Orthodontic, periodontal and prosthodontic treatment for a periodontally compromised patient with a deep overbite

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Background: Periodontitis may result in displacement, overeruption and the tilting of teeth, which can lead to occlusal prematurities and accelerate the loss of periodontal structures. Orthodontic treatment is needed to correct displaced tooth positions, but inappropriate force and tooth movement can lead to further loss of supporting tissues.

Aim: To describe the treatment of a deep overbite in a 32-year-old male with a history of periodontitis, gingival recession and missing premolars.

Methods: After evaluation, fixed appliances applying light forces were chosen as the appropriate treatment approach. A segmental arch and a utility arch technique were applied. Periodontal therapy was conducted before and throughout orthodontic care.

Results: After 28 months of treatment, a normal overbite and overjet were restored. A displaced premolar was repositioned. Space needed for the prosthetic replacement of the missing teeth was obtained and dental implants were planned after orthodontic treatment. The height of the alveolar bone increased in some areas. After 18 months of retention, the attachment level of the upper left incisor increased approximately 1 mm.

Conclusion: For patients with a compromised periodontium, adequate management of the tissues is the basis of orthodontic care. Appropriate orthodontic treatment may be beneficial to periodontal health in the long term.

Introduction

A malocclusion can cause greater susceptibility to periodontal disease, either by hampering adequate oral hygiene practice or by causing occlusal trauma. Periodontal disease, in turn, leads to the loss of supporting structures and pathologic tooth migration, often seen as proclination of the maxillary anterior teeth, irregular interdental spacing, inclination, rotation, overeruption and extrusion. In the treatment of affected patients, orthodontic movement is needed to correct tooth displacement. However, inappropriately directed and applied orthodontic force can lead to the further loss of supporting structures. In addition, orthodontic appliances can accelerate the accumulation of dental plaque by inhibiting complete oral hygiene procedures. Therefore, to correct a malocclusion in a patient affected by periodontal disease whilst improving the periodontal condition is a challenge for orthodontists.

For patients affected by a deep overbite, periodontitis can cause overeruption and proclination of the anterior teeth, which can further lead to premature occlusal contact. The created occlusal trauma could accelerate the loss of periodontal structures. In the present case report, the treatment of a deep overbite and displaced teeth is described in a patient presenting with a history of chronic periodontitis, gingival recession and loss of teeth.
Diagnosis and aetiology

A male, aged 32 years, was referred by his prosthodontist for orthodontic management. The patient had a history of severe periodontitis and tooth loss but was in good general health without systemic disease. Initially and before orthodontic treatment, the patient received periodontal therapy, which included oral hygiene instruction, scaling and root planing. The treatment resolved the soft tissue inflammation and the periodontitis was assessed to be non-active prior to orthodontic therapy.

An intraoral examination showed missing #14, #35 and #44, widespread gingival recession, a Class I molar relationship, moderate crowding, an upper midline shift to the left by 1 mm, and a lower midline shift to the left by 2 mm. The maxillary left central incisor presented obvious overeruption, which contributed to a deep anterior overbite of 5.5 mm. The mandibular right second premolar displayed obvious mesial displacement and inclination due to the loss of the first premolar (Figure 1). The results of the periodontal examination are shown in Figure 2.
An extra-oral analysis revealed a slightly asymmetric face with a mild mandibular deviation to the right, a straight profile with a slightly reduced lower facial third, a normal nasolabial angle and a normal chin-throat angle (Figure 1). No symptoms or signs of temporomandibular disorder were noted from either the clinical examination or a medical questionnaire.

Panoramic radiography showed generalised crestal alveolar bone loss up to 1/3 – 1/2 of the root length in both jaws. The upper right third molar and the lower third molars were impacted. The bilateral morphology of the condyles appeared normal (Figure 3). A cephalometric analysis indicated that the patient had a skeletal Class I malocclusion (Figure 3). The general position of the maxillary incisors was mildly upright but the inclination of the mandibular incisors was normal (Table I).

Treatment objectives

Regular periodontal oversight throughout any orthodontic treatment was deemed necessary. The first orthodontic alternative was to reposition the mesially-inclined lower second premolar, followed by dental implants to replace the missing teeth, without addressing any other occlusal problems. A second plan was to align and level the dentitions and improve the deep overbite, using fixed appliances and very gentle force. Dental implants for the missing #14, #35 and #44 were planned following treatment.

The second alternative was selected because the deep overbite was causing traumatic occlusion upon mastication and the crowded teeth were influencing oral hygiene. Both of these problems were affecting the patient and detrimental to his periodontal condition.

The treatment objectives were therefore to correct the overeruption, migration and inclination of the

| Measurement | Initial value | Final value | Norm     |
|-------------|---------------|-------------|----------|
| SNA (°)     | 83.6          | 83.5        | 82.8±2   |
| SNB (°)     | 80.0          | 80.1        | 80.0±2.0 |
| ANB (°)     | 3.6           | 3.4         | 3.0±2.0  |
| Wits (mm)   | 2.4           | 1.2         | 2.0±2.0  |
| APDI (°)    | 83.4          | 84.4        | 81.0±4.0 |
| ODI (°)     | 73.9          | 77.7        | 73.0±5.0 |
| FMA (°)     | 18.8          | 19.0        | 24.5±4.0 |
| FMIA (°)    | 64.6          | 63.5        | 55.0±6.0 |
| IWPA (°)    | 96.6          | 97.5        | 96.7±6.4 |
| U1-SN (°)   | 102.2         | 106.5       | 102.5±3.4|
| U1-PP (°)   | 110.9         | 115.8       | 118.0±6.0|

SNA, sella-nasion-A point; SNB, sella-nasion-B point; ANB, A point-nasion-B point; Wits, distance between perpendiculares from A point and B point onto the occlusal plane; APDI, anterior-posterior dysplasia indicator; ODI, overbite depth indicator; FMA, Frankfort plane to mandibular plane angle; FMIA, mandibular incisor to Frankfort plane angle; IWPA, mandibular incisor to mandibular plane angle; U1-SN, maxillary incisor to SN plane angle; U1-PP, maxillary incisor to Palatal plane angle.
teeth, improve the deep overbite, provide space for dental implants, and, most importantly, maintain periodontal health.

**Treatment progress**

Three months after the initial periodontal therapy, a Damon Q passive self-ligating appliance (Ormco Corporation, CA, USA) was placed in the maxillary arch except for the incisors, and a 0.012 inch nickel-titanium arch wire was inserted for aligning the inclined posterior teeth. In the mandibular arch, only #45, #46 and #47 were bonded with brackets. A segmental 0.012 inch nickel-titanium arch wire and a 0.025 inch stainless steel ligature wire were used to align and gently distally move #45. During the second month, the segmental arch was changed to 0.016 × 0.022 inch stainless steel arch wire with a closing loop between the lower right second premolar and first molar to continue the distal movement of the second premolar (Figure 4).

Every three to four months throughout the active orthodontic phase, a professional examination of the periodontal status and regular scaling were performed by the periodontist. After five months of distal movement of the upper canines and the creation of space for the upper incisors, #11, #12 and #21 were bonded with self-ligating brackets. A 0.013 inch copper-nickel-titanium arch wire was inserted to gently align the teeth. The proclined #22 was not bonded in order to avoid proclination of the other incisors and unwanted force that might harm periodontal health. After the alignment of #11, #12 and #21, space for aligning #22 was obtained and the tooth was subsequently bracketed. After uprighting the lower right second premolar, the lower arch except the incisors were bonded during the fifth month and a 0.013 inch copper-nickel-titanium aligning arch wire was placed. At 12 months, the lower incisors were bracketed, and the alignment of both arches continued.

Thirteen months after commencement, a 0.016 × 0.022 inch stainless steel utility arch was placed to intrude the lower incisors to level the curve of Spee (Figure 5). Prior to intrusion, a thorough oral hygiene regime was conducted and a panoramic radiograph was taken (Figure 6). Plaque was controlled and the periodontal status was assessed to be stable by the periodontist, so that the anterior tooth intrusion could commence uneventfully. After three months of utility mechanics, the arch wire was changed to 0.016 × 0.022 inch nickel-titanium, which extended from the lower left second molar to the right second molar, to limit persistent intrusion of the lower anterior teeth and prevent tipping of the lower first molar. After a
month’s use of the rectangular nickel-titanium arch wire, the SS utility arch was re-inserted to recommence the intrusion of the lower anterior teeth. At 24 months, reverse-curve 0.016 × 0.022 inch nickel-titanium arch wires were placed. In addition, a vertical elastic generating a force of 60 gm was applied from the upper first molar to the lower first molar, to assist overbite correction.

The total active treatment period was 28 months. During that time, regular examinations showed no worsening of the periodontal situation that would require the cessation of orthodontic treatment. After band removal, a maxillary removable Hawley retainer and a mandibular Hawley retainer with replacement teeth were issued for retention.

Results

The panoramic radiograph, taken at 13 months and prior to overbite correction, indicated neither loss of alveolar bone nor root resorption. Throughout active treatment, no significant mobility was shown, and the gingival margins of the patient remained stable, with an associated pocket depth of less than 2 mm.

After 28 months of treatment, the teeth were well aligned and interdigitated. The mesially-inclined lower second premolar was repositioned. Space needed for dental implants for the missing #14, #35 and #44 had been created. The overerupted maxillary left incisor was significantly intruded, without obvious gingival recession. The overjet and overbite had improved. The post-treatment casts demonstrated the excessive curve of Spee had been flattened (Figure 7). Class I canine and molar relationships on both sides had been maintained (Figure 8). Overall, the soft tissue attachment and tooth mobility did not deteriorate. The attachment level of #41 increased by 2 mm, while the mobility of #11 and #41 improved (Figure 9). The acceptable facial profile showed minimal change according to the post-treatment facial photographs (Figure 8). No temporomandibular disorder signs or symptoms were noted.

A post-treatment panoramic radiograph showed no significant root resorption and acceptable root parallelism. Radiographically, the height of the alveolar bone increased between the lower right first and second molars, and between the upper left central and lateral incisors (Figure 10). The lateral cephalogram and superimposition showed no significant changes in the skeletal measurements except for a 3.8° reduction of the overbite depth indicator (ODI), which suggested an improvement in the mild skeletal overbite. The inclination of the maxillary incisors increased by 4.3° (U1-PP, 115.8°), which was within a normal range, indicating that the roots were upright (Table I). The improved overjet provided protection to both upper and lower anterior teeth from traumatic contact during occlusion. Other cephalometric values remained within the normal ranges (Table I).

Eighteen months after treatment, the dental implants had been completed. The patient’s occlusion remained stable with acceptable overjet and overbite and good posterior intercuspation (Figure 11). At that time, the attachment level of #21 had increased approximately 1 mm, compared with the pretreatment level (Figure 12).

The patient was very satisfied with the treatment outcome and felt much more occlusally comfortable.
After three years of retention, there was no significant evidence of relapse or complication. The periodontal health remained stable, without further gingival recession, tooth mobility, or signs of inflammation (Figure 13).

Discussion
Orthodontic treatment can contribute to periodontal disease, as appliances may increase bacterial aggregations and ill-considered force can aggravate the loss of supporting structures. Nevertheless, orthodontic correction of a malocclusion can improve pathologic tooth migration and providing necessary conditions for functional and aesthetic repair, as well as long-term stability of the periodontal tissues. In the current case, the lower right incisor and the upper left incisor showed significant reduction in gingival recession three years after orthodontic treatment. The height of the alveolar bone increased in the area between the upper left central and lateral incisors and also between the lower right first and second molar.
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Figure 10. (A, B, C) Post-treatment radiographs and superimposition; (D, E, F, G) According to the panorama, the height of the alveolar bone increased in some areas. D. The height of the alveolar bone between lower right first and second molars before treatment; E. The height of the alveolar bone between lower right first and second molars after treatment. F. The height of the alveolar bone between the upper left central and lateral incisors before treatment; G. The height of the alveolar bone between the upper left central and lateral incisors after treatment.

Figure 11. 18-month post-treatment intraoral photographs.
Thorough periodontal management was adopted for the patient and the periodontitis was controlled and in a non-active state before orthodontic treatment commenced. Several clinical studies have demonstrated that, with meticulous plaque control, patients with reduced but a healthy periodontium can receive orthodontic treatment. It has been recommended that orthodontic appliances should be placed two to six months after the completion of therapy to restore periodontal health, and to also assess patient compliance. The specific interval should be determined following an analysis of periodontal disease risk factors and the planned tooth movements. The presented patient maintained sound oral hygiene, but the periodontist recommended monitoring and professional cleaning and examination every three to four months during the active orthodontic phase. Plaque control before tooth intrusion was critical because a previous study demonstrated that it is possible to shift supragingival plaque into a subgingival position by orthodontic tooth intrusion and subsequently generate attachment loss and infra-bony defects. Under the right conditions, several studies have shown that the intrusion of teeth can considerably improve the level of tissue attachment following the adequate control of inflammation and bacterial biofilms. These positive results have been shown to remain relatively stable in the long term (12 years) in previously periodontally-compromised patients. In the current patient, the attachment level of #41 increased by 2 mm and the attachment level of #21 increased by approximately 1 mm, 18 months after orthodontic treatment. The possible explanation includes the reduction of pathologic tooth migration, the uprighting of the teeth in the alveolus, possibly encouraging the regeneration of supporting tissues, and the elimination of a traumatic occlusion. These changes remained stable after a three-year follow-up. Appropriate biomechanical systems are essential for the control of tooth position and maintenance of periodontal health. For teeth with reduced periodontal support, the ability of the periodontal ligament to withstand forces is diminished and so the biological and biomechanical conditions differ from teeth without a compromised periodontium. Passive self-ligating brackets were chosen for the patient, not only because they are considered more helpful to reduce plaque accumulation compared with elastomeric ligatures but, more importantly, because the low or absent associated friction contributes to the application of lighter forces to the teeth (5–15 gm per tooth). For teeth with reduced periodontal support, the loss of alveolar bone causes apical displacement of the centre of resistance, which results in greater force moments during retraction and the likelihood of an increased extrusive component of an applied force. It is suggested that a light force can move teeth efficiently and possibly reduce root resorption and alveolar loss. Throughout the treatment process for the current patient, thin arch wires such as 0.012 inch nickel-titanium and 0.013 inch copper-nickel-titanium were used for aligning.

Generally, in orthodontic treatment, a tooth can be used as anchorage against another during arch wire alignment. It is necessary to avoid unwanted force and undesirable movement on teeth with compromised periodontal support. For the present case, only #45, #46 and #47 were bracketed at the outset and a segmental arch used to initially upright #45 in order to prevent unnecessary force on the lower incisors. The brackets were not initially bonded on all the upper teeth, because without enough space for alignment, the upper incisors would procline and require further
retraction. Canine lacebacks were applied to distally move the upper canines and obtain space before bonding the upper incisors and starting alignment.

The patient’s history of chronic periodontitis and loss of supporting structures had resulted in proclination and overeruption of the maxillary anterior teeth, which in turn had worsened an increased overbite. The anterior teeth were therefore more likely to suffer from occlusal trauma and further aggravate the loss of supporting tissues. The mechanism to correct an anterior overbite in an adult is absolute intrusion of the upper and lower incisors. A utility arch wire made of 0.016 x 0.022 inch stainless steel was used as it would result in a lighter force applied to the anterior teeth compared with other means of intrusion. To avoid persistent intrusive force on the lower anterior teeth and to prevent inclination of the lower first molar, a utility arch was used intermittently for a month. Additionally, to avoid further flaring, the proclined lower anterior teeth were retracted to an upright position before being intruded, so that they would be located in a centralised position in the alveolar bone.

**Conclusion**

For adult patients with a compromised periodontium, adequate control of healthy and stable soft tissues is the basis of orthodontic treatment. Correspondingly, orthodontic treatment that improves a malocclusion involving pathologic tooth migration is beneficial to periodontal health in the long term. A team approach is essential to restore a healthy, functional and aesthetic dentition.

**Conflict of interest**

The authors report no professional or financial conflict of interest in relation to this case report. The patient provided permission for the publication of his clinical data and photographs.

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