

Effect of multibracket orthodontic appliance on frequency and severity of enamel demineralization - A prospective study

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ABSTRACT

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Objective: To evaluate the effect of comprehensive orthodontic treatment on frequency and severity of white spot lesions (WSLs).

Methods: Total 92 (M=43, F=49) subjects in the age range of 12-35 years seeking comprehensive orthodontic treatment were screened for the study. Among 92 subjects, 46 subjects (M=18, F=28) who fulfilled the selection criteria were included in the study. In 46 subjects, a total of 1026 teeth were examined for the evaluation of WSLs. The frequency and severity of WSLs were recorded on a standard proforma at the beginning (T₀) and after completion of orthodontic treatment (T₁) by direct visual assessment and by DIAGNOdent. The pre-treatment (T₀) and post-treatment (T₁) visual and DIAGNOdent scores were compared by using Wilcoxon Signed Rank test. The P-value of 0.05 was considered as the level of significance.

Results: The frequency of WSLs among subjects seeking comprehensive orthodontic treatment was increased significantly from the pre-treatment value of 65.2% to post-treatment value of 95.7% (P < 0.001). Of 1026 teeth examined, 107 (10.4%) teeth had white spot lesions at the beginning of orthodontic treatment and 272 (26.5%) teeth had white spot lesions at the end of orthodontic treatment (P<0.001). The mean DIAGNOdent score was comparable between the pre and post-treatment evaluation (P=0.282).

Conclusion: Treatment of malocclusion by comprehensive orthodontic treatment had a significant effect on the development and severity of white spot lesions.

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INTRODUCTION

Development of white spot lesions (WSLs) around the orthodontic brackets is a common problem, jeopardizing the health and esthetics of the teeth. The frequency of WSLs in patients treated with fixed orthodontic appliances is reported to be up to 50% and these can be seen as early as 4-weeks after bracket placement.¹ The overall prevalence of WSLs among orthodontic patients varies from 0-97%.² There are many prophylactic measures have been introduced to prevent the enamel demineralization during multibracket appliance treatment. One of the commonly used measures for the prevention of WSLs during fixed orthodontic treatment is the use of topical fluorides.³ However, there are differences in the frequency of WSLs development among patients to patients and from one region to another. Therefore, keeping in view, the high prevalence and incidence of white spot enamel lesions in various populations; it is necessary to estimate the effect of comprehensive orthodontic treatment in the development of such problem, so that various preventive measures can be considered. Thus, the present study was designed to assess the effect of multibracket appliance on enamel demineralization among individuals undergoing comprehensive orthodontic treatment.

MATERIALS AND METHODS

The study was approved by the Institute Review Board (IRB No. 16/4Trg/MDS/11/16223). Total 92 (M=43, F=49) subjects in the age range of 12-25 years were initially screened for the study. Those subjects with full complement of teeth except those extracted for orthodontic treatment and 3rd molars were included for the study. Subjects having cleft lip and palate deformity or any syndrome, multiple restorations on labial surfaces and presence of enamel hypoplasia due to fluorosis were excluded from the study. Among 92 subjects, 46 subjects (M=18, F=28) fulfilled the inclusion and exclusion criteria were included in the study. After selecting a subject for the study a written understood consent was obtained and the study was performed in accordance with the Declaration of Helsinki. The frequency and severity of WSLs were recorded on a standard proforma at the beginning (T₀) and after completion of comprehensive orthodontic treatment (T₁) by direct visual assessment and by DIAGNOdent (KAVO Dental Corporation, Lake, Zurich, III).

All brackets were bonded with a Transbond XT light-cured bonding agent (3M Unitek, Monrovia, Calif). For bonding of brackets, teeth were cleaned with pumice, rinsed and dried thoroughly. The area where the bracket was to be placed was etched with a 37% orthophosphoric acid gel (3M ESPE) for 15 seconds and then was rinsed with water. After rinsing, the enamel surface was dried with compressed moisture and oil free air. A layer of Transbond XT primer was applied to the tooth and bracket mesh. Transbond XT adhesive paste

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was applied to the base of the bracket and was pressed firmly onto the tooth surface. Excess adhesive was removed, and the adhesive was light-cured with the Adec LED curing unit for 20 seconds. All subjects were explained to maintain good oral hygiene during fixed orthodontic treatment and at each visit they were motivated to maintain this. All subjects were advised to brush at least 3-minutes after each meal with a fluoride-containing tooth paste (Colgate Total). No other topical fluoride application was used during the study period. During the fixed appliance orthodontic treatment, the archwire was ligated to the brackets by stainless steel ligature wire. In 46 subjects, a total of 1026 teeth (from 1st molar on right side to the 1st molar on left side in maxillary and mandibular arch) were examined for the evaluation of WSLs. For the recording of WSLs, the tooth surface was polished by non-fluoridated pumice powder and were rinsed and dried thoroughly. In direct visual assessment, the scoring systems proposed by Gorelick et al.¹ was followed. Various scores and criteria as suggested by Gorelick et al. are described in table-1. The DIAGNOdent was used to quantify the severity of white spot lesions according to the fluorescence. While recording with the DIAGNOdent, the conical tip of the DIAGNOdent was moved over the enamel surface from the gingival margin of the bracket base to the gingival margin of the tooth. The DIAGNOdent was calibrated for each patient on a sound enamel site (incisal one third of the maxillary central incisor), as recommended by the manufacturer). All the teeth were examined carefully with the tip of the DIAGNOdent held in contact with the tooth surface and tilted around the measuring site so that fluorescence would be collected from all direction. A maximum recording for the evaluation was recorded. Each tooth was examined twice and the mean was considered as final reading.

Table-1: The scores and criteria for recording the white spot lesions.

Score	Criteria
1	No white spots or decalcification
2	Slight white spot formation or decalcification in one area
3	Severe white spot formation or many areas of decalcification
4	Excessive white spot formation and cavitations.

STATISTICS

The statistical analysis was carried out using statistical package for social sciences (SPSS Inc., Chicago, IL, version 17.0 for Windows). Descriptive statistics was used. The pre-treatment and post-treatment visual and DIAGNOdent scores were compared by using Wilcoxon Signed Rank test. The P-value of 0.05 was considered as the level of significance.

RESULTS

The mean age of the subjects at the beginning and end of the study was 17.36 ±5.70 years and 19.41 ± 5.76 years respectively. A total of 1026 teeth were examined in 46 subjects. Among 46 subjects, 30 (65.2%) subjects had one or more white spot lesions at the beginning of orthodontic treatment and 44 (95.7%) subjects had one or more white spot lesions at the end of comprehensive orthodontic treatment (P < 0.001). The number of teeth affected with white spot lesions before and after the comprehensive orthodontic treatment is described in table-2. Of 1026 teeth examined at the beginning of orthodontic treatment, 919 (89.6%) teeth had not any white spot lesions and only 107 (10.4%) teeth had one or more white spot lesions. At the end of orthodontic treatment, 754 (73.5%) teeth had no white spot lesions and 272 (26.5%) teeth had one or more white spot lesions. The number of teeth having one or more white spot lesions at the end of comprehensive orthodontic treatment was significantly more compared to the beginning of orthodontic treatment. (P<0.001) The distribution of teeth with varying severity of white spot lesions according to Gorelick’s visual score before and after the orthodontic treatment is described in table-3. The mean DIAGNOdent score was changed from the pre-treatment value of 3.46±3.34 to the post-treatment value of 3.63±3.62, and the difference was comparable (P=0.282).

Table-2: Distribution of teeth with white spot lesions before and after orthodontic treatment.

Presence or Absence of White Spot Lesions	Before orthodontic treatment	After orthodontic treatment	Significance (P-Value)
	Number of Teeth n (%)	Number of Teeth n (%)	
ABSENT	919 (89.6 %)	754 (73.5 %)	0.000***
PRESENT	107 (10.4 %)	272 (26.5 %)	
Total	1026 (100 %)	1026 (100 %)	

*** = P<0.001

Table-3: Distribution of visual scores before and after the comprehensive orthodontic treatment.

Visual Scores	Before orthodontic treatment	After orthodontic treatment	Significance (P-value)
	Number of Teeth n (%)	Number of Teeth n (%)	
1	919 (89.6%)	754 (73.5 %)	0.000***
2	88 (8.6 %)	222 (21.6 %)	
3	5 (0.5 %)	24 (2.3 %)	
4	14 (1.4 %)	26 (2.5 %)	
Total	1026 (100 %)	1026 (100 %)	

*** = P<0.001

Table-4: DIAGNOdent score among the subjects prior-to and after the comprehensive orthodontic treatment.

DIAGNOdent Score	Number of Teeth	Mean ± SD	Significance P-value
Before orthodontic treatment	1026	3.46 ± 3.34	0.282 ^{NS}
After orthodontic treatment	1026	3.63 ± 3.62	

NS = Non-significant

DISCUSSION

White spot lesions are one of the most common adverse effects of orthodontic treatment and can have lasting negative effects on dental esthetics.⁴ The overall prevalence among orthodontic patients varies from 2% to 96%^{1,5-8} depending on the methods used to assess the decalcification. On visual examination we found significant increase in the frequency of WSLs following comprehensive orthodontic treatment. This could be due to the accumulation of plaque around the orthodontic attachments which resulted decalcification of enamel. However, on DIAGNOdent evaluation, there was no increase in the severity of WSLs following comprehensive orthodontic treatment. The DIAGNOdent readings should be interpreted with caution because DIAGNOdent readings may be affected by stains, calculus and plaque⁹ and are based on bacterial metabolites¹⁰, which are not directly related to the problems perceived by patients or doctors.

Therefore, combined use of technology-based methods and visual assessment is the best

approach for the evaluation of enamel demineralization, which was used in this study. We found the frequency of WSLs following comprehensive orthodontic treatment as 95.7%, which was similar with the results of previous studies. Although the frequency of WSLs was very high (95.7%) at the end of comprehensive orthodontic treatment but it was only 15.9% higher compared to the frequency at the beginning of treatment. This was because 65.2% of the patients had already one or more WSLs at the beginning of comprehensive orthodontic treatment. Similar to our observation, Mizrahi⁵ reported that the frequency of WSLs among patients seeking comprehensive orthodontic treatment as 72.3 % at the beginning and 84% following completion of orthodontic treatment. Julien et al.² also found the development of WSLs only 23.4% of the patients during their course of treatment. However, in contrast to our observation, Sagarika et al.¹¹ found 75.6% frequency of WSLs after orthodontic treatment compared to 15.6% in control group who had registered for orthodontic treatment. Of 1026 teeth examined, 919 (89.6%) teeth had no WSL, 88 (8.6%) teeth had one WSL, 5 (0.5%) teeth had two or more WSLs without cavitation

and 14 (1.4%) teeth had two or more WSLs with cavitation at the beginning of orthodontic treatment. However, at the end of comprehensive orthodontic treatment, 754 (73.5%) teeth had no WSL, 222 (21.6 %) teeth had one WSL, 24 (2.3%) teeth had two or more WSLs without cavitation and 26 (2.5%) teeth had two or more WSLs with cavitation. Thus, during the comprehensive orthodontic treatment new WSLs were developed only in 165 teeth. Similar to our observation¹² examined 469 teeth for decalcification after orthodontic treatment and found that 371 (79%) teeth had no WSL, 61 (13%) had one WSL, 33 (7%) had more than one WSLs without cavitation and 4 (1%) had more than one WSLs with cavitation. When there are WSLs at the beginning of orthodontic treatment these lesions usually become more severe during the comprehensive orthodontic treatment. The presence of brackets, bands and arch wires impair oral hygiene measures and increase plaque retention sites.¹³ Thus, it is more difficult to maintain adequate oral hygiene and this may explain the much stronger relationship between caries incidence in orthodontic patients than in non-orthodontic individuals.¹⁴ As a result of increased plaque accumulation, the level of caries-inducing bacteria in the oral cavity is elevated. The consequently lower pH of the retained plaque on the enamel surfaces adjacent to orthodontic brackets hinders the remineralization process, thus resulting in decalcification. Such initial enamel decalcifications can be seen as early as 4-weeks in the absence of any fluoride supplementation after the initiation of multibracket appliance treatment.¹⁵ Thus, the prevention of WSLs should be one of the objectives during the comprehensive orthodontic treatment. Various measures to prevent plaque accumulation and plaque bacteria metabolic activity; and formation of fluoroapatite crystals and stimulation of remineralization should be emphasized.

CONCLUSIONS

The following conclusions were drawn from the present study.

1. The frequency of white spot lesions was increased significantly from 65.2% at the beginning of orthodontic treatment to 95.7% at the end of orthodontic treatment.
2. Comprehensive orthodontic treatment increases the severity of existing white spot lesions.

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