PREVALENCE OF NEW CARIOUS LESIONS AMONG PATIENTS UNDERGOING ORTHODONTIC TREATMENT WITH FIXED APPLIANCES

[1]NADER A MASARWA, BDS
[2]HIND F. AL-NSOUR, BDS
[3]ZAID H. AL-ZOUBI, BDS
[4]HANEEN F. AL-AWABDEH, BDS
[5]ABEER S. AL-KHRAISAT, BDS

ABSTRACT

The development of new carious lesions is a significant clinical problem during orthodontic treatment. The aim of this study was to evaluate the prevalence of carious lesions, commonly presented as white spots (WSLs) on banded molars among patients undergoing orthodontic treatment with fixed appliances. In addition, the relation between prevalence and treatment duration was evaluated. Another aim was to investigate the relation between severities of detected WSLs and treatment durations.

A study group of randomly selected 100 patients undergoing orthodontic treatment with fixed orthodontic appliances were examined for the presence of white spot lesions on banded molars. The examination was performed after removal of cemented bands. Direct visual examination was the detection method used. The study group patients were divided into three groups according to treatment duration. The detected white spot lesions were given four scores according to severity; zero, one, two and three. A control group of 100 patients who were referred for orthodontic treatment, but no treatment had started yet, were also examined for the presence of white spot lesions on molars to be banded.

The results show that the overall prevalence of white spot lesions in the test group patients was 87%, while it was 18% in control group. Studying the relation between prevalence of WSLs and treatment duration show that prevalence was 74% for the first group with treatment durations less than one year, 85% for second group with treatment durations between one and two years, and 100% for the third group with treatment durations more than two years. A scoring system which consisted of 4 scores (from 0-3) was designed for the study according to white spot lesions depth. Score 0 was given when no WSL was detected, score 1 for detected WSLs with no hard tissue disintegration, score 2 for lesions with disintegration of enamel surface, and score 3 for lesions extending into Dentin. In the first group of the study group patients, 47% of the detected lesions had score of 1, 47% had score of 2 and 6% had score 3. In the second group: 63% of lesions had score of 1, 37% of the lesions had score of 2. In the third group 48% had score of one, 52% had score of two.

Despite preventive measures improvements, development of white spot lesions is still a side effect that can't be ignored and should always be kept in mind by orthodontist before, during and after initiating orthodontic treatment with fixed appliances. Prevalence of WSLs on banded molars increased significantly among patients undergoing orthodontic treatment with fixed orthodontic appliances compared to control group. Prevalence of WSLs was highest when treatment duration increased for more than two years. No relation was found between severity or depth of WSLs and treatment duration.

Key Words: *Orthodontic treatment duration, white spot lesions, orthodontic band.*

INTRODUCTION

Dental caries is a common complication of orthodontic treatment with fixed orthodontic appliances. Prevention of demineralization during orthodontic treatment has been a challenging issue faced by orthodontists although caries prevention measures have improved over the last years. Due to the presence of fixed orthodontic appliances, it is difficult for patients to maintain adequate oral hygiene, as orthodontic

[1,2,3,5] From the department of Dentistry, Royal Medical Services of the Jordan Army.
[4] From the Department of Dentistry, Ministry of Health of Jordan.
Addressed for Correspondence:
[1] Dr. Nader A. Masarwa BDS, JDB
Specialist in Conservative Dentistry
Royal Medical Services - Jordan Army
P.O.B. 778 Madaba - Jordan
Cell: 00962797919828
Email: nadermassarweh@yahoo.com

Received for Publication: August 31, 2013
Revision Received: September 24, 2013
Accepted: September 30, 2013

appliances increase the number of plaque retention areas on teeth surfaces that are normally less susceptible to caries development.[1] Furthermore, the parts of fixed appliances like brackets, bands and wires have irregular surfaces that limit the naturally occurring self-cleansing mechanisms of the oral musculature and saliva. Salivary flow rate is also affected with the presence of fixed appliances and resting salivary flow rate increases during orthodontic treatment.[1] Microbial environment is also altered once the fixed appliances are inserted on the patient teeth, leading to increased proliferation of acidogenic bacteria as streptococcus mutans and lactobacilli which, in the presence of carbohydrate, lower plaque Ph to a great level.[2] The oral environment normally has a coexisting balance between demineralization and remineralization process, which is shifted toward demineralization in the presence of low Ph. This is when enamel caries starts. The clinical manifestation of early enamel caries is presented clinically as White spot lesion (WSL). WSL is the opaque white appearance of enamel lesion resulting from subsurface demineralization which creates pores between enamel rods and results in changes in the optical properties of the enamel.[3] Porous enamel reflects more light than sound enamel and with surface roughness results in visual chalky opaque enamel which appears clear on air drying. WSLs can be either carious or noncarious. Non-carious lesions classified as fluorosis, developmental enamel hypomineralization, and enamel hypoplasia can have genetic and environmental background. These non-carious WSLs are usually limited to few teeth or generalized through the dentition, covering the whole tooth surface and not associated with orthodontic appliances.[3]

Carious lesions or WSLs are usually found on the buccal surfaces beneath plaque accumulation areas around orthodontic bands and brackets, and are identified when the teeth are dry. If etiologic factors persist, WSLs will develop into more extensive forms of demineralization and consequent cavity formation.[3]

Enamel demineralization is an inevitable risk associated with orthodontic treatment with fixed appliances WSLs have the potency to develop within 4 weeks of the initiation of orthodontic treatment, though the progression of the early demineralization to a carious lesion usually takes about 6 months. Not only do WSLs develop in shorter time, but also have different behavior as it develops faster and extends in a more superficial level than caries in non-orthodontic patients.[4]

Prevalence of WSLs in the literature ranges widely from (2-97%).[5] Gorelick et al using the visual examination technique reported that 50% of patients had at least one WSL at the end of orthodontic treatment.[6] Sagarika, et al found a prevalence of 75.6% among orthodontic patients compared to 15.6% among control group.[7] Boersma et al using quantitative light fluorescent technique, found that prevalence was 97%. Much of the variation in detecting WSLs was due to the method of detection with highest prevalence of demineralization was when light induced fluorescent method was used. Similar devices that are mainly based on optical phenomena like digital imaging fiber-optic transillumination (DIFOTI) and red laser-light induced fluorescence also considered as more accurate methods than direct visual examination.[5]

Epidemiological studies found that the teeth most commonly affected are molars, maxillary lateral incisors, mandibular canines and premolars respectively.[1] A study done by Ogaard et al found that the level of visible plaque around the appliance, shortly after bonding was the best predictor for white spot lesion at debonding.[3]

Early detection of white spot lesions during orthodontic treatment is also very important, as it would allow clinicians to implement preventive measures to control the demineralization process before progression of the lesions.

The aim of this study was to evaluate the prevalence of white spot lesions among patients undergoing orthodontic treatment with fixed appliances in the hospitals of Royal Medical Services in Jordan. The study was directed toward examining first molar teeth where stainless steel bands are usually cemented. As time plays a major role in caries development, the relation between prevalence and duration of band insertion or treatment duration was also studied. An additional aim was to study the relation between severities of white spot lesions lesion and treatment duration.

METHODOLOGY

Patients participating in this study consisted of two groups. Study group comprised of 100 patients who were undergoing orthodontic treatment with fixed appliances; Control group comprised of 100 patients who were referred for orthodontic treatment but treatments had not started yet.

The inclusion criteria for the study group were:

- Patients under treatment with fixed orthodontic appliances for no less than three months duration.
- Patients' age group of 12 to 18 years.
- Both healthy male and female patients were selected.

- Orthodontic treatment consisted of both upper and lower fixed appliances.
- The patients selected had stainless steel bands cemented over first molar teeth exclusively. Patients with stainless steel bands cemented on other than first molar teeth were excluded. So, four teeth were examined for each patient.
- The inclusion criteria for the control group were:
- Patients' age group of 12-18 years.
- Both healthy male and female patients were selected.
- The referred patients were in need of orthodontic treatment for both upper and lower jaws.
- Orthodontic treatment planned but has not started yet.

The patients were selected randomly during regular recall visits to orthodontic dental clinics at the hospitals of Royal Medical Services. To detect presence of new carious lesions on banded teeth, the inserted bands were first removed with band remover by orthodontist. Residues of banding cement were removed using hand instruments like dental probe or excavator. White stone burs in low speed hand piece were used carefully and only to remove harder cement residues. This was followed by visual examination under direct illumination on a dental chair using a mirror and three-in-one syringe. Detection was for presence of white spot lesions over smooth surfaces which were previously covered by the stainless steel bands. Incipient white spot lesions (WSLs) are the first carious presentation to appear on smooth surfaces of banded teeth. Visual examination was performed by the same dentist for all the patients. It was assumed that all detected carious lesions were new and their formation was due to the presence of orthodontic bands. This is because every orthodontic patient is subjected to thorough dental examination prior to starting orthodontic treatment. Patient name, insurance number, age and gender were registered. The duration of band insertion or treatment period was registered, too.

The control group patients were also examined using visual examination method, where first molars were examined for presence of carious lesions (WSLs) under dental unit illumination and sufficient drying.

The following scale was used for scoring detected white spot lesions;

Score 0: no visible WSL after 5 second drying with air syringe.

Score 1: apparent opaque WSL with no enamel disintegration.

Score 2: WSL with enamel disintegration or cavitation.

Score 3: extended cavitations involving dentin.

The test group of patients was also classified into three groups according to duration of orthodontic bands insertion or treatment period. The first group consisted of patients undergoing treatment for less than 12 months period. The second group consisted of patients who were undergoing treatment for one year or more but less than 2 years. The third group consisted of patients who were undergoing treatment for 2 years and more.

RESULTS

The results of this study show that in the study group, an overall percentage of 87% of patients had white spot lesions, which means that 8-9 out of 10 patients undergoing orthodontic treatment with fixed appliances had a prevalence of at least one WSL appearing on banded first molars. On the other hand, in the control group an overall prevalence of 18% of patients had WSLs, which means 1-2 patients out of 10 indicated and planned to undergo orthodontic treatment with fixed appliances, had at least one WSL appearing on molars to be banded. The Chi square test result showed that the prevalence of WSLs in the test group compared to the control group is highly significant statistically ($p< 0.001$).

The relation between prevalence of WSLs and duration of orthodontic treatment was studied and the results are shown in Table 1.

The relation between duration of treatment and severity of WSLs was also studied. The results are shown in Table 2.

TABLE 1: THE RELATION BETWEEN TREATMENT DURATION AND PREVALENCE OF WSLS

Treatment duration	Prevalence of WSLs (%)
Group 1 (treatment duration <1 year)	74%
Group 2 (treatment duration >1 and <2 years)	85%
Group 3 (treatment duration >2 years)	100%

TABLE 2: THE RELATION BETWEEN TREATMENT DURATION AND DEPTH (SEVERITY) OF WSLS

	WSL score 1	WSL score 2	WSL score 3
Group 1	47%	47%	6%
Group 2	63%	37%	0
Group 3	48%	52%	0

DISCUSSION

In concurrence with the results of similar studies, this study clearly indicates that fixed orthodontic appliances have a significant role in the formation of white spot lesions on banded first molar teeth. Chi-square test results indicate a high significant role of fixed orthodontic appliances in formation of WSLs, suggesting a direct proportion relationship of enamel demineralization and insertion of orthodontic bands. Despite improvements in preventive dental care, and the many advances in the field of orthodontics, the development of WSLs is still a considerable problem and a well-recognized negative side-effect of orthodontic fixed appliance therapy. In this study visual examination was done to detect WSLs related to banded molars. Although visual examination is the least accurate method of detection, a high prevalence of WSLs was found, which means that using more advanced techniques as QLF (quantified light induced fluorescent) would probably reveal more lesions.[5]

Richter et al found that longer treatment duration was not significantly related to increased cavitated lesions.[2] The results of this study are consistent with their study.

The relation between new carious lesions and many other variables were evaluated in other studies. For example, Boersma et al found a clear difference between the percentage of caries-affected surfaces in boys (40%) and girls (22%).[5] Haugejordan et al found the opposite regarding gender-specific distribution with higher prevalence in females than in male patients.[10]

To prevent development of WSLs, orthodontists should assess each patient's risk factors before and during treatment. Oral hygiene instruction is important, but patients need to be assisted with additional measures including fluoride varnish, chlorhexidine, xylitol, dietary modification, or calcium containing remineralization products that can help prevent enamel demineralization, enhance remineralization and modify patient and plaque formation factors.[9] When patient fail to comply with maintaining good oral hygiene, it is wise to consider premature termination of the treatment rather than risk tooth structure damage. Many researchers encourage the use of a newly produced material MI Paste Plus. MI Paste plus is known to restore minerals to the teeth and helps to stimulate saliva production. It contains casein phosphopeptide amorphous calcium phosphate, a milk-derived protein. MI Paste Plus helped prevent the development of new white spot lesions during orthodontic treatment and decreased the number of white spot lesions already present.[11] Other authors question the benefit of initiating orthodontic treatment with fixed appliances in mixed dentition period. Hsieh et al even advises limiting the treatment with fixed orthodontic appliances because of high risk of WSLs development.[12]

Demineralization after removal of fixed orthodontic appliances usually stops if proper oral hygiene measures are taken. Most of the lesions that developed during orthodontic treatment improve back to normal enamel appearance once the fixed appliances were removed. Formed WSLs may gain back its normal enamel shade, but some may still be opaque and improves with external bleaching. When the results of bleaching are not satisfactory, acid microabrasion is recommended. Restorative treatment with direct composite restoration or even the most aggressive tooth reduction and porcelain veneer, are to be considered for deeper and poor esthetic lesions.[13]

A study done in Netherland found that orthodontists do not implement the available evidence in order to prevent enamel demineralization during treatment with fixed appliances. A practice guideline incorporating this information should develop.[14]

Glass ionomer cements (GIC) are widely used in orthodontic clinics at RMS hospitals for band cementation. It was found that conventional GIC is associated with more leakage than Resin modified GIC and Poly acid modified composites, concluding that more WSLs are detected with the use of GIC. Shifting to Resin modified GIC and Poly acid modified composite will reduce enamel demineralization and minimize caries risk associated with orthodontic bands.[15]

CONCLUSION

Consistent with previous prevalence and incidence reports, significant increase was noted in prevalence of white spot lesions on banded molars for patients undergoing orthodontic treatment with fixed appliances. There was a direct proportion relation between prevalence of WSLs and duration of treatment. Prevalence was highest when treatments durations were two years and more.

REFERENCES

1 HS. Chang, LJ. Walsh, TJ. Freer. Enamel demineralization during orthodontic treatment. Aetiology and prevention. Australian Dental Journal 1997; 42: 5.

2 Amy E. Richter, Airton O. Arruda, Mathilde C. Peters, Woosung Sohn. Incidence of caries lesions among patients treated with comprehensive orthodontics. Amer J of Orthodontics and dentofacial ortho 2011; 139: (5:) 657-664.

3 Readers forum. White spot lesions: Prevention and treatment. Amer J of Ortho and dent orthopedics. 2010; 138: 6.

4 Livas C, Kuijpers-Jagtman AM, Bronkhorst E, Derks A, Katsaros C. Quantification of white spot lesions around orthodontic brackets with image analysis. Angle Orthod 2008; 78: 585-90.

5 J.G. Boersma M.H. van der Veen, M.D. Lagerweij, B. Bokhout, b. Parahl-Andersen. Caries Prevalence Measured with QLF after Treatment with Fixed Orthodntic Appliances: Influencing Factors. Caries Res 2005; 39: 41-47.

6 Goerlick L, Geiger AM, Gwinnett AJ. Incidence of white spot formation after bonding and banding. Am J Orthod 1982; 81: 93-98.

7 Nandikolla Sagarika, Sundaramoorthy Suchindran, SC Loganathan, Velayutham Gopikrishna. Prevalence of white spot lesion in a section of Indian population undergoing fixed orthodontic treatment: An in vivo assessment using the visual international caries detection and assessment system 2 criteria. Jour Cons Dent 2012; 15: 2: 104-8.

8 Ogaard B, Larsson E, Henriksson T, Birkhed D, Bishara SE. effects of combined application of antimicrobial and fluoride varnishes in orthodontic patients. AM.J Orthod Dentofacial Orthop 2001; 120: 28-35.

9 Joshua A. Chapman, W. Eugene Roberts, George J. Eckert, Katherine S. Kula, and Carlos Gonzalez-Cabezas. Risk factors for incidence and severity ofwhite spot lesions during treatment with fixed orthodontic appliances. Amer J of Orthod and Dentfaci Orthped 2010; 138: 188-94.

10 Haugejordan O: Using the DMF gender difference to assess the major role of fluoride toothpaste in the caries decline. A meta-analysis. Community Dent Oral Epidemiol 1996; 24: 369-75.

11 Michael A. Robertson, Chung How Kau, Jeryl D. English, Robert P. Lee, John Powers, and Jennifer T. Nguyenf. MI Paste Plus to prevent demineralization in orthodontic patients: A prospective randomized controlled trial. Amer J of Orthod Dentofacial Orthopedic. 2011; 140: 5: 660-68.

12 Hsieh TJ, Pinskaya Y, Roberts WE. Assessment of orthodontic treatment outcomes: early treatment versus late treatment. Angle Ortho 2005; 75: 162-70.

13 Monique H. van der Veen, a Thomas Mattousch, b and Johan G. Boersmac. Longitudinal development of caries lesions after orthodontic treatment evaluated by quantitative light-induced fluorescence Am J Orthod Dentofacial Orthop 2007; 131: 223-28.

14 Aniek Derks, a Anne Marie Kuijpers-Jagtman, b Jo E. Frencken, c Martin A. Van't Hof, d and Christos Katsarose. Caries preventive measures used in orthodontic practices: An evidence-based decision? Am j ortho dentofacial orthop 2007; 132: 165-70.

15 Tancan Uysal, Sabri Ilhan Ramoglu, Huseyin Ertas, Mustafa Ulker. Microleakage of orthodontic band cement at the cement-enamel and cement-band interfaces. Ame J Orth Dent fac Orthop 2010; 137: 4: 534-39.