Basics in Periodontic-Orthodontic Interrelationships; a Review

Author

Dr. Aous Dannan (D.D.S, M.Sc.)
Department of Periodontology
Faculty of Dental Medicine
Witten/Herdecke University
Witten-Germany

Corresponding author's address

Dr. Aous Dannan
Breite Str. 94
58452 Witten
Deutschland

Tel: +49-(0)2302-1795268
Fax: +49-(0)2302-1795267
Email: aousdannan@yahoo.com
Abstract

It is well established that the patients who undergo orthodontic treatment have a high susceptibility to present plaque accumulation on their teeth because of the presence of brackets, wires and/or other orthodontic elements on the teeth surfaces with which the oral hygiene procedures might be more difficult. The considerable variance of the design and the material characteristics of orthodontic elements may also play an important role in this field. The orthodontic treatment is a double-action procedure, regarding the periodontal tissues, which may be sometimes very meaningful in increasing the periodontal health status, and may be sometimes a harmful procedure which can be followed by several types of periodontal complications, namely: gingival recessions, bone dehiscences, gingival invaginations and/or the formation of gingival pockets.

In this review, some initial concepts and past documented basics concerning the periodontic-orthodontic interrelationships were demonstrated after categorized as follows:

1- Adverse effects of orthodontic procedures on the periodontal tissues;
2- How could orthodontic procedures afford some degree of protection against periodontal breakdown?
3- The relationship between orthodontic treatment and oral hygiene.

Key Words: oral hygiene, orthodontic treatment, periodontal tissues.
1- Adverse effects of orthodontic procedures on the periodontal tissues

All evidence-based literature concerning the orthodontic - periodontic relationships show that a good orthodontic treatment of patients, who have excellent oral hygiene and do not suffer any periodontal breakdown, is a non-harmful treatment for the periodontium, it has been also demonstrated that a diminished oral hygiene in corporation with periodontal disorder would make the orthodontic treatment a real high risk for the periodontium (1). Darwish MA et al. 2007 (2) conducted a clinical study aimed at detecting the reaction of the periodontal tissues to some orthodontic retraction techniques applied by means of (Ricketts) springs, (Power Chain) and (Lace Back) in order to find out whether a "specific" orthodontic technique has "specific" negative effects on the periodontium, and it has been shown that the periodontal tissues did not demonstrate any inflammatorical reactions which could be considered specific to every single type of the canine retraction techniques. Otherwise, familiar different signs of gingival inflammation, bleeding on probing and an increase of the probing depth could be all remarkable as a consequence to plaque accumulation produced because of the difficulties in keeping the teeth free of plaque. This plaque accumulation is a result of the nature of the orthodontic wires and brackets, as well as the failure of the patient to correctly follow the oral hygiene instructions.

A patient with a past history of previous periodontitis obviously is, always, more susceptible to develop the disease once again in the future. Therefore, It is not recommended to begin any orthodontic treatment if active destructive sites are present, and a person who has had periodontal disease in the past should be monitored more closely to prevent new bursts of active sites which may in turn result in rapid bone loss during the orthodontic treatment.
Clinically, there are ranges of force that are biologically acceptable to the periodontium. The root length and configuration, the quantity of bone support, the point of force application and the center of rotation come into play to determine stress areas in the periodontal ligament. To prevent tissue damage, it is important to consider areas of maximal stress that might occur in the periodontal ligament. The risk of bone loss is always higher when inflamed connective tissues are located apical to the crestal alveolar bone. Moreover, certain types of orthodontic force may aggravate the progression of inflammatory periodontal disease (3). Those facts are documented through many animal studies which have shown that periodontal disease in a periodontal ligament under stress, where infectious inflammatory infiltration already existed, spreads from the epithelial aspect into the transseptal ligament. A complete destruction of the transseptal ligament had been shown within 28 days (4).

The gingival inflammation, hyperplasia and the periodontal pathogens:

Besides decalcification, leading to white spots and eventually caries, many past studies mentioned that several types of gingivitis, periodontitis, gingival recession and the formation of gingival pockets had been noted during and / or after the orthodontic treatment (5-8). On the other hand, during any orthodontic treatment, a slight to moderate degree of gingival overgrowth might be seen (9-11). This can be explained by the accumulation of plaque on the teeth surfaces and the increase of periodontal pathogens consequently. Interruption of the orthodontic treatment is often advised when a hyperplastic/ hypertrophic form of gingivitis is diagnosed. However, gingival hyperplasia usually resolves itself or responds to plaque removal, curettage or both. Should the gingival tissue or enlargement interfere with tooth movement, however, it must be removed surgically. Otherwise, it is preferable to wait until
the orthodontic appliances are removed to correct surgically abnormal gingival form and to use the procedure to enhance post-treatment stability.

It has been also shown that different species of bacteria such as *Bacterioids intermedius*, *spirochetes*, *motile roads*, *B.forsythus*, *T.dentcola*, *P.nigrescens*, *C.rectus* and *fusiform* Bacteria were considered to increase more frequently in the dental plaque of patients undergo orthodontic treatment (11).

In a more recent study (12), the influence of the orthodontic bracket design on microbial and periodontal parameters in vivo had been tested, especially two types of brackets: Speeds® (S) and GAC® (G), and it has been shown that the shift from aerobic to anaerobic bacterial species was observed earlier in S-sites than in G-sites, and it was concluded that bracket design can have a significant impact on the bacterial load and on the periodontal parameters.

**Mucogingival considerations:**

An adequate amount of attached gingiva is necessary for gingival health and to allow appliances (functional or orthopedic) to deliver orthodontic treatment without causing bone loss and gingival recession. Clinical experiments and animal studies have shown that clinically recognizable inflammation occurs in regions with a lack of attached gingiva than in areas with a wider zone of attached gingiva. With labial bodily movement, incisors showed apical displacement of the gingival margin, but no loss of connective tissue attachment was apparent where there were no signs of inflammation. Where inflammation was present, loss of connective tissue attachment occurred (13). Therefore if the tooth movement is expected to result in a reduction of soft tissue thickness and an alveolar bone dehiscence may have occurred in the presence of inflammation, gingival recession is a risk.

Thin, delicate tissue is far more prone to exhibit recession during orthodontic treatment than in normal or thick tissue. If a minimal zone of attached gingiva or thin tissue exists, a free
gingival graft that enhances the type of tissue around the tooth helps control inflammation.

This should be done before any orthodontic movement is begun.

The occurrence of gingival invagination:

Tooth extraction is considered to be a frequently needed procedure when planning most orthodontic treatments, especially those which aim at correcting the insufficient space disorders in the upper and the lower jaws and/or some other aesthetic and occlusal problems. The first premolars - and sometimes the second premolars - in either the upper or the lower jaw are usually the first choice when extraction becomes a part of the whole orthodontic treatment plan.

Gingival invaginations are defined as superficial changes in the shape of gingiva which arise after moving the teeth orthodontically in order to close the spaces resulted from extraction procedures. Gingival invaginations vary from slight fissures located in the keratinized gingiva to deep gaps crossing the interdental papilla buccally or lingually through the alveolar bone deeply.

The exact reason for gingival invaginations is still unknown. One expected reason could be the break up of the continuity of the fiber models within the gingiva, and also the movement of the root. However, other studies suggest the gingival peeling as a reason for these gingival invaginations were noted in 35% of cases after orthodontic space closure procedures. Histological and histo-chemical specimens taken from sites of gingival invagination showed hypertrophy in the epithelial and the connective tissues, and sometimes, loss of gingival collagen.

As the gingival invaginations offer good sites in which the dental plaque can be easily embedded, the researchers considered these changes in the gingiva as risk factors for the periodontal tissue disorders.
The gingival recession:

The gingival recession has been shown to be a common adverse effect during and/or after the orthodontic treatment. This effect has been noted more frequently after the application of . If the orthodontic tooth movement is in a labial direction, this (22)buccal ortho-movement area may require a soft tissue graft. For best esthetics in the anterior areas, a connective tissue graft is preferred. If teeth that have thin tissue are going to be moved lingually, there is a . If no orthodontic treatment is planned for children adolescents, areas of thin gingival tissues should be monitored only periodically as the width of the attached gingiva generally increases with .(24)normal growth from the mixed to the permanent dentition

Most gingival recessions which occur during an orthodontic treatment had been shown to occur in the regions of the anterior upper and lower teeth (25-28). However, there are few studies showed no features of gingival recession after an orthodontic treatment. Steiner and his colleagues (29) mentioned that the gingival recessions noted after an orthodontic treatment tend to occur in the regions were the keratinized gingiva and the underlying bone tissues are thin.

An expected relationship could be established between (Tipping) orthodontic movements and gingival recession. However, this relationship is still- to date- controversial. In a study of Batenhorst (30), gingival recessions and bone dehiscences after orthodontic tipping of the lower incisors in monkeys had been recorded. In other studies, no real gingival recessions or muco-gingival defects had been recorded after orthodontic tipping of the incisors (23, 31-33). Moreover, no relationship between the degrees of tipping (proclination) and the gingival recessions had been noted in those studies.
Orthodontic Intrusion:

The orthodontic tooth intrusion used in some orthodontic treatments is considered to be a harmful procedure which may negatively affect the periodontal tissues. A non-controlled intrusive force may be resulted in root resorption, pulp disorders (22), alveolar bone resorption, a concentrated stress within the apical part of the ligament (34) and/or an increase in the periodontal bone defects.

The effect of dental intrusion on the periodontium during an orthodontic treatment is still a controversial issue. Intrusive movements can change the relationship between the cemento-enamel conjunction and the alveolar crest which may produce an epithelial attachment along the root. With a 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 (35) which may be resulted in the formation of infra-bony defects and loss of connective tissue attachment. An increase of sub-gingival pathogens was also noted after teeth intrusion (36).

However, only few studies did not mention the formation of periodontal pockets after tooth intrusion (37). In another study (38), it has been shown that after the achievement of surgical periodontal therapy of upper teeth, the intrusive forces did not show any negative effects on the periodontium, and a reduction of probing depths was clearly noted.
2- How could orthodontic afford some degree of protection against periodontal breakdown?

A strong relationship between the abnormal positions of the teeth in the dental arch and the periodontal disorders had been previously described (39, 40).

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 (3). The correction of the crowded teeth can eliminate any harmful occlusal interference which may offer a great opportunity for the development of a periodontal breakdown (41). Those data definitely support the concept that orthodontic treatment can positively affect the periodontal health, prevent the development of periodontal diseases and offer a possible action to enhance the bone formation within the bony defects (42).

Significant evidence shows that drawing mesially inclined molars upright reduces pocket depth and improves altered bone morphology (43, 44). When mesially-inclined molars are uprighted, the connective tissue attachment on the mesial aspect of the molar to the crestal bone creates tension and allows for remodeling of the bone. Therefore, the bone on the mesial sides erupts as the molar tips distally.

**The orthodontic extrusion, eruption and uprighting:**

Extrusion, or eruption, of a tooth or several teeth, has been reported to reduce infrabony defects and decrease pocket depth (45, 46). Extrusion of an individual tooth is used specifically for correction of isolated periodontal osseous lesions. Studies have shown that eruption in the presence of gingival inflammation reduces bleeding on probing, decreases pocket depth and even causes the formation of new bone at the alveolar crest as tooth erupt.
Eruption or uprighting of molars without scaling and root planning in human patients has been shown to reduce the number of pathogenic bacteria.

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 (47).

**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. In addition, periodontists have believed that if a wide osseous defect is adjacent to a tooth and the tooth were moved to narrow the defect, better healing potential may be possible. On the other side, few studies had shown that bodily tooth movement may increase the rate of destruction of the connective tissue attachment of teeth with inflamed infrabony defects (48). In a histological study concerning the same concept, it had been shown that moving the tooth into infrabony defect was resulted in a long epithelial attachment on the roots, with no creation of a new attachment apparatus (49).
3- The orthodontic treatment and oral hygiene

A high standard of oral hygiene is essential for patients undergoing orthodontic treatment. Without good oral hygiene, plaque accumulates around the orthodontic appliance, causing gingivitis and, in some cases, periodontal breakdown. To avoid such problems, the orthodontist has a double obligation: to advise the patient about methods of plaque control and, at routine visits, to monitor the effectiveness of the oral-hygiene regime. However, despite receiving appropriate advice, many patients undergoing orthodontic treatment fail to maintain an adequate standard of plaque control. It is important that the orthodontist is able to communicate the importance of oral hygiene to motivate patients to maintain a satisfactory standard of oral hygiene during orthodontic treatment.

Before any orthodontic treatment an initial diagnosis and referral for treatment to control active periodontal disease is to be considered. Moreover, all general, dental and periodontal treatment should be completed before the orthodontic treatment.

Once the orthodontic appliances are placed, the patients need to be instructed in how to manage the new oral environment and how to maintain the health of the dental and periodontal structures. The orthodontist has to provide the patient with initial brushing instructions with either a conventional toothbrush or a powered one when the appliances are first placed. However, if the orthodontists correctly advise their patients to follow proper oral hygiene instructions during the orthodontic treatment is still an opened question. In a limited questionnaire among Syrian orthodontists, Dannan (50) has shown that the concept of establishing high level of oral hygiene in patients during orthodontic treatment was still not really understood and that further education for orthodontists in this field is still needed.

Manual tooth brushing, one of the oldest methods of plaque removal, remains the basis of oral hygiene and plaque control. It is often used as the standard or control against which other methods of plaque removal are assessed (51, 52). Instruction should emphasize the need to
use sufficient pressure to remove plaque; a pressure sensitive toothbrush would be a valuable aid to patients undergoing orthodontic treatment.

Chlorhexidine mouthwashes, as an adjunct to tooth brushing, have been found effective in the control of gingival inflammation (53), although prolonged use may cause problems with staining as Chlorhexidine rinses can potentially stain the margins of composite restorations that cannot be easily removed. More recently, pre-brushing rinses have been introduced, though these show no differences in effect on plaque accumulation or gingival health (54). Chlorhexidine is also useful for patients after orthognathic surgery, especially when intermaxillary fixation is to be used.

On the other hand, Fluoride mouth rinses significantly reduce the extent of enamel decalcification and gingival inflammation during orthodontic treatment (54-57).

A number of studies evaluated the effect of mechanical aids, as compared with manual tooth brushing, on oral hygiene in orthodontic patients (52, 53) and it has been shown that the use of electric toothbrushes brought a significant improvement in oral hygiene.

The orthodontist can follow some suggestions in order to improve plaque removal by the patient. Bonding of molars results in better periodontal health than banding. Whenever possible the use of single arch wires is recommended. The removal of excess composite around brackets, especially at the gingival margin, and avoiding the use of lingual appliances whenever possible are also important ideas in order to keep healthy periodontal tissue during any orthodontic treatment.
Conclusion

The orthodontic treatment is a procedure which has two ways of action on the periodontal tissues; it could afford some degree of protection of the periodontium and keep the gingiva, the bone and the periodontal ligament in a healthy status, but on the other hand, it could have negative effects on the periodontium such as gingivitis, gingival recessions and bone dehiscences.

However, a high level of oral hygiene should be achieved before, during and after any orthodontic treatment in order to prevent any side effects on the periodontal tissues.
References

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