

FREQUENCY OF WHITE SPOT LESIONS AFTER FIXED APPLIANCE THERAPY IN A TERTIARY CARE HOSPITAL OF PESHAWAR

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ABSTRACT

Background: Enamel demineralization is one of the key issues faced by clinicians during orthodontic therapy. White spot lesions (WSLs) appear on the surface of enamel when proper oral hygiene instructions are not followed during the treatment process.

Objective: To determine the association of white spot lesion frequency with orthodontic treatment time.

Design: Descriptive, Cross-sectional study

Place and Duration of Study: Department of Orthodontics, Peshawar Dental College, Peshawar. 12 months (February 1st 2022 to January 31st 2023).

Materials and Methods: Eighty orthodontic patients were picked according to inclusion criteria. They were divided in 3 groups based on treatment time, <2, 2-3 and >3 years. All subjects were examined immediately after removal of the appliances, both visually and photographically, to minimize the risk of false positive and negative results. On the basis of the extent of demineralization, patients were scored into 4 groups according to the number of WSLs.

Results: Patients who developed at least one WSL were 42%, 44% and 70% in the groups <2 years, 2-3 years & >3 years, respectively. The group <2 years and 2-3 years had no significant difference but group >3 year was statistically significant.

Conclusion: The study concluded that not following proper oral hygiene during orthodontic therapy will lead to the development of WSLs on enamel. The clinicians should ensure proper oral hygienic conditions during the early days of treatment to avoid complications. If required, extra measures must be taken into consideration in order to avoid demineralization.

Key words: Dental Caries, White Spot Lesions, Oral Hygiene, Orthodontic Appliances, Fixed, Orthodontic Brackets.

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INTRODUCTION

White spot lesions (WSLs) are milky white opacities that arise from subsurface enamel porosity due to carious demineralization¹. Secondary appearance of WSLs after orthodontic treatment is among the major issues faced by clinicians². Poor oral hygienic condition during orthodontic treatment leads to demineralization of enamel and consequently accumulation of plaque on the brackets^{3,4}. Fix appliances are believed to make it difficult for the orthodontic patients to keep up the standard oral hygiene. Additionally, they cause more plaque to remain on teeth, typically less susceptible to developing caries⁵.

Rapid shifts occur in the normal flora of the plaque when fixed orthodontic appliances are applied to the patient⁶. Plaque is occupied by bacteria that produce high level of volatile fatty acids and ferment sugar which lowers the pH in orthodontic patient as compared to non-orthodontic patient. Bacteria that occupy the plaque are usually Lactobacilli and Streptococcus mutans⁷. Presence of acidogenic bacteria results in the fast progression of caries in fixed orthodontic appliances. Caries development usually takes six months, but in the case of orthodontic treatment, it takes about 1 month for the appearance of WSLs^{8,9}. WSLs are usually observed over buccal surfaces of teeth, around brackets, frequently in gingiva¹⁰.

During early days, carious lesions appear clinically as white opaque spots on the enamel surface. These spots are slightly softer in nature as compared to the surrounding enamel¹¹. Demineralization of enamel occurs in two stages, surface softening and subsurface lesions. During surface softening, the interprismatic substances are removed, including minerals on the surface of enamel. Bacterial fermentation also plays an important role by lowering the pH that ultimately results in minerals loss¹². In the second stage, subsurface lesion, minerals dissolution mainly occurs in the deeper regions of enamel. A

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porous layer covering the low mineral lesion are the WSLs that are considered to be the precursors of enamel caries¹³.

The development of WSLs is more prevalent in orthodontic treated individuals as compared to normal subjects. A study conducted by Julien et al reported 23.4% of the subjects having at least one WLSs after the treatment¹⁴. Another study reported the development of WSLs in 50% of the patients after orthodontic treatment¹⁵. The prevalence of WSLs varies depending on the technique used in examination. Anterior maxillary teeth are more prone to WSLs as compared to mandibular teeth. Most of the studies did not report the gender-wise prevalence study on WSLs^{16,17}. The incidence of WSLs can vary depending on the material being used for bonding i.e. either composite or Resin Modified Glass Ionomer Cement (RMGIC)¹⁸. Use of fluoride toothpaste, gel, mouthwash, varnishes, bonding agent RMGICs, probiotic, polyols, antiseptics, sealants, casein supplements, laser, dental whitening, micro-abrasion, and resin penetration, among other methods, can be used for prophylaxis and management¹⁹. Fluoridated toothpaste and Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) paste have been seen to be effective after three follow-ups in reducing white spot lesions, while fluoridated toothpaste was observed to be more effective during the trial²⁰.

Association of WSLs and fixed orthodontics treatment has been studied in Pakistan. A study reported that WSLs were present in 75% of the 60 patients, affecting 19% of the teeth overall. Upper lateral incisors were the most often impacted teeth (78.3%), while WSLs of the chalky white variety were more prevalent (76.2%). The most often impacted area was the middle part of the upper anterior teeth's crown²¹.

Studies have reported the prevalence of WSLs during orthodontic treatment, but after treatment prevalence is not reported from Pakistan. This study was carried out with the objective to determine the association of WSLs frequency with time of orthodontic treatment^{22,23,24}.

MATERIAL AND METHODS

The Institutional Review Board (IRB), Prime Foundation, Pakistan (Prime/IRB/2022-415), granted the ethical approval for this study. An informed written consent was taken by the participants. This descriptive, cross-sectional study was done at Peshawar Dental College where 80 orthodontic patients were selected according to inclusion criteria from February 1st 2022 to January 31st 2023. The formula $n=2(Z_{\alpha}+Z_{1-\beta})^2\sigma^2/\Delta^2$ was used to calculate the sample size¹⁹. Post-treatment records of the patients who met the inclusion criteria were sorted out.

Both, male and female patients, previously treated in orthodontic department and having a complete previous treatment record, were included in the study.

Patients who were currently under-treatment, those with missing previous medical record and who are on daily supplemental regimen of fluoride were excluded from the study. Those who refused to take part were also excluded.

Schedule was searched for the patients meeting the inclusion criteria at the commencement of every weekend. Patients who had previously undergone orthodontic treatment in the orthodontic department, Peshawar medical college, were asked if they were willing to participate or not. A written, informed consent was taken from all subjects. Participants underwent measurements, using a standard edgewise light wire technique, by the same clinician who was involved with the patient during the entire orthodontic therapy. Patients were evaluated after removal of auxiliary and wire attachments. All the examinations were recorded on the patient examination form. According to the orthodontic treatment duration, the patients were divided in 3 groups (<2, 2-3 and >3 years).

To obtain the physical and numerical record of the teeth under examination, photography of the teeth was performed using Canon EOS 850D (Rebel T8i) camera. Dental photography enables the clinician to share the data with other experts for better diagnosis. Photography was performed using ring flashlight and camera with macro lens and lens replacement.

Before the measurements, maxillary teeth were isolated from 2nd right premolar to the 2nd left premolar, using the rolls of cotton and were air-dried for 5 seconds. Surfaces of the teeth, close to arch wires of orthodontic treatment, were examined for WSLs because these areas are more exposed to demineralization. Scoring system that was proposed by Mizrahi and Gorelick et al was used during clinical examination^{3,17}. Scoring was done using a dental lamp with direct illumination. The proposed scoring criteria were specifically used for Premolars, anterior teeth vestibular surfaces, and the first molars in mandible and maxilla.

Score 0 = No visible surface disruption or WSLs (no demineralization)

Score 1 = WSLs that cover < 1/3rd of the surface or WSLs without surface disruption (mild demineralization)

Score 2 = WSLs >1/3rd of the tooth surface or with surface disruption (moderate demineralization)

Score 3 = WSLs with cavitation or requiring restoration (severe demineralization)²⁰.

CAPSULE SUMMARY

Prevalence of the white spot lesions (WSLs) after fixed appliances treatment was determined. Patients were grouped according to treatment time. The percentage of the patients who developed at least one WSL varied between 42% to 70% in different groups. Poor oral hygiene during orthodontic therapy led to the development of WSLs on enamel. Good hygienic conditions should be ensured through the initial days of therapy to avoid complications.

Data were analyzed by SPSS (Version 20.0, SPSS Inc. Chicago). Descriptive statistics were used to calculate mean, standard deviation (SD), and percentages. Frequencies and mean \pm SD of WSLs among the groups were compared by using chi-square test, Fischer's exact test & Anova test respectively. Any p-value that was ≤ 0.05 , held significance.

RESULTS

There were three subject groups analyzed for enamel demineralization in the study. The <2 years group comprised 26 subjects (15 male and 11 female), it contained the individuals who had undergone for less than two years of orthodontic treatment. The second group was the 2-3 years group that contained 34 individuals (19 male and 15 females), which included the individuals who were treated in orthodontic department for 2-3 years duration. The third group were the >3 years group of 20 subjects (10 male and 10 female), who were treated for more than three years in orthodontic department.

Table 1 shows the frequency of WSLs in the three groups of individuals. The WSLs recorded in group <2 years were 42% while 58% were the individuals with no WSLs. In group 2-3 years, WSLs was recorded in 44% and 56% had no WSLs. Age group >3 years had WSLs in 70%, which was higher as compared to the other two groups. Regarding frequency of WSLs, no significant difference was seen between group <2 years and 2-3 years (p-value > 0.05) but group >3 year had statistically significant difference (p-value 0.03).

Second group is the 2-3 years group that contains 34 individuals (19 male and 15 females), it includes the individuals treated in orthodontic department for 2-3 years duration. The third group are the >3 years group of 20 subjects (10 male and 10 female), that were treated for more than three years in orthodontic department.

Table 1 shows the frequency of WSLs in the three groups of individuals. The WSLs recorded in group <2 years were 42% in which 58% were the individuals with no WSLs. In group 2-3 years, the frequency of WSLs was recorded to be 44% and with no WSLs it was 56%. Age group >3 years had 70% WSLs which is higher as compared to the remaining two groups. The group <2 years and 2-3 years had no significant difference but group >3 year had statistical significance (p-value 0.03).

Table 1: Shows frequency of the patients with white spot lesions^a

Groups	Total patients	No WSLs n (%)	With WSLs n (%)
<2 years	26	15 (58%)	11 (42%)
2-3 years	34	19 (56%)	15 (44%)
>3 years	20	06 (30%)	14 (70%)

^a the <2 years group and group 2-3 years show low prevalence of WSLs. These groups have no significant difference. >3-year group have the highest prevalence of WSLs (p =0.03).

Table 2 delves into the distribution of WSLs on enamel. In group <2 years, the mean number of WSLs recorded was 1.15 ± 0.21 . 1-3 WSLs were recorded in 10 patients which is 38% of the total group patients and 1 patient (4%) had more than 4 WSLs. In the group 2-3 years, the mean number of WSLs was recorded as 0.89 ± 0.29 in which 19 patients (56%) were found with no WSLs on tooth enamel. Eight patients (24%) were observed having 1-3 WSLs on the tooth enamel and 7 patients (20%) with more than 4 WSLs. Group >3 years was exceptional in comparison with the other two groups where mean number of WSLs was observed as 1.38 ± 0.18 . Six subjects were found with no WSLs and 9 (45%) were found to have 1-3 WSLs. Five (25%) were observed with more than 4 WSLs on tooth enamel.

Table 2: The distribution of WSLs in each patient group^b

Group	Mean of WSLs(\pm SD)	No WSLs n (%)	1-3 WSLs n (%)	>4 WSLs n (%)
<2 years	1.15 ± 0.21	15 (58%)	10 (38%)	1 (4%)
2-3 years	0.89 ± 0.29	19 (56%)	8 (24%)	7 (20%)
>3 years	1.38 ± 0.18	06 (30%)	9 (45%)	5 (25%)

^b The results of analysis show that >3years group has a high number of WSLs with mean value of 1.38 ± 0.18 (p =0.02) which is statistically significant. The <2 years and 2-3 years groups did not show statistically significant difference from each other but <2 years and 2-3 years groups were statistically significant from >3 years group (p= 0.03).

Gender wise distribution of WSLs was checked in each study group (Table 3). In comparison to female patients, it was seen that male patients had a larger distribution of WSLs. In group <2 years, 7 (64%) male patients out of 11 were found with WSLs in contrast with females (36%). Group 2-3 years were found to be approximately similar to WSLs in both genders with a slight difference. In third group, the difference among WSLs distribution was higher as compared to other two groups, in which males were 4 (67%) and females 2 (33%). Fischer's exact test revealed significant difference among groups (p-value 0.03).

Table 3: Gender wise distribution of WSLs among three study groups

Group	Male patients with WSLs n (%)	Female patients with WSLs n (%)
<2 years	7 (64%)	4 (36%)
2-3 years	8 (53%)	7 (47%)
>3 years	4 (67%)	2 (33%)

DISCUSSION

The current study indicates that WSLs are the problem of considerable interest which is faced by the clinician during

orthodontic therapy. Fixed appliances, used in orthodontic treatment, serve as a source for the retention of plaque when the patient does not meet oral hygienic requirements during the treatment. Not maintaining good oral hygiene leads to accumulation of bacteria that are acidogenic in nature and cause demineralization of enamel. Our study results showed that 42% of individuals developed WSLs, in the group <2 years, after the fixed appliances therapy. Tufekci et al reported 38% of WSLs development in their study within six-month treatment group²¹. That study was conducted during the orthodontic treatment. High prevalence of WSLs in <2 years group is because of their assessment after the orthodontic therapy as compared to the said study as most of the WSLs develop at the end of orthodontic therapy.

Another study, conducted by Gorelick et al indicated the prevalence of WSLs during orthodontic treatment was 50%³. They examined the WSLs after orthodontic therapy. Including both mandibular and maxillary teeth, as well as the duration of orthodontic therapy (24 months), may explain the increased prevalence. Inclusion of more teeth groups for examining WSLs can be a turning point for reporting high prevalence as compared to less inclusion.

Examining WSLs during active orthodontic therapy is more challenging for clinicians as compared to after or without treatment. During orthodontic therapy, the crown used by clinicians must be clear of any debris and plaque. Excessive gingival tissues on the tooth or arch wire can be a cause of difficulty in detection of WSLs on enamel surface. Detection of WSLs on enamel surface requires prior air-drying. Following these steps will allow the clinician to easily identify the WSLs. On each visit, patients should be thoroughly examined, and hygienic regimen should be given to overcome the process of enamel demineralization.

CONCLUSION

WSLs development was seen in 42, 44 and 70 percent in the groups <2, 2-3 and >3 years respectively. With the highest number in >3 years therapy, it is concluded that maintaining and guiding patient for good oral hygiene are key factors in overcoming this complication during orthodontic treatment. Oral hygiene is also necessary during the initial treatment time to prevent enamel demineralization.

AUTHORS' CONTRIBUTION

Gulalai Jan	Drafting the Article
Zafar ul Islam	Analysis and interpretation of data
Kawish Syed	Conception and design
Hasan Ali Raza	Acquisition of data
Shahab Adil	Critical revision

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