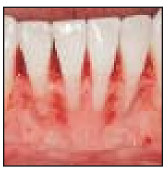
Hard and Soft Tissue Augmentation in a Postorthodontic Patient: A Case Report



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A combination of hard and soft tissue grafting is used to augment a thin biotype. A 26-year-old woman with mandibular anterior flaring and Miller Class I and III recessions requested interceptive treatment. Surgery included a full-thickness buccal flap, intramarrow penetrations, bone graft placement, and primary flap closure. Postoperative visits were at 2 and 4 weeks and 2, 3, and 6 months. Stage-two surgery consisted of submerged connective tissue graft placement. Postoperative visits were completed at 2, 4, 6, and 8 weeks and 1 year. Follow-up was completed 3 years after the initial surgery. Interradicular concavities were resolved and gingival biotype was augmented. Soft tissue recession remained at 6 months. Reentry revealed clinical labial plate augmentation; 2 mm was achieved at the lateral incisors and the left central incisor and 3 mm was achieved at the right canine. No bone augmentation was achieved on the left canine and right central incisor. The dehiscence at the right central incisor appeared narrower. Overall, a 2- to 3-mm gain in alveolar bone thickness/height was observed. Two months after stage-two surgery, near complete root coverage was achieved; 1 mm of recession remained on the left central incisor. There was a soft tissue thickness gain of 2 mm without any visual difference in keratinized tissue height. Interradicular concavities were eliminated; the soft tissue was augmented and the gingival biotype was altered. Interdental soft tissue craters remained. One year after connective tissue graft placement, there was near complete root coverage at the left central incisor, which at 2 months experienced residual recession. Interradicular concavities and interdental soft tissue craters were eliminated with soft tissue augmentation, including clinical reestablishment of the mucogingival junction. Clinical stability remained 3 years after the initial surgery, with the patient noting comfort during mastication and routine oral hygiene. A clinical increase in labial plate thickness, in conjunction with soft tissue augmentation, appears to provide for continued stability and decreased potential for future clinical attachment loss. (Int J Periodontics Restorative Dent 2011;31:19–27.)

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Orthodontic tooth movement may lead to the development of hard and soft tissue defects and is dependent on bone volume and the ideal tooth position.[1] Alveolar bone dehiscences and fenestrations in general can be associated with root prominence and can affect alveolar bone thickness. Rupprecht et al[1] found a positive correlation between the presence of bone dehiscences and fenestrations and thin alveolar bone.

Knowing the ideal or final tooth position and soft tissue characteristics is useful during orthodontic treatment planning. Steiner et al[2] suggested that tooth position is an important factor in gingival recession. If the facial plate is thin and the teeth are moved labially, significant apical migration of the junctional epithelium and reduction in the facial apicocoronal bone height are noted. This is followed by apical migration of the marginal gingiva. Thus, significant proclination of the teeth is correlated to the development of soft tissue defects. Maynard[3] suggested that the apicocoronal width of the attached gingiva is important in relation to orthodontic treatment.

Wennström et al[4] also addressed this matter. They suggested that plaque-induced inflammation and marginal soft tissue thickness (volume) were determining factors for the development of gingival recession, as well as clinical attachment loss in relation to orthodontic tooth movement. The issue of thick versus thin biotype also plays a crucial role in potential soft tissue recession.

Two potential treatment options for addressing these clinical situations exist. The first is guided tissue regeneration (GTR)–based root coverage. The original concept of cell exclusion stemmed from Melcher,[5,6] who suggested that the type of cell that repopulates the exposed root surface will define the nature of the attachment or repair that takes place. These cells originate in either the periodontal ligament or the alveolar bone. Proper tissue handling is important, as well as determining if bone graft addition or barrier membrane use is indicated. If chosen, use of a graft material with osteoinductive potential is crucial. Bowers et al[7] suggested that demineralized freeze dried bone allograft (DFDBA) has an osteoinductive capacity because of the bone morphogenic proteins it contains. These key concepts aid in the desired tissue regeneration. Al-Hamdan et al[8] concluded that GTR-based root coverage was successful in repairing gingival recession defects. In addition, it was suggested that membrane use improved the outcome, but there was no statistical benefit to the addition of a bone graft material.

The second treatment option is placement of a subepithelial connective tissue graft (CTG). A classification of gingival recession defects was established by Miller[9] that addressed certain aspects of attached gingiva and interdental bone height. Langer and Langer[10] developed a technique, later modified by Bruno,[11] by which a CTG can be harvested from the palate and used to achieve root coverage. A modification described by Lorenzana and Allen[12] uses a single incision donor site design, which was used in this report. This transplanted tissue contains cells that are suggested to stimulate keratinization of the overlying mucosal tissue.[13] In addition, the potential for continued coronal "creeping" of the soft tissue margin has been reported to occur up to 1 year post–graft placement.[14,15]

Conventional mucogingival surgery results in statistically better root coverage and width of keratinized gingiva. Roccuzzo et al[16] and Oates et al[17] both concluded that a CTG was statistically and significantly more effective than GTR-based root coverage in recession reduction. Other meta-analyses have drawn similar conclusions, stating that additional research was needed to identify the factors most associated with successful outcomes.[18,19]

The histologic nature of attachment of the CTG to the root surface is also important. It has been shown to vary from true regeneration to a fibrous adhesion to a long junctional epithelium.[20–22] Although regeneration would be preferred, it has not been shown histologically that one form of attachment is superior to another.

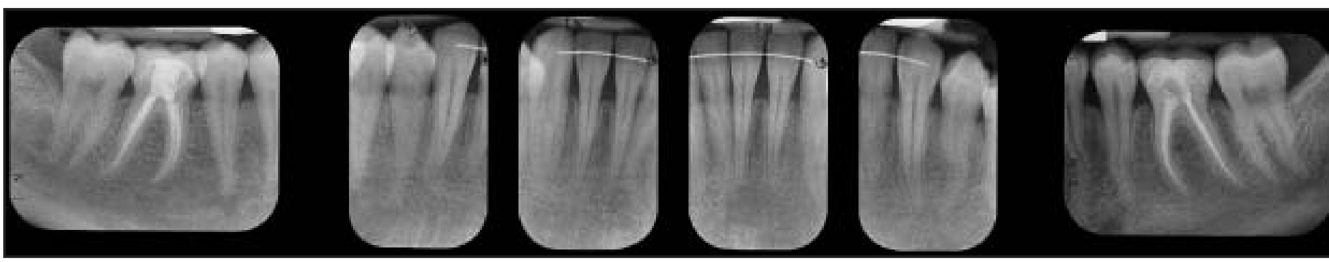
A developing technique for achieving GTR or repair to correct bone dehiscence and fenestration defects was described by Wilcko et al.[23] This technique was used to gain bone height and volume in an area of significant tooth proclination. Wilcko et al[24] also suggested that the use of intramarrow penetrations increases regenerative potential by increasing blood flow to the graft material. Frost[25,26] first noted the healing potential of surgical injury to osseous tissue and the associated increase in tissue reorganization. Later, Schenk et al[27] suggested that pluripotent stem cells, found in the blood from areas of intramarrow penetration (surgical injury), can create a more favorable osteogenic environment.

The objective of this study was to treat areas of thin soft tissue and bony dehiscences using hard and soft tissue regeneration to provide a thick biotype and to prevent further recession.

Case history

A 26-year-old woman with a history of orthodontic treatment presented to Tufts University School of Dental Medicine Department of Periodontology, Boston, Massachusetts, for consultation regarding mandibular anterior labial root prominence and gingival recession. The patient was generally healthy and a nonsmoker. The clinical examination revealed good oral hygiene, a thin biotype, and clinical probing depths ranging from 1 to 3 mm. In addition, a 2-mm labial gingival recession was noted at both premolars and the left central

Fig 1 *Initial* (right) *clinical photograph and* (below) *radiograph showing the existing mandibular root prominence, gingival recession, and bone loss at baseline.*



incisor, and a 0.05- to 1-mm recession was observed at the canines and remaining incisors. Inadequate attached gingiva, 1 to 2 mm of papilla loss, and significant root prominence were also noted. Intraorally, root outlines and severe interradicular concavities of the mandibular anterior teeth were visible through the thin mucosal tissue. At least 1 mm of interproximal bone loss associated with the mandibular incisors was determined radiographically (Fig 1). A diagnosis of Miller[9] Class I and III recession defects was established.

The patient reported having difficulty maintaining this area because of tooth sensitivity and soft tissue discomfort when brushing. Because of these concerns and the potential for further progression, the decision was made to alter the existing bony architecture and soft tissue biotype. The treatment plan included labial GTR from canine to canine and subepithelial CTGs from first premolar to first premolar.

Fig 2 *After flap reflection, areas of bone dehiscence and fenestration of the labial plate were noted.*

Fig 3 *Decortication of the labial plate.*

Surgical technique

Hard tissue augmentation

The patient was started on 500 mg amoxicillin and a systemic corticosteroid (Medrol Dose Pack, Sandoz) the day prior to surgery. Block anesthesia of the inferior alveolar nerve bilaterally was obtained with a combination of 2% lidocaine (Dentsply) 1:100,000 epinephrine and 0.5% bupivicaine (Marcaine, Abbott Laboratories) 1:200,000 epinephrine. Local infiltration of the mental nerve was obtained with 2% lidocaine 1:100,000 epinephrine.

A buccal sulcular incision, including the buccal portion of the interdental papillae, was made from the mesial aspect of the first molar to the mesial aspect of the homologous first molar. No lingual flap was elevated. A mucoperiosteal flap was reflected beyond the apexes of the teeth for access to the entire defect. Teeth in the area of the left canine through the right first premolar were outside of the alveolar envelope. Areas of bone dehiscence and fenestration of the labial plate were observed (Fig 2). There was a 3-mm dehiscence at the left canine, a 5.5-mm dehiscence at the central incisors, and a 6-mm dehiscence at the remaining anterior teeth. A fenestration of 2 mm was present at the right lateral incisor. Intramarrow penetrations[24] extended slightly into the medullar bone and from the crestal bone to the apical region. The intramarrow penetrations were made with a 0.25-mm carbide round bur (Brasseler) and a high-speed hand piece (Dentsply) with copious water

Fig 4 *Placement of DFDBA over the root surfaces.*

Fig 5 *Primary closure was achieved using a continuous sling pattern to stabilize the flap.*

irrigation (Fig 3). DFDBA (ACE Surgical Supply)[7] hydrated with saline was placed over the root surfaces to the cementoenamel junction and into the bone defects, extending beyond the root apexes (Fig 4). The mucoperiosteal flap was then repositioned passively.[23] Suturing was completed using 5-0 resorbable sutures (Vicryl, Ethicon) and a continuous sling pattern to stabilize the flap (Fig 5).

Postoperative instructions included the application of cold packs for the initial 48 hours postsurgery and refraining from mechanical cleansing of the surgical area for 4 weeks. The patient was instructed to use 0.12% chlorhexidine gluconate mouthrinse (Zila Pharmaceuticals) two times per day for 2 weeks and to continue the amoxicillin and systemic corticosteroid prescriptions until completion. After 4 weeks, the patient began gentle tooth brushing and flossing. Postoperative visits were completed at 2 and 4 weeks and 2, 3, and 6 months. The sutures were removed at the 2-week follow-up. Prophylaxis was provided as needed. Postoperative healing was uneventful.

Reentry/soft tissue augmentation

At the 6-month follow-up, there was a thickening of the labial tissue profile (Fig 6). A systemic corticosteroid was started the day prior to reentry surgery. Anesthesia was administered in the same manner. In addition, a bilateral greater palatine nerve block was obtained with a combination of the same anesthetics.

Fig 6 *Clinical view at the 6-month reentry.*

Fig 7 *Mucoperiosteal flap reflected for a subepithelial CTG. Bone augmentation was noted clinically.*

The exposed root surfaces were prepared using hand instruments and a Cavitron SPS ultrasonic scaler (Dentsply). The same incision design was followed. A mucoperiosteal flap was reflected beyond the mucogingival junction (Fig 7). Clinically, there was horizontal and vertical regeneration of the labial plate; 2 mm of bony root coverage was achieved at the lateral incisors and the left central incisor and 3 mm was achieved at the right canine. No coverage was achieved on the left canine or right central incisor. The dehiscence of the right central incisor appeared narrower than first noted. This tissue was firmly attached to the root surfaces and appeared well-vascularized. Non-integrated bone particles were observed both on the surface of the integrated graft and encapsulated within the flap.

Subepithelial CTGs were harvested bilaterally from the palate using the single incision technique.[12] The resulting CTGs were approximately 30 × 5 × 1.5 mm. Absorbable collagen wound dressing (Collacote, Zimmer) was trimmed, hydrated with saline, and placed into each donor site. The donor sites were sutured with 5-0 resorbable sutures with an interrupted horizontal x-type pattern. Periosteal releasing incisions were made beyond the mucogingival junction to allow for coronal flap advancement over the sutured CTGs.[12] The grafts were sutured over the prepared root surfaces and surrounding bone with 5-0 Vicryl continuous sling sutures (Fig 8). The flap was passively positioned at or above the cemento-enamel junction and sutured with 5-0 resorbable sutures using a continuous sling pattern (Fig 9).

Postoperative instructions, suture removal, and prophylaxis were performed as discussed previously. No antibiotic was used for this surgery.

Results

In general, postoperative healing was uneventful. Patient discomfort was minimal in both donor and recipient sites.

At the 2-month soft tissue graft postoperative visit, complete root coverage almost was achieved. The left central incisor exhibited 1 mm of recession. There was a 2-mm gain in labial soft tissue thickness, but no visual difference in the height of keratinized tissue. The procedures eliminated the interradicular concavities; however, interdental soft tissue craters were present. The patient

Fig 8 *CTG sutured over the prepared root surfaces.*

Fig 9 *Primary closure was obtained over the graft.*

was able to maintain the grafted area comfortably with routine oral hygiene practices, and a significant clinical gain in tissue thickness was noted.

At the 1-year soft tissue graft postoperative visit, complete root coverage was maintained at the lateral incisors and canines, while approximately 1 mm of recession was present at the central incisors. The interdental soft tissue craters had resolved with no additional papillary loss between the central and lateral incisors. The soft tissue width and height were maintained, and the interradicular concavities were eliminated. The patient reported no discomfort and indicated that the area was maintainable with routine oral hygiene practices.

At 3 years postsurgery, the area appeared stable with no clinical attachment loss, and probing depths were consistent with pretreatment measurements. Also, there appeared to have been a slight coronal "creep" of the soft tissue margin labial to the central incisors, with maintenance of a stable band of keratinized mucosa and clinical reestablishment of a mucogingival junction. Patient comfort during function and routine oral hygiene was maintained (Fig 10).

Discussion

Reestablishment of an ideal anatomical architecture following orthodontic tooth movement often involves both hard and soft tissue augmentation. This is usually a result of the labial movement of teeth outside of the envelope of the arch. Augmentation of bone volume can correct the associated root dehiscences, and alteration of the gingival biotype will allow for greater compliance with oral hygiene and create an environment less likely to be affected by plaque-induced inflammation. Hard and soft tissue augmentation also addresses esthetic concerns by providing more harmonious contours, and can also reduce the problem of root sensitivity. Correction of these defects may require multiple surgeries to produce a significant benefit.

The results of this report were representative of the overall conclusions drawn from the studies cited. DFDBA was used because of the suggested osteoinductive potential of the bone morphogenic proteins it contains.[7] A clinical gain of 2 to 3 mm in bone thickness and height in almost all defects was noted and further supports the use of DFDBA to stimulate bone formation. The

Fig 10 *Three-year follow-up clinical photograph.*

results also suggest that DFDBA stimulates bone formation when a full-thickness mucoperiosteal flap is chosen as the membrane.[23] The flap was elevated beyond the apexes of the teeth for complete visualization. Graft placement in this manner may be a limiting factor because of the somewhat impaired ability to contain and stabilize particulate graft material. More ideal graft containment may have allowed for additional bone formation and defect resolution. Intramarrow penetrations allow for greater vascularization of the graft material and the efflux of pluripotent stem cells, which can help create a more favorable osteogenic environment. They also provide a source of insult to the osseous tissue, which may trigger an increase in reorganizing activity.[27] Although clinical bone regeneration is evident, histologic evidence of bone formation and the nature of the attachment to the root should be included in future studies.

Long-span connective tissue grafting is more challenging for the patient and surgeon. Additional surgical wounds increase the chance for postoperative discomfort. Also, the donor site may not allow for the amount of tissue needed for regeneration. Complete root coverage of all treated teeth almost was achieved, except for the central incisors, which exhibited approximately 90% root coverage. These results parallel the success rates of the subepithelial CTG procedures presented in the studies cited.

There also was a clinical alteration of this area, which more closely resembled a thick biotype. However, this study failed to use tissue calipers to record tissue thickness, which may have allowed for a more exact measurement of posttreatment tissue thickness gain. The clinical reestablishment of a visible band of keratinized mucosa suggests that palatal coreum, or connective tissue, contains the cells responsible for epithelial tissue keratinization.[13]

Suturing also plays a crucial role in successful root coverage. Constant passive tension must be maintained when using sling-type sutures. Loss of tension may be a reason for the less than complete root coverage at the left central incisor. Although, Harris[14,15] discussed the potential for tissue to "creep," as well as suggesting that mean root coverage continues to increase with time. This may explain the additional root coverage of the left central incisor, which was present at 1 and 2 years postsurgery.

The suggested level of evidence provided by a single case report and the short follow-up period are limitations of this study. Further, there is an inadequate amount of available literature regarding GTR using a bone graft, which compares use of a membrane when treating recession defects to not using one. Further randomized controlled clinical trials comparing graft material with or without a membrane when treating recession defects are needed to determine the long-term clinical significance.

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