

Orthodontics following periodontal regenerative procedures

Authors_ Nezar Watted & Josip S. Bill, Germany

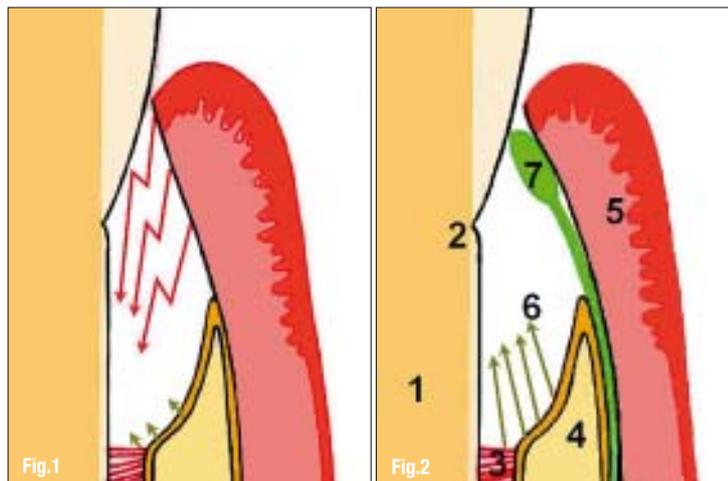


Fig. 1 Illustration of the wound healing mechanisms following conventional flap surgery. Rapid proliferation of the junctional epithelium apically and its population at the root surface prevent regeneration.

Fig. 2 The principle of GTR. Application of a membrane (7) and consequently shielding of the gingival epithelium (5) from the cementum and alveolar bone (4) creates a void (6); this enables population of the periodontal defect with cells from the desmodont (3) and the alveolar bone (4). (1: dentin, 2: cementoenamel junction, 3: desmodont, 4: alveolar bone, 5: gingival and gingival epithelium, 6: void, 7: membrane as barrier)

_Introduction

Recently, a continuing trend can not be overlooked: the number of orthodontically treated adult patients, with a particular interest in the correction of aesthetic imbalances, is increasing continuously. Because the mouth and teeth play a significant role in the attractiveness of the human face and the teeth are viewed as a prominent feature of personal identity, the correction of dentofacial anomalies must be realised with the appropriate emphasis on the objective goal-setting in orthodontics.

Adult treatment itself confronts the orthodontist with interdisciplinary questions that, for example, concern orthodontic tooth movements in periodontally damaged section of the jaw. The

high success rates of newer periodontal treatment techniques—such as guided tissue or bone regeneration—raised the questions of how these could reasonably be employed in combined periodontal-orthodontic therapy.

Marginal periodontitis frequently results in the destruction of the tissues supporting the teeth, especially the alveolar bone and the connective tissue attachments.²⁴ The purpose of

conventional periodontal therapies, like scaling and root planing, is to arrest the progression of periodontal attachment loss and destruction of alveolar bone and thus to preserve the teeth and their function, but they are incapable of regenerating existing defects using tissue regeneration.^{13,24}

Studies of periodontal wound healing mechanisms following conventional flap surgery have shown that the rapid apical proliferation of the junctional epithelium substantially prevents new attachment or regeneration (Fig. 1). Regeneration of the periodontium appears to be able to proceed on the basis only of cells of the alveolar bone and the desmodont.^{6,21,30,36,47} These findings prompted Nyman et al. to shield the defect, which was cleansed of granulation tissue, in-



Fig. 3a_The dental malpositionings impair appearance when smiling.

Figs. 3b-d_Situation prior to periodontal and orthodontic treatment: a class I occlusion at the first molar due to agenesis of the mandibular incisor.

Figs. 3e-g_Top view of the two jaws: dental malpositionings and crowding in both fronts, agenesis of tooth 41, interfered shape of the front teeth in the maxilla.

Fig. 3h_A very pronounced probing depth mesially of tooth 26, the gingiva appears inflamed in this region.

fectured cement and bone tissue, against the gingival epithelium, using a mechanical barrier (membrane). Two variants of the membranes can be used for this purpose: absorbable (eg Hypro-Sorb F, Hypro-Sorb M Resorbable Bilayer Collagen Membrane, CardioPhil Ltd.) and non-absorbable (eg Gore-Tex membranes). When non-absorbable membranes are used, a second surgical procedure for removal will be required. The membranes are intended to create the basis for regeneration of cement, bone and connective tissue attachment under the influence of periodontal ligament cells (Fig. 2).^{8,16,17,23,36,37} This procedure is referred to as guided tissue regeneration (GTR).

Histological studies, like those by Gottlow et al.¹⁶, Becker et al.³, Zappa⁵⁰ und Cortellini et al.⁸, demonstrated regeneration of the periodontium following GTR.^{1-4,6,7,13,18,29,39,40,43-46,48} Restitutio ad integrum, that is the complete qualitative and quantitative restoration of the lost periodontal tissue, is not possible with the currently available techniques.

Combination of GTR and bone augmentation (bone grafts and/or bone implants)

Regeneration of the periodontium can be supported by bone grafts. This is autogenous bone that can be harvested both extra- and in-



Fig.4

Fig. 4 _The X-ray shows a bony defect between tooth 25 and 26.

traorally. The iliac crest is the preferred extraoral removal site. The harvested spongy bone and the bone marrow have a markedly high osteogenic potential. The tuber, an edentulous section of the jaw, a healing extraction alveolus or the chin region are suitable intraoral harvest sites. The bone implants are donor bones that are available in different forms (frozen, freeze-dried and demineralised freeze-dried). With its high biocompatibility, Dexabone (CardioPhil Ltd.) is suitable as a bone implant or bone substitute. This preparation has shown to be effective in implantology as well as in the treatment of periodontal defects.

A number of authors have reported on the success of periodontal regeneration following localised augmentation in alveolar or periodontal defects using bone grafts or implants.^{9,19,23,41,42}

A bony defect fill and attachment gain have been confirmed histologically.^{9,41} In other histological studies, a long junctional epithelium between the newly formed alveolar bone and the root surface could also be found in addition to the new attachment.^{26,33} Mellonig³² concluded that the treatment of periodontal defects using bone implants represents only one of many therapeutic options and, with correct implementation, generally runs a successful course.

The combination of guided tissue regeneration with bone augmentation seems to be a promising approach. This is particularly effective if the bone defect is so large or the defect shape so unfavourable, that a void cannot be created under the membrane.^{1,21}

Cleft jaw reconstructions (secondary osteoplasty) have successfully been achieved with bone grafting prior to orthodontic tooth movement into the former cleft area.^{5,10,14,28}

Localised augmentations in the alveolar or periodontal defect prior to orthodontic tooth movement²⁷ have shown to be successful. Bowers et al.⁶ summarised a selection of previously published histological findings that demonstrate regeneration following application of bone grafts.

Orthodontic tooth movements in areas with reduced bone availability are not accompanied by



Fig. 5a



Fig. 5b

Figs. 5 a, b _Surgical exposure of the bony defect at tooth 26 buccally and palatally.

Figs. 6a, b _The granulation tissue was removed and the bony defect was treated with bone and membrane.



Fig. 6a



Fig. 6b

a loss of connective tissue attachment when the marginal inflammation was eliminated pre-orthodontically.^{15,20,25,31,38} In other words: even in these patients, orthodontic therapy or tooth movements can be achieved. The prerequisite for this, however, is that all inflammatory periodontal changes are eliminated and clean root surfaces are available. In animal experiments with rhesus monkeys, Polson et al.³⁸ concluded that orthodontic tooth movements into periodontal defects do not cause a deterioration of the connective tissue attachment level on neither the pressure nor the tension side. In experimental animal studies, in which teeth were moved into periodontal defects, Geraci et al.¹³ found that new connective tissue attachments formed on a root surface that previously abutted on an inflammatory lesion. The authors are aware of the need for interpretation of these findings obtained in an animal model. There are still inadequate studies available in humans.

The reaction of periodontal and alveolar tissue to orthodontic forces following regenerative treatment of advanced periodontal lesions have previously been described in a number of clinical case presentations.^{15,20,34,35,49} Although clinical experience allows the presumption that orthodontic movement following regenerative procedures is possibly better and results in the formation of new attachments, there are few experimental indications confirming this hypothesis.

Case presentation

A 38-year-old female patient presented to our practice for orthodontic treatment. The intraoral photos showed class I occlusion on the right and left. The top view photos showed the dental malpositioning in both arches and crowding in both fronts. According to the patient, none of the lower jaw front teeth had been extracted, which confirmed agenesis of a front tooth (Figs. 3a-g).

At clinical examination and when recording periodontal status, a pronounced pocket depth (12 mm) of tooth²⁶ was determined mesially, buccally and palatally (Fig. 3h). There was first degree loosening and zero for the adjacent teeth. The gingival appeared unphysiological (red and oedematous).

These findings were confirmed radiologically with demonstration of massive bone loss, which can be seen only mesially, representing a localised periodontitis – periodontitis marginalis profunda (Fig. 4).

The following treatment plan was set up:

1. conventional periodontal therapy
2. surgical periodontal therapy with guided tissue or bone regeneration
3. orthodontic therapy with a multibanded orthodontic appliance
4. restorative therapy
5. retention phase.

Fig. 7 Enamel reduction: stripping of the upper front.

Figs. 8a-c The gaps in the lower front were eliminated through tooth expansion with composite mass.



Fig. 7



Fig. 8a



Fig. 8b



Fig. 8c

Figs. 9a-g_Situation at completion of the entire treatment (orthodontics, periodontal, prosthetic and conservative).



After motivation and detailed oral hygiene instruction, the first treatment phase (initial therapy) began. In the root planing phase, a mouth rinse (Dicapinal) and antibiotics were prescribed.

After the first treatment phase and thanks to the patient's excellent cooperation, the papillae bleeding index (PBI) and approximal plaque index (API) were reduced to almost zero. Periodontal surgery followed several weeks later.

During the surgical procedure, a large bone defect was revealed that affected the entire root length of the molar (Figs. 5a, b). Root planing and removal of infected soft tissue was then carried out. The removal of the entire infected hard and soft tissue is a fundamental requirement for the success of guided tissue or bone regeneration. To support the procedure, ultrasound was implemented for the subgingival scaling.

Guided tissue regeneration (GTR) in combination with a bone implant was used for regener-

ating the periodontal defect. A demineralised freeze-dried bone product (particle size 1000–2000 mm, Dexabon, CardioPhil) was used (Fig. 6a). An absorbable membrane was used as a barrier between the bone-filled defect and the gingival epithelium (Hypro-Sorb F, Resorbable Bilayer Collagen Membrane, CardioPhil) (Fig. 6b).

Careful clinical examination with review of the periodontal status was done five months postoperatively. An attachment gain was diagnosed at the preoperatively deepest point and there was regeneration of the alveolar bone buccolingually and vertically.

These positive results were the prerequisite for orthodontic therapy with the goal to resolve the frontal crowding. A prosthetic tooth replacement of the absent front tooth in the lower jaw was not planned. It was planned to distribute the resulting gap over the entire frontal region, so that tooth expansion with composite could be done.

Both arches were bonded with a multibanded orthodontic appliance. The upper front teeth were stripped (enamel reduction), in order to create a harmonious tooth shape in the upper front and to prevent excessive protrusion of the front teeth (Fig. 7). The orthodontic treatment was carried out gradually and with low controlled forces. Additionally, the patient was enrolled in a monthly recall programme.

Upon conclusion of the orthodontic treatment, expansion of the lower front teeth and formal correction of both upper cuspids was done (Figs. 8a-c). A retainer was bonded in both fronts. The clinical images show a gap-free front segment (Figs. 9 a-g). Figure 10 shows the bone conditions in the regenerated region into which tooth 26 was moved.

Discussion

Although orthodontic tooth movement into an area with heavily resorbed alveolar bone—provided there is no inflammation—does not necessarily have to be accompanied by attachment loss,^{15,22,25,38} there can be reduced bone support and increased loosening. In patients with an inflamed periodontium, orthodontic tooth movements without previous periodontal treatment would result in further periodontal destruction and consequently to the loss of the affected teeth.

Professional dental cleaning and plaque control during orthodontic treatment are compulsory measures for ensuring an inflammation-free periodontium. This is particularly important where an active intrusion of elongated maxillary incisors is required, because the orthodontic movement can result in subgingival plaque from the former supragingival plaque.^{11,12}

The result of conventional or non-regenerative periodontal therapy is the formation of a long junctional epithelium. Such measures for reducing pocket depth and establishing healthy periodontal conditions can result in major gingival recession prior to orthodontic tooth movement, which makes subsequent GTR procedures technically more difficult.

This paper evaluates the feasibility of orthodontic tooth movements after treatment of advanced periodontal defects using GTR and bone augmentation.

In the case presented, periodontal attachment gain in the area of the preoperatively

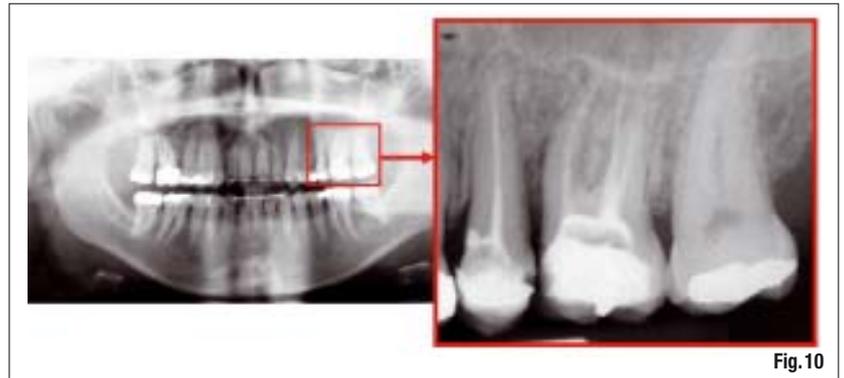


Fig.10

largest probing depth was shown clinically. Radiologically, a bone gain was also presented in the defect in virtue of the GTR procedure, which then enabled tooth movements into the newly regenerated tissue. Without combined periodontal-orthodontic therapy and permanent stabilisation, this patient would have faced premature loss of tooth 26.

Fig. 10 Situation after completion of orthodontic treatment. The augmentation was done in the context of the periodontal treatment and prior to orthodontic treatment.

In summary, it can be said that regenerative periodontal therapy prior to orthodontic tooth movements, as implemented in the case presented, increases osseous and periodontal regeneration. The long-range prognosis for teeth can therefore be improved.

Consequently, treatment options with good prognoses can be offered to patients with advanced periodontitis. More clinical and histological studies could help in gaining a better understanding of the biological bases of this type of periodontal-orthodontic therapy.

Editorial Note: A complete list of references is available from the publisher.

author info

cosmetic
dentistry



Prof Dr Nezar Watted

is lecturer at the University of Würzburg, Germany, and runs a private practice in Würzburg, Germany.

Wolfgang Str. 12
97980 Bad Mergentheim
Germany
E-Mail: nezar.watted@gmx.net