

PREVALENCE OF WHITE SPOT LESIONS AMONG PATIENTS IN SANAA, YEMEN DURING ORTHODONTIC TREATMENT

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ABSTRACT

Aims: Establishing the prevalence of white spot lesions (WSLs) in orthodontic patients in Sanaa, Yemen at 7 and 14 months into treatment with the visual examination method. There have not been many studies done on the prevalence of WLSs for any region in Yemen.

Materials and Methods: Patients 7 and 14 months into treatment were examined for the presence of WSLs. The control group consisted of patients who were examined for WSLs immediately after bonding. Upon clinical evaluation, teeth were given a visual score based on the extent of demineralization.

Results: The percentages of individuals having at least one WSL were 47%, 57%, and 10% for the 7-month, 14-month, and control groups, respectively. The 7-month ($P = .028$) and 14-month groups ($P = .007$) were significantly different from the control group but were not significantly different from each other ($P = .50$). Of subjects in the study who had at least one visible WSL, 75% were males and 25% were females ($P = .008$).

Conclusions: During the first 7 months of treatment there was a marked increase in the number of WSLs. This increase continued at a slower rate to 14 months. During the initial months of treatment clinicians are advised to assess the oral hygiene status of patients and, when necessary, to counter demineralization by employing preventive measures.

INTRODUCTION

A significant risk associated with orthodontic treatment when oral hygiene is poor is enamel demineralization. Despite modern advances in caries prevention, demineralization during orthodontic treatment is one of the greatest challenges faced by clinicians. The development of white spot lesions (WSLs) is attributed to prolonged plaque accumulation around the brackets.¹⁻⁷ Not only do fixed orthodontic appliances make conventional oral hygiene procedures more difficult, they also increase the number of plaque retention sites on the surfaces of the teeth that are normally less susceptible to caries development.⁸

After the introduction of orthodontic fixed appliances into the oral cavity, a rapid shift in the bacterial flora of plaque occurs. Higher levels of acidogenic bacteria are present in the plaque, most notably *Streptococcus mutans* and *Lactobacilli*.⁹⁻¹⁰ High levels of bacteria are capable of decreasing the pH of plaque in orthodontic patients

to a greater extent than in non-orthodontic patients.¹¹ Therefore, the progression of caries is faster in patients with full orthodontic appliances. WSLs can become noticeable around the brackets within 1 month of bracket placement, although the formation of regular caries usually takes at least 6 months.¹² These lesions are commonly seen on the buccal surfaces of teeth around the brackets, especially in the gingival region.^{1,3,14}

A review of available literature on the prevalence of WSLs revealed that most relevant studies reported the presence of these lesions at the completion of orthodontic treatment. Depending on the examination technique used, the prevalence of WSLs varies. Ogaard,¹ in his study using the visual examination technique, reported that 50% of patients had one or more WSLs at the end of treatment. Boersma et al.,¹³ using quantitative light fluoroscopy, investigated the prevalence of WSLs at the end of orthodontic treatment and reported that 97% of subjects had one or more lesions. In light of these studies, one may conclude that demineralization is a significant clinical problem resulting in an unacceptable esthetic presentation that, in some severe cases, may require restorative treatment.

Even though it was reported previously that WSLs can develop within 1 month, the formation of these lesions and their prevalence at different points of time during orthodontic treatment have not been investigated. Early detection of WSLs during orthodontic treatment is of great importance, as it would allow clinicians to implement preventive measures to control the demineralization process before lesions progress. Therefore, the objective of this study was to determine the prevalence of white spot lesions using the visual examination method in orthodontic patients before orthodontic treatment and at 7 and 14 months into treatment. There have not been many studies done on the prevalence of WSLs for any region in Yemen and another aim of this study is to remedy that situation.

MATERIALS AND METHODS

Subjects 13 years and older with complete initial records who agreed to participate in the study were recruited among patients who were being treated with fixed orthodontic appliances at the United dental and Orthodontic Clinic in Sanaa, Yemen. Patients on a daily supplemental fluoride regimen were excluded from the study.

Measurements were performed on all patients enrolled in the study by the same clinician who was blind as to the patient's time frame for orthodontic therapy. The clinician evaluated subjects only after wires and auxiliary attachments had been removed by an orthodontic assistant, thus minimizing the availability of information that would otherwise indicate the duration of previous treatment. Following these measurements, the name of the group to which the patient belonged was added to the examination form by the research assistant.

The patient's date of birth, race, and gender, along with visual examination findings, were recorded on a clinical form with the treatment group section left blank. Before measurements were taken, maxillary teeth from the right second premolar to the left second premolar were isolated with cotton rolls and air-dried for 5 seconds. Only tooth surfaces gingival to the archwire were examined for the presence of WSLs, as this is the area most prone to enamel

demineralization during orthodontic treatment. The following scale was used for the visual examination:

- **Score 0** = No visible white spots or surface disruption (no demineralization)
- Score 1** = Visible white spot without surface disruption (mild demineralization)
- Score 2** = Visible white spot lesion having a roughened surface but not requiring a restoration (moderate demineralization)
- Score 3** = Visible white spot lesion requiring restoration (severe demineralization)

Statistical Analysis

The three groups (7-month, 14-month, and control) were evaluated for differences in the prevalence of having at least one white spot lesion by chi square analysis and were followed by Fisher's exact test. To evaluate the multiple effects of group (time in therapy) and gender, and to determine interactions between groups and gender, logistic regression was used. Differences in the mean number of white spots between groups were analyzed using analysis of variance. The prevalence of white spots by tooth type was evaluated with logistic regression. The significance level was set at $P < .05$.

RESULTS

The study consisted of three groups of patients who were examined for the presence of enamel demineralization. The 7-month group consisted of 30 subjects (12 females, 18 males) with a mean age of 16.3 ± 1.4 years who were 7 months (± 2 weeks) into orthodontic treatment. The 14-month group consisted of 28 patients (15 females, 13 males) with a mean age of 16.4 ± 1.3 years who were 14 months (± 3 weeks) into orthodontic treatment. The control group consisted of 21 patients (9 females, 12 males) with a mean age of 14.2 ± 1.5 years who were examined for WSLs immediately after braces were placed on their teeth. The frequency of individuals having a WSL upon visual examination is presented in Table 1. In the 7- and 14-month groups, the percentages of individuals having at least one visible WSL were 47% and 57%, respectively. In the control group, only 10% of the sample had at least one WSL. The 7-month ($P = .028$) and 14-month groups ($P = .007$) were significantly different from the control group but were not significantly different from each other ($P = .50$).

Table 1. Frequency of Individuals With WSLs^a

Group	No WSL, n (%)	WSL Present, n (%)
14 month	12 (43)	16 (57)
7 month	16 (53)	14 (47)
Control	19 (90)	2 (10)

^a The control group had a lower prevalence of individuals with white spot lesions than the 7-month group ($P = .028$, Fisher's exact test) and the 14-month group ($P = .007$, Fisher's exact test). The 7-month and 14-month groups were not significantly different from each other.

Table 2 presents the distribution of the white spots in greater details. In the 7-month group, 20 patients had no detectable WSLs (67%), 6 patients had between 1 and 3 WSLs with visual scores of 1 and 2 (20%), and 4 patients had greater than or equal to 4 WSLs with visual scores of 1 and 2 (13%). In some cases, all six of the maxillary anterior teeth presented with WSLs. The 14-month group was similar with 15 patients unaffected (54%), 9 patients with 1-3 white spot lesions with visual scores of 1 (32%), and 4 patients with greater than or equal to four lesions per individual with visual scores of 2 and 3 (14%). In both groups, a great amount of individual variability was noted among patients, with some displaying no demineralization and others having WSLs almost on each tooth. However, 90% of the control group did not have any WSLs on the day of their bonding, and all of the remaining 10% had between one and three WSLs per patient.

Table 2. Distribution of WSLs per Individual^a

Group	Mean WSLs/Patient (\pm SD)	No WSLs, n (%)	1 to 3 WSLs, n (%)	≥ 4 WSLs, n (%)
14 month	1.13 \pm 0.22	15 (54)	9(32)	4(14)
7 month	0.92 \pm 0.22	20 (67)	6(20)	4(13)
Control	0.14 \pm 0.24	25 (89)	3(11)	0 (0)

^a Following are the results of analysis of variance with number of white spots per patient as the outcome variable: Group ($P = .01$), and gender ($P = .0004$), were statistically significant; however, the interaction between the two was not significant. Tukey's honestly significant difference (HSD) showed that the 14-month and 7-month groups were not significantly different from each other but were significantly different from the control group ($P \leq .05$).

When the gender effect on WSL development was evaluated, a statistically significant difference ($P = .008$) was noted in the prevalence of WSLs between males and females (Table 3). In the 7-month group, 11 of 18 males (61%) had at least one WSL, as opposed to only 2 of 12 females (17%) within this group. In the 14-month group, 10 of 13 males (77%) developed at least one WSL. In the same group, the

number of females who had at least one lesion was only 4 of 15 (27%). Overall, 75% of subjects in the study who had at least one visible white spot were males and 25% were females.

Table 3. Gender Effect on White Spot Lesion Formation^a

Group	Number (%) of Males With WSL	Number (%) of Females With WSL
14 month	10 (77)	4(27)
7 month	11 (61)	2(17)
Control	2 (17)	1(11)

^a Following are the results of logistic regression analysis of the prevalence of individuals with white spot lesions: Group ($P = .01$), and gender ($P = .008$), were statistically significant; however the interaction between the two was not significant. No statistically significant differences were noted in the distribution of WSLs among different types of teeth (maxillary central incisors, Maxillary lateral incisors, and maxillary canines), indicating that all types of teeth were equally subjected to demineralization.

DISCUSSION

As the results of the present study show, WSLs are a significant problem during orthodontic treatment. In the absence of good oral hygiene, fixed appliances serve as plaque retention sites and when plaque accumulates bacteria cause noticeable demineralization. In this study, 47% of subjects had visual WSL 6 months after treatment, and this number increased to 57% 6 months later. Only 10% of the control group presented with at least one white spot lesion. Gorelick et al.³ reported a prevalence of about 50% in their study, which examined the presence of WSLs at the end of orthodontic treatment. A higher prevalence in our study may be attributed to the poor oral hygiene habits of residents of Sana'a area.

When the clinician is identifying WSLs the clinical crown must be free from plaque and debris. Furthermore, to detect incipient WSLs, the tooth must be air-dried. Thus, a careful examination of each patient should be done at each appointment, and each patient should receive a customized oral hygiene treatment regimen to halt the progression of any demineralization.

In the literature, conflicting reports have described the distribution of WSLs. Gorelick et al.³ reported that the tooth most commonly affected was the maxillary lateral incisor. On the other hand, Mizrahi⁷ concluded that the maxillary and mandibular first molars were the teeth most commonly affected. In a later study, Ogaard¹ agreed with Mizrahi's conclusions. The present study, however, found no significant differences among teeth in the distribution of WSLs at 7 months, at 14 months, or on the day of bonding (control).

According to Ogaard et al.,¹ WSL lesions can become noticeable around the brackets within 1 month of bonding. Therefore, it is important for the clinician to recognize inadequate oral hygiene early, so that preventive measures can be implemented before the development of WSLs occurs.

In this study, the 7- and 14-month groups had an average of 1.03 and 1.11 white spots per individual, respectively, but these averages may be deceiving, as many patients had a much larger problem with demineralization. For instance, of subjects in the 6- month group with WSLs, 43% had four or more lesions in the maxillary anterior segment. However, not all subjects had such a severe problem, and individual results reflected a great amount of variability.

The overwhelming difference between the prevalence of white spot lesions in males and females is an interesting finding of this study. Of subjects who had at least one white spot lesion, 75% were male. These findings differ from Gorelick's findings³ where the incidence was 44% for boys and 54% for girls. However, a more recent study by Boersma¹³ found that 40% of the buccal surfaces in males had demineralization compared with 22% in females. A possible explanation for these results is that female orthodontic patients are generally more compliant than males.

CONCLUSIONS

Most of the patients had a minimum of one white spot lesion in mild form. Moderate or severe demineralization was evident in a few patients. The prevalence of white spot lesions was 47% in the 7-month group, whereas it was 57% in the 14-month

group. This high number of lesions indicates the importance of evaluating the oral hygiene status of patients during the initial months of orthodontic treatment. To prevent demineralization it might be necessary to employ preventive measures.

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