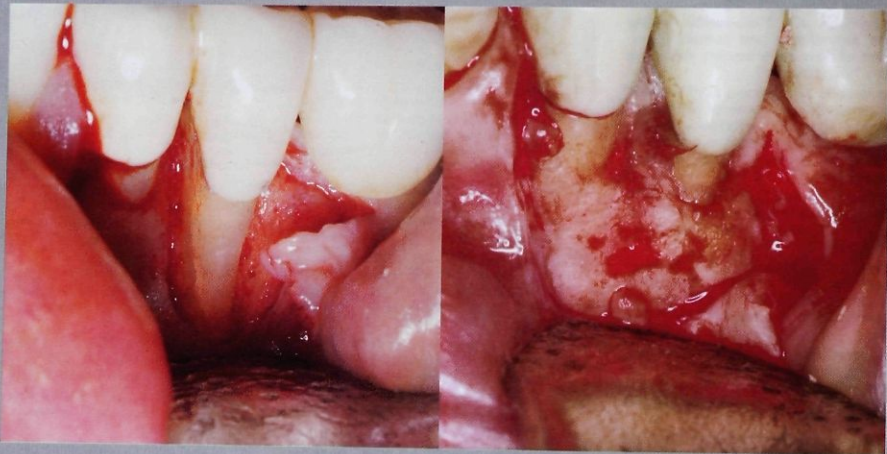




Reconstruction of Bone on Facial Surfaces: A Series of Case Reports



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Abstract

To rebuild the damaged periodontium to its original form, it would be ideal not only to cover the denuded root surfaces with soft tissue, but also to reconstruct the cortical plate. This paper presents four cases in which osseous grafts and guided tissue regeneration, along with root surface conditioning, were used to encourage growth of new facial bone. Some degree of success was achieved in each case.

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Bone grafting has been performed for many years with varying degrees of success. Many grafting materials have been used, and much attention has been given to prognostic indicators for success, such as the number of bony walls in the defect. Mellonig et al,¹ in a large clinical trial, used freeze-dried bone allografts and reported that 64% of the defects exhibited greater than 50% fill. With the combination of freeze-dried bone allografts and autogenous grafts, one can expect 50% fill 80% of the time in three-wall defects, less in two-wall defects, and even less in one-wall defects.² The average amount of attachment gain in grafted intrabony defects, regardless of the graft material used, appears to be 2 to 3 mm. While this amount is significant in research papers, clinical practitioners have long sought ways to regenerate even more bone, dramatically improving the prognosis of the tooth.

In the mid 1980s, many clinicians turned to guided tissue regeneration in an attempt to achieve more predictable regeneration. These procedures often were performed in areas such as furcations and wide intrabony defects, where the results from osseous grafting had been less than favorable. Becker et al³ placed expanded polytetrafluoroethylene membranes (GORE-TEX periodontal membranes, WL Gore & Assoc) in 27 patients and stated that the tissue in the defects at the time of reentry was firm and resistant to probing forces, but that it was not bone. They found a gain of 1.5 mm in Class III furcations, 1.8 mm in Class II furcations, and 3.7 mm in three-walled bony defects.³ The next logical step was taken by Schallhorn and McClain in 1988.⁴ They reported on the results of combining osseous grafting, root surface conditioning, and guided tissue regeneration. Their results indicated that the combined approach was superior to the regeneration achieved with the membrane alone. Prior to their study, no reports on combined techniques had demonstrated apposition of alveolar bone in dehiscences and horizontal defects.

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Recently, much interest has been focused on soft tissue coverage of denuded root surfaces.⁵ This is a useful procedure, but if the goal of periodontics is to rebuild the periodontium to its original form, then it would be ideal not only to cover the denuded root surfaces with soft tissue, but also to reconstruct the cortical plate. This paper presents four cases, three of which were treated by combined grafts consisting of osseous grafts, guided tissue regeneration, and root surface conditioning. In a fourth case, guided tissue regeneration alone were used. In each case, to some degree, the facial bone was reconstructed.

Case reports

All of the treatments had certain similarities. Unless otherwise noted, all incisions were intrasulcular, and full thickness flaps were raised. After complete removal of the granulation tissue in the defect, the roots were meticulously scaled and root planed. Fiberoptics and surgical telescopes were used to improve visualization of the surgical field. Gross scaling was performed with ultrasonic instruments, followed by a flame-shaped finishing bur. The finishing bur was used primarily to ensure complete root planing into the narrow areas of the osseous defect near the periodontal ligament. Definitive root planing was performed by hand with Gracey curettes. Root surfaces were then bur-nished with a tetracycline solution on a cotton pellet for approximately 3 minutes, followed by a sterile saline rinse. Tetracycline solution was prepared by dissolving a 250-mg tetracycline hydrochloride capsule in 1 mL of sterile water. The rationale for use of tetracycline is covered in the discussion section.

No attempt was made to provide intramarrow penetrations, because all of the defects were fairly vascular. All bone grafts consisted of human, demineralized, freeze-dried, crushed cortical bone allograft which was reconstituted with sterile saline at least 15 minutes prior to use. It was packed densely into the defect. The GORE-TEX periodontal membrane was carefully adapted to the defect and sutured to place. Care was taken to ensure the best flap adaptation and to achieve as much primary closure as possible. Dressings were not used. All patients were seen 1 week following surgery for postoperative evaluation, suture removal, and home care instructions. Three weeks after the surgery, prophylaxis and light scaling were accomplished. After removal of the membrane 5 to 12 weeks postoperatively, the patient was seen for a final evaluation prior to placement on a regimen of supportive periodontal treatment. Initially, the patient was typically seen at monthly intervals. If the periodontium was stable, recall appointments were extended to 2 months and finally to 3 months.

All patients involved in these case reports have been followed for at least 2 to 3 years postoperatively. All surgical sites have remained stable, and no probing depth greater than 4 mm has been found.

Case 1

A 56-year-old woman presented with moderate-to-severe osseous destruction in the posterior areas of her mouth. Her medical history was unremarkable, but she related having frequent abscesses associated with the mandibular left second premolar (tooth 35). Previous treatment consisted of frequent scaling and antibiotics. When this did not resolve the problem, endodontic therapy was performed on the tooth (2 months prior to periodontal consultation). A 10-mm probing depth was recorded on the facial aspect of tooth 35, while the other probing depths were 5 to 6 mm. The patient was informed that the tooth had a questionable prognosis, but because it served as an abutment for a fixed bridge, it was decided to pursue periodontal therapy.

Surgery was performed, after the patient was administered a local anesthetic, without presurgical scaling and root planing. After debridement, it was apparent that there was almost complete destruction of the cortical plate facial to tooth 35. The defect wrapped around to the midpoint on the tooth mesially and distally. A large piece of calculus was present on the facial aspect of the root (Fig 1a). After root planing (Fig 1b) and tetracycline root conditioning, a freeze-dried bone graft (Fig 1c) was placed over the denuded root surface. A single, wide GORE-TEX periodontal membrane was then positioned over the bone graft (Fig 1d). The flaps were sutured with GORE-TEX suture. Appropriate analgesics and tetracycline HCL (250 mg, four times a day, for 1 week) were prescribed.

There were no postoperative complications, and the membrane was surgically removed 6 weeks after placement. Visual inspection at that time (Fig 1e) suggested complete reconstruction of the bone facial to tooth 35. The patient was placed on appropriate supportive periodontal treatment, and the area was reentered 1 year later. The graft appeared stable, with no change apparent between this evaluation and when the membrane was removed. The surface texture was hard, with the typical, nonporous look of a naturally occurring cortical plate (Fig 1f).

Case 1

Fig 1a The cortical plate facial to tooth 35 has been almost completely destroyed. A large piece of calculus is present on the facial aspect of the root.

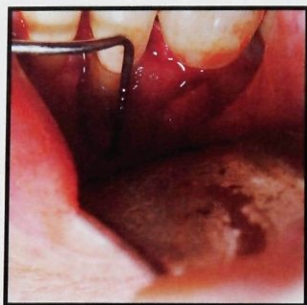


Fig 1b After debridement of the defect, the root has been scaled, planed, and burnished with tetracycline.



Fig 1c Demineralized, freeze-dried, cortical bone is placed over the root surface, completely filling the defect.



Fig 1d A single, wide GORE-TEX periodontal membrane is placed over the freeze-dried, cortical bone.

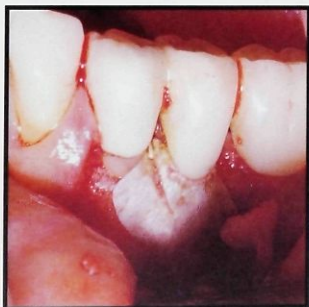


Fig 1e The membrane has been removed at 6 weeks, and it appears that the graft has been successful in reconstructing the facial bone.



Fig 1f At 1 year, the graft is stable. The bone facial to tooth 35 has been reconstructed.



Case 2

A 62-year-old woman with an unremarkable medical history presented initially, on an emergency basis, with a fluctuant abscess facial to her mandibular left first and second molars (teeth 36 and 37). The abscess was incised and drained, closed root planing was performed, and she was given penicillin (250 mg, four times a day, for 1 week). The patient was recalled for reevaluation of the area and a complete periodontal examination, which revealed severe osseous destruction throughout the mouth. A 10-mm probing depth was encountered interproximal to teeth 36 and 37, and both teeth were found to have Class II furcation involvements.

No further scaling and root planing was undertaken. Surgery was performed in the mandibular left quadrant with the patient under local anesthetic and nitrous oxide analgesia. Severe osseous destruction was encountered around teeth 36 and 37, leading into a deep Class II facial furcation on tooth 36 and a shallow Class II facial furcation on tooth 37 (Fig 2a). Following root planing, the surfaces were burnished with tetracycline, and a wraparound GORE-TEX membrane (interproximal configuration was not available at that time) was placed interproximal to teeth 36 and 37. The flaps were then sutured with GORE-TEX suture and the patient was prescribed appropriate analgesia, penicillin (250 mg, four times a day, for 1 week), and 0.12% chlorhexidine gluconate (twice-daily rinses; Peridex, Procter & Gamble).

Case 2

Fig 2a One- and two-wall osseous defects are found around teeth 36 and 37.

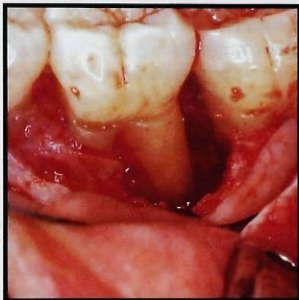


Fig 2b The 6-month reentry reveals significant fill of the defect.



There were no immediately post-operative problems, but approximately 1 month after surgery, purulence was noted around the membrane. The abscess was incised and drained and the patient was again prescribed penicillin (in the same dosage). The membrane was surgically removed the next week. No purulence was noted, and the clinical

impression of the graft was favorable. The patient was placed on a 2-month recall interval. Six months later, the area was reentered and it appeared that the guided tissue regeneration had been successful in reconstructing not only bone lost interproximal to teeth 36 and 37, but also some of the lost facial bone (Fig 2b).

Case 3

A 54-year-old man, who was a recovering alcoholic with an otherwise unremarkable medical history, presented with severe osseous destruction in the posterior areas of his mouth. Treatment began with complete-mouth root planing and scaling performed in one half of the mouth at a time after administration of a local anesthetic. Oral hygiene instructions were given and a periodontal maintenance visit and reevaluation was performed. Probing depths ranged from 6 to 10 mm, and bleeding on probing and purulence remained.

The mandibular right posterior quadrant was entered surgically with the patient under local anesthesia. After debridement, it was found that there was no cortical plate interproximal to the mandibular right second premolar and first molar (teeth 45 and 46). The large, one- and two-wall intrabony defects were also associated with a shallow Class II facial furcation on tooth 46 (Fig 3a). A demineralized, freeze-dried, cortical bone graft was placed into the defect and over the denuded root surface. An interproximal GORE-TEX membrane was then placed over the bone graft (Fig 3b) and the flaps were sutured with GORE-TEX suture. Appropriate analgesics were pre-

scribed, along with Augmentin (250 mg, four times a day, for 1 week; Beecham Laboratories) and twice daily Peridex rinses.

There were no postoperative complications, and the membrane was surgically removed 5 weeks after placement. It appeared that the graft was successful not only in filling the large defect interproximal to the teeth, but also in rebuilding the bone facial to the denuded mesial root of tooth 46 (Fig 3c). The facial furcation on tooth 46 was closed, and the defect was filled with a nonprobable tissue. The patient was placed on a regimen of supportive periodontal treatment.

Case 3

Fig 3a The mesial root of tooth 46 has lost most of its cortical plate. Large one- and two-wall defects exist interproximally.

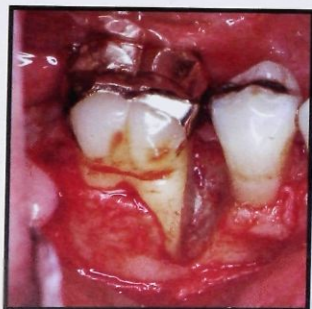


Fig 3b A piece of interproximal GORE-TEX material is placed over the bone graft.



Fig 3c Complete fill of the defect is evident at the time of membrane removal.



Case 4

A 50-year-old woman with an unremarkable medical history presented to the office for implant consultation. Based on clinical and radiographic findings (periapical radiographs), it was decided that two Brånemark fixtures (Nobelpharma) would be placed interproximal to the maxillary right canine and second molar, and one fixture would be placed interproximal to the maxillary left canine and second premolar (teeth 23 and 25).

With the patient under intravenous sedation and local anesthesia, a full thickness flap was raised in each area. Unexpected facial and palatal undercuts were present (Fig 4a). The alveolar process was not wide enough to place a fixture interproximal to teeth 23 and 25, and the original plan of placing two fixtures on the maxillary right side was abandoned. Instead, one 10-mm, self-tapping fixture was placed in the region of what would be the maxillary right second premolar. There was minimal width of bone in this area, but the fixture was placed without penetration of the cortical plate. The bone was so thin in the area, however, that the fixture could be seen through the bone (Fig 4b). The flaps were coapted.

The patient was informed of the potential problems associated with the minimal amount of bone around the fixture. Six months later, the area was reentered. A full thickness flap was elevated so that the facial aspect of the fixture could be explored. As expected, the cortical plate was no longer present facial to the implant (Fig 4c). The fixture appeared to be integrated on its other aspects, and there was no mobility. A demineralized, freeze-dried, cortical bone graft was placed over the exposed portion of the implant (Fig 4d). A single, wide GORE-TEX periodontal membrane (GORE-TEX Augmentation Material was not yet available) was adapted over the graft, and the membrane was secured by slightly loosening the cover screw and running a suture through the membrane and around the cover screw (Fig 4e). The flap was closed with GORE-TEX sutures. Three months later, the area was reentered and the membrane was removed. It appeared that the graft was successful in restoring the bone facial to the implant (Fig 4f). The abutment was connected to the fixture 6 months after the graft. The patient was referred back to the general dentist for completion of prosthetic care and was placed on supportive periodontal treatment.

Case 4

Fig 4a Severe facial undercuts in the maxillary left quadrant prevent implant placement.



Fig 4b The thin cortical plate facial to the fixture permits visualization of the outline of the implant.

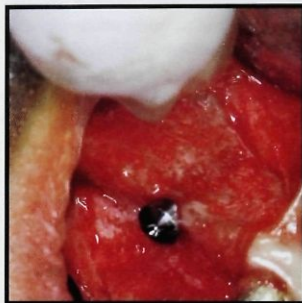


Fig 4c At the 6-month reentry, there is no longer any cortical plate facial to the fixture.

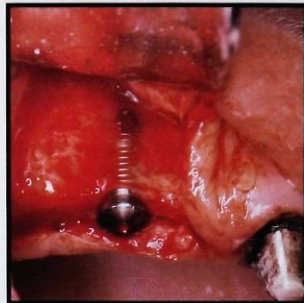


Fig 4d A demineralized, freeze-dried, cortical bone graft is placed over the exposed portion of the fixture.

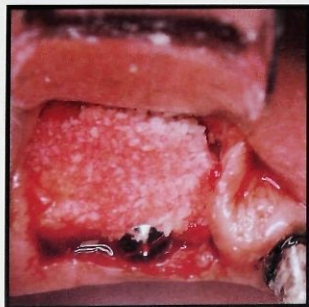


Fig 4e A piece of single, wide periodontal GORE-TEX material is positioned over the graft.

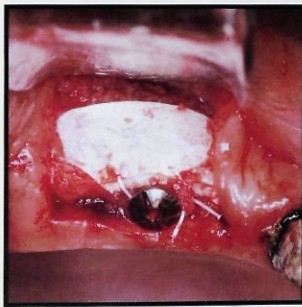
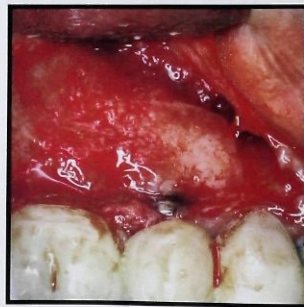


Fig 4f The membrane has been removed at 3 months, and it appears that there is bone facial to the fixture.



Discussion

Periodontal regeneration has long been the goal of clinicians and researchers alike. One of the most elusive problems has been rebuilding the cortical plate over avascular root surfaces. Hancock⁶ stated that, to attain successful regeneration, healing responses must contain evidence of not only new connective tissue attachment with functionally oriented periodontal ligament fibers, but also coronal movement of the alveolar bone. Without histologic documentation, it is impossible to know whether true regeneration had taken place in any of the four cases presented in this paper, but there is little doubt that dramatic coronal movement of the margin of alveolar bone had occurred. Bone appears to have been regenerated in the amount that would significantly improve the prognosis of the dentition. The treated teeth and implant, which were initially questionable, now have a fair-to-good prognosis.

Three of the four cases presented were combination grafts consisting of demineralized, freeze-dried bone allograft and a periodontal membrane. The other case, which consisted only of membrane placement, was included in the paper not only because it demonstrated a significant fill of the defect, but also because the fill appeared to be bone and not the soft tissue usually associated with guided tissue regeneration. As successful as the procedure was, regeneration coronal to the margin of the defect did not occur. In each of the other three cases, in which a combination approach was used, bone was reconstructed above the alveolar crest to the region of the cemento-enamel junction. It is the author's experience that if one is attempting significant coronal growth of the alveolar bone, the combination approach, with bone graft and periodontal membrane, is more predictable. Whether it is the bone graft itself that is important to the increased success or whether the material just serves as a filler to prevent the membrane from collapsing and touching the root surface is unknown.

Results of human trials regarding the role of root surface conditioning agents are mixed. Some reports have favored the use of tetracycline on the root surface *in vitro*.^{7,8} The author's decision to use it in all of the cases presented, except for the implant, was strictly empirical, based on the knowledge of the literature at that time and personal correspondence with other clinicians. It was hoped that the demineralization of the root surface with tetracycline would inhibit epithelial migration, promote fibroblast adherence, and render the root biologically compatible. Whether or

not it had any positive or negative effects on the outcome of the grafts is unknown.

In cases 1 and 2, no attempt was made at definitive presurgical scaling and root planing. Both of these patients initially presented with acute lesions, and it was thought that root planing might be counterproductive in the regenerative procedure.⁹ Case 3 involved a chronic situation, and scaling and root planing was performed presurgically, primarily to improve the tissue tone in the surgical area and to resolve other minor periodontal problems in the quadrant. As a general rule, the author does not scale and root plane prior to regenerative procedures.

The fact that the graft was able to regenerate the bone facial to the implant as reported in case 4 demonstrates that clinical success is possible in the absence of the periodontal ligament. Current research¹⁰⁻¹³ suggests that progenitor cells are available from the bone, and that the periodontal ligament may not be as important as once thought in guided tissue regeneration.^{14,15}

When possible, the author coronally repositions the flaps by suturing over the contact points. It is thought that this further delays proliferation of the epithelial cells into the surgical site.¹⁶⁻¹⁹ This technique is also useful to improve soft tissue coverage of the membrane.

Some clinicians have suggested that bone regeneration reported in the literature has, in fact, occurred in periodontally healthy areas below the pathologically exposed root surface. There is no doubt that the regeneration reported here occurred over and coronal to previously diseased root surfaces.

This paper does not represent a controlled study, and there is no way to assess which of the components used in the grafting technique are significant. Clinical intuition and past experience leads the author to believe that the meticulous debridement of the defect and root surface is one of the most important parts of the equation. Furthermore, a combination of osseous graft and guided tissue regeneration seems to have advantages over either technique alone. The outcomes of all of the cases presented met the requirements set forth by the World Workshop on Clinical Periodontics²⁰ for clinical objectives of periodontal regeneration. These include increase in bone height, gain in probing attachment, pocket reduction, decreased mobility, improved esthetics, and long-term maintenance of teeth in health and comfortable function.

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