

Influence Of Orthodontic Therapy On Periodontal Health: A Review

Abstract

Periodontic and orthodontic interactions usually deal with the establishment of an appropriate diagnosis and the treatment planning needed to enable coordinated perio-ortho therapy. These interactions are mutually beneficial, allowing diseased periodontium to be significantly improved and permitting orthodontic tooth movement. The purpose of this review is to discuss in detail the various orthodontic movements that can afford some degree of protection against the periodontal breakdown provided periodontal inflammation is controlled and oral hygiene is maintained through out the treatment.

Key Words

orthodontic movements, periodontium, ortho-perio interactions, review

Introduction

Every orthodontic intervention has periodontal dimension as all orthodontic movements are strongly related to interactions of teeth with their supportive periodontal tissues. In recent years, because of the increased number of adult patients seeking orthodontic treatment, orthodontists frequently face patients with periodontal problems. Furthermore orthodontics may be a mode of treatment when periodontally involved teeth are repositioned. Some of the bone changes induced during tooth movement may be potentially osteogenic and alter bone deformities and contours. The reasons for instituting orthodontic treatment may be of greater significance, once chronic destructive periodontal disease has caused a significant pattern of loss of the periodontal supporting structure. At this point secondary occlusal trauma may further complicate an already difficult problem. The periodontal prognosis and the elimination of pockets are influenced by the topography of the underlying bone and any intraosseous deformities^[1]. It has been proposed that orthodontic treatment may be used to attain more favourable bone levels and contours in periodontally involved cases through mechanisms such as increased ease of plaque removal, reduced occlusal trauma and offer a possible action to enhance the bone formation within the bony defects^{[2],[3],[4]}. Much of the literature is there regarding the interrelationship between orthodontics and periodontics^{[3],[5],[6],[7]} but very few studies have discussed the effect of individual orthodontic movements on periodontium in detail^{[8],[9]}.

The purpose of this article is to discuss in detail the various orthodontic movements that can offer some degree of protection against periodontal breakdown.

Correction of crowding;

One possible justification for orthodontic treatment is that irregular teeth are more difficult to clean and therefore predisposed to gingivitis and so aligning the crowded or malposed teeth permit the patient better access to clean all the surfaces of their teeth properly. This could be tremendous advantage for patients who are susceptible to periodontal bone loss or do not have the dexterity to maintain their oral hygiene. Food impactions, both vertical and lateral, may be reduced or eliminated by the creation of proper arch form and proximal contact. Besides this malposed or rotated teeth may be predisposed to more rapid breakdown of the periodontium when the roots are too close to one another, resulting in a thin interproximal septum. Since a rotated tooth may have a portion of the root out of the alveolar housing, there is a great possibility of such a tooth having a dehiscence or fenestration and more readily succumbing to periodontal insults. Correction of the rotation of such a tooth may be therapeutic or prophylactic^[3]. A strong relationship between the abnormal positions of the teeth in the dental arch and the periodontal disorders had been previously describe^{[10],[11],[12],[13]}. Buckley^[11] found that individual tooth irregularity had a low, but statistically significant

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correlation with plaque and gingival inflammation in a group of 300 teenagers, although he considered that the likely sequence was that crowded and irregular teeth facilitated the accumulation of bacterial plaque and then indirectly contributed to gingival inflammation. Stauffer and Landmesser^[14] concluded that an anterior crowding > 3 mm (threshold value) as an individual "host factor" represents a cumulative risk potential for chronic inflammatory processes whose consequences are manifested only at a higher age. Moreover, it had been shown that the number of periodontal pathogens in the anterior sites of crowded teeth is much greater than that in the sites of aligned teeth and gingivitis is generally associated with crowding^[15]. The correction of the crowding can eliminate any harmful occlusal interference which may hasten the development of a periodontal breakdown^[16]. Diedrich, 2000 listed the following positive periodontal effects which can be expected from correction of orthodontic crowding : better access for oral hygiene, improved morphology of soft and hard periodontal tissues; future research has to substantiate the value of this benefit, simplified mechanical and surgical therapy (scaling, root planing, curettage) and more favorable conditions for periodontal regeneration^[4].

Uprighting;

A useful application of orthodontics in the periodontally involved dentition is the restoration of suitable inclination of molars that have tilted. Apart from producing a suitable abutment for prosthesis, this procedure also has a stimulatory effect on the periodontal attachment^[21]. Generally, during orthodontic movement, the entire periodontal attachment apparatus, including the osseous structure, periodontal ligament and the soft tissue components move together with the tooth^[17]. The extrusive component is the key factor in uprighting of tipped molars with a mesial angular bony lesion. In these situations, moving the tooth away from the osseous defect in a distoocclusal direction shallows out the slanted contour of the alveolar crest^[21,18]. Because of the tension of collagen fibers in the periodontal ligament, the alveolar bone follows the moving tooth on the mesial side, with the level of connective tissue attachment remaining unchanged. Therefore, the bone on the mesial sides erupts as the molar tips distally. Significant evidence shows that drawing mesially inclined molars upright reduces pocket depth and improves altered bone morphology^{[18],[19],[20],[21]}. Brown^[2] studied the effect of uprighting molars on the periodontium in four patients. Seven months following the initiation of treatment, the associated pocketing at uprighted molars had 2.5 mm greater pocket depth reduction than the one control tooth. Moreover, improvement of gingival architecture and less plaque accumulation on the uprighted teeth were also noted. Similarly in a follow-up study on 22 patients with uprighted mandibular molars after an average of 3.5 years, Kraal et al.^[22] reported that pockets on the mesial surfaces were shallower on the uprighted teeth than on the control teeth. In a double-blind molar uprighting study bacterial samples were taken from the mesial pockets of molars to be uprighted (experimental tooth) and from the contralateral mesially inclined molar that served as the control in each subject. During the study no scaling, root planning or subgingival inflammatory control was used. This study revealed that in all experimental sites that showed these microorganisms at the time of bonding, the number had diminished significantly by the end of treatment^[23]. In another clinical study, Wehrbein and Diedrich^[24] examined the effects of molar uprighting. Five parameters - probing depth, bone level, plaque index, sulcus

bleeding index, and tooth mobility-were evaluated before, during, and after orthodontic correction. Because of better accessibility for oral hygiene especially in the mesial region of uprighted molar, a significant decrease in probing depth, plaque accumulation, and sulcus bleeding was found. Comparison of pre orthodontic and post orthodontic findings revealed that tooth mobility too was significantly reduced, with the attachment level remaining unchanged. The reduction in tooth mobility may be explained by the improved tooth position against occlusal forces.

Extrusion;

Movement of a tooth by extrusion involves applying traction forces in all regions of the periodontal ligament to stimulate marginal apposition of crestal bone. Because the gingival tissue is attached to the root by connective tissue, the gingiva follows the vertical movement of the root during the extrusion process. Similarly, the alveolus is attached to the root by the periodontal ligament and is in turn pulled along by the movement of the root. During the orthodontic tooth movement it is very important for the periodontal tissues to be in a balanced situation along with the tooth at the cervical areas. The extrusive tooth movement leads to a coronal positioning of intact connective tissue attachment and the bony defect is shallowed out. In a recent study, Pikdoken et al.^[25] reported that the extrusion of mandibular incisors resulted in displacement of gingival margin and the mucogingival junction by 80% and 52.5% respectively, out of total amount of extrusion. There have been reported cases of localized juvenile periodontitis in which eruption of teeth reduced probing depths^{[26],[27]}. Others have described the benefits of forced vertical eruption in the exposure of tooth structure to facilitate prosthetic treatment in healthy periodontium^[28]. It has been postulated that tooth extrusion and periodontal treatment can be effective for improving alveolar bone defects, gingival esthetics, and the crown-root ratio in patients with one- or two-wall isolated vertical infrabony defects^{[19],[21],[29],[30]}. The orthodontically induced improvement of the crestal bone structure has been reported in some animal experiments also^{[17],[31]}. The use of extrusive and intrusive forces in healthy periodontium has been studied in animals with favourable results in the presence of

oral hygiene^[32]. Dannan et al.^[33] carried out a study to investigate whether orthodontic extrusion movements have negative effects on the periodontal tissues, and to detect the relationship between orthodontic tooth extrusion and the width of the keratinized gingiva. They concluded that no negative effects on the periodontal tissues were noted around the canines during the application of orthodontic tooth extrusion. A very slight increase of the keratinized gingiva width was detected at the examined teeth after 6 months comparing to baseline without any statistical significance.

Bodily orthodontic movements into a bony defect;

It has been suggested that orthodontic tooth movement into infrabony defects can result in healing and regeneration of the tooth attachment apparatus. Moving a tooth bodily into a periodontal defect has been believed to 'carry the bone' along with the tooth resulting in improvement of the defect. This could improve adjacent tooth position before implant placement or tooth replacement. In a histological study concerning the same concept, it had been shown that moving the tooth into infrabony defect resulted in a long epithelial attachment on the roots, with no creation of a new attachment apparatus^[34]. A recent clinical trial on 10 subjects has shown that orthodontic tooth movement towards the infrabony defect combined with intrusion and surgical periodontal therapy results in significant clinical attachment gain and in radiographic bone fill^[35]. On the other side, one study reported that bodily tooth movement may increase the rate of destruction of the connective tissue attachment of teeth with inflamed infrabony defects^[36]. Carlos E. Nemcovsky^[37] carried out a study to determine whether orthodontic tooth movement into a bony defect created in rat molars influences periapical healing and findings suggested favourable effects of orthodontic tooth movement on restraining epithelial apical down-growth and decreasing pocket depth. However orthodontic treatment could not completely avoid formation of a long epithelial attachment. Therefore, periodontal regenerative surgery might be indicated prior to orthodontic tooth movement. Orthodontic movement, shortly after periodontal surgery, had no detrimental effect on periodontal soft tissue healing or on diminished but non-inflamed periodontal tissues.

Incisor Retraction;

Pathologic tooth migration, especially in the front region, is a frequent concomitant symptom of advanced periodontitis. Spaced elongated upper incisors with the corresponding negative effects on profile and lip posture often lead to considerable impairment of dentofacial esthetics. After initial periodontal therapy has been completed, it may be possible to reposition the teeth palatally through the deformity to the palatal bony wall, thus eliminating the bony deformity and significantly decreasing the pocket depth^[3]. Experimental studies have shown that alveolar bone height is reduced in areas of increased overjet and the labial bone will re-form in the area of a dehiscence when the tooth is retracted toward a proper positioning of the root within the alveolar process^{[38],[39]}. Lingual tooth movement will result in an increased buccolingual thickness of the tissue at the facial aspect of the tooth, which results in coronal migration of the soft tissue margin and hence decreased clinical crown height^[40]. It is therefore likely that the reduction in recession seen at a previously prominently positioned tooth, which has been moved into a more proper position in the alveolar process, is also accompanied with bone formation. Consequently, in cases with a thin gingiva caused by prominent position of the teeth, there is no need for a gingival augmentation procedure in advance of the orthodontic tooth movement. Neither, in the case of a recession type defect should a mucogingival surgical procedure, aimed at root coverage, be performed before the orthodontic therapy. The recession, as well as the dehiscence, may decrease as a consequence of the lingual movement of the tooth into a more proper position within the alveolar bone, and if still indicated at that time, the surgical procedure will have a higher predictability of success than if it was performed before the tooth movement^[41].

Orthodontic Intrusion;

The orthodontic tooth intrusion used in some patients is considered to be a harmful procedure which may negatively affect the periodontal tissues. A non-controlled intrusive force may result in root resorption, pulp disorders, alveolar bone resorption, a concentrated stress within the apical part of the ligament^{[42],[43]} and/or an increase in the periodontal bone

defects. Intrusive movements can change the relationship between the cemento-enamel junction and the alveolar crest which may produce an epithelial attachment along the root. Erkan et al.^[44] reported that during orthodontic intrusion of lower incisors in patients with intact periodontium, the gingival margin and the mucogingival junction moves apically 79% and 62% respectively of total intrusion. However, with poor oral hygiene during an orthodontic treatment, intrusion can initiate periodontal problems. It has been shown that intrusive forces usually change the position of dental plaque from supra-gingival sites to sub-gingival sites which may result in the formation of infra-bony defects and loss of connective tissue attachment^[45]. An increase of sub-gingival pathogens was also noted after teeth intrusion^[46]. The combination of orthodontic intrusion and periodontal treatment has been shown to improve reduced periodontal conditions in animals, provided oral hygiene is maintained and tissues are healthy^{[35],[47],[48],[49]}. According to Kessler^[3], intrusion of a periodontally involved tooth that has extruded is a distinct possibility and a very different situation than intrusion of a healthy nonextruded tooth. Intrusion of a tooth that has been extruded due to periodontal involvement, will re-establish the correct occlusal plane and may produce a greater bone level. Intrusion is best accomplished when it is achieved coincident with another movement, such as lingual or labial movement and not when mechanics are designed to achieve only pure depression^[3]. Intrusion of incisors in adult patients with marginal bone loss and deep overbite has been described with root resorption varying from 1-3 mm. It is suggested that intrusion is best performed with low forces (5-15g/tooth) and in the presence of gingival health^[50].

Incisors proclination;

Uncontrolled tipping in all the cases causes heavy forces at the alveolar crest resulting in severe destruction of epithelial attachment and crestal bone loss. Controlled tipping also produces heavy forces in the periodontal ligament as the fulcrum shifts more and more apically with increasing amount of bone loss. It has been suggested that proclination of the lower incisors results in gingival recession^{[51],[52],[53]}. Proclination is, however, a valuable alternative to extraction especially when considering

facial aesthetics in adult patients. Facial tooth movement, on the other hand, will result in a reduced thickness of soft tissue and bone and, thereby a reduced height of the free gingival portion and an increased clinical crown height^{[54],[55]}. However, recession type defects will not develop as long as the tooth is moved within the envelope of the alveolar process^[56].

Number of studies conducted in the recent past have concluded that orthodontic proclination is unlikely to affect recession, rather other factors may also account for recession, including variation of oral hygiene practice and adequate soft tissue covering^{[57],[58],[59]}. Vassalli et al.^[60] carried out a systematic review and concluded that the amount of recession found in studies with statistically significant differences between proclined and non-proclined incisors is small and the clinical consequence questionable. Another systematic review found no association between appliance induced labial movement of mandibular incisors and gingival recession, rather other factors such as reduced thickness of free gingival margin, a narrow mandibular symphysis, inadequate plaque control and aggressive tooth brushing were identified which may lead to gingival recession after orthodontic tipping and/or translation movements^[61]. Orthodontic tooth movement alone as such, will not cause soft tissue recession, but the thin gingival which develops as a result of the facial tooth movement may serve as a predisposing factor for soft tissue defects in the presence of bacterial plaque and/or trauma caused by improper toothbrushing techniques^[55]. Based on these observations one should, therefore consider surgically increasing the buccolingual thickness of soft tissue before orthodontic treatment.^{[52],[55]}

Recent update in ortho-perio interactions Periodontic-orthodontic inter relationships is still a controversial topic as far as effects of orthodontic therapy on periodontal tissues is concerned. Although some systematic reviews indicate an absence of reliable evidence for the positive effects of orthodontic therapy on patient's periodontal status^{[62],[63]}, but some of the limitations suggested by the authors of these reviews were; the potential for bias of the identified studies, low number of included studies, the inability to determine the mechanisms by which

orthodontic treatment caused the periodontal effects and also inability to determine whether adverse changes are due to site-specific changes (molar bands) or host specific changes (oral hygiene habits) and the kind of periodontal outcomes that were assessed. Gkantidis et al,^[9] in a systematic review concluded that orthodontic therapy can expand the possibilities of periodontal therapy in certain patients, contributing to control of microbiodata, reducing the potentially hazardous forces applied to teeth and finally improving the overall prognosis. Other recent systematic reviews^{[60],[61]} attributed other factors besides orthodontic treatment to be the cause of decrease periodontal health after orthodontic treatment. So further research is needed to assess the association between type of orthodontic therapy imparted and periodontal health.

Conclusion

With the large number of adult patients seeking orthodontic treatment, integrating orthodontics and periodontics in the management of adult patients with underlying periodontal defects is very important. The key to treating these patients is proper diagnosis and appropriate risk assessment before orthodontic therapy as well as close collaboration between orthodontist and periodontist during orthodontic treatment. A positive outcome with adjunctive orthodontic treatment is achievable in patients with periodontitis as long as physiological forces are used, periodontal inflammation is controlled and meticulous oral hygiene is maintained. Furthermore specific periodontal problems may be better managed through adjunctive orthodontic treatment, following successful control of the periodontal inflammation.

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