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Perio-Ortho Amalgamation: A Literature Review

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Abstract

Orthodontic treatment involves interactions of the tooth movement with the supportive periodontal tissues. An appropriate periodontal diagnosis and treatment planning is crucial for a successful orthodontic treatment. In this era, when a large number of patients are seeking orthodontic treatment, the role of interdisciplinary treatment should be taken into consideration. The purpose of this article is to familiarize clinicians with the adjunctive treatment approach and the symbiotic relationship between the two specialties for a successful treatment.

Keywords: Interrelationship, Orthodontics, Periodontics, Synergy

Introduction

Synergy: the bonus that is achieved when things work together harmoniously: -Mark Twain

The periodontic-orthodontic interrelationship resembles synergy. The main objective of periodontal therapy is to prevent the progression and recurrence of the disease. The basic purpose is to restore and maintain the health and integrity of the periodontal structures. Periodontitis is associated with loss of periodontal support which may lead to pathological tooth migration. Orthodontic treatment is important in such cases to correct these problems or prevent them from progression. Thus, orthodontic and periodontics treatment have a symbiotic relationship.

A multidisciplinary approach is often required for the correction of complex dentoalveolar problems in dentistry. The biologic basis of orthodontic treatment is that bone remodels in response to orthodontic force which brings about the tooth movement. The bone resorption and bone formation occur in a selective manner thus enabling the tooth to move through the bone along with its attachment apparatus i.e. periodontal ligament. Orthodontic patients could belong to 3 categories: those with good health, with periodontal disease or loss of permanent teeth and with skeletal discrepancies. In case of periodontal disease both specialties should be involved for effective treatment.

Dental alignment achieved with orthodontic treatment facilitates plaque removal and reduces occlusal trauma whereas the important requirement for orthodontic treatment is healthy periodontium. If the periodontal health is altered, orthodontic treatment is difficult. Thus, both the branches of dentistry are dependent on one another for maintenance of a healthy periodontium.

Periodontal Response to Various Kinds of Tooth Movement

Extrusion: It is the least hazardous kind of tooth movement as far as periodontium is considered. Extrusion followed by equilibration of the clinical crown has been shown to reduce infrabony defects and pockets[1].

Intrusion: Intrusion results in deepening of infrabony pockets, root resorption and intrabony defects[2]. Inadequate oral hygiene results in the shift of supragingival plaque into a subgingival position responsible for periodontal destruction[3].

Tipping: Uncontrolled tipping cases causes heavy forces at the alveolar crest resulting in severe destruction of the epithelial attachment and crestal bone loss. Controlled tipping also produces high forces in the periodontal ligament as the fulcrum shifts apically with increasing amounts of bone loss.

Bodily Movement: Moving a tooth bodily into a periodontal defect has been believed to carry the bone along with the tooth resulting in improvement of the defect. But recent studies show that this is only an illusion because it causes only an improved connective tissue attachment and worsens the bony defect.

Deleterious Effects of Orthodontic Force

Gingival Problems: The gingiva rotates to the same degree and in the same direction as that of the tooth. Extensive rotational movement results in the rotational gingiva to be compressed in the interdental area at the direction of rotation. Possible consequences of excessive labial tooth movement, especially that of incisors results in irreversible gingival recession.

The development of gingival inflammation during orthodontic treatment is associated with specific bacterial types. Huser et al studied microbial flora in plaque of patients undergoing orthodontic treatment and found a definite increase in plaque scores and periodontal disease when compared with controls. The bacterial plaque was composed mainly of spirochetes and motile rods[4].

Microbiology around orthodontic bands shows increase in Lactobacillus[5], increase in motile organisms and increase in Prevotella intermedia[4,6].

Root Resorption: Orthodontic force application can sometimes evoke excessive resorption of root cementum proceeding into the dentin and eventually shortening the root length in a process called as root resorption. **Ketcham (1927)** were the first to report severe root resorption associated with orthodontic tooth movement[7]. Of the various orthodontic tooth movements, intrusion and torquing make a tooth root more prone to resorption.

Brezniak and Wasserstein (1993) classified root resorption according to its severity: cemental or surface resorption - where only the outer layers are resorbed, to be fully regenerated or remodeled later, dentinal resorption with repair where the cementum and the outer layers of dentin are resorbed and are repaired along with morphological alterations and circumferential root resorption where full resorption of the hard tissue components of the root apex occurs resulting in root shortening[8].

Pulpal Reactions: Various experiments have demonstrated an initial decrease in blood flow lasting approximately 32 minutes followed by an increase in blood flow (lasting 48 hours) whereas **Mostafa et al** reported congested and dilated blood vessels, and edema of pulpal tissue in their histologic observations[9].

Benefits of Orthodontics for a Periodontal Patient

- Aligning crowded or malposed teeth allows the adult patient better access to clean all surfaces of their teeth adequately
- Orthodontic therapy allows for forced eruption of tooth that benefits the patient with a severe fracture of a maxillary anterior tooth to permit adequate restoration of the root

- Vertical orthodontic tooth repositioning can improve certain types of osseous defects in periodontal patients and the tooth movement eliminates the need for resective osseous surgery
- Orthodontic treatment can improve the esthetic relationship of the maxillary gingival margin levels before restorative dentistry
- Orthodontic treatment allows open gingival embrasures to be corrected to regain the lost papilla
- Orthodontic treatment can improve adjacent tooth position before implant placement or tooth replacement

Sequence of Orthodontic Treatment in Periodontally Compromised Individuals

Mathews and Kokich (1997) designed a systematic approach for orthodontic treatment in periodontally compromised individuals including following steps[10]:

- **Periodontal examination by the orthodontist**
  - Periodontal screening and recording
  - Periodontal probing
  - Assessment of attached gingiva
  - Radiographs
  - Parafunction
- **Pre-orthodontic periodontal therapy**
  - Pre-orthodontic osseous surgery
    - Osseous craters
    - Three wall intrabony defects
    - Hemiseptal defects
    - Furcation defects
    - Root proximity
  - Pre-orthodontic gingival surgery
    - Gingival grafting
    - Root coverage
- **Orthodontic treatment**
- **Post-orthodontic treatment phase**

Constant monitoring of the periodontal health is crucial during the orthodontic and post-orthodontic treatment period.

Periodontal Examination by the Orthodontist

Periodontal examination during the primary consultation with the patient is crucial to prevent long-term problems. Periodontal screening and recording (PSR) is an effective method to evaluate the status of the periodontium before starting the orthodontic treatment. The width of attached gingiva should be evaluated by the periodontist. If found less than 2mm, then required periodontal treatment to be decided by the periodontist. Radiographic examination should be done to evaluate the underlying bone topography. Periapical, bitewing and panoramic radiographs may be advised as and when required. Patients with parafunctional habits increase the osseous breakdown during orthodontic treatment. These patients may require correction of these abnormal habits to achieve optimum result of the treatment.

Pre-Orthodontic Osseous Surgery

The requirement for the periodontal surgical procedure is to be decided after non-surgical periodontal therapy and removal of the etiologic factors. In case of moderate to deep periodontal pockets, periodontal flap surgeries along with respective or regenerative procedures are planned.

Osseous Craters: These are the most common osseous defects. Osseous craters are the interproximal, two-walled defects that does not improve with orthodontic treatment. Some shallow craters (4 to 5 mm pocket depth) may be maintainable non-surgically during orthodontic treatment. If surgical correction is needed this type of osseous lesion can be eliminated by reshaping the defect & thus reducing the pocket depth. This in turn enhances the ability to maintain these interproximal areas during orthodontic treatment.

Three Wall Intrabony Defect: Three-walled defects are amenable to pocket reduction with regenerative periodontal therapy. Bone grafts along with the use of barrier membranes have been successful in filling three-wall defects. If the result of periodontal therapy is stable for 3 to 6 months after periodontal surgery, then orthodontic treatment may be initiated.

Hemiseptal Defects: Hemiseptal defects are one or two wall osseous defects that often are found around mesially tipped teeth or teeth that have supraerupted. Usually, these defects can be eliminated with the appropriate orthodontic treatment. In the case of the tipped tooth, uprighting and eruption of the tooth levels the bony defect. If the tooth is supraerupted, intrusion and levelling of the adjacent cementoenamel junctions can help level the osseous defect.

Furcation involvement: Furcation lesions require special consideration since these are the most difficult lesions to maintain which can worsen during orthodontic therapy. The molars require bands with tubes and other attachments that impede the patient's access for oral hygiene maintenance. Class I furcation involvement has a good prognosis and can be treated by osseous resective surgery. Class II furcation defects can be treated with periodontal regenerative procedures. Class III and Class IV furcation lesions are more difficult to treat. Regenerative procedures may not be successful and procedures like hemisection, root resection or even extraction followed by implant placement may be carried out.

Root Proximity: When roots of posterior teeth are in close proximity, it results in compromised accessibility for restoration of adjacent teeth. Orthodontic therapy allows for roots to be moved apart so that bone forms between adjacent roots. Open embrasure beneath the tooth contact enhances patient's access to interproximal region and thus improves the periodontal health.

Pre-Orthodontic Gingival Surgery

Gingival grafting: The areas with less than adequate width of attached gingiva may be considered for free gingival graft procedure to increase the width of attached gingiva.

Root coverage: Teeth to be proclined during orthodontic treatment have more chances of gingival recession and dehiscence. Root coverage procedures can be done in areas of gingival recession to cover the exposed root surfaces whereas those indicated for esthetic purpose can be done post orthodontic treatment.

Orthodontic Treatment of Osseous Defects

Advanced Horizontal Bone Loss: In such a case the bone level may have receded several millimetres from the CEJ and the crown - root ratio becomes less favourable. Aligning the crowns may perpetuate tooth mobility & significant bone discrepancies. In such a situation the crowns of the teeth may require considerable equilibration. The goal of equilibration and creative bracket placement is to provide more favourable bony architecture and a more favourable crown - root ratio. Placement of brackets is determined by the incisal edges of anterior teeth and the marginal ridges in the posterior teeth. But in cases of horizontal bone loss considering the crown anatomy is inappropriate. The orthodontist may use the bone level to position the brackets.

Fractured Teeth/ Forced Eruption: When children and adolescents fall and injure their anterior teeth, the fracture may extend beneath the level of the gingival margin & terminate at the level of the alveolar ridge. Restoration of the fractured crown is difficult because the tooth preparation would extend to the level of the bone. If the crown margin is overextended. It would result in invasion of the biologic width of the tooth resulting in persistent

inflammation of the marginal gingiva. It may be beneficial to erupt the fractured root out of the bone & move the fractured margin coronally so that it can be properly restored. If the fracture extends too far apically, it may be better to extract the tooth and replace it with an implant or bridge. The criteria to determine whether the tooth should be forcibly erupted or extracted include the root length, the root form, the level of fracture, the relative importance of tooth, esthetics and endodontic or periodontal prognosis. The orthodontic mechanics necessary to erupt the tooth can vary from elastic traction to orthodontic banding and bracketing.

Hopeless teeth maintained for Orthodontic Anchorage: Patients with advanced periodontal disease may have specific teeth diagnosed as hopeless which would be extracted before orthodontic treatment. However, these teeth can be useful for orthodontic anchorage if the periodontal inflammation can be controlled.

Orthodontic Treatment of Gingival Discrepancies

Uneven Gingival Margins: The relationship of the gingival margins of the six maxillary anterior teeth plays an important role in the esthetic appearance of the crowns. Factors contribute to ideal gingival form: The gingival margins of the two central incisors should be at the same level. The gingival margins of the central incisors should be positioned more apically than the lateral incisors and at the same level as the canines. The contour of the labial gingival margins should mimic the CEJs of the teeth. A papilla should exist b/w each tooth, & the height of the tip of the papilla is usually halfway between the incisal edge & the labial gingival height of contour over the center of each anterior tooth.

Significant Abrasion and Overeruption: Occasionally, patients have destructive dental habits such as a protrusive bruxing habit that could result in significant wear of the maxillary and mandibular incisors and compensatory overeruption of these teeth. Two options are available: i) Crown lengthening ii) Orthodontically intrude the teeth and move the gingival margins apically.

Open Gingival Embrasures: The presence of an interproximal papilla between the maxillary central incisors is a key esthetic factor in any individual. The open space is usually due to one of three causes: tooth shape, root angulation or periodontal bone loss. Ratio of interproximal papilla to tooth contact is another possibility to erupt the adjacent teeth when the interproximal bone level is positioned apically. This type of movement may help create a more esthetic papilla between two teeth despite alveolar bone loss. By closing open contacts, the interproximal gingiva can be squeezed and moved incisally. In some situations, a deficient papilla can be improved with orthodontic treatment. If the patient has an open embrasure, evaluate whether it is caused by the papilla or the tooth contact.

Pericision (Circumferential Supracrestal Fiberotomy): Relapse of severely rotated teeth due to rebound of elastic fibers in the supracrestal tissues can be reduced by pericision. The procedure involves inserting a surgical blade into the gingival sulcus and severing the epithelial attachment surrounding the involved teeth. The blade also transects the transseptal fibers by interdentally entering the periodontal ligament space[11].

Periodontal Surgery for the Orthodontic Patient

Frenectomy or Frenotomy: Bergstrom et al (1973) stated that the probability for diastema in the long run is the same whether or not frenectomy is performed. Earlier frenectomy extending into palatal surface was advocated. But this leads to loss of inter dental papilla between upper central incisors[12]. Therefore, the frenotomy procedure by **Edwards (1977)** was introduced which represents partial removal of frenum and with the purpose of relocating the attachment in an apical direction[13].

Removal of Gingival Invagination (Clefts): Incomplete adaptation of supporting structures during orthodontic closure of extraction spaces results into infoldings or invagination of the gingiva. The clinical appearance of such invagination resulting in a minor surface crease to deep clefts that extend across the interdental papilla. There is general trend towards some resolution of these defects with time but many invaginations persist for 5 years or more after completion of orthodontic therapy. **Edward (1971)** suggested that simple removal of only the excess gingiva in the buccal and lingual area of approximated teeth would be sufficient to alleviate the tendency for the teeth to separate after orthodontic movement[14].

Gingivectomy: If a gingival margin discrepancy is present, but the patient's lip does not move upward to expose the discrepancy upon smiling, then it does not require correction. If the gingival discrepancy is apparent, following techniques may be used: Gingivectomy, intrusion and incisal restoration or porcelain laminate veneer, extrusion, fiberotomy and porcelain crown or surgical crown lengthening, by flap procedure and ostectomy/osteoplasty of bone[15].

Periodontally Accelerated Osteogenic Orthodontics (PAOO): Wilcko et al 2001 reported a revised corticotomy-facilitated technique. It is a combination of a selective decortication facilitated orthodontic technique and alveolar augmentation. With this technique, teeth can be moved 2-3 times further in one third or one fourth of the time required for traditional orthodontic therapy. Wilcko and co-workers reported that in a computed tomographic (CT) scan evaluation of selectively decorticated patients was that the rapid tooth movement was not the result of bony block movement but due to a transient localized demineralization-remineralization phenomenon in the bony alveolar housing consistent with the wound healing pattern of the Regional Acceleratory Phenomenon (RAP) [16].

Surgical Exposure of Unerupted Tooth: Excision of gingival tissue over the embedded tooth is a popular procedure for exposure of the tooth. But, it results into sacrifice of the keratinized tissue. Hence, repositioning of the existing keratinized tissue should be considered in such cases.

Can Orthodontic Treatment Prevent the Periodontal Disease Progression?

Malocclusion or abnormal teeth positions is a predisposing factor for periodontal disease progression[17]. Orthodontic treatment helps to eliminate the occlusal interferences which prevents periodontal tissue damage[18]. **Bollen (2008)** carried out two systematic reviews and found a positive correlation between the presence of malocclusion and periodontal disease. But, he did not find out any reliable evidence for the positive effect of orthodontic treatment on periodontal health[19,20].

Contraindications for Orthodontic Treatment

- Poor patient compliance
- Patients with systemic problems which are difficult to be treated or difficult to control
- Uncontrolled infection and inflammation
- Inadequate anchorage for tooth movement
- Conditions where periodontal stability will not improve despite tooth movement
- Lack of retention or stabilization of teeth into their new position

Recent Evidence in Perio-Orthodontic Interrelationship

Gray and McIntyre (2008) conducted a systematic review to determine the effectiveness of orthodontic oral health promotion (OHP) upon gingival health and it was found that an OHP program for patients undergoing fixed appliance orthodontic treatment produces a short-term

reduction (up to 5 months) in plaque and improvement in gingival health[21].

Another systematic review suggested that orthodontic therapy was associated with 0.03 millimeters of gingival recession, 0.13 mm of alveolar bone loss and 0.23 mm of increased pocket depth when compared with no treatment and it was concluded that the effects of orthodontic therapy on gingivitis and attachment loss were inconsistent across studies. Thus, it could be concluded that there is an absence of reliable evidence for the positive effects of orthodontic therapy on patients' periodontal status[22].

A systematic review and meta-analysis by concluded that orthodontic treatment with fixed appliances has little to no clinically relevant effect on periodontal clinical attachment levels[23].

A systematic literature review to assess the orthodontic treatment in periodontitis-susceptible subjects conclude that no evidence currently exists from controlled studies and randomized controlled clinical trials, which shows that orthodontic treatment improves or aggravates the status of periodontally compromised dentitions[24].

Conclusion

Proper diagnosis before the commencement of orthodontic treatment and appropriate treatment planning with continued observation of the periodontal status throughout the orthodontic treatment is important for the overall success of the treatment. The orthodontist should have knowledge about the various types of tooth movement in different types of osseous defects and the periodontist should be well aware of the different types of procedures to be done before, after and during the orthodontic treatment. Thus, the success of the treatment depends upon the multidisciplinary approach of a periodontist and orthodontist.

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