OPEN ACCESS
Global Journal of Research in Dental Sciences
ISSN: 2583-2840 (Online)
Volume 05 | Issue 05 | Sept. – Oct. | 2025
Journal homepage: https://gjrpublication.com/gjrds/
Review Article

Perio – Ortho Inter Relationship

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DOI: 10.5281/zenodo.17376526 **Submission Date:** 30 Aug. 2025 | **Published Date:** 17 Oct. 2025

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Abstract

It is well established that the patients who undergo orthodontic treatment have a high susceptibility for plaque accumulation on their teeth because of the presence of brackets, wires and/or other orthodontic elements on the teeth surfaces which makes the oral hygiene procedures 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 including gingival recessions, bone dehiscence, gingival invaginations, and the formation of gingival pockets. A harmonious cooperation of the periodontist and the orthodontist offer great possibilities for the treatment of various orthodontic-periodontal problem. This review deals with how periodontal tissue reacts to orthodontic forces, influence of tooth movement on the periodontium, effect of circumferential supracrestal fiberotomy in preventing orthodontic relapse, effect of orthodontic bands on the periodontium, specific microbiology associated with orthodontic bands, mucogingival considerations and time relationship between orthodontic and periodontal therapy In addition, the relationship between orthodontics and implant restorations (e.g., using dental implants as orthodontic anchorage) will be discussed. Periodontic and orthodontic interactions usually deal with the establishment of an appropriate diagnosis and the treatment planning needed to enable coordinated periodontic-orthodontic therapy. A harmonious cooperation of the periodontist and the orthodontist offer great possibilities for the treatment of various orthodontic-periodontal problem.

Keywords: *Periodontics, Orthodontics, Periodontal tissue, Orthodontic forces, Retention.*

Introduction

It is well established that the patients who undergo orthodontic treatment have a high susceptibility for plaque accumulation on their teeth because of the presence of brackets, wires and/or other orthodontic elements on the teeth surfaces which makes the oral hygiene procedures 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 including gingival recessions, bone dehiscence, gingival invaginations, and the formation of gingival pockets. A harmonious cooperation of the periodontist and the orthodontist offer great possibilities for the treatment of various orthodontic-periodontal problem. This review deals with how periodontal tissue reacts to orthodontic forces, influence of tooth movement on the periodontium, effect of circumferential supracrestal fiberotomy in preventing orthodontic relapse, effect of orthodontic bands on the periodontium, specific microbiology associated with

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orthodontic bands, mucogingival considerations and time relationship between orthodontic and periodontal therapy In addition, the relationship between orthodontics and implant restorations (e.g., using dental implants as orthodontic anchorage) will be discussed. Periodontic and orthodontic interactions usually deal with the establishment of an appropriate diagnosis and the treatment planning needed to enable coordinated periodontic-orthodontic therapy. A harmonious cooperation of the periodontist and the orthodontist offer great possibilities for the treatment of various orthodontic-periodontal problem.

Theoretical framework

The primary objective of periodontal therapy is to restore and maintain the health and integrity of the attachment apparatus of teeth. In adults, the loss of teeth or periodontal support can result in pathological teeth migration involving either a single tooth or a group of teeth. This may result in the development of a median diastema or general spacing of the teeth with or without incisal proclination, rotation or tipping of bicuspids and molars with the collapse of the posterior occlusion and decreasing vertical dimension. Adjunctive orthodontic therapy is necessary to resolve these problems. Additionally, orthodontic therapy can facilitate management of several restorative and aesthetic problems/difficulties relating to fractured teeth, tipped abutment teeth, excess spacing, inadequate pontic space, malformed teeth, hypererupted incisors and diastema/frena as summarized

- Uprighting or repositioning teeth to improve parallelism of abutment teeth.
- Improving future pontic spaces.
- Correcting cross – bites.
- Extruding teeth (fractured teeth) / Intruding teeth (hyper erupted teeth).
- Correcting crowding of teeth.
- Achieving adequate embrasure space and proper root position.
- Repositioning teeth for placement of implants.
- Restoring lost vertical dimension.
- Increasing or decreasing overjet/overbite.
- Closure of diastemas.

Periodontal tissue response and Orthodontic forces

Tooth movement induced by orthodontic force is the result of placing controlled forces on teeth. The applied force causes remodelling changes in the dental and periodontal tissues. Orthodontic force application results in compression of the alveolar bone and the periodontal ligament on one side while the periodontal ligament is stretched on the opposite side. The bone is selectively resorbed on the compressed side and deposited on the tension side.

Light orthodontic force, i.e., force less than capillary blood pressure, causes periodontal ligament ischemia with simultaneous bone resorption and deposition resulting in continuous tooth movement. Moderate orthodontic forces, i.e., forces exceeding capillary blood pressure led to periodontal ligament strangulation resulting in delayed bone resorption. Strong/heavy orthodontic forces, i.e., forces far exceeding capillary blood pressure, cause ischemia, and degeneration of the periodontal ligament on the compressed side resulting in hyalinization with more delay in tooth movement.

The most common periodontal problems that can be solved by minor orthodontic procedures are mainly the correction of crowding, pathologic tooth migration, trauma from occlusion, mesially tilted molar, closure of midline diastema, etc.

Bone surrounding a tooth subjected to a force responds in the following manner: Burstone (1962) suggested that if the rates of tooth movement were plotted against time, there would be three phases Initial phase, Lag phase and Post lag phase. In the initial phase which is a period of very rapid movement, which occurs immediately after application of force to the teeth up on which teeth gets displaced with in the PDL space.

Immediately following initial phase, there is a lag period, where very low/no tooth movement happens and this lag phase is produced by the hyalinisation of PDL in areas of compression and there will be no further tooth movement until the hyalinised layer is degraded. Post Lag phase follows this stage and the rate of tooth movement gradually increases in this stage.

When pressure is applied to a tooth, there is an initial period of movement for six to eight days as the PDL is compressed. Compression of the PDL results in blood supply being cut off to an area of the PDL and this produces an avascular cell-free zone by a process termed "hyalinization". When hyalinization occurs, the tooth stops moving.

This delay in tooth movement varies from short, with the application of light forces, to long periods of time, with heavier forces. The hyalinized zone is eliminated by PDL regeneration that occurs from the reorganization of the area through resorption by the marrow spaces (undermining resorption) and adjacent areas of unaffected PDL and alveolar bone. Once the hyalinized zone is removed, tooth movement can occur again.

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Orthodontic treatment as an adjunct to periodontal therapy

In many situations, orthodontic treatment can serve as an adjunct to periodontal therapy. Various orthodontic treatments such as uprighting, intrusion, and rotation are performed to correct the pathologically migrated teeth that control further periodontal breakdown, improve oral function, and provide acceptable aesthetics.

These procedures should be performed only after controlling the periodontal disease. Although there is no consistent relation between malocclusion and periodontal disease, certain characteristics of malocclusion can promote a pathologic environment and hinder periodontal therapy. Correction of crowded or malposed teeth permit the patient better access to clean all the surfaces of his/her teeth. Food impactions are also reduced or eliminated by the creation of proper arch form and proximal contact.

Orthodontic uprighting of the tilted molars has several advantages: The distal movement tooth allows the deposition of alveolar bone on the mesial defect. This also eliminates the gingival folding and plaque retentive area on the mesial side.

Orthodontic extrusion of teeth may be indicated for shallowing out intraosseous defects and for increasing the clinical crown length of single teeth. Extrusion results in coronal positioning of intact connective tissue attachment along the tooth and the bone deposition.

Orthodontic intrusion has been recommended for teeth with horizontal bone defect or infrabony pockets.The intrusion of plaque-infected teeth may lead to apical displacement of supragingival plaque, which results in periodontal destruction.

Professional supragingival and subgingival scaling are important during the active phase of intrusion. Furcation defects require special attention during orthodontic treatment. They are difficult to maintain and can worsen during orthodontic treatment. In Class III furcation cases, a possible method for treating the furcation is by hemisecting the crown and root and pushing the roots apart may be advantageous.

The hemiseptal defects can be eliminated using uprighting, extrusion, and levelling of the bone defect. Bodily movement of the tooth into an intrabony defect has been believed to “carry the bone,” along with the tooth, that results in improvement of the defect. This could improve adjacent tooth position before placement of implant or tooth replacement. If the tooth is supraerupted with osseous defect, intrusion and levelling of the bone defect can help to eliminate these problems.

Moreover, it has 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. 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.

It has been suggested that orthodontic tooth movement into intrabony 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 teeth were moved to narrow the better healing potential may be present. should be parallel and performed with low orthodontic forces.

Crown lengthening is usually performed in teeth with shorter clinical crown to facilitate proper placement of orthodontic appliance. Crown lengthening is usually performed by gingivectomy or an apically repositioned flap in combination with gingivectomy prior to orthodontic bonding procedures. Pre orthodontic osseous surgery is mainly indicated for crater, hemiseptal defect, three-wall defect, and furcation lesion. Osseous craters are interproximal, two-wall defects that do not improve with orthodontic therapy alone. Some shallow craters (i.e., 4-5 mm pocket depth) can be maintained non surgically during orthodontic therapy. Large craters can be eliminated by reshaping the bony defect. This enhances the patient's ability to maintain these interproximal areas during orthodontic treatment. Three-wall defects are amenable to pocket reduction with regenerative periodontal therapy. Bone grafts are usually advised to fill these defects. If the result of periodontal therapy is stable, orthodontic treatment can be initiated 3-6 months after periodontal surgery Alveolar ridge augmentation and placement of implants for orthodontic retention are other adjunctive procedures performed to achieve orthodontic treatment goals. Gingival invaginations were usually noted after the orthodontic closure of extraction space. These invaginations act as a site for plaque retention and are considered as one of the risk factors for periodontal disease during orthodontic treatment. A surgical correction of these invaginations is usually performed to eliminate plaque accumulation. The gingival margin level of the six maxillary anterior teeth plays an important role in the aesthetic appearance of the crowns. Discrepancies in the gingival marginal level may be due to ectopic eruption of the tooth or due to altered position of the gingiva.

A combined orthodontic-periodontic interdisciplinary approach is usually preferred to correct these abnormalities. Missing interdental papilla are frequently referred to as gingival "black holes" and may be due toa number of factors such as over-divergence of adjacent roots and advanced periodontal disease with loss interdental alveolar crest.

An orthodontic periodontic interdisciplinary approach is usually advised to manage these problems.

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Relationship between orthodontic and periodontal therapy

It is generally recommended that orthodontics be preceded by periodontal therapy based on the belief that orthodontics in the presence of inflammation can lead to rapid and irreversible breakdown of the periodontium. Scaling, root planing (if necessary, by open flap debridement procedures for access) and gingival augmentation should be performed as appropriate before any tooth movement.

The corrective phase of periodontal therapy, i.e., osseous or pocket reduction/ elimination surgery ought to be delayed until the end of orthodontic therapy, because tooth movement may modify gingival and osseous morphology.

An adult orthodontic patient may be susceptible to periodontal disease. Therefore, close monitoring of marginal periodontal status during the active phase of orthodontic therapy is mandatory and appropriate supportive periodontal treatment instituted.

Microbiology and Orthodontic appliances

The orthodontic appliances create a favorable environment for the accumulation of microbiota and food residues, which may cause caries or periodontal disease.

Levels of P. gingivalis, P. intermedia/P. nigrescens, T. forsythia, and Fusobacterium species were significantly elevated after bracket placement. Super-infecting micro-organisms such as E. cloacae, K. oxytoca, K. pneumoniae, and S. marcescens were also found from areas of gingivitis in patients with and without fixed appliances:

T. forsythia, T. denticola, and P. nigrescens were more common in the orthodontic patients with a consequential increase in gingivitis.

Studies on polymerase chain reaction analysis for the presence of Porphyromonas gingivalis, Tannerella forsythia, Actinobacillus actinomycetemcomitans, Prevotella intermedia, and Prevotella nigrescen, showed that the elastomeric rings were associated with a higher score for plaque index and bleeding than steel ligatures and concluded that elastomeric rings promoted significant retention of the biofilm with clinical alterations on the plaque index and favored the peridontopathogens with a detrimental effect for the gingival conditions.

Local changes occur in the microbiota and periodontal tissues following placement of an orthodontic appliance. It was reported that there was increased plaque and bleeding scores on the banded teeth.

Tooth movement and implant aesthetics

There are mainly three areas where orthodontics plays a role in implant rehabilitation. The lack of adequate space for implant can be managed by orthodontic movement of the neighbouring teeth to an optimal position, which will allow redistribution of the available space in the dental arch and provide space for implant placement.

Selective orthodontic extrusion of a hopeless incisor or molar may be useful to improve the placement of a single tooth. Both the alveolar bone and periodontal tissues follow the extruded tooth, leading to bone formation in the direction of tooth movement.

The reduced buccolingual ridge thickness associated with extraction space shows difficulty in implant placement. It can be managed by orthodontic movement of the adjacent tooth to the edentulous space, which results in bone deposition along the tension side and the implant can be placed at the site of the orthodontically moved tooth. This is an alternative to surgical horizontal ridge augmentation.

Effect of orthodontic bands on the periodontium

a) Short – term: gingivitis and gingival hyperplasia not associated with loss of attachment in children.
b) Long – term: no effect in adults, some effect – loss of attachment in adolescents, root resorption in adults with increase in lactobacillus, motile organisms, anaerobes, prevotella intermedia and a decrease in facultative anaerobes.

PIEZOCISIONASSISTED ORTHODONTICS

Piezosurgery assisted orthodontics is a new minimally invasive surgical procedure introduced by Dibart in 2009. In this technique microincision is performed on the buccal gingiva that allows the piezoelectric knife to give osseous cuts to the buccal cortical plates and initiate RAP (regional acceleratory phenomenon).

This procedure provides rapid tooth movement without an extensive traumatic surgical approach and maintains the clinical benefit of the bone or soft tissue grafting, along with tunnel approach.

Piezosurgery works only on mineralized tissues, sparing soft tissues and producing micrometric and selective osteotomy cuts without any osteonecrosis. Compared to the classic decortication procedure, piezosurgery has added advantages such

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as being minimally invasive, safe, and less traumatic to the patients. Piezocision can also be combined with Invisalign in selected cases to produce outcomes that are less time-consuming as well as satisfy the patient's desire of aesthetic appliance.

Periodontally accelerated osteogenic orthodontics

Periodontally accelerated osteogenic orthodontic, also termed Wilckodontics, was introduced by Wilcko et al. in 2001. It is a revised corticotomy-facilitated technique, which involves a full-thickness labial and lingual flap elevation 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.

Rapid tooth movement associated with Periodontally accelerated osteogenic orthodontic is substantially different from periodontal ligament cell-mediated tooth movement. Recent evidence suggests that regionally accelerated phenomenon is a localized osteoporosis state, which occurs as a part of healing and may be responsible for rapid tooth movement associated with Periodontally accelerated osteogenic orthodontic.

The placement of orthodontic appliance and its activation are typically done in the week before surgical procedure. However, in complex mucogingival procedures, the absence of orthodontic appliance may enable easier soft tissue manipulation and suturing. A heavy orthodontic force immediately after surgery is usually recommended in this condition. The initiation of orthodontic force should not be delayed more than 2 weeks after surgery. The time for RAP usually lasts for 4-6 months. A delay in activation of the orthodontic appliance will fail to take full advantage of the regional acceleratory phenomenon.

Surgically accelerated modalities like selective alveolar decortication and periodontally accelerated osteogenesis orthodontics can be used as an adjunct to conventional approaches to accelerate orthodontic tooth movement with fewer adverse effects. It is a procedure where linear and punctuate decortications are made after reflecting the flap. The decortications should not impinge on root-PDL-cribriform plate complex and not extend to the alveolus crest. Accelerated orthodontic tooth movement occurs due to inflammation and wound healing processes that are evoked by surgical trauma to the alveolar bone. In addition, alveolar bone surgery may also stimulate the production of mesenchymal stem cells s in marrow cavities that function synergistically with neighbouring PDL and alveolar bone cells resulting in accelerated orthodontic tooth movement. Addition of bone graft to a tooth moving through a surgical wound increases bone mass and enhances long-term stability. The term popular is the "regional acceleratory phenomenon" with normal metabolic rate of inflammation and wound healing process is accelerated.

Retention in Orthodontics

Most orthodontic treatment results are potentially unstable and therefore retention is necessary for reorganization of the gingival and periodontal tissues when the appliances are removed.

Reorganization of PDL occurs over a 3 to 4 month period and even a slight mobility which is present during debonding gradually disappears. Prolonged imbalances arising from the tongue, lip and Cheek pressures associated with pressures from gingival fibers are resisted by active stabilization due to PDL metabolism.

Gingival fibre network are also disturbed by orthodontic tooth movement and must remodel to accommodate the new tooth positions. Gingival fibers comprise of both collagenous and elastic fibers.

Reitan (1959) stated that the gingival fibers reorganization occurs more slowly than the PDL fibers. These gingival fibers require four to six months of time for reorganization. Elastic supracrestal fibers around the teeth remodel extremely slowly and can displace a tooth more than a year after removal of orthodontic appliance.

Orthodontic relapse is primarily driven by the elastic recoil of gingival fibers and unbalanced tongue-lip pressures, causing teeth to regress toward their pretreatment positions. To manage this instability, retention is mandated for at least 12 months, beginning with a phase of daily, full-time wear (or the equivalent of 8 hours/day) for the first 3 to 4 months following fixed appliance removal. The retention appliance, whether a removable retainer worn outside of meals or a non-rigid fixed design, must allow for individual tooth flexibility to promote periodontal ligament (PDL) reorganization. After the initial intensive phase, wear can transition to part-time, but permanent retention is often necessary in non-growing patients where residual muscular forces are too great for active stabilization; growing patients, conversely, require retention until skeletal development reaches adult levels. Stability, in the absence of continued growth, is typically achieved within one to two years if it is to be achieved at all.

Acknowledgement

I am deeply grateful to the anonymous peer reviewers for their dedicated time and expertise. Their meticulous review process improved content and their expertise uphold scholarly standards, ensuring accuracy and relevance.

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Conclusion

Periodontal health is essential for any form of dental treatment, especially for orthodontic treatment.

Harmonious cooperation between the periodontist and the orthodontist offers great possibilities for the treatment of combined orthodontic-periodontal problems. Orthodontic treatment along with patient's compliance and absence of periodontal inflammation can provide satisfactory results.

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CITATION
Bondili, M. K., & Kolli, R. (2025). Perio – Ortho Inter Relationship. In Global Journal of Research in Dental Sciences (Vol. 5, Number 5, pp. 50–56). https://doi.org/10.5281/zenodo.17376526

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