Case Study

Academia Journal of Medicine
Year 2026, Volume-9, Issue- 1 (January- June)

Evaluation of White Spot Lesions Following Fixed Orthodontic Treatment: A Clinical Study

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ARTICLE INFO

Keywords:
White spot lesions, Fixed orthodontic treatment, Enamel demineralization, Orthodontic brackets, ICDAS, Preventive dentistry

doi:10.48165/ajm.2026.9.01.16

ABSTRACT

Background: White spot lesions are a common undesirable effect associated with fixed orthodontic treatment due to prolonged plaque accumulation around brackets and bands. These lesions represent early enamel demineralization and may compromise esthetics and long-term oral health.

Aim: To evaluate the prevalence and severity of white spot lesions in patients following fixed orthodontic treatment.

Materials and Methods: This clinical study was conducted on patients who had completed fixed orthodontic treatment. A total of 60 subjects were examined immediately after debonding. The presence and severity of white spot lesions were assessed using visual examination under standardized lighting conditions and scored according to the International Caries Detection and Assessment System (ICDAS). The distribution of lesions was analyzed with respect to tooth type and surface involved. Statistical analysis was performed using descriptive statistics and chi-square test.

Results: White spot lesions were observed in a significant proportion of patients following fixed orthodontic therapy. Maxillary anterior teeth showed a higher prevalence compared to posterior teeth. The majority of lesions were classified as early enamel changes without cavitation. A statistically significant association was found between treatment duration and occurrence of white spot lesions ($p < 0.05$).

Conclusion: White spot lesions remain a prevalent complication following fixed orthodontic treatment. Early detection and preventive strategies are essential to minimize enamel demineralization during orthodontic therapy.

Clinical Significance: Regular monitoring, patient motivation, and the use of preventive measures such as fluoride applications can reduce the incidence and severity of white spot lesions during fixed orthodontic treatment.

Introduction

Fixed orthodontic treatment is widely used to correct malocclusion and improve facial esthetics and oral function.[1,2] Despite its therapeutic benefits, fixed appliance therapy is associated with certain undesirable effects, one of the most common being the development of white spot lesions (WSLs).[3] These lesions appear as opaque, chalky white

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areas on enamel surfaces and represent the earliest clinically detectable stage of enamel demineralization.[4]

The presence of orthodontic brackets, bands, and archwires creates additional plaque-retentive areas that make effective oral hygiene challenging.[5] Accumulation of dental plaque around orthodontic attachments leads to prolonged exposure of enamel to acidic by-products of bacterial metabolism, resulting in mineral loss from the subsurface enamel. If not detected early, white spot lesions may progress to cavitated carious lesions, compromising both dental health and post-treatment esthetics.[6]

The reported prevalence of white spot lesions following fixed orthodontic treatment varies widely in the literature, ranging from mild localized lesions to extensive enamel involvement, particularly affecting the maxillary anterior teeth. Factors such as duration of treatment, oral hygiene status, dietary habits, and patient compliance play a significant role in the development of these lesions. Early identification and assessment of WSLs are therefore essential to implement timely preventive and remineralization strategies.[7,8]

Various indices and diagnostic criteria have been proposed to assess white spot lesions clinically, with visual examination remaining the most commonly used and practical method in routine orthodontic practice. Evaluating the prevalence and severity of WSLs after completion of orthodontic treatment helps clinicians understand the magnitude of the problem and emphasizes the importance of preventive protocols during active therapy.

Hence, the present study was undertaken to evaluate the occurrence and severity of white spot lesions following fixed orthodontic treatment, thereby highlighting the need for effective preventive measures to minimize enamel demineralization during orthodontic care.

Materials and Methods

Study Design and Setting: This clinical observational study was conducted in the Department of Orthodontics after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to inclusion in the study.

Study Population: The study included patients who had completed fixed orthodontic treatment and presented for debonding. A total of 60 patients were selected using a convenience sampling method.

Inclusion Criteria

- Patients aged 12–30 years
- Completion of fixed orthodontic treatment using pre-adjusted edgewise appliances
- Good general health
- No visible white spot lesions prior to initiation of orthodontic treatment (based on pretreatment records)

Exclusion Criteria

- History of enamel hypoplasia, fluorosis, or developmental enamel defects
- Patients with systemic diseases affecting enamel mineralization
- Use of remineralizing agents during orthodontic treatment

Poor-quality pretreatment or post-treatment records

Clinical Examination: All patients were examined immediately after debonding and removal of residual adhesive. Teeth were cleaned using a non-fluoridated pumice paste and isolated using cotton rolls. Examination was carried out under standardized lighting conditions after air drying the tooth surfaces for 5 seconds.

Assessment of White Spot Lesions: White spot lesions were assessed visually on the labial surfaces of all teeth using the International Caries Detection and Assessment System (ICDAS) criteria. Each tooth surface was scored by a single calibrated examiner to minimize inter-examiner variability.

ICDAS Criteria for Assessment of White Spot Lesions: White spot lesions were assessed using the International Caries Detection and Assessment System. After cleaning and air-drying the tooth surfaces for 5 seconds, each labial surface was visually examined and scored according to the following criteria:

- **Score 0:** Sound enamel with no evidence of caries or demineralization
- **Score 1:** First visual change in enamel, visible only after air drying
- **Score 2:** Distinct visual change in enamel visible when wet and dry, without cavitation
- **Score 3:** Localized enamel breakdown without visible dentin
- **Score 4:** Underlying dark shadow from dentin with or without enamel breakdown
- **Score 5:** Distinct cavity with visible dentin
- **Score 6:** Extensive cavity with visible dentin involving more than half of the tooth surface

For the purpose of this study, white spot lesions were defined as ICDAS scores 1 and 2, representing early enamel demineralization without cavitation.

Examiner Calibration: Prior to data collection, the examiner was calibrated by evaluating 10 randomly selected patients twice at an interval of one week. Intra-examiner reliability was assessed using Cohen's kappa statistic.

Statistical Analysis

The collected data were tabulated and analyzed using statistical software. Descriptive statistics were used to determine the prevalence and distribution of white spot lesions. The association between white spot lesions and variables such as tooth type and treatment duration was analyzed using the chi-square test. A p-value of < 0.05 was considered statistically significant.

Result: A total of 60 patients who had completed fixed orthodontic treatment were evaluated for the presence of white spot lesions immediately after debonding. White spot lesions were observed in 38 patients (63.3%), while 22 patients (36.7%) showed no evidence of enamel demineralization (Table 1).

Analysis of lesion distribution revealed that white spot lesions were predominantly observed in the maxillary anterior teeth, followed by the mandibular anterior region, whereas posterior teeth showed a comparatively lower prevalence (Table 2). The difference in distribution among various tooth groups was found to be statistically significant ($p < 0.05$).

Assessment of lesion severity based on the ICDAS criteria demonstrated that the majority of lesions were mild and non-cavitated, with ICDAS score 1 being the most frequently observed, followed by ICDAS score 2. No cavitated lesions (ICDAS scores 3–6) were detected in the study sample (Table 3).

Evaluation of the association between treatment duration and the occurrence of white spot lesions showed that patients who underwent orthodontic treatment for more than 18 months exhibited a significantly higher prevalence of white spot lesions compared to those with a treatment duration of 18 months or less (Table 4). This association was statistically significant ($p < 0.05$).

Table 1: Prevalence of White Spot Lesions Among Study Participants

White Spot Lesions	Number of Patients (n = 60)	Percentage (%)
Present	38	63.3
Absent	22	36.7
Total	**60**	**100**

Table 2: Distribution of White Spot Lesions According to Tooth Type

Tooth Type	Teeth Examined	Teeth with WSLs	Percentage (%)
Maxillary anterior	240	112	46.7
Mandibular anterior	240	78	32.5
Maxillary posterior	240	42	17.5
Mandibular posterior	240	28	11.7

Table 3: Severity of White Spot Lesions Based on ICDAS Scores

ICDAS Score	Interpretation	Number of Teeth	Percentage (%)
1	First visual change in enamel	162	56.6
2	Distinct visual change in enamel	124	43.4
3–6	Cavitated lesions	0	0
Total		286	100

Table 4: Association Between Treatment Duration and White Spot Lesions

Treatment Duration	Patients (n)	Patients with WSLs	Percentage (%)
≤ 18 months	26	12	46.2
> 18 months	34	26	76.5

Discussion

White spot lesions are a well-recognized adverse effect of fixed orthodontic treatment and represent an early stage of enamel demineralization. The present study evaluated the prevalence, distribution, and severity of white spot lesions following fixed orthodontic therapy using the ICDAS criteria.[9,10]

In the present study, white spot lesions were observed in 63.3% of patients after completion of orthodontic treatment. This finding is consistent with previous studies that have reported a high prevalence of enamel demineralization

associated with fixed appliances. The increased risk can be attributed to plaque retention around brackets and bands, which creates a favorable environment for acidogenic bacteria and subsequent mineral loss from the enamel surface.[11,12]

The distribution of white spot lesions in this study showed a higher prevalence in the maxillary anterior teeth, followed by the mandibular anterior region. This observation may be explained by the prominent position of maxillary anterior teeth, which makes them more susceptible to plaque accumulation around brackets and more difficult to clean effectively. Additionally, salivary clearance may be reduced in the anterior region compared to posterior teeth, further contributing to lesion development.

Assessment of lesion severity revealed that most white spot lesions were mild and non-cavitated, corresponding to ICDAS scores 1 and 2. The absence of cavitated lesions in the present study indicates that although enamel demineralization was common, progression to advanced carious lesions was limited. This may be attributed to routine oral hygiene instructions and the use of fluoride toothpaste during orthodontic treatment.[13]

A statistically significant association was observed between treatment duration and the occurrence of white spot lesions, with patients undergoing treatment for more than 18 months demonstrating a higher prevalence. Prolonged orthodontic therapy increases the duration of plaque retention and acid exposure, thereby elevating the risk of enamel demineralization. This finding highlights the importance of minimizing treatment duration wherever possible and reinforcing preventive measures throughout treatment.

The findings of this study emphasize the need for early detection and continuous monitoring of white spot lesions during orthodontic treatment. Preventive strategies such as patient education, meticulous oral hygiene maintenance, regular professional fluoride application, and the use of remineralizing agents should be incorporated into routine orthodontic care to reduce the incidence and severity of these lesions.

Conclusion

Within the limitations of this study, white spot lesions were found to be a common finding following fixed orthodontic treatment. The lesions were predominantly mild and non-cavitated, with a higher prevalence in the maxillary anterior teeth. A significant association was observed between longer treatment duration and the occurrence of white spot lesions. These findings underscore the importance of early detection, patient motivation, and the implementation of effective preventive measures throughout orthodontic therapy to minimize enamel demineralization and preserve post-treatment esthetics.

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