that there would be no difference in WSL improvement associated with the tooth-related factors.

MATERIAL AND METHODS

This study is a further investigation of data from a previous project regarding WSLs. The photographs that formed the sample data were originally collected from a randomized (1:1:1), single-blind, active-controlled, parallel-group trial evaluating the improvement of WSLs in 3 treatment arms.⁶ The treatment arms were MI Paste Plus (GC America, Allisip, Ill), containing casein phosphopeptide-amorphous calcium phosphate and 900 ppm of fluoride; PreviDent fluoride varnish (22,600 ppm of fluoride; Colgate Oral Pharmaceuticals, New York, NY); and a home-care control group with oral hygiene instructions and over-the-counter toothpaste (1100 ppm of fluoride; Colgate Oral Pharmaceuticals). In the original study, photographs of the WSLs were taken at 2 times: the start of the study (T1) and 8 weeks later (T2). Data were collected from private orthodontic and general dentistry offices belonging to

the Practice-based Research Collaborative in Evidence-based Dentistry network in the Northwestern United States (Northwest PRECEDENT). The network was co-operated by the University of Washington and the Oregon Health and Science University, and it comprised Washington, Oregon, Montana, Idaho, and Utah.

Eligibility criteria for this study included the fulfillment of the following conditions: completion of fixed appliance orthodontic therapy within the past 2 months, at least 1 WSL on the facial surface of a maxillary incisor that was not present before starting orthodontic treatment, and age between 12 and 20 years. Subjects excluded from this study were those who were unwilling to be randomly assigned to 1 of the 3 treatment groups; had any abnormal oral, medical, or mental conditions; received therapy for WSLs after orthodontic treatment; displayed frank cavitations associated with the maxillary incisors; or were unable to speak or read English. Patients (and parents, for those under 18 years of age) consented to participate before the study.

Throughout treatment, oral hygiene was reinforced by staff members. Clinicians provided patient information, including age, sex, length of orthodontic treatment, and retainer type. All subjects also completed a questionnaire, which gave us information regarding their average daily brushing frequency.

Two types of evaluations (subjective and objective improvement) were performed for the 4 maxillary incisors, for each pair of photographs (initial and 8 weeks). For subjective improvement, a blinded panel of 5 dental professionals (expert panel) assessed improvement using a visual analog scale from 0 to 100 mm (0 mm, no improvement or worsened, to 100 mm, complete resolution). These evaluations were performed as part of the original study, and the mean ratings of the panel were used for overall improvement of the 4 maxillary incisors.

For objective improvement, 2 examiners (a dental student and a general dentist) performed the assessments for improvement by measuring changes in WSL surface area at each time point. WSL surface area was divided by total tooth surface area to calculate the pretreatment and posttreatment percentages of affected surface areas. The change in percentage of affected surface area was obtained by subtracting the T2 surface area from the T1 surface area. These assessments were also performed as part of the original study for all 4 incisors.

For this current study, we considered improvement of a lesion to be a visible decrease in the affected surface area, minimized contrast between the WSL and surrounding healthy tooth structure, or any combination of changes resulting in an overall improved esthetic appearance. In the previous study, all 4 incisors were

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