

## Review Article

# ORTHODONTIC TREATMENT AND THE COMPROMISED PERIODONTAL PATIENT

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### ABSTRACT:

Significant development has taken in recent time in adult orthodontics. Orthodontic treatment is carried out through periodontium. So, healthy periodontium is considered to be a pre-requisite for orthodontic tooth movement. While past studies have shown that orthodontic treatment can positively affect the periodontal health, recent reviews indicate an absence of reliable evidence for the positive effects of orthodontic therapy on patients' periodontal status. Periodontic-orthodontic interrelationships are still controversial issues. However, a standard language between the periodontist and the orthodontist must always be established to eliminate the existing communications barrier, and to improve the outcomes of the whole treatment.

Key Words: Orthodontics, Peiodontitis, Oral Health, Periodontics.

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## INTRODUCTION

The demand for orthodontic treatment has been growing in the past few years, due to growing awareness and interest in general population for improving dental aesthetics and functionality. Adult orthodontics is increasing in popularity as it is becoming more feasible to move and improve teeth alignment, irrespective of the technique. Although a comprehensive orthodontic treatment cannot preclude the possibility of periodontal disease developing later, periodontal diagnosis and treatment can be a useful part of the overall treatment plan for a patient who could have periodontal involvement.<sup>1</sup> Orthodontic forces are known to produce mechanical damage and inflammatory reactions in the periodontium and dental pulp, as well as inflammatory mediators, e.g. prostaglandins, interleukin (IL)-1, IL-6, tumor necrosis factor  $\alpha$ , and receptor activator of nuclear factor  $\kappa$ B ligand, in the periodontal ligament (PDL) and dental pulp.<sup>2</sup> If the orthodontic movement is applied in a periodontal inflammatory/infectious process active state, there is a significant increase of the risk of insertion loss and

bone loss. Furthermore, if the periodontal inflammatory/infectious process returns to its active phase during the orthodontic treatment, the orthodontic movement per se is risky, and such risk might be accentuated by the compulsory occlusal trauma involved in the orthodontic correction process.<sup>3</sup>

The outcome of orthodontic treatment is influenced by the patient's periodontal status before, during and after active treatment. Patients with periodontal problems considering orthodontic treatment should be assessed in an interdisciplinary fashion with the restorative dentist, orthodontist and periodontist contributing to a comprehensive treatment plan.<sup>4</sup>

Thus, orthodontic treatment can be referred to as a two-edge sword, 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. However, this issue seems to be debatable. Present article is aimed to discuss orthodontics- periodontics inter-relationships.

### **CONTRIBUTIONS OF ORTHODONTICS IN THE PERIODONTICS<sup>5-8</sup>:**

- 1) It allows better oral hygiene by the patient, since it provides well shaped dental arches. Without dental crowding, malocclusion as a periodontal disease facilitator is eliminated;
- 2) It allows vertical occlusal impact parallels to the long axis of the teeth to distribute stress uniformly all over the dental arch;
- 3) Prosthetic rehabilitations, for a normal vertical dimension;
- 4) To achieve adequate dental crown-root relationship with induced orthodontic extrusion, with no bone loss;
- 5) It improves the positioning of prosthetic pillars for fixed prostheses and of the next teeth of osteointegrated
- 6) It facilitates that bone vertical defects are corrected or improved with dental uprighting;

### **PDL RESPONSE TO MECHANICAL FORCES**

The PDL lies between hard tissues such as the cementum and alveolar bone, where it functions as a cushion to withstand mechanical forces applied to teeth; thus it receives and responds to external forces. It is likely that PDL cells stimulated by forces of mastication, occlusal contact, and orthodontic treatment produce local factors that participate not only in the maintenance and remodeling of the ligament itself, but also in the metabolism of adjacent alveolar bone. Cyclo-oxygenase-2 is induced in PDL cells by cyclic mechanical stimulation and is responsible for the augmentation of PGE2 production.<sup>2</sup>

Several authors have demonstrated that compressive force upregulates RANKL expression and induction of COX-2 in human PDL cells in vitro. PDL cells under mechanical stress may induce osteoclastogenesis through up-regulation of RANKL expression via PGE2 synthesis during orthodontic tooth movement.<sup>9</sup>

Other studies, have shown that tooth movement induce increased recruitment of phagocytic cells.

Experimental studies have shown that when PGE1 was administered locally or systemically to rats, accelerated bone resorption and tooth movement were observed after the application of orthodontic forces. Therefore, PGs play an important role in orthodontic tooth movement.<sup>10</sup>

Shiotani et al. also showed the presence of RANKL in periodontal tissues during experimental tooth

movement of rat molars. Therefore it is suggested that RANKL is regulated by inflammatory cytokines in the PDL in response to mechanical stress.<sup>11</sup>

### **ADVERSE EFFECTS OF ORTHODONTIC PROCEDURES ON PERIODONTAL TISSUE**

#### **Gingivitis:**

The orthodontic patient's inability to clean adequately should be expected to contribute to the development of gingival inflammation. Gingivitis and gingival enlargement appear to be the main short-term effects of orthodontic treatments on the periodontium. It has been noted that gingival enlargement occurs after placement of a fixed appliance. The condition rapidly improves within 48 hours of the appliance being removed.<sup>12,13</sup>

#### **Root Resorption:**

Radiographs only provide a crude two-dimensional assessment of root resorption and accurate assessment can be assessed from a histological analysis of the root surface after orthodontic movement. These studies have shown that root resorption occurs in over 90 percent of the cases when a tooth root is compressed against the alveolar socket. Therefore, root resorption is a common sequel of orthodontic movement.

Recent studies have found that the presence or absence of hyaline in the periodontal ligament affects the incidence of root resorption. Hyalinization is a common sequel after a compressive load is placed on the periodontal ligament.<sup>14</sup> Hyalinization of the periodontal ligament usually occurs after a few days, and the hyaline may remain within the periodontal ligament up to four to eight weeks after initiation of the compressive load. During this time, resorption of the alveolar socket is virtually prevented, and undermining resorption of the alveolar bone may occur.<sup>11</sup> In addition, root resorption near the areas of hyalinization will occur. Since most of these resorption lacunae repair themselves with time, there is little or no radiographic evidence of root resorption in the majority of orthodontic patients. If the cementoblasts do not repair the resorption lacunae, patients may show moderate to severe root resorption. It is observed that root resorption stops after orthodontic treatment has been discontinued. Although there may be some remodeling of the irregular resorbed edges of the root with time due to reparative deposition of cellular cementum, this type of remodeling merely produces a smoother surface

long term. However the length of the root does not continue to shorten after orthodontic appliances have been removed.<sup>15-17</sup>

Researchers have tried to explore that If the patient requires further orthodontic treatment, will the roots continue to resorb? However, most orthodontists need to retreat patients who have had root resorption during an earlier phase of orthodontic treatment.

### **ORTHODONTIC TOOTH 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,<sup>18</sup> alveolar bone resorption, a concentrated stress within the apical part of the ligament<sup>19</sup> 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. 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<sup>20</sup> 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.<sup>21</sup> However, only a few studies did not mention the formation of periodontal pockets after tooth intrusion.

### **MICROBIOTA IN PATIENT UNDERGOING ORTHODONTIC TREATMENT**

Differences in the subgingival plaque of patients equipped with fix structures has been reported with *Tannerella forsythia* (*T. forsythia*), *Treponema denticola* (*T. denticola*) and *Prevotella nigrescens* (*P. nigrescens*) being the most common conditions. These results suggested that, following the implantation of orthodontic devices, an increase of periodontal- pathogen micro-organisms and gingivitis does occur but there was no substantial loss of attachments observed in the tissues.<sup>22</sup> Naranjo *et al.* observed a transformation of microorganisms populating the sub-gingival plaque, after the positioning of brackets, and a considerable increase of gingivitis in the test group. The level of *Porphyromonas gingivalis* (*P. gingivalis*), *Prevotella intermedia* (*P. intermedia*)/*P. nigrescens*, *T. forsythia* and *Fusobacterium* species increased after the

bracket positioning in patients treated, compared to that observed in the non-treated control group. Super-infectant microorganisms such as *Enterobacter cloacae* (*E. cloacae*), *Klebsiella oxytoca* (*K. oxytoca*), *Klebsiella pneumoniae* (*K. pneumoniae*) and *Serratia marcescens* (*S. marcescens*) were detected in the treated group.<sup>23</sup> Huser *et al.* performed clinical and bacteriological tests at the beginning of the treatment, and 90 days after the bonding was made, detected in treated patients an increase in plaque and bleeding in the bonded dental elements compared to those in control group. Furthermore, there was no increase in pocket depth. The composition of bacterial plaque showed significant growth in spirochaetes percentage, fusiform rods with motility and filaments in post-bonded sites, but no relevant differences were found in the flora of the control group.<sup>24</sup>

### **PERIODONTAL SURGERY FOR THE ORTHODONTIC PATIENT**

#### **Gingivectomy:**

Robiscek in 1884 and Zentler in 1918 described gingivectomy procedure in detail. The gingivectomy procedure that is followed today was described by Goldman in 1951.<sup>25</sup>

#### **Frenotomy:**

The maxillary labial frenum is a fold of tissue, usually triangular in shape, extending from the maxillary midline area of the gingiva to the vestibule and midportion of the upperlip. The failure of the attached frenal fibers to migrate apically results in a residual band of tissue in-between the maxillary central incisors, which has been implicated as an important cause of persistent midline diastemas. The residual frenal fibers which persist between the maxillary central incisors may also attach to the periosteum and internal connective tissue of the V-shaped intermaxillary suture. In 1939, Hirschfeld first called attention to the marginal attachment of the frenum as an etiologic factor in periodontal disease and recommended its excision. Thick frenum resists orthodontic forces and is responsible for relapse of space closure subsequent to orthodontic forces. In addition to creation of space between the maxillary central incisors, and thus creating an area for food impaction, the frenal tissues have been implicated with poor oral hygiene, due to difficulty in tooth brushing and the resultant inflammatory periodontal destruction. There is a definite paucity of detailed

clinical evidence directly correlating the existence of abnormal frenums (frenums which appear abnormally large and/or attached especially close to the gingival margin) and maxillary midline diastemas and consistently cause the relapse movement of orthodontically approximated incisors in a midline diastema situation.<sup>25</sup>

### **Frenectomy**

A maxillary midline frenectomy may be indicated to enhance post-treatment stability, particularly if there is a diastema with a large or broad frenum. It should be noted that a prominent labial frenum in the mixed dentition will often recede during growth to become clinically insignificant. A mandibular frenectomy may also be considered if associated with a mucogingival problem. Generally, a frenectomy procedure should be delayed until after alignment and space closure so as to prevent formation of scar tissue which can make space closure more difficult. A frenectomy can however be considered prior to space closure should the tissue prevent space closure, becomes painful or is traumatised (Edwards, 1977). Frenectomy, as described by Edwards, involves apical repositioning of the frenum with denudation of alveolar bone, destruction of the transeptal fibers, and gingivoplasty or recontouring of the labial or palatal gingival papilla in cases of excessive tissue accumulation. A simple incision is often used to allow access to the interdental area with the interdental fibrous tissue connection to the bone then removed. The frenum is then sutured at a higher level. Other techniques include simple excision, Z-plasty and laser removal.<sup>26-28</sup>

### **Gingival Grafting**

In several cases it is to defer gingival grafting until completion of orthodontic treatment, particularly if the exposed or prominent root can be orthodontically positioned more favourably within alveolar bone. Mucogingival surgery may be indicated in situations where a tooth which is planned for orthodontic movement has thin facial gingiva. By increasing the thickness of the covering tissue, the risk of gingival recession during or following orthodontic therapy should be reduced. Numerous grafting techniques have been advocated including free gingival grafts and inter-positional pedicle grafts (Lindhe, 1992). The free gingival graft (FGG) provides increased thickness of tissue and increased width of keratinised tissue. However the aesthetic result with the FGG

technique is poor. Root coverage with the FGG is unpredictable although this can be addressed via a second surgical procedure involving coronal repositioning of the augmented tissue. Pedicle grafts (laterally repositioned flap LRF and coronally repositioned flap CRF) are dependant on the presence of an adequate width of keratinized tissue either adjacent or apical to the defect. Both the LRF and CRF provide acceptable results in terms of tissue augmentation, aesthetics and root coverage. There is a risk however of induced gingival recession at the donor site with the LRF procedure.<sup>29-30</sup>

### **CONCLUSION**

As the orthodontic treatment of periodontally health patients, the orthodontic treatment of periodontally susceptible or compromised patients is multifactorial. So, we conclude by suggesting that the maintenance of healthy periodontal tissues throughout active orthodontic treatment is of paramount importance with non-surgical and surgical periodontal techniques often required to ensure that a healthy and aesthetic periodontium is achieved.

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