EGYPTIAN DENTAL JOURNAL

VOL. 60, 3181:3187, JULY, 2014

I.S.S.N 0070-9484

WWW.EDA-EGYPT.ORG

POTENTIAL HAZARDS OF HARD AND SOFT TISSUES FOLLOWING ORTHODONTIC TREATMENT: A CLINICAL SERIES

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ABSTRACT

The aim of the study was to outline the possible adverse tissue reactions that could happen following orthodontic treatment. Methods: the study sample consisted of 35 subjects, completed their orthodontic treatment with fixed appliances 2-3 years earlier. Post-orthodontic treatment clinical and radiographic examination of randomly selected orthodontic patients were taken. Results: majority of the cases showed a good result with no gingival or periodontal diseases. Radiographic examination showed four subjects with root resorption and three subjects with bone loss, whereas clinical examination of the patients showed few cases of white spot formation on the enamel surface, relapse, and one case of gingival recession. Conclusion: maintaining good oral hygiene and adequate patient compliance seem to be a major factors during orthodontic treatment. These factors will be reflected positively in the health of the teeth and adjacent structures during and after orthodontic treatment.

KEY WORDS: Orthodontic appliances, orthodontic treatment, gingival recession, bone resorption, gingival and periodontal tissues, adverse tissue reaction, decalcification.

INTRODUCTION

Orthodontic treatment with fixed appliances could potentially cause adverse tissue reactions affecting gingival and periodontal health, alveolar bone, and enamel surfaces. Also, apical root resorption is a common idiopathic problem associated with orthodontic treatment.[1] A number of clinical studies have documented the potential damage to the teeth and adjacent structures (gingiva, periodontal ligament, and alveolar bone) associated with fixed orthodontic appliances.[2-4] It is well established that plaque accumulation around fixed orthodontic appliances, due to decreased oral hygiene measures, and the close proximity of the orthodontic appliances to the gingival sulcus are the main etiological factors for the development of transient gingivitis and periodontitis.[3,5,6] Further, orthodontic appliances could potentially cause gingivitis that may progress to periodontitis, especially during intrusive and tipping movements. This is because these kind of movements pushing the supragingival plaque subgingivally, resulting in the development of a pseudopocket.[7] There are few human studies concerning infrabony pockets

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and orthodontic treatment, and most are limited to case reports or case series.[8-10] Some studies reported temporally reversible periodontal changes following bracket placement.[11,12] On the other hand, Janson et al reported a significant loss of attachment during orthodontic treatment.[13]

Gingival recession is a common adverse tissue reaction related to orthodontic treatment. One of the etiological factor of gingival recession could be orthodontic movement of teeth to positions outside the labial or lingual alveolar plate, resulting in thinning of the alveolar plate or dehiscence formation. Consequently, root exposure and hypersensitivity, root caries, and esthetic impairment may develop.[14-16] Thomson (2002)[11] found that no effect of orthodontic treatment on gingival recession, whereas Slutzkey and Levin (2008)[16] observed a positive relation between the past orthodontic treatment and the occurrence of gingival recession.

Tooth movement providing a high load at the alveolar crest, such as torque and rapid tipping, resulting in reduction in the height of the alveolar crest.[17] Furthermore, decalcification, white spot formation, and eventually caries have long been recognized as an adverse reaction during orthodontic treatment.[18-20] Moreover, retention of plaque around orthodontic appliances and oral hygiene efficiency have been identified as related factors to the white spot formation during orthodontic treatment. In addition, mechanical damage of the enamel such as deep, or even fine scratches and facets could be left on the enamel surfaces during or after bracket debonding. Another common adverse response to orthodontic treatment is the reversible pulpal injury with narrowing of the pulp. This pulpal damage would be more severe when a greater force is used and when the force is applied for a longer time. However, orthodontic tooth movement with a physiologic force application does not lead to pathologic changes in pulpal blood flow or necrosis.[21-23] Also, patients who have risk factors for pulpal necrosis with orthodontic treatment, such as impacted teeth, teeth with a history of trauma, caries or restorations, teeth with periodontal bone loss, or teeth with evidence of pulpal obliteration should be informed about the risk of pulpal damage during treatment.

Root resorption is an inevitable side effect of orthodontic treatment, it is affecting the apical 1-2 mm only, and can occur during and at the end of treatment. Many factors have been investigated and showed a relation to root resorption such as type, duration, magnitude of the applied force, and type of tooth movement.[24-27] Therefore, root resorption is a concern for the orthodontic specialty, and the light forces during orthodontic treatment have been recommended to reduce such an adverse tissue reaction.[4] Finally, relapse, which defined as changes in teeth position after orthodontic treatment, will continue to be a concern for patients and orthodontists. The only way to ensure long-term post-treatment stability by permanent retention in particular cases. Moreover, proper treatment planning and retention management appear to play an important role in achieving physiologically stable results.[28-30] Therefore, the purpose of the present study was to determine the possible adverse tissue reactions that could happen following orthodontic treatment and to suggest a recommendations to minimize, or even, to avoid these adverse reactions.

MATERIALS AND METHODS

The sample of this study consisted of 35 subjects (20 male and 15 female) completed their orthodontic treatment two to three years earlier. All subjects were between the ages of 18 to 34 years. They were treated with edge-wise fixed appliances. Two subjects were treated first with rapid palatal expansion appliance, and one subject was treated with functional appliance, and then all of these three subjects were followed with fixed orthodontic appliances as a second phase of treatment. The patients were selected randomly from the orthodontic clinic in the College of Dentistry at King Saud University. Written informed consent was given to each patient.

The study was conducted by examining each patient clinically, taking upper and lower incisal periapical and posterior bite wing radiographs, and intra-oral photos were taken. Ethical approval of the study was obtained from Ethical Committee of College of Dentistry Research Center (CDRC) at King Saud University. All subjects included in the study fulfilled the following criteria:

- Any patient treated with fixed orthodontic appliance, or removable appliance followed by fixed orthodontic appliance,
- Any patient with duration of his/her orthodontic treatment with fixed appliances not more than 2-3 years.
- Any patient completed his/her orthodontic treatment one year before the present study,
- Any patient with absence of pre-existing untreated periodontal disorders, and
- Finally, Availability of standardized and high quality periapical and bite wing radiographs.

RESULTS

Post-orthodontic treatment results of the thirty-five subjects were propitious in 23 of the subjects (66%). No significant gingival and periodontal disease, gingival recession, or bone loss were observed. The distribution of study sample according to the presence or absence of adverse tissue reactions following orthodontic treatment is presented in Figure 1. Among the 35 participants, intra-oral photos of two subjects (6%) exhibited one or more teeth with white spot lesions (Figure 2). Furthermore, two subjects (6%) had experienced a relapse, one case was reopening of median diastema (Figure 3), and the second case was reopening of the right maxillary extraction space (Figure 4). Moreover, periapical radiographs of four subjects (11%) showed root resorption at the apices of maxillary incisors (Figure 5), while three subjects (8%) presented with marginal bone loss of posterior teeth as shown in the bite-wing radiographs (Figure 6). A recession of maxillary and mandibular first molar teeth was noticed in one subject (3%) [Figure 7].

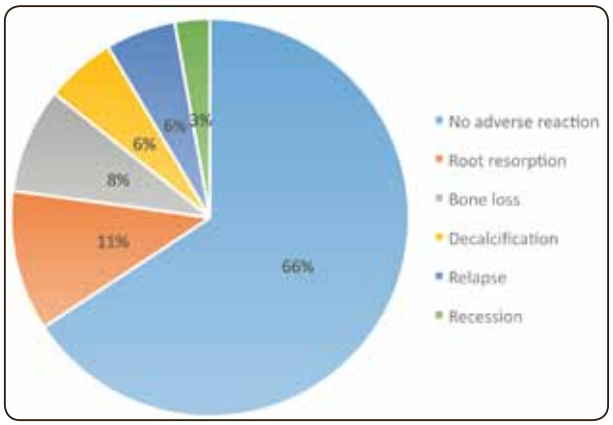

FIG. (1) Pie graph shows percentage of patients with and without adverse tissue reaction following orthodontic treatment.

FIG. (2) Clinical photograph showing multiple teeth with white spot lesions following orthodontic treatment.

FIG. (3) Clinical photograph showing a relapse of upper median diastema after completion of treatment.

FIG. (4) Clinical photograph showing a relapse by re-opening of extraction space between maxillary right canine and 2nd bicuspid after completion of treatment.

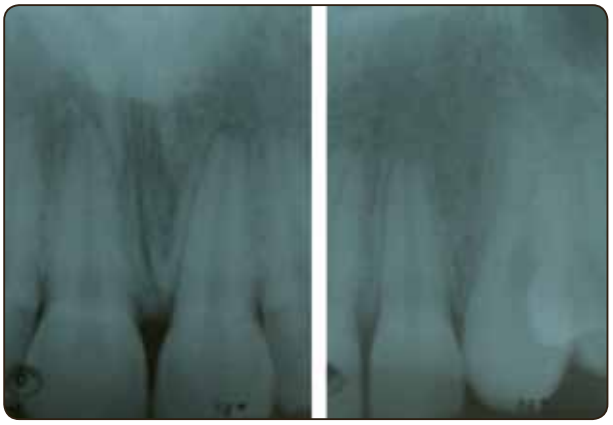

FIG. (5) Periapical radiograph showing root resorption at the apices of central and lateral incisors following orthodontic treatment.

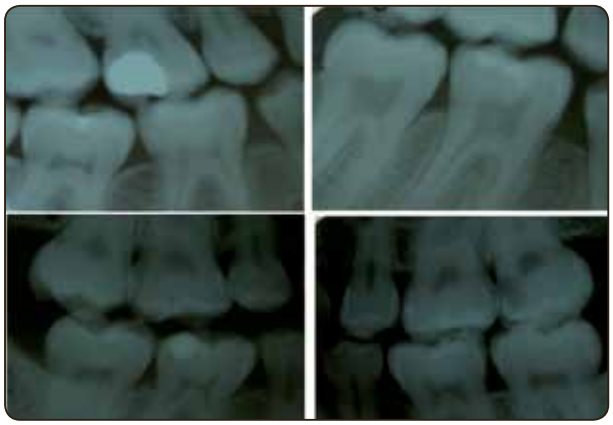

FIG. (6) Bite-wing radiographs showing three different cases with marginal bone loss of posterior teeth.

FIG. (7) Clinical photograph showing gingival recession of maxillary and mandibular first molars following orthodontic treatment.

DISCUSSION

The present study outlined the common adverse tissue reactions that could happen after any orthodontic treatment whether inevitable side effects, such as root resorption, or other side effects that can be prevented. The majority of the study sample did not show any gingival or periodontal diseases following orthodontic treatment. This result can be explained by the beneficial effect of the combined personal and professional control of plaque and calculus to prevent any gingival or periodontal diseases, reinforcement of the personal oral hygiene practice, and preventive fluoride programs in office-applied or self-administered regimes. Alexander[31] evaluated the effect of banded and bonded attachments on the gingival health of permanent second molars. He found that once the appliances were removed, both areas returned to pretreatment levels. This is consistent with previous studies, which have postulated that gingival inflammation in almost all orthodontic patients is usually transient and does not lead to attachment loss.[5,11,12] Also, Sadowsky and BeGole[32] found that no significant amount of either damage or benefit to periodontal structures could be directly attributed to the orthodontic therapy.

In the present study, four subjects had root resorption, approximately 2 mm at the apices of maxillary incisors. Root resorption is considered an inevitable adverse tissue reaction after orthodontic treatment. However, most root loss resulting from orthodontic treatment should not compromise the long-term health or the functional capacity of the involved teeth.[1] Giannopoulou et al (2008)[25] assessed the relationship between periodontal parameters and root resorption in orthodontically moved teeth. They found that nearly all orthodontically moved teeth showed signs of root resorption. The applied force, which one of the factors that may cause root resorption, might be enough to move teeth without causing damage to the teeth and periodontal structures.[26] Furthermore, Schwarz[33] found that when applied orthodontic force exceeded the optimal force level for tooth movement, which is between 7 and 26 gram per square centimeter, root resorption would occur. The results of the present study also showed three subjects with marginal bone loss, one subject with gingival recession, and two subjects with white patches and decalcification on the enamel surfaces. The explanation for occurrence of such a reactions is that the orthodontic appliances during the treatment and the post-orthodontic fixed retainer placement could promote plaque accumulation, resulting in greater gingival recession, bone loss, and decalcification.[6,34,35] Consequently, good oral hygiene and close monitoring are recommended during and long after therapy. The reinforcement of daily use of 0.05% sodium fluoride mouth rinse during orthodontic treatment, the use of tooth paste containing fluoride, and professional use of fluoride-releasing materials, such as glass-ionomer cement and elastomeric ligatures, may reduce the prevalence of demineralization.[19,20,36]

In addition, professional measures to restore the enamel surface to normal smoothness with minimum damage is required. A good debonding technique is to squeeze the bracket at the base so that the bracket comes off leaving some residual composite at the enamel surface, which can be cleaned up later with a carbide bur. The use of burs at high speed with water coolant and then pumicing is considered the best technique leaving the smoothest enamel surface. On the other hand, the removal of residual composite by using twelve-fluted tungsten carbide bur at low speed is considered effective, but leaving fine scratches and facets on the enamel surface.[37]

Two cases were reported with a relapse in the present study. This could be happened due to the fact that the risk of relapse is very high in such cases, reopening of midline diastema and extraction space, without proper treatment planning, retention management, and patient noncompliance in wearing the removable retainers. Long-term post-treatment stability remains an issue of great concern to all orthodontists and patients. A similar findings have been previously reported for possible adverse tissue reactions related to orthodontic treatment among Pakistani patients.[38] Lack of similar studies in this topic has restricted more direct comparison of these results to only one study.[38]

In conclusion from the data presented in this study, the challenge for both orthodontists and patients during orthodontic treatment is to establish meticulous oral hygiene and patient compliance. It is important to emphasize that if patients comply with preventive recommendations during orthodontic treatment with fixed appliances, no harm will occur to either soft (gingival and periodontal) or hard tissues (teeth and bone). Limitations of the study include the small sample size and cross-sectional nature of the study. So, further research is required for a prospective study with clinical and radiographic examination before, during, and after orthodontic treatment and to increase the sample size to be more representative.

REFERENCES

1. Brezniak N, Wasserstein A. Root resorption after orthodontic treatment: Part 1. Literature review. Am J Orthod Dentofacial Orthop; 103: 62-66, 1993.
2. Ellis PE, Benson PE. Potential hazards of orthodontic treatment – what your patient should know. Dent Update; 29: 492-496, 2002.
3. Gastel JV, Quirynen M, Teughels W, Coucke W, Carels C. Longitudinal changes in microbiology and clinical periodontal variables after placement of fixed orthodontic appliances. J Periodontol; 79: 2078-2086, 2008.
4. Paetyangkul A, Türk T, Elekdağ-Türk S, Jones AS, Petocz P, Darendeliler MA. Physical properties of root cementum: Part 14. The amount of root resorption after force application for 12 weeks on maxillary and mandibular premolars: A microcomputed- tomography study. Am J Orthod Dentofacial Orthop; 136: 492.e1-492.e9, 2009.
5. Lee SM, Yoo SY, Kim HS, Kim KW, Yoon YJ, Lim SH, *et al*. Prevalence of putative periodontopathogens in subgingival dental plaques from gingivitis lesions in Korean orthodontic patients. J Microbiol; 43: 260-265, 2005.
6. Pandis N, Vlahopoulos K, Madianos P, Eliades T. Long-term periodontal status of patients with mandibular lingual fixed retention. Eur J Orthod; 29: 471-476, 2007.
7. Ericsson I, Thilander B, Lindhe J, Okamoto H. The effect of orthodontic tilting movements on the periodontal tissues of infected and non-infected dentitions in dogs. J Clin Periodontol; 4: 278-293, 1977.
8. Iino S, Taira K, Machigashira M, Miyawaki S. Isolated vertical infrabony defects treated by orthodontic tooth extrusion. Angle Orthod; 78: 728-736, 2008.
9. Modoni D, Modoni M, Verdino A, Deli R. Treatment of an isolated vertical infrabony defect with orthodontic intrusion. J Clin Orthod.; 43:453-458, 2009.
10. Rotundo R, Bassarelli T, Pace E, Iachetti G, Mervelt J, Pini Prato G. Orthodontic treatment of periodontal defects. Part II: A systematic review on human and animal studies. Prog Orthod; 12: 45-52, 2011.
11. Thomson WM. Orthodontic treatment outcomes in the long term: findings from a longitudinal study of New Zealanders. Angle Orthod; 72: 449-455, 2002.
12. Gomes SC, Varela CC, da Veiga SL, Rosing CK, Oppermann RV. Periodontal conditions in subjects following orthodontic therapy. A preliminary study. Eur J Orthod; 29: 477-481, 2007.
13. Janson G, Bombonatti R, Brandoa AG, Henriques JF, de Freitas MR. Comparative radiographic evaluation of the alveolar bone crest after orthodontic treatment. Am J Orthod Dentofacial Orthop; 124: 157-164, 2003.
14. Al-Wahadni A, Linden GJ. Dentin hypersensitivity in Jordanian dental attenders. A case-control study. J clin Periodontol; 29: 688-693, 2002.
15. Allais D, Melsen B. Does labial movement of lower incisors influence the level of the gingival margin? A case-control study of adult orthodontic patients. Eur J Orthod; 25: 343-352, 2003.
16. Slutzkey S, Levin L. Gingival recession in young adults: occurrence, severity, and relationship to past orthodontic treatment and oral piercing. Am J Orthod Dentofacial Orthop; 134: 652-656, 2008.
17. Thilander B, Rönning O. Introduction to orthodontics. 2nd ed. p.197 Sweden: Lagerblads and Karlshamn; 1995.
18. Benson PE, Pender N, Higham SM. Quantifying enamel demineralization from teeth with orthodontic brackets – a comparison of two methods. Part 2: validity. Eur J Orthod; 25: 159-165, 2003.
19. VanMiller EJ, Donly KJ. Enamel demineralization inhibition by cements at orthodontic band margins. Am J Dent; 16: 356-358, 2003.
20. Benson PE, Shah AA, Willmot DR. Measurement of white lesions surrounding orthodontic brackets: captured slides vs digital camera images. Angle Orthod; 75:226-230, 2005.
21. Santamaria M Jr, Milagres D, Stuani AS, Stuani MB, Ruellas AC. Initial changes in pulpal microvasculature during orthodontic tooth movement: a stereological study. Eur J Orthod; 28: 217-220, 2006.
22. Ramazanzadeh BA, Sahhafian AA, Mohtasham N, Hassanzadeh N, Jahanbin A, Shakeri MT. Histological changes in human dental pulp following application of intrusive and extrusive orthodontic forces. J Oral Sci; 51: 109-115, 2009.
23. Meeran NA. Iatrogenic possibilities of orthodontic treatment and modalities of prevention. J Orthod Sci; 2: 73-86, 2013.
24. Chan EKM, Darendeliler MA. Physical properties of root cementum: part 5. Volumetric analysis of root resorption craters after application of light and heavy orthodontic forces. Am J Orthod Dentofacial Orthop; 127: 186-195, 2005.

25. Giannopoulou C, Dudic A, Monet X, Kiliaridis S, Mombelli A. Periodontal parameters and cervical root resorption during orthodontic tooth movement. J Clin Periodontol; 35: 501-506, 2008.

26. Gonzales C, Hotokezaka H, Darendeliler MA, Yoshida N. Repair of root resorption 2 to 16 weeks after the application of continuous forces on maxillary first molars in rats: A 2- and 3-dimentional quantitative evaluation. Am J Orthod Dentofacial Orthop; 137: 477-485, 2010.

27. Motokawa M, Sasamoto T, Kaku M, Kawara T, Matsuda Y, Terao A, *et al*. Association between root resorption incident to orthodontic treatment and treatment factors. Eur J Orthod; 34: 350-356, 2012.

28. Casko J, Vaden J, Kokich V. American Board of orthodontics objective grading system for dental casts and panaromic radiographs. Am J orthod Dentofacial Orthop; 114: 530-532, 2000.

29. Taner TU, Haydar B, Kavuklu I, Korkmaz A. Short-term effects of fiberotomy on relapse of anterior crowding. Am J Orthod Dentofac Orthop; 118: 617-623, 2000.

30. Bondemark L, Holm AK, Hansen K, A xelsson S, Mohlin B, Brattstrom V, *et al*. Long-term stability of orthodontic treatment and patient satisfaction. A systematic review. Angle Orthod; 77: 181-91, 2007.

31. Alexander SA. Effects of orthodontic attachments on the gingival health of permanent second molars. Am J Orthod Dentofacial Orthop; 100: 337-340, 1991.

32. Sadowsky C, BeGole EA. Long-term effects of orthodontic treatment on periodontal health. Am J Orthod; 80: 156-172, 1981.

33. Schwarz AM. Tissue changes incidental to orthodontic tooth movement. Int J Orthod; 18: 331-352, 1932.

34. Levin L, Samorodnitzky-Naveh GR, Machtei EE. The association of orthodontic treatment and fixed retainers with gingival health. J Periodontol; 79: 2087-2092, 2008.

35. Renkema AM, Fudalej PS, Renkema AAP, Abbas F, Bronkhorst E, Katsaros C. Gingival labial recessions in orthodontically treated and untreated individuals: a pilot case-control study. J Clin Periodontol; 40: 631-637, 2013.

36. Mattick CR, Mitchell L, Chadwick SM, Wright J. Fluoride-releasing elastomeric modules reduce decalcification: a randomized controlled trial. J Orthod; 28: 217-219, 2001.

37. Rouleau BD, Marshall GW, Cooley RO. Enamel surface evaluations after clinical treatment and removal of orthodontic brackets. Am J Orthod; 81: 423-426, 1982.

38. Rashid F, Dent M. Possible adverse tissue reactions related to orthodontic treatment. Pak Oral Dent J; 32: 96-98, 2012.