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REVIEW ARTICLE

ORTHODONTIC- PERIODONTIC INTERRELATION: AN OVERVIEW

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ABSTRACT

The relationship between periodontology and orthodontics consists of a highly complex, bidirectional and close interaction that is now a days characterized by controversial scientific opinions and clinical approaches. Biologic basis of the orthodontic tooth movement is the selective resorption and formation of alveolar bone around the tooth in response to application of pressure to the tooth for a prolonged period. These tooth movements are specifically related to interactions of the teeth with their supportive periodontal tissues; therefore, orthodontic tooth movement is basically periodontal ligament phenomenon. It appears that every orthodontic intervention has some kind of periodontal dimension. Therefore, to enable coordinated perio-ortho therapy, both the specialists should be involved in establishment of an appropriate diagnosis and treatment planning as well as for evaluation of the progress of treatment undertaken. In this review article, a harmonious and mutually beneficial relationship shared between these two specialities will be highlighted.

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INTRODUCTION

The combined Orthodontic-Periodontic treatment approach can greatly enhance the periodontal health and dentofacial aesthetics in many situations. The main aim of periodontal therapy is to restore and maintain the health and integrity of the attachment apparatus of teeth (Ong *et al.*, 1998). Orthodontic treatment aims at providing acceptable functional and aesthetic occlusion with appropriate tooth movements. These movements are strongly related to the interactions of teeth with their supportive periodontal tissues (Gkantidis *et al.*, 2010). Thus, Orthodontic treatment can be justified as a part of periodontal therapy, if it is used for reduction in plaque accumulation, correction of abnormal gingival and osseous topography, improvement of aesthetics by intruding and repositioning pathologically migrated teeth (Newman *et al.*, 2011). Thus, periodontic and orthodontic interactions usually deal with the establishment of an appropriate diagnosis and the treatment planning needed to enable coordinated periodontic-orthodontic therapy. Thereby, a harmonious cooperation of the periodontist and the orthodontist offers great possibilities for the treatment of various orthodontic-periodontal problems. The purpose of this article is to provide an update of the interrelationship between periodontics and orthodontics, particularly in adults.

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Periodontal tissue and orthodontic forces: During orthodontic therapy, teeth are moved as a consequence of controlled forces placed on teeth, which causes remodeling changes in the dental and periodontal tissues in the form of compression and stress of the alveolar bone and the periodontal ligament. The bone is selectively resorbed on the compressed side and deposited on the tension side. Similarly, in response to pressure, a tooth moves in first ten days followed by formation of an avascular cell-free zone (hyalinization) as a result of compression of the periodontal ligament (PDL). Once hyalinization occurs, the tooth stops moving, which can be initiated again with the removal of hyalinized area (Vinod *et al.*, 2012). The response of periodontal ligament to orthodontic forces varies with the amount of forces. Light orthodontic forces (\leq capillary blood pressure) cause periodontal ligament ischemia with simultaneous bone resorption and deposition resulting in continuous tooth movement. Moderate orthodontic forces (\geq capillary blood pressure) lead to periodontal ligament strangulation resulting in delayed bone resorption. Heavy orthodontic forces (forces far exceeding capillary blood pressure) cause ischemia and degeneration of the periodontal ligament on the compressed side resulting in hyalinization that prevents tooth movement in the intended direction. However, once the hyalinized zone is eliminated, tooth movement restarts (Meeran, 2013). Orthodontic bands, brackets and wires interferes the ability to maintain good oral hygiene as well as compromise the self-cleansing property of the dentition.

This may result in gingival inflammation, invagination/superficial changes in the shape of gingiva, enlargement and subsequently, loss of alveolar bone height (Fig. 1). Orthodontic attachments have the potential to cause plaque accumulation and increase the pathogenicity of the microbes (Sallum *et al.*, 2004; Newman *et al.*, 2011).

Orthodontic treatment as an adjunct to periodontal therapy: In many situations, orthodontic treatment can serve as an adjunct to periodontal therapy to improve oral function, as well as to provide acceptable aesthetics. Following are the few examples of such orthodontic treatment:

- J Aligning crowded or malposed maxillary or mandibular anterior teeth permit the adult patients better access to adequately clean all surfaces of their teeth. This could be a tremendous advantage for patients who are susceptible to alveolar bone loss or those who do not have the dexterity to adequately maintain their oral hygiene (Moyers *et al.*, 1998).
- J Vertical orthodontic tooth repositioning can improve certain types of osseous defects in periodontal patients. Often, the tooth movement eliminates the need for resective osseous surgery (Sallum *et al.*, 2004).
- J Orthodontic treatment can improve the relationship of the maxillary gingival marginal levels esthetically before restorative dentistry. Aligning the gingival margins orthodontically avoids gingival recontouring, which potentially could require bone removal and exposure of the roots of the teeth (Palomo *et al.*, 1988)
- J A patient who has suffered a severe fracture of maxillary anterior tooth requires forced eruption to permit adequate restoration of the root. In this situation, extruding the tooth allows the crown preparation to have sufficient resistance form and retention for the final restoration (Paolantonio *et al.*, 1999)
- J Protracted maxillary anterior teeth can cause loss of lip seal. This is usually a common cause for gingivitis. If the teeth are retracted orthodontically, lip seal is achieved and the gingivitis subsides (Moyers *et al.*, 1998).
- J Drifted teeth with abnormal proximal inclination causes periodontal problem because of difficulty in maintenance of oral hygiene. This can be corrected by orthodontic treatment (Mattingly *et al.*, 1983).
- J Extreme buccal and lingual position of teeth results in gingival recession and loss of attached gingiva. These can be brought to normal position by orthodontic repositioning of the teeth (Moyers *et al.*, 1998).
- J Orthodontic treatment allows open gingival embrasures to be corrected to regain lost papilla. Loss of papillary gingiva particularly in the maxillary anterior region appears unesthetic. This open gingival embrasures are corrected by the regaining of lost papilla, which is done through orthodontic therapy (Keim, 2001) (Fig. 2, I).
- J Drifting of teeth occurs to an adjacent edentulous space, when a person is having missing teeth for several years. That type of situation demands repositioning of the adjacent teeth before implant placement or tooth replacement, which can be carried out by Orthodontic treatment (Moyers *et al.*, 1998).

Periodontics as an adjunct to orthodontic treatment: To achieve a stable and esthetically acceptable outcome,

periodontal procedures are required on many occasions along with orthodontic therapy:

- J A high labial frenum attachment is considered to be a causative factor of midline diastema. Frenectomy is recommended in such cases as the fibres are thought to prevent the mesial migration of the central incisors (Gkantidis *et al.*, 2010) (Fig. 2, II).
- J Forced eruption of a labially or palatally impacted tooth is now a common orthodontic treatment procedure. Careful exposure of an impacted tooth with preservation of keratinized tissue is important to prevent loss of attachment. Thus, it demands the expertise of a Periodontist (Deepthi *et al.*, 2015). The same is applicable in case of excision of gingival tissue over the embedded tooth (Fig. 2, III)
- J Preservation of final orthodontic result is often considered as the third phase of overall orthodontic therapy and its major long-term goal. Post-orthodontic relapse has been mainly attributed to elasticity of gingival tissues that are compressed towards the direction of tooth movement. In order to enhance post-treatment stability attributed to soft periodontal fibres, many authors have suggested adjunctive interventions including circumferential fibrotomy of supracrestal gingival fibres particularly to prevent relapse in the maxillary arch. Again, it demands the expertise of a Periodontist (Deepthi *et al.*, 2015; Ahad *et al.*, 2016).
- J The lack of keratinized gingiva is one of the most common complications following orthodontic movement. Pre-orthodontic mucogingival surgery is indicated for teeth with an inadequate zone of keratinized gingiva, to prevent mucogingival involvement post-orthodontically, which is more difficult to treat (Ong *et al.*, 1998). Again, this situation demands the expertise of a Periodontist.
- J Crown lengthening procedures can facilitate easy placement of orthodontic attachments on teeth with short clinical crowns (Bhaskar *et al.*, 2013).
- J The dimension of the alveolar ridge is an important consideration prior to orthodontic tooth movement. Alveolar ridge augmentation using bone grafts, hydroxyapatite crystals and placements of dental implants are the other adjunctive periodontal treatment procedures sometimes undertaken to facilitate achievement of orthodontic treatment goals (Mattingly *et al.*, 1983; Paolantonio *et al.*, 1999, Newman *et al.*, 2011).
- J Loss of periodontal support is the most common factor in displacement of tooth from its original position. In such situation, orthodontic treatment is initiated only after periodontal disease is brought under control (Newman *et al.*, 2011).
- J The presence of healthy periodontal tissues is of vital importance for undertaking any kind of orthodontic or prosthetic therapy. In adult patients, even if periodontal tissues might be reduced and have compromised sustaining capacity, they should be free of inflammation. If any attempt of orthodontic treatment is made on inflamed periodontal tissues, it will aggravate the periodontal state and result in an iatrogenic damage (Newman *et al.*, 2011).

Periodontal aspects of adult orthodontic treatment: Periodontal problems are rarely a major concern during orthodontic treatment of children and adolescence, as the tissue

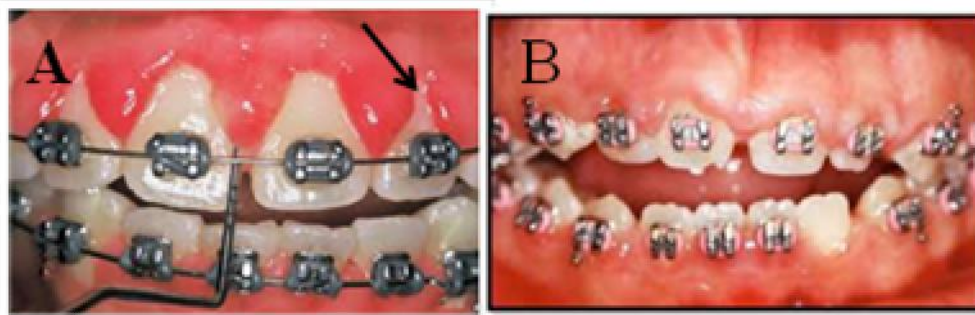


Figure 1.

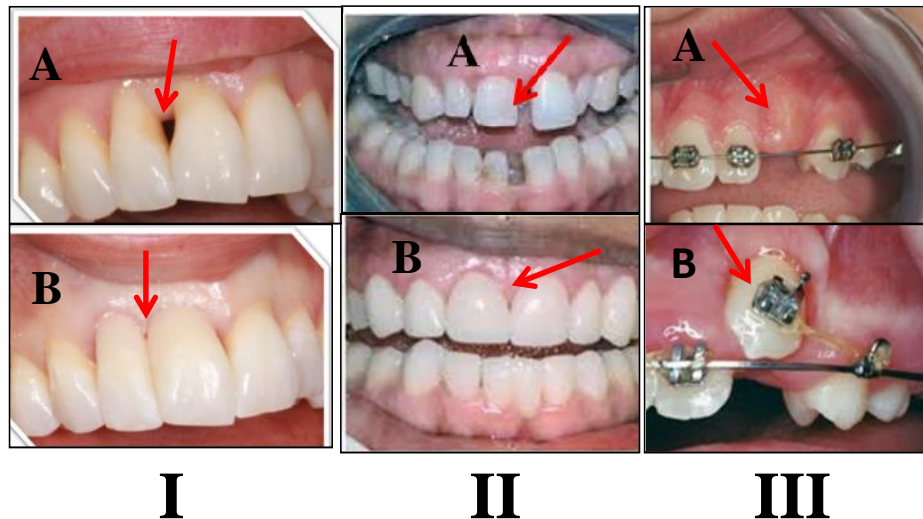


Figure 2.

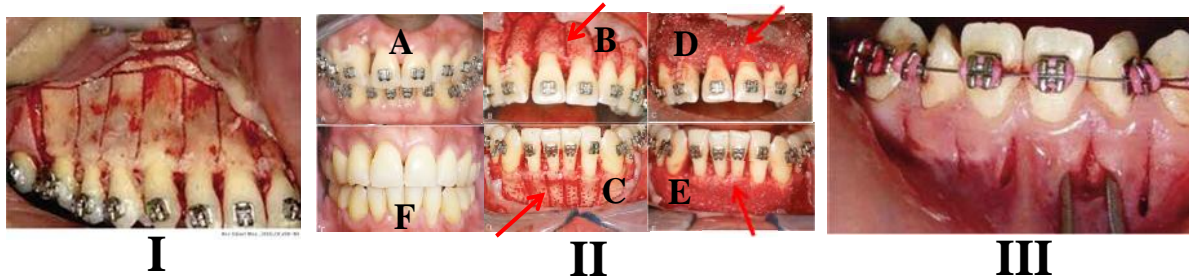


Figure 3.

resistance to irritation caused by orthodontic appliance is higher in younger patients. Recently, the number of adults seeking orthodontic treatment is increased markedly. In adult patients, the altered periodontal health might result in teeth loss, altered function and compromised aesthetics. Most of these patients present a variety of problems, which include teeth overeruption, migration, traumatic occlusion, irregular interdental spacing, attrited occlusal surfaces, irregular occlusal planes and loss of vertical dimension. Therefore, adult orthodontics need special attention in several aspects such as psychosocial, biological, mechanical, and age-related considerations such as the aging of tissues, lack of growth potential, vulnerability of TMJ disorder and root resorption (Mattingly *et al.*, 1983). As such, there are no contraindications to treat adult subjects with periodontal disease as long as the disease has been brought under control. Periodontal break down must be anticipated before treatment and the situation must receive major attention in planning and executing orthodontic treatment for all adults.

In such complex and challenging clinical situations, an interdisciplinary treatment is mandatory.

Again, the long duration of orthodontic treatment is a common complaint of a significant number of orthodontic patients. This leads to the development of new methods that accelerate orthodontic tooth movement through periodontal surgical procedures that has shortened the duration of orthodontic treatment with increased the quality of treatment. It includes Corticotomy-assisted orthodontic treatment (CAOT), periodontally accelerated osteogenic orthodontics (PAOO), Piezocision-assisted orthodontics.

Corticotomy-assisted orthodontic treatment (CAOT): Corticotomy-assisted orthodontics was first described by Bryan *et al.* in 1893 and first introduced by Henry Kole in 1959 and has been employed in various forms to accelerate tooth movement. In Corticotomy, continuity of the cortical bone is broken down by selectively cutting it using surgical burs without changing the medullary bone and

maintaining the vitality of the teeth along with keeping the marginal periodontium intact, which facilitates rapid teeth movement (Yaffee *et al.*, 1994; Diedrich, 2000; Hassan *et al.*, 2010). Full thickness buccal and lingual flaps are raised and vertical osseous grooves are made extending from apical to the interproximal margin beyond apices of the teeth, which are then connected by horizontal grooves (Patel *et al.*, 2014) (Fig. 3, I). In this regard, surgical techniques generate trauma in the alveolar bone to alter the physiological response and cause a local transitory increase in bone metabolism and a decrease in its density (Frost, 1983). This biological response is known as the Regional Acceleratory Phenomenon' (RAP) and has been associated with the acceleration of orthodontic tooth movement (Proffit & Fields, 2000). This procedure claims to have several advantages including reduced treatment time, expansion of the dental arch, increased traction of impacted teeth, less root resorption due to reduced resistance from cortical bone and added post orthodontic stability. It is very effective in Class I malocclusion with crowding, Class II malocclusions which requires expansion or extractions, and mild Class III malocclusions.

Periodontally Accelerated Osteogenic Orthodontics (PAOO)/ Wilckodontics: This technique was first introduced by Wilcko *et al.* in 2001. This is also called the Periodontally-accelerated osteogenic orthodontic (PAOO) procedure that involves elevation of a full-thickness labial and lingual flap accompanied by selective surgical scarring of the labial and lingual cortical bones (corticotomy) followed by placement of the graft material, surgical closure, and orthodontic force application (Fig. 3, II). Basically, tooth movement is achieved in lesser time compared to conventional treatment because of disruption of the cortical plates as cortical plates inhibit the tooth movement (Frost, 1983; Wilcko *et al.*, 2001). This technique is based on corticotomy-facilitated tooth movement, as described above. Orthodontic appliance is usually activated in the week before surgical procedure. Heavy orthodontic forces can be applied immediately after the flap repositioning and should not be delayed for more than 2 weeks after surgery. A delay in activation of the orthodontic appliance will fail to take full advantage of the RAP (Goyal *et al.* 2012). The time period for RAP usually lasts for 4-6 months. It creates rapid orthodontic tooth movement (two to three times faster) and reduces side effects like inadequate basal bone, root resorption, tooth devitalisation, periodontal infection and relapse (Murphy and Wilcko, 2009).

Piezocision-assisted Orthodontics: Since alveolar corticotomies are considered as an invasive technique, other alternatives to obtain RAP and consequent acceleration of orthodontic tooth movement have been proposed (Vercellotti and Podesta, 2007; Dibart *et al.*, 2009). In this regard, the use of a piezoelectric tip has been proposed as a substitute to surgical burs in an attempt to decrease the trauma, since it allows more accurate cuts, reducing the chances of developing osteonecrosis (Vercellotti and Podesta, 2007). Subsequently, techniques implementing decortication without raising mucoperiosteal flaps such as corticision, piezopuncture (Kim *et al.*, 2013) and micro-osteoperforations (Aksakalli *et al.*, 2014) have also been described. However, piezocision has gained more prominence in the literature.

Piezocision is a minimally invasive surgical procedure introduced by Dibart *et al.* in 2009. In this procedure, a microincision on buccal gingiva is performed to allow access

of the piezoelectric tip to the cortical bone in the interradicular regions and initiate RAP of 6 months duration (Dibart *et al.*, 2009) (Fig. 3, III). There is a three to four months window of opportunity to move teeth rapidly through the demineralized bone matrix before remineralization of the alveolar bone. Despite being considered minimally invasive, this technique allows the addition of bone or soft tissue grafts to correct bone deficiencies or gingival recessions (Dibart *et al.*, 2009). This procedure claims to have several advantages including less trauma with no osteonecrosis.

CONCLUSION

Periodontal health is essential for any form of dental treatment, especially for orthodontic treatment. Apart from establishing a functional occlusion and improving dental and facial aesthetics, one of the major objectives of orthodontic therapy is enhancement and maintenance of periodontal health. In contrast, it may produce deleterious effects on the periodontium that clinically manifest as gingivitis, gingival recessions, and bone dehiscences, *etc.* Due to increased number of adult orthodontic patient, orthodontist frequently encounters subjects with periodontal disease, where a combined Orthodontic-periodontic interdisciplinary approach could be more effective. Considering the higher prevalence of periodontal disease in adults, the adults undergoing orthodontic treatment may be reinforced with regular oral hygiene performance as well as periodontal maintenance in order to maintain the periodontal health during active orthodontic therapy. In this regard, a harmonious cooperation of the Periodontist and the orthodontist offers great prospects for the treatment of combined Orthodontic-periodontal problems. Those can be achieved through newer periodontal surgical procedures, namely PAOO and piezocision, which accelerates orthodontic tooth movement through regional acceleratory phenomenon.

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