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Original Article

Incidence of white spot lesions and DMFT among patients treated with comprehensive orthodontics

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Abstract

Aim: The development of new caries lesions in patients undergoing orthodontic treatment is an undesirable side effect of treatment that arises because the fixed appliance tends to accumulate plaque. The aim of this study was to examine the white spot lesions (WSL), caries incidence, and decayed, missing, and filled teeth (DMFT) indices in patients with fixed orthodontic treatments.
Methodology: The records of 150 patients treated at Necmettin Erbakan University Department of Orthodontics between 2018 and 2022 who met the study selection criteria were examined. Traditional methods and 2D color photographs were used to detect cavities. Pretreatment (T0) and post-treatment (T1) recordings were made.
Results: Overall, 118 patients (78.6%) developed at least 1 new WSL during treatment and 49 patients (32.6%) developed active caries lesions. Increases in WSL, caries incidence, and the DMFT index were important during the treatment process. The length of treatment and the number of oral hygiene warnings were significantly associated with the development of new lesions.
Conclusion: Individuals undergoing fixed orthodontic treatment have a significant incidence of WSLs and caries lesions. Patients and physicians should pay strict attention to this problem to effectively prevent caries occurrence during treatment.

Keywords: Incidence, prevalence, white spot lesion, DMFT, caries lesion

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Introduction

Patients undergoing orthodontic treatment cannot adequately clean around their fixed appliances (1). Orthodontic appliances, in turn, increase the population of facultative bacteria, including Streptococcus mutans, and cause deterioration of the demineralization-remineralization balance (2). The severity of the resulting dental caries can range from the development of opaque white spot lesions (WSL) to active caries that lead to loss of surface integrity in the enamel and dentin (3-5)

Decalcifications or WSL pose a particular risk in orthodontic treatment, as these lesions form faster than normal during orthodontic treatment due to long-term plaque accumulation and persistence (6-9, 10-12). A recent study reported that patients undergoing orthodontic treatment experienced a very high development of at least 1 new WSL or increased severity of an existing carious lesion (13). Another WSL study showed that 49.6% of orthodontic patients

developed enamel decalcification in at least 1 tooth after orthodontic treatment (7). Adverse esthetic results of orthodontic treatment also appear, as initially healthy teeth are damaged by patient neglect and subsequently need restoration. Therefore, caries detection is important in patients who have completed orthodontic treatment.

The traditional methods for detecting caries are visual examination, mirror probe examination, and radiographic examination (14-17). For the visual examination, the teeth are dried and visually examined under a light (14). Color photographs can also be used as an alternative in the clinic, as this method is a powerful tool for recording enamel opacities (18). Evaluation of enamel surfaces from color photographs is also advantageous because it can be replicated by direct visual inspection with the naked eye to help diagnose caries (19). Radiographic examination frequently includes panoramic and bitewing radiographs. The purpose of bitewing radiographs is to detect proximal carious lesions that cannot be detected by visual examination (20).

The aim of the present study was to examine the WSLs, caries incidence, and decayed, missing, and filled teeth (DMFT) indices in patients undergoing fixed orthodontic treatments.

Materials and Methods

Ethical approval for this study was obtained from Necmettin Erbakan University, Faculty of Dentistry Ethics Committee, in accordance with the World Medical Association Declaration of Helsinki, with the approval number (2022/16-117). The records of the patients who were treated in the orthodontics department of Necmettin Erbakan University Faculty of Dentistry between 2018 and 2022 were examined, and 150 patient records were randomly selected.

The inclusion criteria in the study were:

(1) patients who received comprehensive orthodontic treatment,

(2) patients with complete pre-treatment and post-treatment records (photographs and x-rays),

(3) patients with complete treatment information.

Exclusion criteria were:

(1) patients who removed the appliance early, before orthodontic treatment was completed; and

(2) patients with a treatment duration of more than 30 months due to various cooperation disorders, as those patients could have an increased risk of caries.

In the data collection process from patient charts, several treatment variables, such as gender, age, whether extraction was performed, and duration of the comprehensive treatment, were recorded at the beginning of orthodontic treatment. In the standard record-keeping procedures for orthodontics, intraoral pre-treatment (T0) and post-treatment (T1) photographs were obtained for each patient. All photos were taken in our clinic using our standard procedure. These photographs included anterior, right, left, and occlusal views. The images were scanned for each patient and transferred to a separate PowerPoint presentation for each patient. The presentation consisted of slides with a solid black background. The images of the patients were evaluated together on a single slide before and after the treatment.

The images were appraised by the researcher using a specially adapted scoring system. The surfaces of all teeth were included in the examination; only the second molars were excluded from the calculation because they could not be seen easily in the photographs. Pre-treatment and post-treatment panoramic films and bitewing films were taken from the patient and used to evaluate the interface caries. In this study, the caries detection criteria were based on traditional methods and color photographs.

Statistical analysis

All analyses and graphs were prepared using SPSS 21 (IBM SPSS Inc., Armonk, NY, USA). The incidence was defined as the formation of new lesions. The incidence of new lesion development was determined by comparing the pre-treatment and post-treatment results. Dependent and independent variables were compared. New lesions were compared with independent variables, and independent samples were analyzed using a t-test and analysis of variance (ANOVA). Values of $p < 0.05$ were considered statistically significant.

Results

The development of WSL in the first and last recordings is shown in Figure I. The overall incidence of patients who developed at least 1 WSL during orthodontic treatment was 78.6%, while the incidence of active caries lesions was 32.6%. Of the patients who developed active caries lesions during treatment, 22 had 1 new active lesion (14.6%), and 27 (18%) had 2 or more active caries lesions.

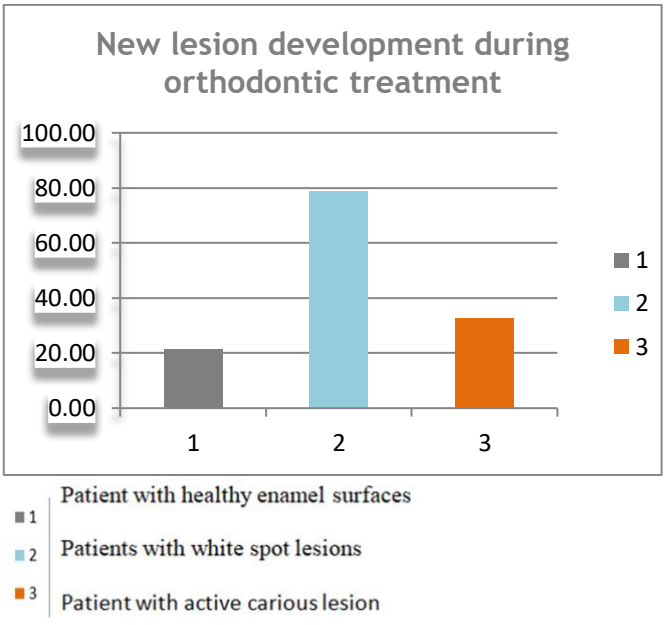

Figure 1. New lesion development in the first and last recording

Overall, 50 patients (30%) had at least 1 new filling restoration in the last recording. Of those 50 patients, 18 (10.8%) had 1 new restoration and 32 (19.2%) had 2 or more new restorations.

Four (2.6%) patients had their teeth extracted during orthodontic treatment. A significant increase in the DMFT index was observed ($p < 0.001$). Table 1 presents the various changes (means and standard deviations) in tooth status for each patient. Table 2 presents the relationship between lesions observed during treatment and the independent variables. Age and gender had no significant relationship with new lesions.

There was a significant relationship between increased treatment duration and the number of newly developed decalcified lesions ($p = 0.03$). Age and gender were found to have no relationship with newly developed lesions.

A relationship was found between treatment duration and the number of newly developed lesions ($p = 0.03$). Patients whose treatment duration was less than 18 months had a new lesion development per capita of 3.02. However, this incidence increased to 5.32 for patients whose treatment duration was more than 24 months. There was no relationship between newly developing lesions and whether or not tooth extraction was performed during the treatment ($p = 0.25$). Lesion development had a significant relationship with oral hygiene instructions provided to patients during treatment ($p < 0.01$*). The mean number of newly decalcified lesions was 3.12 in patients without oral hygiene instructions in their charts, but it increased to 6.92 in patients who received three or more oral hygiene instructions. There was no significant correlation between the number of new lesions and the topical fluoride treatments ($p = 0.1$).

Table 1. Changes in the patients' teeth

Changes per patient	Tooth enamel surfaces		
	Mean	SD	Significance
WSL	6.9	4.1	p<0.001
Caries lesions	4.14	3.16	p<0.001
Restorations	4.05	3.04	p<0.001
Extracted teeth	0.18	0.1	NS
DMFT	5.6	4.02	p<0.001

SD:standard deviation, *p value significant at <0.05, DMFT: decayed, missing, and filled teeth

Table 2. Bivariate analysis of development of new lesions.

Independent Variable	n	Mean	SD	p-value
Sex				
-Female	98	3.82	4.68	0.10
-Male	52	4.72	5.51	
Age group				
12-15	58	5.15	5.58	0.07
15-18	62	4.14	4.86	
>18	30	2.82	4.51	
Treatment Length				
<18	56	3.02	4.45	0.03*
18-24	59	3.94	4.72	
24-36	35	5.32	5.78	
Extraction vs nonextraction				0.25
-Extraction	15	0.80	1.04	
-Non extraction	135	4.52	5.10	
Hygiene discussions (n)				
0	75	3.12	4.10	>0.00*
1-2	58	4.82	5.52	
>3	17	6.92	6.08	
Topikal florid				
-no	132	3.96	4.86	0.1
-yes	18	5.42	6.08	

*p value significant at <0.05; Mean number of lesions in labial surfaces per patient.

Discussion

Enamel demineralization is an undesirable side effect that occurs during orthodontic treatment, particularly in patients with poor oral hygiene. Further demineralization causes white spot lesions (WSLs) with caries onset (21). This study aims to evaluate the effects of WSLs on the DMFT index of patients who undergo fixed orthodontic treatment. The DMFT and DMFS indices are widely used to determine the oral health status of individuals. The WHO recommends using these indices to measure and compare dental caries in the general population (22).

The use of intraoral photographs is another acceptable method for detecting caries in orthodontic patients. Photographs serve as a permanent record and are useful for evaluating tooth surfaces (18). Some researchers have argued that photographs are reliable for evaluating changes in teeth. However, others do not find them reliable because photography conditions (lighting, angulation, and magnification) change (23). Chapman et al. found no difference between a digital camera and a visual inspection. In their studies, they eventually detected a few lesions that were overlooked during photographic examination and stated that they were insignificant (7, 9, 12, 23-25). In this study, photographic recordings were made for this purpose, and all photographs were taken using standard photography rules. We used the method. Important photographic variables were eliminated by maintaining angling, magnification, and lighting conditions. Pretreatment and posttreatment lesions were examined by juxtaposing the first and last photographs of each patient. Anatomical anomalies, hypoplasia, and caries were excluded from the pre-existing teeth. This consequently improved the reliability of this study. The strengths of this study include the examination protocol and the high reproducibility of the evaluation results. Intraoral color photographs have been used to detect caries in a few studies on lesion development in orthodontic patients (7, 8, 13). The findings of these studies revealed a significant variation in WSL incidence. These variations may be due to the different methods used to assess and score decalcification (26, 27). In this study, the Gorelick index and bite-wing radiographs were used to minimize methodological differences in WSL detection. Gorelick et al. claimed that although their study had the advantage of including a control group, it was cross-sectional in design (7). Our study was designed to determine the true incidence of lesions by comparing 150 patients over time. In the study, the incidence of caries lesions was evaluated using photographs, and it was discovered that 95.3% of the patients had at least one lesion (13). A possible limitation of our study is the group size, considering the number of people included in previous studies using photographs (7, 9, 13, 23-25). However, the number of patients examined in this study provided sufficient statistical power to identify substantial differences between groups. According to a previous study, WSL formation was found to be 50% in the group with orthodontic treatment and 24% in the group without treatment. In a study conducted in our country without the establishment of a control group, the WSL incidence was reported to be 21% before treatment and 65% after treatment (7). Our study revealed a high rate of WSLs, which is consistent with other studies.

Considering the effect of age on skills, it is accepted that it will affect maintaining adequate oral hygiene. As age increases, individuals provide better oral hygiene, and it has been reported that this affects caries formation in orthodontic patients (28, 29). Age and lesion development were not found to be important factors in our study. This is because the age range was not too wide, and the patients were instructed on oral hygiene in the control sessions. In a study, they reported a significant difference between gender and the development of new lesions (30). Although girls have better oral hygiene, the risk of caries formation is thought to increase in some periods due to hormonal factors (31). In our study, no significant relationship was found between the newly developed lesion and gender. A significant correlation was found between the number of newly developed lesions and the length of the treatment period. As the duration of treatment increases, the development of new lesions increases. This is because the teeth are more exposed to cariogenic factors against the plaque that accumulates around the fixed appliances. A patient's motivation for good oral hygiene affects the lesions that occur. There is a strong correlation between the development of new lesions and the number of instructions physicians offer to patients about good oral hygiene. Previous studies have reported that fluoride supplementation in orthodontic treatment reduces and prevents new lesion development (32, 33). Our study did not find any association between the examined fluoride sources and new lesion development. This is due to a lack of fluoride information and reliable information. The lack of fluoride information may be a limitation of this study. Considering the paucity of studies on this topic in our country, we believe that there is a need for large-scale and long-term follow-up studies that account for the general caries risk and the etiological factors of WSL formation in patients undergoing fixed orthodontic treatment.

Conclusions

The development of WSL is a common problem in patients undergoing orthodontic treatment. It has been observed that patients undergoing fixed orthodontic treatment have a significant incidence of WSL and caries lesions. Orthodontists should consider newly developed lesions while providing orthodontic treatment. Additionally, orthodontists should decide on treatment continuation based on the demineralization and caries observed in their patients.

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Ethical Approval: Ethics committee approval was received for this study from Necmettin Erbakan University, Faculty of Dentistry Scientific Research Ethics Committee, in accordance with the World Medical Association Declaration of Helsinki, with the approval number: 2022/16-117).

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