

Augmentation of an anterior edentulous ridge for fixed prosthodontics with combined use of orthodontics and surgery: A clinical report

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Untreated periodontitis may lead to tooth and tissue loss that can result in diminished masticatory function and esthetic deformities. Combined periodontal/prosthodontic treatment for patients with advanced periodontal disease has been well documented, and treatment results can often be improved with the use of adjunctive orthodontic treatment such as forced eruption. This clinical report describes a method of preprosthetic preparation of an edentulous ridge for a fixed partial denture that incorporates the combined use of orthodontics and surgical ridge augmentation. (J Prosthet Dent 2003;90:111-5.)

When teeth are extracted because of periodontal disease, the residual alveolar ridge commonly heals with deficient contour.¹ If the resorbed residual alveolar ridge is located anteriorly, the esthetic result of a fixed partial denture that replaces the missing teeth may be compromised. Seibert^{2,3} classified deformed partially edentulous alveolar ridges and proposed the use of full thickness onlay grafts to restore a more favorable contour. Langer and Calagna⁴ proposed the placement of a subepithelial connective tissue graft to improve edentulous ridge soft tissue deformities.

More recently, osseous regenerative techniques have been used and guided bone regeneration with the use of graft materials combined with physical barriers has been advocated as a predictable method to reshape hard and soft tissue deformities.⁵ These periodontal plastic and regenerative procedures can improve the appearance of FPDs by preventing the need to adapt long, unesthetic pontics to resorbed ridges.⁶

Hard and soft tissue alterations can also be obtained through tooth movement and forced eruption. During orthodontic forced eruption the supra-alveolar and gingival fibers, together with the periodontal ligament fibers, are stretched coronally. This stretching of the fibers will cause "coronal repositioning" of the gingiva and new bone apposition in the direction of the movement. These phenomena have been previously described by Atherton⁷ who also observed how the sulcular epithelium would, under these circumstances, invert outwards following the coronal movement of the tooth, and by Mantzikos⁸ who reported on the benefits of an enhanced anatomic topography of the soft and hard tissues after orthodontic tooth extrusion before implant placement.

In the periodontal management of patients undergoing orthodontic treatment, meticulous oral hygiene

practices combined with frequent professional recalls have been recommended.^{9,10} Van Venrooy and Yukna¹¹ have shown that forced eruption in animal studies can improve the periodontal condition of the teeth and that only routine periodontal maintenance care is required.

This clinical report describes a method of preprosthetic preparation of an edentulous ridge for an FPD that incorporates the combined use of orthodontics and surgical ridge augmentation. For this patient, the use of orthodontic tooth movement, under routine professional maintenance, enhanced the periodontal condition of the teeth while producing optimal ridge height for the planned pontics.^{12,13}

CLINICAL REPORT

A 59-year-old white man presented with pain and swelling in the maxillary left central incisor. The medical history was noncontributory and the dental history revealed several missing teeth and multiple amalgam and composite restorations. Penicillin had been prescribed by a physician for treatment of the swelling.

The level of oral hygiene was poor. Intraoral examination revealed several open contacts between the maxillary anterior teeth. The maxillary left central incisor was extruded and the right central incisor presented a palatogingival groove. The patient displayed a medium lip line combined with "black triangles" between the 2 maxillary central incisors and the left central and lateral incisors (Fig. 1, A). Probing depths ranged from 2 to 10 mm. Mobility was Miller Grade 1¹⁴ for most teeth, although the maxillary left central and lateral incisors exhibited grade 2 mobility.

Radiographic examination revealed moderate-to-severe bone loss, localized about the left maxillary central and lateral incisors and a pattern of vertical bone loss associated with both central incisors (Fig. 1, B). The radiographs also suggested multiple furcation involvements, ill-fitting restorations, dental caries, and impaction of the maxillary left third molar.

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Fig. 1. A, Clinical appearance of anterior teeth at first consultation. **B,** Radiograph shows moderate-to-severe bone loss, localized about left maxillary central and lateral incisors, and pattern of vertical bone loss associated with both central incisors.

Occlusal examination revealed an Angle Class I canine relationship with a vertical overlap of 5 mm and a horizontal overlap of 2 mm. The anterior guidance was unfavorable because of the malalignment of the teeth and aberrant occlusal plane. The periodontal diagnosis was generalized moderate-to-severe chronic periodontitis¹⁵ with pathologic tooth migration. The patient was provided with oral hygiene instructions. Initial therapy of scaling and root planing was completed, and periodontal reevaluation was conducted after 3 weeks.¹⁶ The prognosis of the left central and lateral incisors was considered hopeless because of the severe bone loss.¹⁷ The maxillary right and the mandibular left second molars were also considered nonmaintainable and were extracted. The initial phase of treatment successfully reduced the inflammation.¹⁸ Nevertheless, conventional periodontal surgical procedures were required to further reduce residual probing depths.

After periodontal therapy a considerable amount of recession was present, especially in the area of the maxillary left central and lateral incisors, where the bone loss was substantial. The restorative treatment plan included an FPD extending from the maxillary right and left canines, replacing maxillary left central and lateral incisors. The extensive bone loss about the left central and lateral incisors was a concern because, after extraction, the anticipated deficient ridge contour would compromise the esthetic qualities of the pontics.

Surgical correction of the postextraction residual defect could be accomplished with either the use of an onlay graft,^{2,3} an interpositional graft,¹⁹ or a subepithelial connective tissue graft.⁴ Any of these procedures would require a donor site as source of the graft with possible multiple surgical procedures to achieve the desired amount of soft tissue augmentation. Restoration of the ridge contour with fewer surgical interventions and surgical sites was considered to be more desirable. Guided bone regeneration represented another alternative⁵; however, this option was impractical because of the high cost of regenerative materials, as well as the reported 3-mm average in the amount of vertical regeneration height that can be achieved.²⁰ A prosthetic alternative to the use of long unesthetic pontics would be the addition of gingival colored porcelain to the pontics.²¹ These pontics are difficult for the patient to clean, and often the shade does not adequately match the natural gingival tissues.

To maximize the esthetic outcome of the proposed fixed partial denture and minimize the number of surgical procedures, the hopeless maxillary left central and lateral incisors were provisionally retained and used to increase the vertical height of the residual bone defect by forced eruption. Forced eruption has been well documented as a method to reshape soft and hard tissue deformities associated with periodontal disease and as an

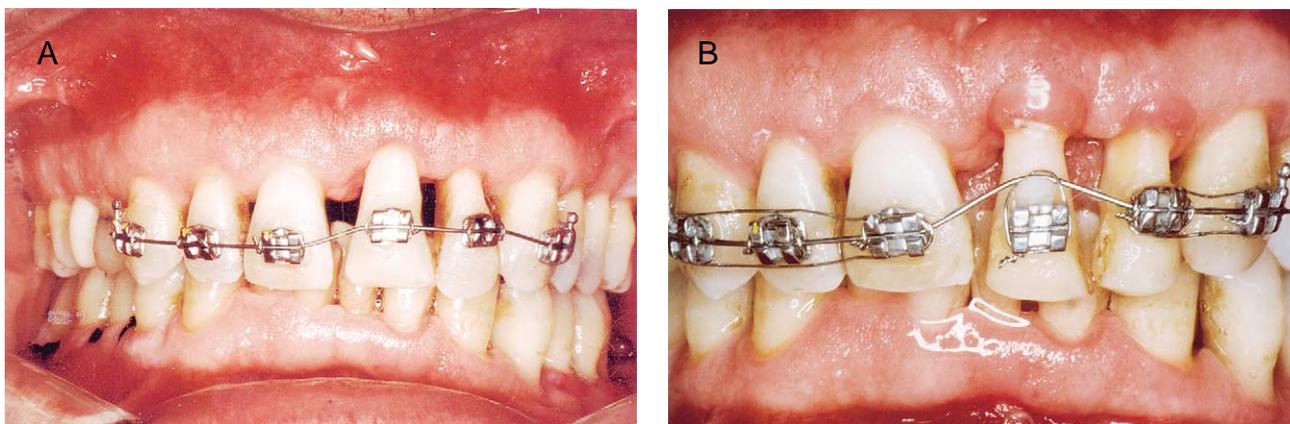


Fig. 2. **A**, Brackets and orthodontic wire before tooth movement. **B**, Clinical appearance after 12 weeks of forced eruption.

adjunctive orthodontic procedure to alter osseous and soft tissue contours.^{7,8,22-27}

Orthodontic brackets (GAC International, Inc, New York, NY) were bonded to the 6 maxillary anterior teeth, with the bracket of the left central and lateral incisors placed in a more apical position.²⁷ A nickel-titanium 0.016-inch wire (GAC International, Inc) was used to produce orthodontic movement. The desired coronal movement of the teeth was completed in 3 months. During the movement, a power chain elastic ligature (GAC International, Inc.) was added to achieve uniform distribution of the abutments by closing the interdental spaces (Fig. 2).²⁸ After 3 months of retention, the left central incisor was extracted (Fig. 3). The left lateral incisor was extracted 4 weeks later and a 6-unit acrylic resin interim FPD was placed (Fig. 4).

After the insertion of an interim FPD, a ridge augmentation procedure in the edentulous area was accomplished to maximize the esthetic result. A wide semilunar incision was designed high in the vestibule (Fig. 5) and a split-full thickness flap was elevated. A regenerative material, (PepGen P-15 Peptide Enhanced Bone Graft material; CeraMed Dental, LLC, Lakewood, Colo), was inserted under the full thickness portion of the flap and sutures were placed (Fig. 6). A definitive FPD was placed after a healing period of 3 months (Fig. 7). A night guard was also provided for the patient to protect the teeth from any possible parafunctional habits.²⁹ The overall duration of the treatment was 1.5 years. The follow-up period after insertion of the definitive restorations has been 1.5 years.

Currently, the patient has found it more convenient to receive routine maintenance care from a local dentist. Throughout treatment, the periodontal status of the patient improved substantially, and the esthetic deformity of the anterior edentulous ridge was eliminated with only 1 surgical procedure. The use of a commercially available bone graft material eliminated the need for a donor site.



Fig. 3. One week after extraction of maxillary left central incisor. (Artificial tooth bonded to bracket for immediate replacement.)

At the 1.5-year follow-up, the periodontal status of the patient was stable and no problems were detected in the restorations. The patient was highly satisfied with the functional and esthetic results.

DISCUSSION

The use of orthodontics to alter the alignment of the abutments and improve the osseous profile of the residual ridges was an important component of the preprosthetic treatment. Ingber^{22,23} first described forced eruption as an adjunctive procedure used in conjunction with surgical crown lengthening to minimize the increase in the crown-to-root ratio. Changes occur in the topography of the periodontal tissues as a result of the eruptive process.

The use of forced eruption provided the opportunity to permanently increase the vertical height of hard and soft tissues at the pontic sites. However, the bone that moved coronally was attached to the apical third of the roots, where the root diameters are relatively narrow.



Fig. 4. Provisional acrylic resin FPD extending from canine to canine.



Fig. 5. Initial incision for ridge augmentation procedure.



Fig. 6. Clinical appearance of edentulous ridge after healing period of 6 weeks. (Cervical one third of pontics of provisional FPD was removed to allow undisturbed healing of ridge.)



Fig. 7. Clinical appearance of definitive metal ceramic FPD with ovate pontic design.

This coronal movement of the bone produced the necessary height to the edentulous ridge, but the width was deficient because of the narrow root diameters. After the desired ridge height was developed, mucogingival surgery was used to widen the ridge.

One interesting observation on the radiograph of the central incisor was the “avulsion appearance” at the apex during the eruptive phase, a phenomenon that has been previously reported.¹² After a period of stabilization of this tooth, calcification of the bone in the apical area was evident (Fig. 8).

The primary advantage of using orthodontic forced eruption to permanently alter and augment the soft and hard tissue topography for this patient was related to minimizing the number of surgical procedures required. The vertical and horizontal augmentation that was achieved was limited by the amount of residual sound

periodontal ligament surrounding the roots. The only known contraindication to the use of the presented orthodontic procedure is the presence of root ankylosis that may prevent the teeth from moving.

SUMMARY

This clinical report illustrated a method in which teeth that were planned for extraction were orthodontically erupted to improve the soft and hard tissue contour of the future edentulous ridge. The active phase of the treatment lasted 1.5 years. This treatment approach resulted in high patient satisfaction because it minimized the required number of surgical interventions. During the 1.5 years of follow-up the achieved results were maintained, the patient was confident about the outcome and returned to his general dentist for regular maintenance.



Fig. 8. Radiographic appearance of left central incisor before (left) and after (right) forced eruption.

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