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Rejuvenation of Periodotal Cases During Adult Orthodotic Tretment: A Review

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Abstract:
Introduction: *Orthodontic biomechanics and treatment planning are basically determined by periodontal factors. A magnificent orthodontic treatment can be destroyed by poor periodontal support. Hence, evaluation and maintenance of periodontal health before, during and after treatment is very important. To achieve this goal, 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.*
Objective: *The purpose of this article is to provide the basic understanding of the interrelationship between periodontics and orthodontics in adult patients.*
Methodology: *A literature search was made in pub med and Google scholar for articles pertaining to the interrelationship between orthodontic treatment and periodontal conditions. The search terms used were Periodontal tissue response to orthodontic forces, effect of orthodontic bands on the periodontium, microbiology associated with orthodontic bands, relationship between orthodontic and periodontal therapy, retention of hopeless tooth during orthodontic treatment, tooth movement in various periodontally compromised condition. The articles thus obtained were then screened manually and relevant ones were selected for the review.*
Conclusion: *Periodontal health is necessary for any kind of dental treatment. During orthodontic treatment in adult patient, they must undergo regular periodontal maintenance to have healthy gingival response to treatment. Orthodontic instrumentation may be necessary in certain situations for a successful restoration of periodontal health as well as for satisfactory maintenance of tissue integrity. With the basic understanding of interrelationship between periodontal and orthodontic therapy clinician can improve the treatment outcome in patient's best interest.*
Key words*: Multidisciplinary approach, periodontal health, orthodontic treatment, tissue response*
Key Message: *In recent years, significant numbers of adult patients are seeking for orthodontic treatment. Because of which, Orthodontics and Periodontics multidisciplinary approach is often necessary to treat and prevent dental problems. Orthodontic treatment may be necessary in certain situations for a successful restoration of periodontal health as well as for satisfactory maintenance of tissue integrity. Increased susceptibility of plaque accumulation in patients undergoing orthodontic treatment hampers the success of orthodontic treatment. To achieve successful and long term stability of orthodontic treatment, involvement of periodontist is necessary.*

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I. Introduction

Edward H. Angle (1899) advocated the correlation between Orthodontics and Periodontics and concluded that Orthodontic biomechanics and treatment planning are basically determined by periodontal factors.[1] The orthodontist still needs a perfectly healthy periodontium, in the sense of complete absence of infectious or inflammatory conditions, prior to undertaking any treatment plan involving comprehensive orthodontics. Multidisciplinary approach is often necessary as orthodontics and Periodontics are interrelated in a variety of situations.

The purpose of this article is to provide the basic understanding of the interrelationship between periodontics and orthodontics in adult patients and review the current state of the art relative to aesthetic orthodontic treatment and their application to gingival aesthetics.

Use of orthodontics as an adjunct to treatment

Adjunctive orthodontic treatment is necessary after the periodontal treatment to resolve the problems like 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. It can be summarized as,[2] Uprighting or repositioning teeth to improve parallelism of abutment teeth (e.g., tipped abutment teeth)

1. Improving future pontic spaces (e.g., inadequate space)
2. Correcting cross-bites
3. Extruding teeth (e.g. fractured teeth)/Intruding teeth (e.g., hypererupted teeth)
4. Correcting crowding of teeth
5. Achieving adequate embrasure space and proper root position
6. Restoring lost vertical dimension
7. Increasing or decreasing overjet / overbite
8. Closure of diastemas

Periodontal Tissue Response to Orthodontic Forces

Orthodontic treatment affects the periodontal health on two grounds. First is forces generated to move teeth and second, the compromise in oral hygiene. The forces transmitted to the periodontium by orthodontic appliances quite certainly have a trauma producing effect. Without this trauma producing effect, tooth movement would not be possible. Many advances have been made in understanding the mechanisms involved in the process of tooth movement.[3]

During orthodontic tooth movement, resorption occurs on pressure side and new bone forms where there is tension.[4] For an initial six to eight days of tooth movement, PDL is compressed due to pressure. Compression of the PDL produces an avascular cell-free zone by a process termed "hyalinization". During hyalinization, tooth stops moving. Gryson J. (1965) described the changes in the periodontal ligament to various magnitude of orthodontic forces. Strong forces (>> capillary blood pressure) creates hyalinization zone on pressure side by crushing the periodontal ligament. This "hyalinization" cause delayed tooth movement. Moderate forces (>capillary blood pressure) results delay in bone resorption because of strangulation of periodontal ligament. Light forces (<capillary blood pressure ~20—25 mmHg) on the other hand are successful in moving the teeth, with frontal resorption, a steady attack on the outer surface of the lamina dura results in smooth continuous tooth movement.[5] Once the hyalinized zone is removed, tooth movement can occur again.[2, 6]

During orthodontic therapy, the tooth movement is caused by controlled forces on teeth. Removable appliances place intermittent tipping forces while fixed appliances can create continuous multidirectional forces.[3] In adults, hyalinized zones are formed more easily on the pressure side which may temporarily prevent the tooth from moving in the intended direction.[7] As growth and development have ceased in adults it can't be influenced by orthodontic movements.[3, 8] Treatment is thus limited to different types of tooth alignment. It is recommended that in the initial stage of orthodontic treatment in adults, an interrupted force of 20-30g to be used. Later on the force may be increased up to 30-50 g for tipping movement and 50-80g for bodily movements, corresponding to a distance of movement of 0.5-1.0 mm per month.[3] When greater orthodontic forces (bodily movements and intrusive movements) are employed the chance of development of root resorption is significantly increased.[9] The majority of resorption lacunae are small and generally appear at the border of the PDL hyalinized zone within the marginal and middle thirds of the root. These get soon repaired by apposition of cellular cementum. In contrast, apical root resorption is an irreversible injury and results in permanent shortening of the root. Thus, there is a risk for root resorption in anchorage teeth which are often subjected to heavy loading and inflammation.[3]

Effects of Orthodontic Bands on the Periodontium

The orthodontic appliance has to be properly designed, must provide stable anchorage without causing tissue irritation and must be aesthetically acceptable. For physiologic reasons, bonded plastic or ceramic brackets are preferred in the most visible regions. To counteract the tendency of orthodontic appliances to increase the accumulation of plaque on the teeth, attempts should be made to keep appliances and mechanisms simple, and to avoid hooks, elastomeric rings and excess flash around the bracket base. The use of steel ligatures is recommended on all brackets and bonds.[3]

Effects of orthodontic bands on periodontium can be divided as short term and long term. Gingivitis and gingival enlargement appear to be the main short-term effects of orthodontic bands on the periodontium. Gingival enlargement occurs after placement of a fixed appliance.[10] The condition rapidly improves within 48 hours of the appliance being removed.[11] As this gingival enlargement is also seen in patients with good oral hygiene, mechanical irritation caused by the band or cement must be implicated, in addition to trapped plaque.[12, 13] Some conflict exists as to the long term effects of orthodontic bands on the periodontium. Two retrospective studies in adults concluded that no significant damage occurred.[14, 15] In a 2 year post-orthodontic study, *Trossello & Gianelly* compared 30 adult females following multibanded therapy with 30 age-matched control individuals. They found that orthodontically treated patients had a higher prevalence of root resorption (17% vs 2%) although there was a lower prevalence of mucogingival defects (5% vs 12%). This root resorption was most

common in the maxillary incisors followed by mandibular incisors. In adults, it thus appears that apart from root resorption, orthodontic treatment has minimal detrimental effects on the health of the periodontium in both the short and long-term.[16]

Microbiology around Orthodontic Bands

The orthodontic patient's inablility to clean adequately should be expected to contribute to the development of gingival inflammation. In addition a generalized increase in salivary bacterial counts, especially Lactobacillus, has been shown after orthodontic band placement.[17] *Leggott et al* reported 2- to 3- fold increases in both clinical indices and numbers of motile organisms at sites 6 months after appliance placement.[2] Studies reported early increases in anaerobes and *Prevotella intermedia* and a decrease in facultative anaerobes.[18, 19] This shift in the subgingival microflora to a periopathogenic population is similar to the microflora at periodontally diseased sites.[20] From studies comparing the microbiological and periodontal responses in adolescents and adults, it appears adults are at same risk that of adolescents of subsequently developing periodontal disease as a result of orthodontic treatment.[2, 21]

A recent study which aimed to investigate changes in periodontal pathogen levels before, during, and after orthodontic treatment in adolescents, eight pathogens were examined; *Actinobacillus actinomycetemcomitans* (AA), *Porphyromonas gingivalis* (PG), *Prevotella intermedia* (PI), *Tannerella forsythia* (TF), *Eikenella corrodens* (EC), *Fusobacterium nucleatum* (FN), *Treponema denticola* (TD), and *Campylobacter rectus* (CR). It has been shown that for six (PI, TF, EC, FN, TD, CR) of the eight pathogens, the percentages of subjects with high pathogen counts increased significantly after six months of fixed appliance treatment, but these returned to pretreatment levels by 12 months of orthodontic treatment. No pathogen level was significantly higher after 12 months of orthodontic treatment.[22]

Time 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.[3] Non-surgical, surgical and gingival augmentation should be performed as appropriate before any tooth movement.[23] The corrective phase of periodontal therapy, i.e., osseous surgery ought to be delayed until the end of orthodontic therapy, because tooth movement may modify gingival and osseous morphology. In case of regenerative therapy, if the result of periodontal therapy is stable 3 to 6 months after periodontal surgery, orthodontic treatment may be initiated.[24]

Retention in periodontally compromised patient – problems and solutions.

Longer period of retention is required in adult patient, due to the anatomic and biologic differences in tissue reaction between adults and children.[3] Two major primary factors are involved in the equilibrium which determines the final position of teeth. These are the resting pressures of lip or cheek and tongue, and forces produced by metabolic activity within the periodontal membrane. With an intact periodontium, unbalanced tongue–lip forces are normally counteracted by forces from the periodontal membrane. However, when the periodontium breaks down, its stabilizing function no longer exists and the incisors begin to move.[25] According to this concept, persons with advanced periodontal disease and tooth migration would need permanent retention after the orthodontic correction.

The optimal long-term retainer for adults with reduced periodontium is the flexible spiral wire (FSW) retainer bonded on each tooth in a segment.[3] As long as the retainer remains intact, small spaces might open up distal to, but not within the retainer. Instead of bonded retainer, a removable plate or spring retainer is used at night on a long-term basis; there is a risk for ongoing jiggling of the teeth because of the relapse tendency during the day.

Retention of "Hopeless teeth" during orthodontic treatment

According to old concepts, the retention of periodontally "hopeless" teeth accelerates the destruction of the adjacent interproximal periodontium, therefore frequently extracted. However, recent follow-up studies have denied it.[26] These teeth can be useful for orthodontic anchorage, if the periodontal inflammation can be controlled. The hopeless tooth may be improved after orthodontic treatment that it is retained.[27] Alternatively, a hopeless molar may be hemisectioned after the orthodontic treatment, and the best root may be used as a bridge abutment. But most of the time the hopeless tooth will be extracted, especially if other restorations are planned in the segment.

Tooth movement into infrabony pockets

Orthodontic forces per se are unlikely to convert gingivitis into destructive periodontitis. But Infrabony pockets can be created by orthodontic tipping and/or intruding movements of teeth harboring plaque.[28] Studies

have also shown that moving teeth into adjacent osseous defects, orthodontic extrusion with and without fiberotomy and labial tipping of anterior teeth can be successfully accomplished without jeopardizing the periodontal support in the presence of adequate plaque control.[29] Orthodontic movement of teeth into inflamed infrabony defects may create a high risk for additional periodontal destruction. It is equally important to maintain excellent oral hygiene throughout the course of treatment in patients with infrabony defects.[3]

Tooth movement into compromised bone areas

Orthodontic tooth movement may sometimes be performed in adults with partially edentulous dentitions (due to agenesis or previous extractions of teeth) and in many of these individuals there is a reduced alveolar bone height.[30] Experimental reports and clinical studies have shown that a reduction in vertical bone height is not a contraindication for orthodontic tooth movement towards, or into, the constricted area.[30, 31, 32] Histologic observations in animal experiments have confirmed that when light forces were applied to move teeth bodily into an area with reduced bone height, a thin bone plate was recreated ahead of the moving tooth. As long as orthodontic tooth movement is performed within the genetically determined boundaries of the jaw, area will maintain the original height of the supporting apparatus.[31]

Tooth movement through cortical bone

Experimental studies in animals have demonstrated that when a tooth is moved bodily in a labial direction towards and through the cortical plate of the alveolar bone, no bone formation will take place in front of the tooth and a labial bone dehiscence is therefore created.[33, 34] It may happen, in the mandibular anterior region due to frontal expansion of incisors,[35] in the maxillary posterior region during lateral expansion of cross-bites,[36] lingually in the maxilla associated with retraction and lingual root torque of maxillary incisors in patients with large overjets,[37] and by pronounced traumatic jiggling of teeth.[38] There is also potential for repair when malpositioned teeth are moved back toward their original positions, and bone apposition may take place. The results of studies indicated that the soft tissue, facial to a produced bone dehiscence, contains a bone matrix with the capacity to remineralize, following repositioning the tooth into the alveolar process.[30]

Periodontal Tissue Reaction to Orthodontic Extrusion

Orthodontic extrusion of teeth, or so-called "forced eruption", may be indicated for shallowing out intraosseous defects and for increasing clinical crown length of single teeth. The forced eruption technique was originally described by for the treatment of one-wall and two-wall bony pockets that were difficult to handle by conventional therapy alone.[39] The extrusive tooth movement leads to a coronal positioning of intact connective tissue attachment, and the bony defect is shallowed out. This was confirmed in animal experiments and clinical trials.[40]

Extrusion with periodontium

Orthodontic extrusion of a single tooth that needs to be extracted is an excellent method for improvement of the marginal bone level before the surgical placement of single implants. Not only the bone, but also the soft supporting tissues will move vertically with the teeth during orthodontic extrusion. In-vivo data related to the accompanying gingival tissue movement after orthodontic extrusion of mandibular incisors were evaluated.[41] The widths of the attached gingiva and the keratinized gingiva, and the clinical crown length increased significantly after treatment.

Extrusion out of periodontium

In teeth with crown–root fracture, or other subgingival fractures, the goal of treatment may be to extrude the root out of the periodontium. When an increased distance between the CEJ and the alveolar bone crest is aimed at, the forced eruption should be combined with gingival fiberotomy.[29,42] In animal experiments, study showed that when the fiberotomy was performed frequently (every 2 weeks), the tooth was virtually moved out of the bony periodontium, without affecting the bone heights or level of the marginal gingiva of the neighboring teeth.[43]

Periodontal Tissue Reaction to Orthodontic Intrusion

A common problem in adult patients suffering from periodontal disease is the migration, elongation and spacing of incisors. This frequently leads to trauma from occlusion, a situation that might enhance destruction of the periodontium if plaque-associated inflammatory lesions of the gingiva are present. Anterior teeth are especially prone to elongation since they are not protected by occlusal forces and have no anteroposterior contact inhibiting migration. In such cases, intrusive movement has been recommended to realign the teeth and improve clinical crown lengths and marginal bone levels in periodontally compromised patients.[44]

But, the intrusion of plaque-infected teeth may lead to the formation of angular bony defects and increased loss of attachment due to the positioning of supragingivally located plaque subgingivally.[28, 45] This explains why professional subgingival scaling is particularly important during the phase of active intrusion. It is suggested that intrusion is best performed with low forces (5-15 g/tooth) and in the presence of gingival health.[44]

Regenerative procedures and orthodontic tooth movement

Orthodontic tooth movement could not completely avoid formation of a long epithelial attachment along the planed root surface. Therefore, periodontal regenerative surgery prior to orthodontic tooth movement is indicated & Regeneration of the PDL does not occur when inflammation is present in the periodontal tissues.[28]

In theory, the regenerative techniques would be advantageous, if the epithelium can be prevented from proliferating apically, a bodily tooth movement into or through an intraosseous defect could eliminate the bony pocket more effectively. Some clinical observations confirm that different regenerative procedures may enrich the therapeutic spectrum in combined periodontal/ orthodontic approaches. The potential of the intrusive/regenerative mechanism was most impressive within the inter-radicular area.[46] New supracrestal and periodontal ligament collagen fibers may be gained on the tension side, which can transfer the orthodontic force stimulus to the alveolar bone.[47]

Teeth can be successfully moved and intruded into bone defects previously augmented with bone substitute and fibrin glue. During the orthodontic treatment, this combined augmentation material was able to be replaced by bone-like hard tissue.[48] Similar results were obtained after orthodontically moving the migrated teeth into infrabony defects augmented with a biomaterial. Reduction of probing pocket depths to physiologic values, clinical attachment levels gain, and radiologic defect resolution were obtained.[49]

Molar uprighting, furcation involvement

Tipped molars have been considered a causative or at least an aggravating factor for future periodontal tissue breakdown. *Brown* looked at the influence 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. There was also noted improvement of gingival architecture and less plaque accumulation on the uprighted teeth.[50, 51]

In a follow up study on 22 patients with uprighted mandibular molars after an average of 3.5 years, it was reported that pockets on the mesial surfaces were shallower on the uprighted teeth than on the control teeth.[52]

Plaque control

Results extrapolated from animal studies done in dentitions with reduced periodontium show that in the absence of plaque, orthodontic forces and tooth movements do not induce gingivitis.[28, 45] In the presence of plaque, however, similar forces can cause angular bone defects and with tipping and intruding movements, attachment loss can occur.[28] Clinical studies have demonstrated that with plaque control, teeth with reduced periodontal support can undergo successful tooth movement without compromising their periodontal situation.[52]

II. Conclusion:

The question of whether orthodontic tooth movement may have deleterious effects on the periodontal tissues has been evaluated in a number of clinical and experimental studies. The results show that if periodontal health and proper oral hygiene standards are maintained during the phase of orthodontic therapy, no injury, or only clinically insignificant injury to the supporting tissues will occur. However, if the oral hygiene is less effective and periodontal inflammation is present during orthodontic treatment, the studies have indicated an increased risk of adverse effects on the periodontium.

In conclusion, adult orthodontic tooth movement can be performed with both healthy and diseased periodontium with few detrimental effects (root resorption) provided physiologic forces are used, periodontal inflammation is controlled and meticulous oral hygiene is maintained throughout active therapy. With this basic understanding of periodontics-orthodontic interrelationships, the clinician can then work accordingly in the patient's best interest.

References:

[1]. Angle, E.H. Treatment of Malocclusion of Teeth, S. S. White Dental Manufacturing Comp., Philadelphia. 7th edn. 1907.
[2]. Ong MA, Wang H-L, Smith FN. Interrelationship between periodontics and adult orthodontics. J Clin Periodontol. 1998; 25: 271-272.
[3]. Zachrisson B. Orthodontics and periodontics. In Lindhe J (editor) Clinical periodontology and implant dentistry.5th ed. 2008: 1241-1263.

[4]. Reitan K. Biomechanical principles and reactions. In current orthodontic concepts and techniques, eds. Graber, XM. & Swain, B.F, 1985: 101-192.
[5]. Gryson J. Changes in the periodontal ligament incident to orthodontic therapy. J West Soc Periodontol Periodontal Abstr. 1965; 13: 14-21
[6]. Proffit WR. Contemporary orthodontics. 4th ed. St Louis: CV Mosby. 2007: 334-340.
[7]. Reitan, K. Effects of force, magnitude and direction of tooth movement on different alveolar bone types. Angle Orthod.1964; 34: 244-255.
[8]. Bond, J. A. The child versus the adult. Dent Clin North Am. 1972; 16: 401 -412.
[9]. Proffit WR. Contemporary orthodontics. 4th ed .St Louis: CV Mosby. 2007: 350-351
[10]. Baer P N, Coccaro P J. Gingival enlargement coincident with orthodontic therapy. J Periodontol. 1964; 35: 436-439.
[11]. Alexander S A. Effects of orthodontic attachments on the gingival health of permanent second molars. Am J Orthod Dentofacial Orthop. 1991; 100: 337-340.
[12]. Zachrisson S, Zachrisson B U. Gingival condition associated with orthodontic treatment. Angle Orthod. 1972; 42: 26-34.
[13]. Boyd R L, Baumrind S. Periodontal considerations in the use of bands or bonds on molars in adolescents and adults. Angle Orthod. 1992; 62: 117-126.
[14]. Sadowsky C, BeGole E A. Long term effects of orthodontic treatment on periodontal health. Am J Orthod.1981; 80: 156-172.
[15]. Polson A M, Subtelny J D, Meither S W et al. Long-term periodontal status after orthodontic treatment. Am J Orthod Dentofacial Orthop.1988; 93: 51-58
[16]. Trossello, V K, Gianelly A A. Orthodontic treatment and periodontal status. J Periodontol. 1979; 50: 665-671
[17]. Bloom R H, Brown L R. A study of the effects of orthodontic appliances on oral microbial flora. Oral Surg Oral Med Oral Pathol.1964; 17: 658-667
[18]. Diamanti Kipioti A, Gusberti FA, Lang NP. Clinical and microbiological effects of fied orthodontic appliances. J Clin Periodontol 1987; 14: 326-33
[19]. Huser MC, Baehni PC, Lang R. Effects of orthodontic bands on microbiologic and clinical parameters. Am J Orthod Dentofacial Orthop 1990; 97: 213-8.
[20]. Listgarten MA, Hellden L. Relative distribution of bacteria at clinically healthy and periodontally diseased sites in humans. J Clin Periodontol 1978; 5: 115-32.
[21]. Boyd R L, Leggott P J, Quinn R S, Eakle W S, Chambers D W. Periodontal implications of orthodontic treatment in adults with reduced or normal periodontal tissues versus those of adolescents. Am J Orthod Dentofacial Orthop. 1989; 96: 191-198.
[22]. Thornberg MJ, Riolo CS, Bayirli B, Riolo ML, Van Tubergen EA, Kulbersh R. Periodontal pathogen levels in adolescents before, during, and after fixed orthodontic appliance therapy. Am J Orthod Dentofacial Orthop. 2009; 135: 95-108.
[23]. Proffit WR. Contemporary orthodontics. 4th ed. .St Louis: CV Mosby. 2007: 657-662
[24]. Goldman, H. & Cohen, D. W. Periodontal therapy. 4th ed. St Louis: CV Mosby. 1968: 518-567.
[25]. Proffit W R. Equilibrium theory revisited: Factors influencing position of the teeth. Angle Orthod . 1978; 48: 175–186
[26]. Chace R, Low S B. Survival characteristics of periodontally- involved teeth: A 40-year study. J Periodontol. 1993; 64: 701–705.
[27]. Mathews, D.P. & Kokich, V.G. Managing treatment for the orthodontic patient with periodontal problems. Semin Orthod. 1997; 3: 21–38.
[28]. Ericsson L, Thilander B, Lindhe J, Okamoto, H. The effect of orthodontic tilting movements on the periodontal tissues of infected and non-infected dentitions in dogs. J Clin Periodontol. 1977; 4: 278-293.
[29]. Kozlowsky A, Tal H, Lieberman M. Forced eruption combined with gingival fiberotomy. A technique for clinical crown lengthening. J Clin Periodontol. 1988; 15: 534–538
[30]. Thilander B. Infrabony pockets and reduced alveolar bone height in relation to orthodontic therapy. Semin Orthod. 1996; 2: 55–61
[31]. Lindskog Stokland B, Wennstrom JL, Nyman S, Thilander B. Orthodontic tooth movement into edentulous areas with reduced bone height. An experimental study in the dog. Eur J Orthod. 1993; 15: 89–96
[32]. Hom B M, Turley P K. The effects of space closure on the mandibular first molar area in adults. Am J Orthod. 1984; 85: 457–469.
[33]. Steiner GG, Pearson JK, Ainamo J. Changes of theginal periodontium as a result of labial tooth movement in monkeys. J Periodontol. 1981; 52: 314–20
[34]. Karring T, Nyman S, Thilander B, Magnusson I. Bone regeneration in orthodontically produced alveolar bone dehiscences. J Periodontal Res. 1982; 17: 309–15
[35]. Wehrbein H, Fuhrmann R A W, Diedrich P R. Periodontal conditions after facial root tipping and palatal root torque of incisors. Am J Orthod Dentofacial Orthop. 1994; 106: 455–462.
[36]. Greenbaum K R, Zachrisson B U. The effect of palatal expansion therapy on the periodontal supporting tissues. Am J Orthod. 1982; 81: 12–21
[37]. Ten Hoeve A, Mulie R M. The effect of anteroposterior incisor repositioning on the palatal cortex as studied with laminography. J Clin Orthod. 1976; 6: 804–822.
[38]. Nyman S, Karring T, Bergenholz, G. Bone regeneration in alveolar bone dehiscences produced by jiggling forces. J Periodontal Res. 1982; 17: 316–322.
[39]. Ingber JS. Forced eruption. Part I. A method of treating isolated one and two wall infrabony osseous defects – rationale and case report. J Periodontol. 1974; 45: 199–206
[40]. Van Venrooy JR, Yukna RA. Orthodontic extrusion of single rooted teeth affected with advanced periodontal disease. Am J Orthod. 1985; 87: 67–74
[41]. Pikdoken L, Erkan M, Usumez S. Gingival response to mandibular incisor extrusion. Am J Orthod Dentofacial Orthop. 2009; 135: 432-436
[42]. Pontoriero R, Celenza F, Ricci G, Carnevale G. Rapid extrusion with fiber resection: a combined orthodontic-periodontic treatment modality. Int J Periodontics Restorative Dent. 1987; 7: 31–43
[43]. Berglundh X, Marinello C, Lindhe J, Thilander B & Liljenberg B. Periodontal tissue reactions to orthodontic extrusion, an experimental study in the dog. J Clin Periodontol. 1991; 18: 330-336.
[44]. Melsen B, Agerbaek N, Markenstam G. Intrusion of incisors in adult patients with marginal bone loss. Am J Orthod Dentofacial Orthop. 1989; 3: 232-241.
[45]. Ericsson L, Thilander, B. Orthodontic forces and recurrence of periodontal disease. Am J Orthod. 1978; 74: 41-50.
[46]. Rabie AB, Gildenhuys G, Boisson M. Management of patients with severe bone loss: Bone induction and orthodontics. World J Orthod. 2001; 2: 142–53
[47]. Diedrich P. Periodontal relevance of anterior crowding. J Orofac Orthop. 2000; 61: 69-79.

[48]. Re S, Corrente G, Abundo R, Cardaropoli D. The use of orthodontic intrusive movement to reduce infrabony pockets in adult periodontal patients: A case report. Int J Periodontics Restorative Dent. 2002; 22: 365-371.
[49]. Corrente G, Abundo R, Re S, Cardaropoli D, Cardaropoli G. Orthodontic movement into infrabony defects in patients with advanced periodontal disease: A clinical and radiological study. J Periodontol. 2003; 74: 1104-1109.
[50]. Brown S. The effect of orthodontic therapy on certain types of periodontal defects (I). Clinical findings. J Periodontol. 1973; 44: 742-756.
[51]. Kraal J H, Digiancinto J J, Dail R A, Lemmerman K & Peden J W. Periodontal conditions in patients after molar uprighting. J Prosthet Dent. 1980; 156-162.
[52]. Eliasson L, Hugoson A, Kurol J, Siwe, H. The effects of orthodontic treatment on periodontal tissues in patients with reduced periodontal support. Eur J Orthod. 1982; 4: 1-9.

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