Root Coverage: A Comparison of Techniques: The Free Gingival Graft versus The Subepithelial Connective Tissue Graft

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This past decade has seen the goals of periodontal surgery undergo much refinement. Gingival recession is a frequent concern to both the clinician and patient. Regeneration of the lost gingival tissues is now an achievable goal. This article reviews and compares two techniques currently employed for predictable root coverage.

A renewed interest in mucogingival surgery became evident during the past decade. The procedures involved in this rapidly developing field have progressed from an emphasis on oral health alone to one of aesthetic enhancement. Periodontal surgeons should be aware of these evolving goals and of the techniques available for achieving them. Such a review is given in this paper.

It is still unclear how much gingival tissue is sufficient to ensure periodontal health.

In the 1950, Friedman first introduced the term "mucogingival surgery." [1] This was the early era of resective periodontal therapy. Techniques available at that time included gingivectomies, vestibular extension, and the removal of aberrant frena and/or muscle attachments. Oral health was the primary surgical objective. In the course of achieving it, periodontal procedures often resulted in aesthetic gingival deformities.

Figure 1. Recession, root exposure, and mucogingival defects are associated with teeth 24 and 25. Note the significant inflammation about the labial of tooth 24.

Figure 2. Mucoperiosteal bed has been prepared to receive the graft. An adequate amount of periosteum has been exposed cervically to the area of recession and interproximally to nourish the graft.

Through the late 1950s, 1960s, and 1970s, gingival procedures were developed which could augment the amount of attached gingival tissue. The techniques developed included variations of the sliding flap, the free gingival graft, and combinations of these procedures. [2-10] As before, the sole objective was one of oral health. Fundemental to this goal was the assumption that an "adequate" band of attached gingiva was essential for periodontal health.

In the late 1970s and early 1980s, the question of what constituted an "adequate" band of attached gingival tissue came under close scrutiny. The issue was broadly debated, without resolution. Some theories maintained that gingival recession was progressive in nature, and that areas without adequate gingival tissue required augmentation. Others argued that in the absence of inflammation, keratinized attached gingiva was not necessary, and, therefore, grafting to augment the existing gingival tissue was superfluous.[11]

It is still unclear how much gingival tissue is sufficient to ensure periodontal health. However, modern dental practice has come to agree that if recession is progressive in nature, gingival augmentation does become a strong consideration.[12] Yet, even today, the absence of keratinized tissue alone remains an insufficient reason to undertake gingival grafting. Instead, a number of medical and patient objectives are used to determine whether grafting should be undertaken. These include the need for orthodontic therapy or restorative dentistry, plaque control, root sensitivity, and aesthetics.

The past decade of the 1980s has seen the goals of periodontal surgery go through yet one more dramatic refinement. During this time, the prime surgical objective has focused with increasing clarity on regenerating the periodontium. This, in turn, has led to the development of new and specific techniques for achieving periodontial regeneration. These include osseous grafting, guided tissue regeneration, ridge augmentation, and what Miller refers to as "periodontal plastic surgery."[13] The latter is the subject of this article.

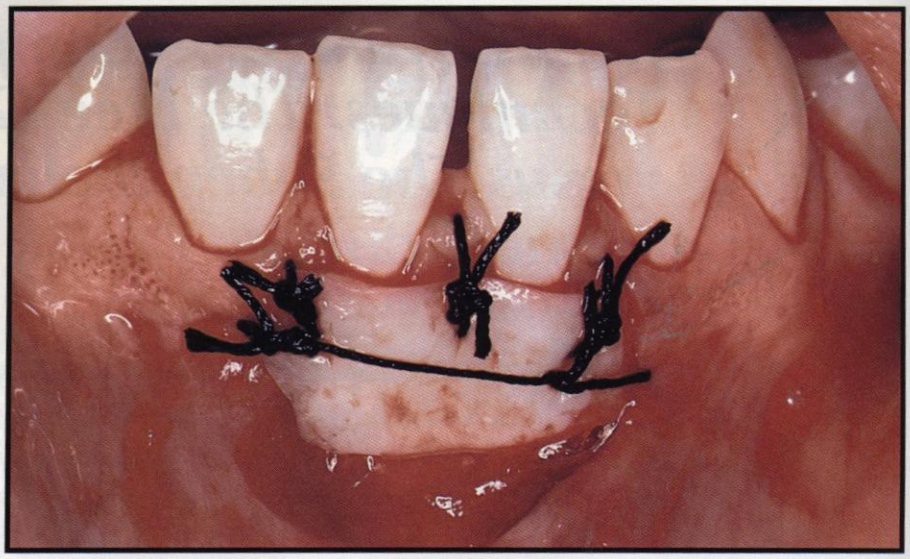

Figure 3. The graft is sutured to the papilla with interrupted sutures for initial stabilization. A horizontal suture serves to stretch the graft and, theoretically, open up the capillaries, as well as to further stabilize the

Figure 4. Circumferential sutures are placed to adapt the graft intimately to the root and periosteal bed, thereby eliminating any dead space beneath the graft.

The article focuses on one goal of periodontal plastic surgery — that of root coverage. A number of successful techniques can be used to achieve root coverage once gingival recession has taken place. This article will examine two such techniques, the free autogenous gingival graft and the subepithelial connective tissue graft.

THE FREE GINGIVAL GRAFT

The free gingival graft was introduced in 1963.[14,15] Sullivan and Atkins first described its potential for achieving root coverage in areas of gingival recession.[16] Many of their early observations still hold true, and the procedure continues to be widely reported as achieving positive results.[17,18,19,20]

In 1982, Miller reported excellent success in attaining root coverage through an innovative new surgical technique: a thick gingival graft, used in conjunction with citric acid root conditioning.[19] His results were impressive, achieving 95.5% total root coverage when recession was less than 3 mm, 80.6% when recession was 3 to 5 mm, and 76.6% when it exceeded 5 mm. With the publication of these early reports, the free gingival graft was accepted as a successful method for achieving root coverage.

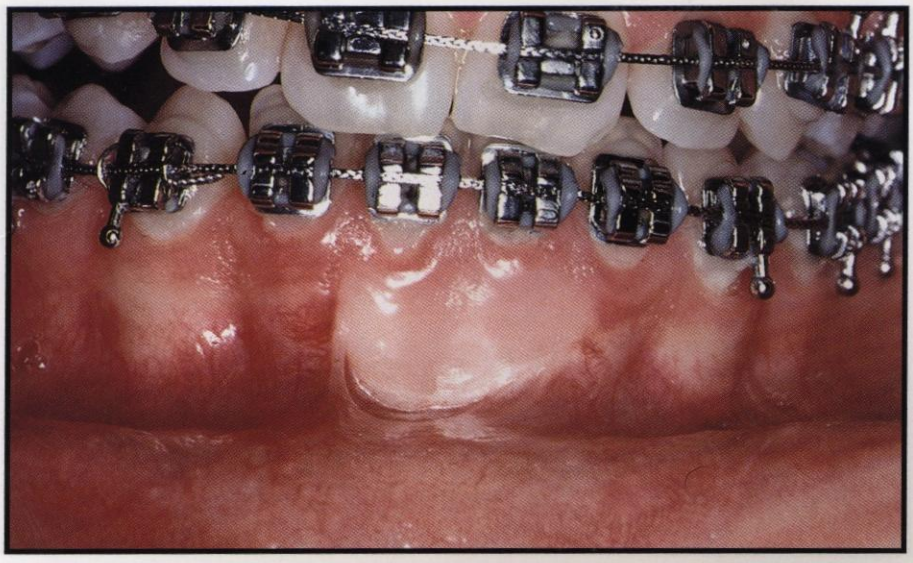

Figure 5. Patient is undergoing the active phase of orthodontics over one year post gingival grafting. Note the closure of the midline diastema.

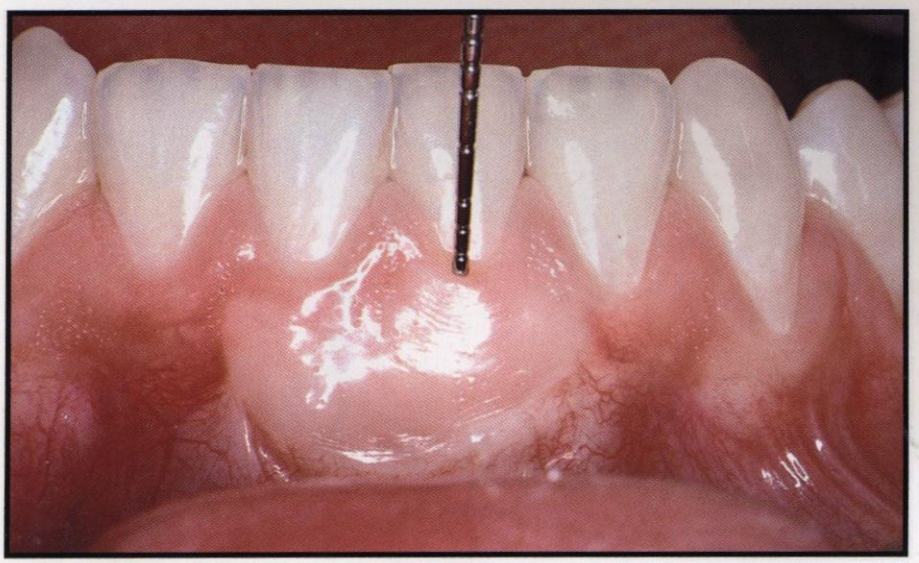

Figure 6. Patient post orthodontic treatment and six years post gingival grafting remains stable and does not probe.

INDICATIONS

The considerations which favor the autogenous free gingival graft as the procedure of choice to cover exposed, denuded roots are as follows:

- Progressive recession
- Root sensitivity
- Caries proclivity
- Oral hygiene facilitation
- Pre-orthodontic gingival stabilization
- Aesthetic considerations
- Minimization of further recession in the presence of restorative dentistry.

CONTRAINDICATIONS

The contraindications to a free gingival graft are as follows:

- Lack of donor tissue thickness
- Medical considerations (uncontrolled diabetes, hypertension, bleeding disorders, anti-coagulant therapy, etc.)
- When the mesial distal width of the denuded root is significantly larger than the interproximal periosteal blood supply, so that the graft would not receive an adequate blood supply.
- An unacceptable color mismatch between the grafted site and its adjacent gingiva.

PROCEDURE

The accepted procedure for effecting a free gingival graft is a combination of the Miller and the Holbrook-Ochsenbein techniques. The steps involved are as follows:

1. The area of recession is identified, and the graft bed is prepared (Figures 1 and 2)
2. The mucoperiosteal bed is prepared, so that it extends approximately 5 mm past the apical margin of the denuded root. Vertical incisions are made at least one papilla mesial and distal to the recipient site (Figure 2). Sulcular epithelium, which borders the denuded root, is removed.
3. The exposed root is meticulously planed with curettes, so that the diseased cementum is removed, and the root has a smooth and glassy appearance. If possible, any existing root convexities are reduced, thereby decreasing the distance which the graft must cover.
4. The recipient site is covered with damp gauze while the donor tissue is obtained.
5. The graft dimensions are measured. The donor tissue should completely cover the denuded root and extend apically and laterally to cover the connective tissue. In addition, the amount of graft contacting on the periosteum should be maximized, as opposed to that covering on the denuded root. This ensures a better blood supply and improves the likelihood that the graft will "take."
6. The graft is harvested from the anesthetized hard palate. Care must be taken not to include any rugae, which will otherwise compromise the aesthetic results.

The graft should be between 1.5 and 2.0 mm in thickness.

7. The graft is kept moist until ready for suturing. An option which may be undertaken at this time is to condition the root. Citric acid and/or tetracycline hydrochloride have been recommended for this purpose. (In the case studies which follow, no such conditioning was undertaken.)
8. The graft is sutured into place. Interrupted 5-0 silk sutures are used to tack the graft coronally to the papilla (Figure 3). A continuous horizontal suture is positioned in a mesial-to-distal direction across the graft surface to stretch the graft and tie it down to the lateral periosteum. Circumferential sutures are then placed. The periosteum apical to the graft border is engaged, and the suture is carried around the cervical margin of the tooth and tied to itself with positive pressure. This minimizes dead space between the graft and the underlying priosteum, thereby enhancing the chances for graft adaptation (Figure 4). Additional vertical sutures may be placed to achieve greater adaptation of the graft to any underlying concavities.
9. Five minutes of finger pressure is applied to the graft through moist gauze. In the author's experience, this has led to a significant increase in graft take.
10. Periodontal dressing may be applied to the graft site.
11. The donor site is dressed. This may be accomplished in one of several ways. Periodontal dressing may be applied. Alternately, a stent can be fabricated in advance and applied over the wound with or without a hemostatic agent such as Avitane. The author has found the following method of dressing the donor site to be most efficacious:

Figure 7. Two millimeters of recession with gingival clefting is associated with tooth 9.

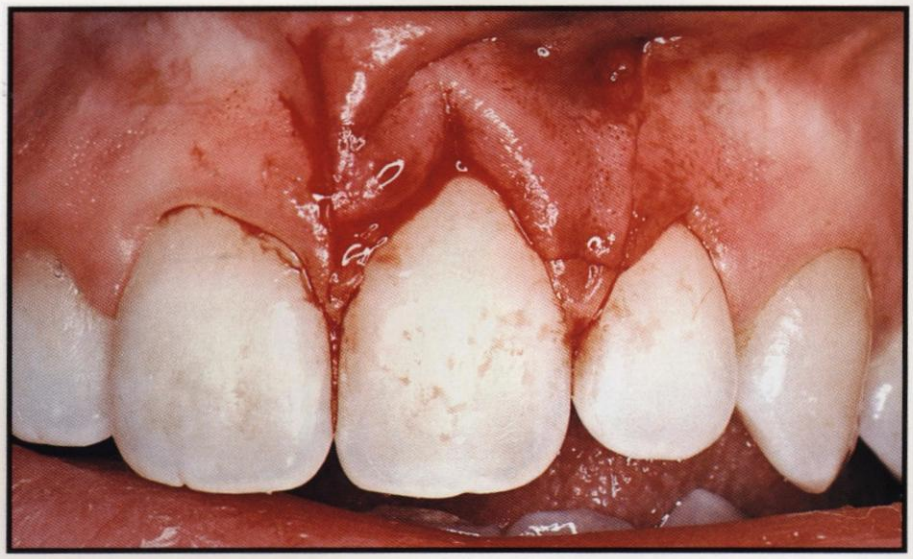

Figure 8. Vertical incisions are made to the crest of bone at the line angle of the adjacent teeth. A partial thickness flap is reflected past the mucogingival junction to free a pedicle.

- Iodoform gauze is cut and shaped to the size of the donor site.
- Cyanoacrylate is applied to the gauze, which is then placed directly over the wound.
- A periodontal dressing is applied, which will normally remain on the wound for one week.

12. Sutures are removed one week after surgery. The patient is instructed not to brush the graft site for two more weeks. Oral hygiene is established by use of a 0.12% chlorhexidine mouth rinse. Following this regimen, complete healing is usually achieved (Figures 5 and 6).

THE SUBEPITHELIAL CONNECTIVE TISSUE GRAFT

The subepithelial connective tissue graft was introduced by Langer and Langer in 1985 [21], and a modification of the process was introduced by Nelson in 1987.[22] The purpose of the technique was to provide coverage of individual and multiple root sites. A specific goal of the technique was to treat areas with deep, wide recessions, such as those often encountered. In this region, root coverage is often very difficult to attain.

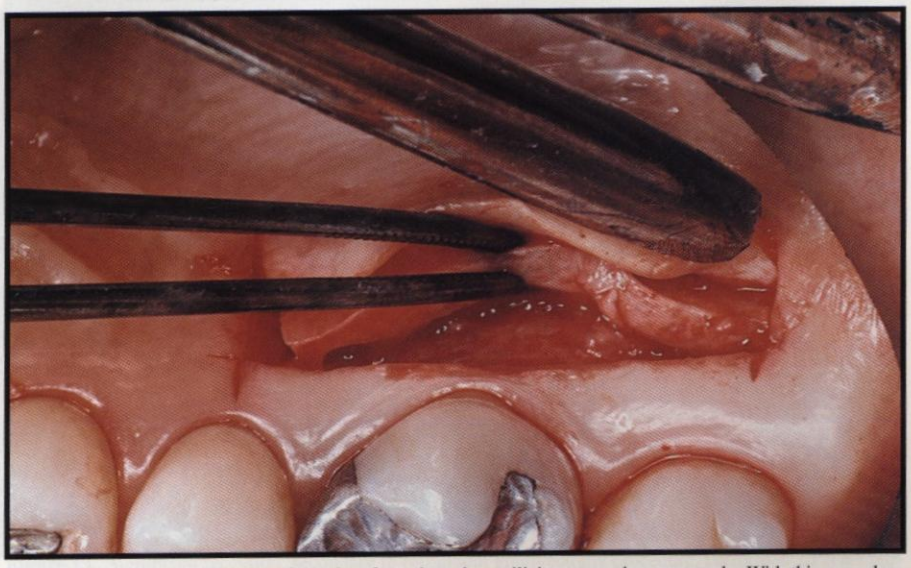

Figure 9. A connective tissue graft is taken from the palate utilizing a trap door approach. With this procedure primary coverage of the donor palate site is achieved, leading to a less traumatic healing period for the patient.

Figure 10. The connective tissue graft is sutured at the level of the CEJ with two interrupted sutures to the papilla.

The procedure is an adaptation of the subepithelial connective tissue graft, which is used to correct edentulous ridge concavities.[23,24] It is an integration of two basic procedures, the free gingival graft and the pedicle flap, combined in a single surgical technique to provide maximum root coverage. It differs from the free gingival graft in that a secondary flap is employed. This secondary flap, the pedicle, serves as an additional blood supply for the grafted tissue.

INDICATIONS

The conditions for undertaking a subepithelial connective tissue graft are similar to those for choosing a free gingival graft. However, the following specific conditions are addressed:

- Similar coverage for multiple root exposures
- Root coverage where a gingival color match is aesthetically important
- Avoidance of "keloid" formation
- Recession adjacent to an edentulous area which also requires ridge augmentation.

CONTRAINDICATIONS

The contraindications for the subepithelial connective tissue graft are the same as those which apply to the free gingival graft. This technique may require more skill to perform than other grafting procedures.

PROCEDURE

The procedure for accomplishing a subepithelial connective tissue graft is as follows:

1. The area of recession is identified, and the graft bed is prepared (Figure 7).
2. A partial thickness flap is created, with two vertical incisions placed at a distance of at least one papilla mesial and distal to the area of recession (Figure 8).
3. The partial thickness flap is dissected apically past the mucogingival junction, taking care not to perforate the flap and preserving the connective tissue over the bone and root (Figure 8).
4. The root is meticulously planed. As an option, it may be chemically conditioned, using tetracycline hydrochloride and/or citric acid.
5. The recipient site is covered with damp gauze while the donor tissue is being obtained.
6. The donor tissue is harvested from the anesthetized hard palate. To remove it, the following steps are followed:

- An inverse bevel horizontal incision is made on the palate, equal to the desired graft length. Care must be taken to keep it several millimeters away from the gingival margins of the maxillary teeth (Figure 9).
- Next, two vertical cuts, extending to the bone, are made at the ends of the horizontal incision to facilitate graft removal. The initial horizontal cut is carried apically, so that a split thickness flap of 2 mm thickness is elevated (Figure 9).
- A second horizontal incision, extending to the bone, is made through the initial one. The connective tissue between the bone and the split thickness flap is removed.

- The split thickness palatal flap is then replaced and sutured back, thus achieving primary closure. A periodontal dressing may be applied.

7. The connective tissue graft is sutured in place at the papilla (Figure 10). If the graft is large, lateral sutures may be placed, to help stabilize it and achieve intimate adaptation. Gut sutures should be used for this purpose: the partial thickness flap will be placed over the graft, making suture removal difficult.
8. The partial thickness flap is elevated and positioned over the connective tissue graft, covering as much of the graft as possible. Sling or interrupted sutures may be used to secure it (Figure 11).
9. Five minutes of finger pressure is applied to the graft through damp gauze. This encourages close adaptation of the graft to the root and flap and minimizes the formation of hematomas between the graft, root, and/or flap.
10. A periodontal dressing is applied over the graft.
11. Sutures are removed after one week. The patient is instructed not to brush the graft site for two weeks, during which time oral hygiene is accomplished by the use of a 0.12% chlorhexidine mouthwash. Good color blending is usually achieved (Figure 12).

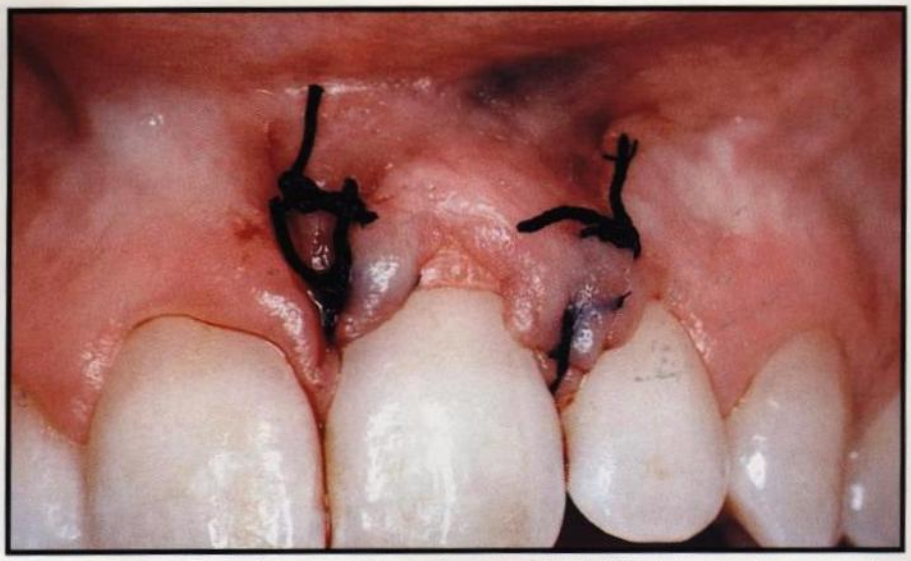

Figure 11. The pedicle flap is elevated over the connective tissue graft and stabilized with a sling suture. As much of the graft as possible is covered for better nourishment of the graft and improves the prognosis for root coverage.

Figure 12. Complete root coverage of tooth 9 has been achieved. Note the color blending of the newly grafted tissue and absence of a "keloid"-like appearance.

CASE REPORTS

The following five cases demonstrate the success of the surgical techniques discussed above.

Case One

A 14-year old girl presented with mucogingival defects associated with teeth 24 and 25 (Figure 1). Recession of 3 mm was from the cemento-enamel associated with tooth 25, and 5 mm with tooth 24. Oral hygiene was also compromised due to an inadequacy of vestibular depth. The patient's orthodontist was reluctant to proceed with therapy in the absence of attached gingival tissue on the labial of teeth 24 and 25. It was decided to place a free gingival graft to augment the attached tissue, to eliminate further recession, facilitate oral hygiene, and to cover the roots for aesthetic reasons.

Vertical incisions were made one papilla distal to the areas of recession (Figure 2). An epithelialized free gingival graft was obtained from the hard palate. It conformed to the exact dimensions of the bed preparation and was designed to cover the root (Figures 3 and 4). However, it was also designed to extend apically and cover the periosteum so that an adequate band of gingiva would exist even if root coverage was not achieved. This would allow for a second repositioning procedure to be undertaken, if necessary.

Root coverage was 100% successful, and the patient proceeded with full mouth orthodontic therapy over the next two years. Figure 5 illustrates her condition following this treatment. Note that the midline diastema has closed, and that the graft has maintained its stability throughout the orthodontic care.

The graft can be distinguished from the surrounding tissues by its pinker appearance. This is due to its having been taken from the palatal tissues, which differ slightly in color

Figure 13. Significant recession, secondary to full mouth gingivectomy procedure, performed 20 years previously. Patient felt that recession was increasing and complained of tooth mobility.

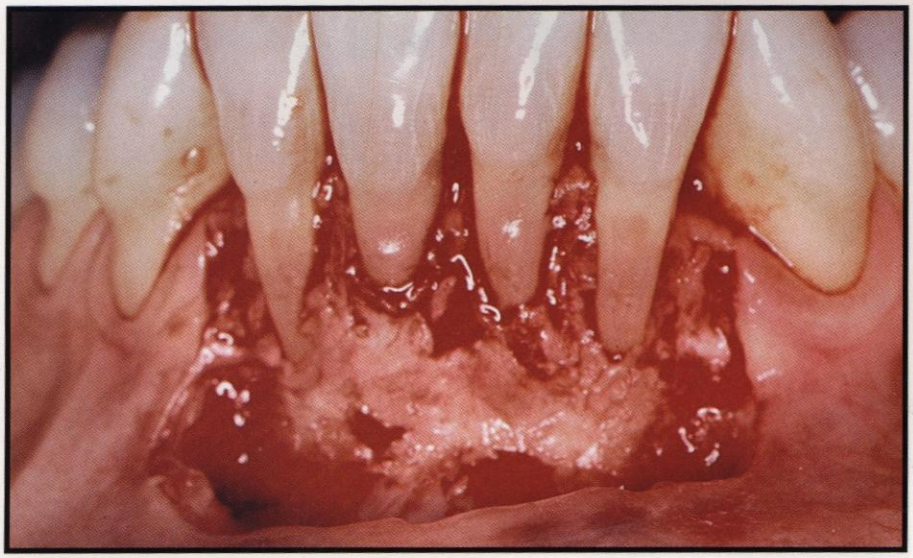

Figure 14. Mucoperiosteal bed preparation. Note lost of interproximal bone making complete root coverage an impossibility.

and texture from normal gum tissue. Note that, in this case, no gingivoplasty has been performed. However, if aesthetics are of concern, the graft could be "smoothed" with a dermabrasion technique. The patient remains stable at the present time, 6-1/2 years after the grafting, with minimal pocket depth and complete root coverage (Figure 6).

Case Two

A 28-year old woman presented with a chief complaint of gingival recession of tooth 9 (Figure 7). She stated that the recession had only recently occurred and that it had been increasing. Gingival grafting was the treatment of choice for aesthetic reasons.

Two vertical incisions were made at the line angles of the teeth adjacent to the area of recession (Figure 8). A partial thickness flap was elevated past the mucogingival junction. Care was taken not to perforate the flap so as not to compromise the blood supply. A connective tissue graft was harvested from the hard palate. A "trap door" design flap was used to obtain the graft. This allowed for primary coverage of the palatal donor site, and also reduced trauma to the patient, since postoperative discomfort is diminished with this harvesting procedure (Figure 9).

The connective tissue graft was placed over the denuded root to the cemento-enamel junction and sutured in place with two interrupted sutures to the interproximal papilla (Figure 10). The partial thickness flap was elevated over the connective tissue graft and secured in place with a sling suture (Figure 11). In this procedure, an attempt is made to cover the entire graft. This establishes a dual blood supply to the graft, which, in theory, increases the chance that the graft will "take."

The procedure was successful, and the patient obtained complete root coverage (Figure 12). In addition, the grafted tissue blended so completely with the surrounding gingiva that now it is difficult to distinguish the grafted tissue from the adjacent gingiva.

Case Three

A 53-year old woman presented in 1986 with full mouthingival recession and mucogingival defects (Figure 13). Recession varied from 3 to 7 mm, and tooth mobility ranged from one to two throughout her dentition. In the mid 1960s, this patient had undergone a full mouth gingivectomy to treat her periodontal disease. This was one of the standard treatments of that time for periodontal pocketing. Unfortunately, severe gingival disfigurement resulted. The patient was concerned about the looseness of her teeth and the amount of recession which had occurred. She was informed of gingival grafting procedures and elected to have them performed.

Over several visits, the severely receded mandibular labial gingiva was treated with epithelialized free gingival grafts. Since so many teeth needed mucogingival therapy, it was decided to treat multiple teeth at each visit to minimize the patient's surgical experiences. In total, the bed preparation area extended from the mesial of tooth 22 to the mesial of tooth 27 (Figure 14). A thick gingival graft was sutured in place with multiple circumferential sutures, ensuring close adaptation of the graft to the teeth and periosteum (Figure 15).

Excellent root coverage was achieved. However, it was not possible to achieve 100% coverage because bone and soft tissue had already been lost from the interdental area. The patient had been in class III recession at the time of grafting (according to Miller's classification)[25], and only partial root coverage can be expected at this advanced stage of periodontal disease. However, the root coverage achieved has remained stable for 6 years, and probing depth is minimal (Figure 16). The patient's tooth mobility has also deminished. This may be due to reduced periodontal inflammation and to the additional support provided by the gingival grafts.

Figure 15. Multiple grafting of four teeth. A variety of sutures have been used to intimately adapt the graft to the teeth and mucoperiosteal bed.

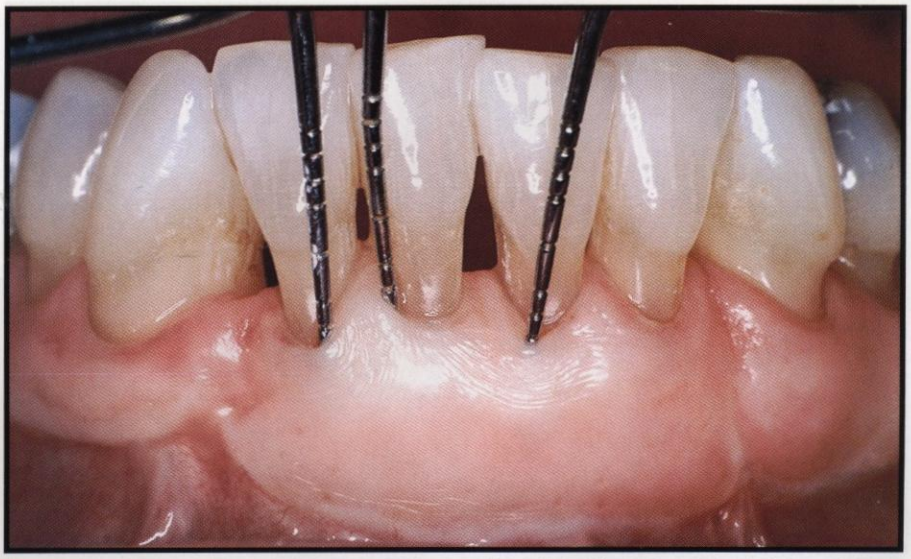

Figure 16. Probes in place five years post gingival grafting with minimal pocket depth. The graft has a thickened-like appearance, and excellent root coverage has been achieved. Compare to Figure 13.

Case Four

A 26-year old man presented for periodontal care with the chief complaint of increasing recession which had led to root sensitivity. The patient had a history of gingival grafting in other parts of his mouth which had met with limited usccess. The surgery had been performed 2 to 3 years previously. He had also received orthodontic therapy. Periodontally, the patient was disease-free, with pocketing in the 2 to 3 mm range.

Recession was present on the labial surfaces of teeth 3, 4, and 5 (Figure 17). The vertical component of the recession extended 5 mm, while 4 to 6 mm of root were exposed horizontally. Since the area of recession was broad and extended over several teeth, it was decided to use the Langer and Langer subepithelial connective tissue graft technique.[21]

The procedure was modified so that the donor would consist entirely of connective tissue with no epithelium present. The modified technique was adopted, since, in this author's experience, the deep pink color of the retained epithelium on a donated graft creates a visible line of demarcation between the donor palatal epithelium and the gingival epithelium of the split thickness flap on the recipient site. It was decided to avoid this disfigurement, if possible.

The patient tolerated the procedure well, and adequate root coverage was obtained (Figure 18). Root sensitivity diminished, and the patient was content with the aesthetic results.

Case Five

The patient, a 38-year old female, presented with recession of teeth 20 through 28. Mucogingival defects existed on all teeth. Some loss of labial and interproximal bone had occurred so that total root coverage was impossible (Figure 19). In addition, the patient had a skeletal class II relationship with very thin labial alveolar bone. Fixed prosthetic rehabilitation was being contemplated for the posterior mandible, and root sensitivity was present on the mandibular anterior teeth. Periodontal pocketing was minimal.

Gingival grafting was the treatment of choice for teeth 20 through 28. However, due to the extent of grafting necessary, the treatment was broken into three stages. In addition, both the epithelialized free gingival graft and the subepithelial connective tissue graft were planned for this patient, allowing the surgeon to choose whichever technique healed most effectively in the earliest operation.

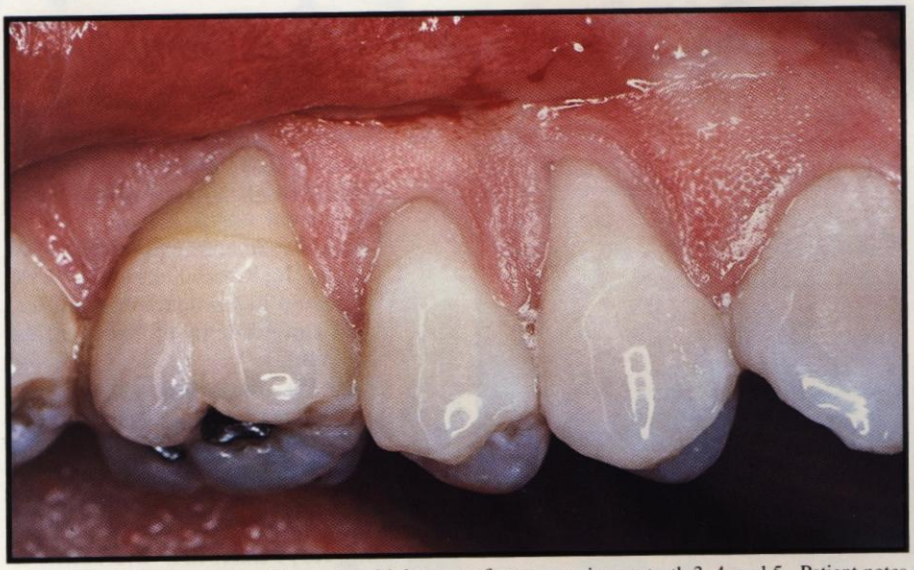

Figure 17. Patient presents with broad multiple areas of root recession on teeth 3, 4, and 5. Patient notes that teeth are sensitive and that recession has been increasing. Note the lack of vestibular depth.

Figure 18. Excellent root coverage has been achieved with one surgical procedure. Sensitivity has been eliminated and vestibular depth has been increased, facilitating better oral hygiene.

Since neither technique offered significant advantages over the other, the effectiveness of the surgery was not compromised by this choice. Additionally, it was felt that the use of both techniques on a single patient would provide an excellent opportunity to study any differences which might occur in the healing process. Consequently, teeth 20, 21, and 22 received an epithelialized free gingival graft, as did teeth 23 through 26, while teeth 27 and 28 received a subepithelial connective tissue graft.

All three procedures were successful, and root coverage was achieved. Differences in healing are clearly seen (Figure 20). Note that the epithelialized free gingival graft is pinker and thicker than the surrounding tissue. This demonstrates again that the areas which receive an epithelialized free gingival graft can usually be distinguished from the adjacent, non-grafted tissue. For this reason, this may not be the best technique to use if aesthetics are an important consideration. The subepithelial connective tissue graft blends more closely with the color of the adjacent tissue, and its thickness is more easily controlled. Therefore, the "keloid"-like healing appearance can be avoided by choosing this technique.

CONCLUSIONS

These five cases demonstrate that, where recession has occurred, root coverage can be a predictable goal if the appropriate graft procedures are used. This is true even though the process by which the graft attaches itself to the tooth is not yet clearly understood.

No controlled studies have been done on the histology of gingival grafting, and no long-term studies have been performed to track their condition over time. However, this author can report favorable results in which the grafts have remained stable for six to seven years after surgery. Therefore, the prognosis for long-term success appears encouraging.

... Root coverage can be a predictable goal if the appropriate graft procedures are used.

Both the free epithelialized gingival graft and the subepithelial connective tissue graft work well. The comparative benefits of the subepithelial connective tissue graft include an excellent color match with the receiving gingival site, the ability to cover wider areas of recession than the alternate technique, and a less traumatic wound to the palatal donor site. However, when a thick band of keratinized gingival tissue is the desired result, and a perfect color match is not essential (as in the mandibular anterior teeth), the thick epithelialized gingival graft is quite useful.

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Figure 19. Patient presents with root recession and inadequate amount of attached gingiva on teeth 20 through 28. Patient is missing all posterior mandibular teeth except for number 31.

Figure 20. Root coverage and augmentation of attached gingiva has been achieved utilizing two different techniques and three separate surgical procedures. Free gingival grafts were performed on teeth 20 through 22, and 23 through 26. A subepithelial connective tissue graft was performed on teeth 27 and 28. Note the pinker, more thickened appearance of the tissue on teeth 20 through 26. The tissue on teeth 27 and 28 more closely resembles the color and texture of the pre-grafted gingiva.

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