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Evaluation of Depths of White Spot Lesion under Polarized Light Microscope with and Without Local Fluoride Supplements - Invitro Study

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Abstract

Introduction: White spot lesions are the incipient enamel demineralization seen in the form of white spots lesions around orthodontic brackets, due to prolong accumulation of plaque.

Aim and objectives : The main purpose of the study was to evaluate the maximum depth of enamel demineralization during fixed orthodontic treatment at given time period using polarized light microscopy and measured with J software (java-based digital software), and compare the amount of demineralization after local supplementations of fluoridated tooth paste and mouth rinses.

Material and method: Sum of 96 extracted premolars was taken from 24 orthodontic patients. Patients were categories into three groups, group I with fluoride supplements time of extraction is 3months, group II with fluoride supplements time of extraction 6 months, and group III non fluoride supplements, sub divided into two, and group 1 extraction done at 3 months and group 2 extractions done at 6 months.

Data collection: sum of 96 extracted premolars were subjected to microtome for slicing with 200 micron thicknesses and then depth were measured under polarized microscopy with J software.

Statistical analysis: Obtained data was analyzed with appropriate statistical analysis, and mean SD Range was obtained. Student t test was applied to compare the lesion depth with and without fluoride application.

Results: Mean incipient depth was 36.4 microns, range was33.8-38.7 microns and SD 1.8 microns were obtained at 3months in Group III sub group 1, no values were obtained (mean, range, SD) in fluoride supplemented group. White spot lesions mean depth was 59.10 micron,

range was 54.8-66.7, and SD was 3.1 were obtained at 6 month in Group II and Group III sub group 2.

Conclusion: Local supplements aids in preventing the prevalence of incipient and white spot lesions during fixed orthodontic treatment.

Keyword: incipient, white spots, fluoride, polarized microscopy, demineralization.

Introduction

The term white spot lesion has been coined as the incipient dematerialized lesion seen on enamel around orthodontic bracket in the form of white spots Fejerskov 2000; these are the first sign of caries lesion that can be seen through naked eye. Enamel decalcification is unavoidable threat associated with orthodontic treatment, due to prolonged plaque accumulation around the brackets Geiger AM, Gorelick L, 1988 [1-5].

The most challenging task for the clinicians is to Anticipation of demineralization and to prevent the development of white spot lesions (WSLs) during orthodontic treatment. This is because various etiologies play vital role, the most common etiology of white spot lesion is altered pH of oral cavity and plaque accumulation O'Reilly M 1987 [2-5].

Various studies have been reported that fixed orthodontic treatment associated with common negative sequel of enamel demineralization in poor oral hygiene. However, they are seen as small lines along the periphery of bracket, and in a few patients as large decalcifications without caries lesion. Furthermore, the prevalence rate varies from 2% to 96% in fixed orthodontic patients [4-6].

Pertaining to detection of WSL orthodontic photographic method is said to be the best in comparison with general dentistry, several approaches were previously described for detection of WSL, including fiber-optic transillumination, ultraviolet-light application, fluorescent-dye uptake, and laser fluorescence Mizrahi E. 1982, Øgaard B 1988, Boersma J G 1988 [1-7].

Studies based on incidences of WSLs were based on the assessment methods and indices, however, Boersma et al used quantitative light-induced fluorescence. Hence, ours the almost first study to report the depth of demineralization with the help of polarized microscopy. Studying depth of demineralization illustrate rate of demineralization in given period of time[3-8].

Furthermore, studies have been reported that the presence of plaque calcium, phosphate ions, and fluoride ions in saliva can promote re-mineralization and prevent WSL. However, few recent studies have been shown that local supplementation of fluoride in the form of varnish, toopaste, and fluoride releasing bonding materials have minimal or no positive effect on enamel demineralization Zachrisson B 1971O'Reilly M 1987, Mitchell L 1992, Pasini S 2006 [1-9].

This the first study to evaluate the depth of demineralization of enamel under polarized microscopy and compares with local fluoride supplements during orthodontic treatment at given time period.

Material and methods

Sample selection

The cross-sectional study sample was selected from patients who were willing to take orthodontic treatment. There were the sum of 36 patients were willing for fixed orthodontic treatment. However, only 24 patients (boys=06, girls=18) were selected, who were undergoing orthodontic treatment with first/ second premolars extractions.

Inclusive criteria: no history of previous orthodontic treatment or surgery, absence of congenital anomalies, Caucasian origin, medium socioeconomic status, and from the same geographical area (Mediterranean).

Exclusion criteria: Patients with any systemic disease, cysts, clefts, or any congenital malformations, generalized dental problems, or ongoing medication for a chronic disease, or who wore a removable. Each patient's parent or guardian signed an informed consent form before treatment.

Study design

The patients were divided into three groups and were examined for the presence of WSLs under polarized microscopy for depth of demineralization.

Group I (supplied with fluoride tooth paste and mouth rinse)

Sum of 6 patients (4 girls and 2boys) with an average age of 15 ± 1.3, who had been undergoing orthodontic treatment with premolar extraction after for 3months (± 3 weeks).

Group II (supplied with fluoride tooth paste and mouth rinse)

Sum of 6 patients (5 girls and 1 boy) with an average age of 15 ± 1.4, who had been undergoing extraction of premolar after 6 months.

Group III control group sub divided into two, Group 1 and Group 2.

Group 1 (no supplementation of fluoride tooth paste and mouth rinse)

Sum of 6 patients (4 girls and 2boys) with an average age of 15 ± 1.3, who had been undergoing orthodontic treatment with premolar extraction after for 3months (± 3 weeks).

Group2 (no supplementation of fluoride tooth paste and mouth rinse)

Sum of 6 patients (5 girls and 1 boy) with an average age of 15 ± 1.4, who had to undergo extraction of premolar after 6 months

Method

Patients in all the groups were bonded with a 0.022-inch slot preadjusted appliance (MBT Prescription; dentos) and they wore a functional fixed appliance. Metal brackets were bonded using a light-cured composite resin and adhesive (ormco enlight) in accordance with the manufacturer's instructions.

Patients within group I and II were supplied fluoride supplementations (fluoride mouth rinse and tooth paste). Group III patients were not supplied any of fluoride supplementations.

Patients of group I and II were instructed to apply fluoridated paste on bracket bonded teeth and left for 10 minutes, after ten minutes with the same paste instructed to brush with regular brushing for 3 month and 6 month. Than recalled to extraction.

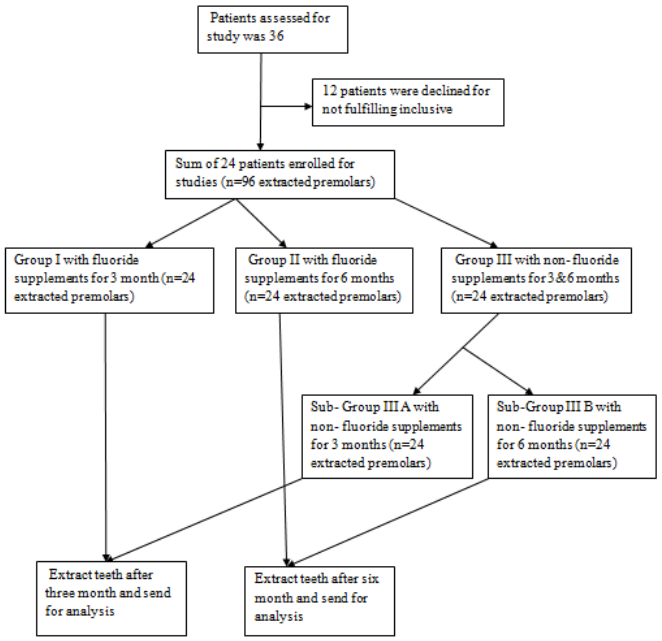

Figure 1: Research flow chart

Sample preparation

Group I and group III 1 patients, first/ second premolars were extracted after 3 months of bonding and Group II and group III 2 patients, first/ second premolars were extracted after 6 months of bonding.

Sum of 96 premolars were extracted from 24 patients and cleaned with toothbrush under deionized water and sectioned using hard tissue microtome (Leica SP 1600) into 200 μm thicknesses. Each section obtained was analyzed for depth of the lesion under polarized light microscope (Olympus BX51 Japan).

Data collections

The depth of incipient demineralization at 3months and white spots lesion at 6 months were measured from the surface of the tooth to the maximum depth using the Image J software (Java-based image processing program).

The data were statistically analyzed using descriptive analysis and range, mean, SD were obtained. Student t test was applied to compare the entire group. Furthermore, regression co-efficient was set to <0.05.

Error correction

The obtained measurements of depths, were re-evaluated after 15 days with same machine and obtained result were calculated test–retest reliability test, obtained value was interpreted as per cronbach's score table. Obtained values of our study were $0.8 > \alpha \geq 0.7$

Statistical analysis

The three groups (3months, 6 months, and control) were evaluated for differences demineralization depth and fluoride penetration depth under polarized microscope. Logistic regression and t-test was used to evaluate the multiple effects of group (time in therapy) on the prevalence of WSLs and penetration of locally applied fluoride. The prevalence of WSLs and local applied fluoride depth was the significance level set at $P < 0.05$.

Results

Sum of 96 slides of extracted premolars were assessed to evaluate the depth of demineralization under polarized microscopy and lesion was measured using the Image J software (Java-based image processing program). To minimize errors the reproducibility measurement technique was performed with repeatability tested on the entire slide with single examiner with time interval of 15days for 3 times and mean values were obtained. The interclass correlation coefficient equals was 0.87, showing that the random error of repeated measurements was low.

No significant difference was seen, in group I, with extraction of first or second premolar teeth immediately after 3months of bracket bonding. (Fig1)(table1). However, incipient demineralization was seen in control group (fig2). The range of demineralization was 33.8 - 38.7, mean depth of demineralization was 36.4, and standard deviation was 1.8(table1).

No Significant difference was seen, in group II, with extraction of first or second premolar teeth after 6 months of bracket bonding. However, significant demineralization was seen in control group (fig2).

The range of demineralization was 54.8-66.7, mean depth of fluoride penetration was 59.1, and standard deviation was 3.10 (table2). The t value was 68.01, shows highly significant difference between control group and study groups (Table 3).

Discussion

As the study conducted was invitro, obtained values were considered and compared with control and study group; as various factors involved in the basic mechanism of demineralization involves the diffusion of calcium and phosphate ions from enamel into saliva.

In Our study we found that significant amount of decalcification at 6 months after orthodontic bonding in group III. Twelve of 24 patients (50%) had a visible WSL, which indicated that WSLs are undoubtedly a major clinical problem in relation to treatment with fixed orthodontic appliances. Furthermore, this percentage increased to more than 50 % among patients, as the treatment proceeds for 12-18 months.

Øgaard 1988, done the study to evaluate appearance of WSLs with orthodontic photographic method, study was concluded reporting that WSLs can become visible around the orthodontic appliance within 1 month of bonding. However, our results disagree with these investigations that showed a higher prevalence of WSLs[9-12].

In Our study we found that incipient decalcification at 3 months after orthodontic bonding in group III, may be due to use of advances technological and new composite materials that are now available for bonding, and their fluoride release properties , might have contributed to the lower prevalence of WSLs in our study.

Gorelick 1982, carried out study to evaluate WSLs with using quantitative light fluoroscopy, the study was concluded reporting that incidences of WSLs were approximately 50% at the end of orthodontic treatment (at 14 months). Furthermore, in support with previous study Boersma 2005 carried out study to evaluate the prevalence rate of WSLs with treatment duration (~24 months). His study reported that 97% of patients had one or more lesions at the end of orthodontic treatment [9-13].

In contrast, no significant sign of WSL was found in group I, II. The negligible incidences were seen at 3 months of bonding in group I, however, these were statistically insignificant. The incidences of WSLs at 6 months after bonding in group II were nil. The traces of WLSs in group I may be due to poor oral hygiene and fixed appliances become sites of plaque retention, and without good oral hygiene, plaque accumulates and acidogenic bacteria cause marked demineralization.

We have not considered the distribution of WSLs with gender difference, however, Øgaard 1989, reports that incidences of WSLs were more in females (55%) than males (44%), also Boersma 2005, who reported a prevalence of 40% in male and 22% in female patients.

Most common teeth affecting in mandible with WSLs were the first molars and second premolars, followed in decreasing order by first premolars, canines, lateral incisors, and central incisors. In the maxilla, in the treated group, a high incidence of WSLs was observed on lateral incisors and canines, followed by central incisors, second premolars, first molars, and finally first premolars Gorelick 1982 [9-15].

Our analysis does not support teeth affecting as we have considered teeth which are under going for orthodontic extractions. Secondly our aim was to evaluate depth and demineralization after fixed orthodontic bonding. Hence our study supports Chapman2010, reported that premolars were one of the affecting teeth from WSLs during fixed orthodontic treatment.

The present study showed that significant decalcification occurred within only 6 months after orthodontic bonding in group III. Illustrating the rapid progression of these irreversible WSLs lesions, early diagnosis and local supplementation of fluoride is of critical important. In comparison with group I, II, group III has shown the high number of lesions at 6 months, it is significant to evaluate the oral hygiene status of patients and provide local supplementation of floured paste and mouth rinses during the first months of orthodontic treatment.

Conclusion

Our study clearly shows that role of plaque and local supplementation of fluoride supplements. Fixed orthodontic bracket facilitates site plaque accumulation around it, resulting in rapid demineralization of enamel.

Through our study we suggest that to develop an oral hygiene protocol that should be followed both at home and at the dental practice for each orthodontic patient. Furthermore, advice use of fluoride mouthwash is effective in preventing WSLs.

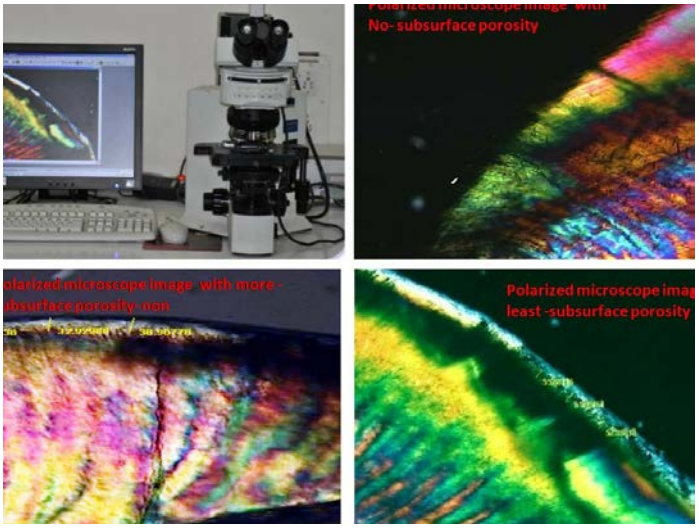

Figure 2:

Table 1. after 3 months the range .demineralization ,range and depth of fluoride mean and SD

Sl no	Sample group	Month of pre-molars extraction	Demineralization	Range of demineralization	Mean depth	SD
1	Group I	3 month	Nill	Nill	Nill	Nill
2	Group III 1	3 months	Present	33.8-38.7	36.4	1.8

Table 2 after 6 months the range .demineralization, range and depth of fluoride mean and SD

Sl no	Sample group	Month of pre-molars extraction	Demineralization	Range of demineralization	Mean depth	SD
1	Group II	6 month	Nill	Nill	Nill	Nill
2	Group III 2	6 months	Present	54.8-66.7	59.10	3.01

Table 3 the range .demineralization, range and depth of fluoride mean and SD and t Value

Sl no	Sample group	Month of pre-molars extraction	Demineralization	Range of demineralization	Mean depth	T value
1	Group I	3 month	Nill	Nill	Nill	Nill
2	Group III 1	3 months	Present	33.8-38.7	36.4	68.01
3	Group II	6 month	Nill	Nill	Nill	Nill
4	Group III 2	6 months	Present	54.8-66.7	59.10	63.08

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