Alveolar Bone Upper Growth in Furcation Area Using a Combined Orthodontic-Regenerative Therapy: A Case Report

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**Background:** This case report demonstrates orthodontic and regenerative combined therapy in a 49-year-old male whose right maxillary premolar furcation had a bony defect with poor biologic width resulting from extensive subgingival caries. In these advanced interdisciplinary cases, crown lengthening with periodontal surgery alone does not solve the complex clinical problems. We believe that a combined orthodontic and periodontal regenerative combination therapy offers the best option for achieving a predictable outcome.

**Methods:** First, regenerative therapy by open debridement with a bioabsorbable synthetic bone graft, bioabsorbable membrane, and minocycline root conditioning was carried out. Eight weeks after initial surgery, orthodontic extrusion was initiated.

**Results:** Radiographs and reentry documentation suggest that the furcation defect associated with poor biologic width was successfully treated.

**Conclusion:** This case report demonstrates that orthodontic-regenerative combined therapy can resolve complex clinical problems and enhance predictability. J Periodontol 2002;73:1522-1527.

**KEY WORDS**

Bone regeneration; grafts, bone; membranes, barrier; membranes, bioabsorbable; minocycline/therapeutic use; furcation/surgery.

The treatment of furcation invasions remains one of the most difficult clinical problems. In this advanced interdisciplinary case, we present more complex clinical problems, i.e., a furcation defect associated with poor biologic width resulting from extensive subgingival caries. The purpose of this case report is to discuss the rationale that orthodontic-regenerative combined therapy offers the best option for achieving a predictable outcome. There are case reports using an orthodontic-regenerative combined therapy to improve the preorthodontic, periodontal condition for orthodontic tooth movement. However, an advanced interdisciplinary case using orthodontic extrusion and guided tissue regeneration (GTR) combined therapy has not been previously reported. There has been general agreement that orthodontic extrusion is the most predictable way to reestablish the biologic width. In this case, the furcation problem cannot be managed with orthodontic extrusion alone, since it contributes to further periodontal tissue breakdown. Furthermore, GTR therapy alone cannot solve the biologic width problem. This case demonstrated that complex clinical problems may be solved with an orthodontic-regenerative combined therapy. The discussion includes the role of periodontal ligament (PDL) cells in combined therapy, and how the healing potential depends on PDL cells. Further possibilities and treatment modalities of combined therapy are also reviewed.

**CASE DESCRIPTION**

A 49-year-old male presented with a bifurcation defect associated with poor biologic width due to extensive subgingival caries on the buccal aspect of the right maxillary first premolar. The probing depth (PD) was 8 mm. This condition originated about 15 years earlier. His right maxillary canine was previously extracted, after which there was epithelial cell downgrowth from the extraction socket to the furcation defect. The patient was diagnosed...
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with chronic periodontitis. As part of the initial therapy, plaque control was initiated as well as supragingival and subgingival scaling and root planing. Endodontic treatment and bite adjustment were completed, and all etiologic factors were removed. After initial therapy, clinical examinations included assessment of PD by probe and clinical radiographs (Figs. 1, 2, and 3). Prior to initial surgery, a labial metal bur with resin pontic was placed by direct bonding for orthodontic extrusion. An elastic hook was also placed into the root canal by direct bonding (Fig. 4).

The patient rinsed immediately prior to initial surgery with 0.12% chlorhexidine solution. After local anesthesia, a full-thickness flap made by sulcular and vertical incisions was reflected. The furcation defect was completely debrided and the root planed with hand and ultrasonic instruments. Minocycline solution root conditioning was done for 3 minutes. The furcation defect had an 8 mm vertical component (Fig. 5). A bioabsorbable synthetic bone graft‡ mixed with minocycline was compacted into the defect to obtain space provision (Fig. 6). A bioabsorbable membrane§ was placed to cover the defect with 2 to 3 mm of bone margin, and fixed by a sling suture. The full-thickness flap was advanced to a coronal position. A vertical mattress sling 5-0 monofilament suture was placed for flap adaptation, and an interrupted 5-0 monofilament suture for flap closure. Periodontal dressing¶ was placed on the surgical site for 14 days. Minocycline for 4 days, 100 mg per day, was prescribed. The patient was seen for postoperative treatment including plaque debridement (PMTC) and oral rinse with 0.12% chlorhexidine solution and reinforcement of oral hygiene every week for 8 weeks.

‡ Biogran, 3i Implant Innovations, Inc., Palm Beach Gardens, FL.
§ Osseo Quest, W.L. Gore and Associates, Flagstaff, AZ.
¶ Coe-Pak, G.C. America, Alsip, IL.

Figures 2 and 3.
Radiograph after initial therapy demonstrating the extent of the defect by the insertion of a silver point.
Eight weeks after initial surgery, the membrane was exposed and orthodontic extrusion was initiated (Fig. 7). Four weeks after orthodontic extrusion was completed, temporary stabilization was done with ligature wire and resin. Approximately 2.5 mm of extrusion was achieved in 4 weeks (Fig. 8).

Five months after initial surgery, a provisional crown was placed and reentry surgery was performed. The furcation defect was filled with bone and the biologic width was reestablished (Fig. 9). Reentry surgery was completed, using a full-thickness flap which was advanced coronally, positioned, and sutured as described above. Nine months after initial surgery, a final restoration was placed (Figs. 10 and 11).

DISCUSSION
This case report demonstrated that in a complex advanced interdisciplinary case, the maxillary first premolar, with a bifurcation defect associated with poor biologic width due to extensive subgingival caries, can be resolved using combined orthodontic and regenerative therapy.

The concept of GTR therapy originated in Melcher’s study. Many researchers contributed to later research, especially in the management of furcation defects.
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However, clinical outcomes are variable and depend on 3 related factors: 1) the patient; 2) the type of defect; and 3) the treatment technique. In conducting orthodontic-regenerative combined therapy, one must evaluate the defect, since a furcation defect has the characteristics of a horizontal lesion. In addition, new attachment formation depends on the coronal growth of PDL cells. In order to obtain a predictable outcome, McClain and Schallhorn established new criteria for furcation management: 1) combination therapy (demineralized freeze-dried bone allograft + barrier membrane); and 2) adjunctive technique which includes root conditioning (citric acid, EDTA, tetracycline) and coronally positioned flap. Furthermore, evidence of true regeneration can only be achieved by histological examination, as Harris demonstrated.

How can orthodontic extrusion solve biologic width problems? The concept of biologic width originated...
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in Sicher’s study. Later, Gargiulo described the biologic width as the dimension from the crest of the alveolar bone to the base of the sulcus, the connective tissue, and epithelial attachments. There is general agreement that a biologic width of 2.5 mm is necessary to provide for insertion of the attachment apparatus. In addition, orthodontic extrusion (so-called forced eruption) was clearly documented by Ingber. Forced eruption has been suggested for management of poor biologic width of root fracture, extended subgingival caries, and the 1- or 2-wall defect, i.e., reestablishment of the biologic width. There is also general agreement that we can resolve biological problems by orthodontic extrusion with predictability since orthodontic extrusion can achieve both physiologic and microbiologic changes in the local tooth environment.

However, in this advanced interdisciplinary case, orthodontic eruption alone could not solve these complex problems. Corn has suggested that the inability to maintain a plaque-free environment resulted in greater bone loss on the furcation. Even in physiological environments, collagen turnover in the PDL is much higher than in other connective tissue. For example, collagen turnover in the PDL is about 4 times greater than that of skin. So, the turnover rate of the collagen could not keep up with the eruptive force in the presence of inflammation.

Experimental studies including histological analysis are therefore necessary. Polson et al. have reported periodontal response after tooth movement into intrabony defects. Histological examination showed a thin epithelial layer lining the root surface with no new attachment apparatus on either the pressure or tension side. Furthermore, Wennström et al. have reported that tooth movement may increase the rate of destruction of connective tissue attachment of teeth with inflamed, intrabony pockets. Because of these side effects, we must alter the preorthodontic periodontal condition by GTR, which is a predictable way to gain PDL collagen fibers.

Recently, the role of PDL cells has been explained. Teeth can be moved with bone. According to Melsen, bone apposition is the result of the bending of the alveolar wall, which is produced by the pull from the PDL fibers, since, as Frost has suggested, the bone has a positive balance at higher strain values.

Thus, in this case, preorthodontic GTR therapy could significantly improve the preorthodontic periodontal condition in the furcation area. Diedrich has suggested that new PDL fibers gaining on the tension side in the furcation area can transfer the orthodontic force and stimulate the alveolar bone. As a result, bone apposition can occur in the furcation area, since the alveolar bone is turned in a positive balance. Also, GTR therapy could enhance the predictability, preventing the epithelial downgrowth.

In conclusion, this case report demonstrates that orthodontic and regenerative combined therapy can resolve complex clinical problems. Radiographs and reentry documentation suggest that the furcation defect associated with poor biologic width can be successfully treated with predictable results. Orthodontic-regenerative combined therapy enhances this predictability. However, more observation and histological research need to be conducted.

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