Use of the Supraperiostea Envelope in Soft Tissue Grafting for Root Coverage. I. Rationale and Technique

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Recent advances in graft procurement and suturing encourage a reassessment of the "envelope" technique in soft tissue grafting for root coverage. Use of the supraperiostea envelope permits conservation of existing gingiva, minimal surgical trauma to the recipient area, and firm fixation of the connective tissue graft over single and multiple adjacent areas of recession. The intimate coaptation of the bilaminar soft tissue complex thus achieved may facilitate graft survival and postoperative blending of soft tissues. (Int J Periodont Rest Dent 1994;14:217-227.)

The search for predictable clinical solutions to the problem of gingival recession has led to several important surgical advances this past decade. The free autogenous gingival graft, once used primarily for augmentation of existing gingiva, has shown increased predictability for root coverage, as described by Miller¹,² and others.³,⁴ Exacting specifications for graft shape and thickness, recipient site preparation, and suturing appeared to increase the ability of the subjacent periosteal bed to provide a nutrition "bridge" to that portion of the graft over the root surface. Miller’s success was indeed remarkable when viewed in the context of prevailing clinical opinion, which, with the notable exception of one case report,⁵ held that gingival grafts usually failed when placed over previously exposed root surfaces.⁶-⁸

The free gingival graft for root coverage is a one-stage procedure, independent of the

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quality or quantity of the gingival tissue adjacent to the recession. As such, it has advantages over the gingival graft-coronally positioned flap and pedicle flap approaches to the treatment of gingival recession.\(^6,9\) The gingival graft must be used with caution in esthetically sensitive areas because of inconsistent color blending of the graft with adjacent gingival tissues.\(^9\)

Free connective tissue grafting for root coverage combines an overlying flap and an underlying vascular bed for graft nourishment. The bilaminar blood supply thus created may more closely approximate that of the pedicle flap while retaining the advantage of the gingival graft in controlling donor tissue characteristics.

Langer and coworkers\(^9,10\) developed the subepithelial connective tissue graft technique for use in both isolated and multiple adjacent areas of recession. The authors hoped to increase predictability for root coverage in areas of wide-deep recession frequently found in the maxilla.\(^9\) A "trap door" flap was created in the palate for procurement of a connective tissue graft, which was coronally positioned between a partial-thickness flap and underlying peristeum. The harvesting technique produced a strip of palatal epithelium on the superficial edge of the graft, which was retained for use as marginal tissue in areas of recession. This approach resulted in less palatal denudation and a more esthetic color blending in the recipient area when compared to gingival grafting techniques for root coverage. A possible disadvantage is the high degree of technical proficiency necessary to suture the graft and the flap in a clinically acceptable relationship to each other and to the recipient site.

Raetzke\(^12\) described the envelope technique for use in covering isolated areas of root exposure. After excising a collar of tissue and preparing the root surface, a partial-thickness envelope was created within the tissue adjacent to the area of recession. A semilunar wedge of tissue from the palate was then placed within the envelope and secured with cyanoacrylate. No sutures were used. The author listed several advantages, including minimal surgical trauma and esthetic blending of tissues postoperatively. Raetzke advocated use of the envelope in localized areas only, and
reported difficulty in obtaining sufficient tissue for use in more extensive areas of recession.

Nelson\textsuperscript{13} employed a subpedicle approach to connective tissue grafting for root coverage. Unlike Langer and Langer,\textsuperscript{10} he placed full-thickness pedicle flaps over connective tissue grafts to enhance nutrition where they contacted areas of recession. Nelson described the subpedicle technique as more difficult and time consuming than others, but expressed optimism for future use of bilaminar soft tissue grafting in periodontal practice. Harris\textsuperscript{14} reported using partial-thickness pedicle flaps in a similar manner. He also introduced a scalpel handle with parallel blades as an aid in graft procurement. Jahnke et al\textsuperscript{15} recently suggested that connective tissue autografts achieved greater root coverage than do thick gingival grafts. The authors employed a single horizontal incision in preparation of the recipient site.

Most bilaminar techniques for root coverage use both horizontal and vertical incisions to prepare the recipient site and rather complex suturing techniques for graft placement and fixation.\textsuperscript{10,13,14} In contrast, the recipient envelope, as described by Raetzke,\textsuperscript{12} appears both simple and elegant—no incisions, no sutures, and minimal surgical trauma. Unfortunately, its use has been limited to isolated areas of recession only. In addition, envelope preparation began with excision of a collar of gingival tissue “corresponding to the sulcus depth,” which may have resulted in excessive sacrifice of existing tissue and supporting vasculature. These limitations may account for its poor long-term success.\textsuperscript{13,14,16}

Based on these reports, modifications were sought that would simplify procedures technically while respecting surgical principles developed by previous authors. The purpose of the first part of this report is to describe the rationale and technique for use of the suprastructure envelope to include multiple adjacent areas of recession. Modifications in envelope design and suturing will be proposed, discussed, and clarified with illustrations.

Indications for use of the suprastructure envelope technique are as follows:

1. Minimal probing depths at recipient sites
2. Presence of Miller Class I and II recession
3. Inadequate tissue quality or quantity for lateral pedicle or other single-stage flap procedure confined to one operative site
4. Single or multiple adjacent areas of recession
5. Gingival clefts or irregular margins compromising esthetics, oral hygiene effectiveness, or thermal sensitivity

Contraindications for use include the following:

1. Habitual use of tobacco or other systemic influences known to compromise healing potential
2. Periodontal pockets or osseous defects in recipient area requiring flap elevation for access and visibility
3. Inadequate connective tissue donor site
4. Presence of Miller Class III or IV recession
5. Previous damage to root surfaces incompatible with postoperative soft tissue health
6. Aberrant frenum in recipient area

Aberrant frenum cannot be corrected at the time of surgery because incisions would compromise the blood supply available to the graft. When indicated, a frenectomy is scheduled 4 to 6 weeks prior to grafting.
Method and materials

Recipient site

Initially, an internal bevelled incision is performed to enable use of a sharp curet for enucleation of the sulcular epithelium adjacent to areas of recession. When marginal tissues are thin and friable, curets are employed exclusively for sulcular debridement. Care must be taken to conserve as much gingival tissue as possible to help nourish the graft. Exposed root surfaces are root planed under copious saline irrigation to remove bacterial contaminants and reduce root convexity, thus decreasing avascular surface area under the graft. As tissue thickness permits, sharp dissection is used to form a partial-thickness supraperiosteal envelope extending 3 to 5 mm laterally and apically to areas of recession, undermining intermediate papillae (Fig 1). Preparation of papillary areas adjacent to remaining root convexities may be facilitated by gently elevating the tissue while dissecting laterally with a small surgical blade (Bard-Parker 15C; Beckton Dickinson) (Fig 2). Thinning gingiva requires careful full-thickness elevation to ensure tissue viability over the graft. A foil template can be fabricated to approximate the size of the envelope for later use. Saline-moistened gauze is placed over the recipient site while the donor tissue is procured.

Donor site

Connective tissue graft procurement has been described by several authors.\textsuperscript{10-14} Raetzke\textsuperscript{12} has advocated gradually converging semilunar incisions to define a palatal graft of desired thickness and contour. This approach is used for isolated areas of recession. The palatal flap described by Langer and Langer\textsuperscript{10} is used for graft procurement when two or more adjacent areas of recession are to be treated.

Unfortunately, genetically thin gingiva, which predisposes to facial mucogingival defects, often seems to be reflected in the characteristics of the palatal mucosa. In these instances, the most productive palatal area for connective tissue graft procurement occurs 2 to 4 mm apical to the marginal gingiva from the mesial aspect of the palatal root of the first molar forward to the canine.\textsuperscript{17}

Typically, the coronal 3 to 5 mm of the graft will be composed of dense lamina propria, while the apical portion will contain loosely organized submucosal elements. The graft including the submucosa is placed between saline-moistened gauze squares while the palatal donor area is sutured.
Fig 1. Facial view of adjacent areas of recession. Internal bevelled incisions were used to remove sulcular epithelialum, retaining as much gingiva as possible. Diagonal lines indicate approximate dimensions of the supraperiosteal envelope.

Fig 2. Cross section of adjacent areas of recession. Gentle elevation of papillary tissues aids sharp dissection adjacent to remaining root convexities.
Graft placement and suturing

The graft is placed over the recipient envelope or foil template, and evaluated and recontoured as necessary. The mesiodistal dimension should permit slight tension on the graft after suturing, and thus should be 1 to 2 mm less than that of the envelope. Uniform thickness is established with a minimum of 1.5 mm over root surfaces. Graft borders are bevelled where they will be submerged in the envelope, facilitating coaptation of the bilaminar soft tissue complex to the underlying periosteal bed. Keratinized epithelium is usually removed, but may be retained in areas that will remain exposed when the graft is in position. The graft lamina propria is positioned over the root surface where a zone of gingiva is desired; submucosal elements are submerged within the envelope apical to the gingival zone. A mattress suture placed in one end of the graft is helpful in guiding the graft under intermediate papillae (Fig 3). A small suturing forceps (Corn suture pliers, SP 20, Hu-Friedy) is used to place a 5-0 gut suture 3 to 5 mm from the distal edge of the graft prior to insertion into the envelope. Tissue borders are gently teased into the envelope using a tissue forceps and a packing instrument (gingival margin packer, serrated #1608N, EA Beck). Once the graft is in position, the distal suture is completed. The mesial aspect is then sutured in a similar manner, introducing slight tension within the graft (Fig 4). Intermediate papillae are anchored with vertical mattress sutures to ensure firm fixation of the graft within the envelope (Figs 5 and 6). Pressure is applied with moistened gauze for 5 minutes to facilitate hemostasis with minimal clot thickness. Burlew foil (Schein) is placed over the graft area and a noneugenol dressing (Coe Pac, Schein) is applied to both donor and recipient sites. Postoperative care parallels comparable mucogingival procedures.

Discussion

Habitual use of tobacco (smoking) is listed as a contraindication to the use of the supraperiosteal envelope. Although contrary evidence is available, most agree that the local and systemic effects of smoking are deleterious to periodontal health and healing. The supraperiosteal envelope, as with most mucogingival procedures for root coverage, requires optimal host response for successful healing. Hence, a strict ban on use of tobacco is advised.

The envelope design is contraindicated in the presence of periodontal pockets or osseous defects. Elimination of horizontal and vertical incisions in the recipient site limits visibility and access to other periodontal pathology that may be present.

Miller has been a strong advocate for the use of citric acid treatment of the root prior to soft tissue grafting. While his rationale has been compelling, others have not found efficacy for its routine use in humans. Results of corrective soft tissue surgery on convex root surfaces highly accessible to effective daily oral hygiene have not yet convinced the author of a need for its use.

Partial-thickness sharp dissection is used in the recipient area to prepare the supraperiosteal envelope. While periosteal retention over interproximal bone does not appear necessary for osseous preservation, it may facilitate initial revascularization of the overlying connective tissue graft. Caffesse et al compared the healing of gingival grafts when placed on a recipient bed of either denuded bone or retained periosteum. The comparison revealed that denuded cortical bone underwent an initial resorption, delaying vascular proliferation in the early stages of healing. Although these findings may not fully apply to bilaminar grafting, prompt initial revascularization may be facilitated by
Fig 3 Connective tissue graft with bevelled edges is teased into envelope using a mattress suture and a packing instrument.

Fig 4 The connective tissue graft, contoured slightly shorter than the envelope, is first secured with a distal suture. The mesial suture is completed, creating slight tension within the graft.
Fig 5  Intermediate papilla is anchored with a vertical mattress suture. Arrows indicate slight mesiodistal tension.

Fig 6  Facial view of the connective tissue graft sutured into position over adjacent areas of recession.
partial-thickness preparation. Nelson,\textsuperscript{13} however, has reported excellent results using full-thickness flap coverage of grafts. Consequently, full-thickness elevation is recommended for use in forming the envelope when gingiva is thin, friable, or likely to necrose if subjected to partial-thickness dissection.

Design of the envelope permits elimination of customary horizontal and vertical releasing incisions, resulting in mobilization of papillary and lateral blood supplies to the overlying gingiva. Will this additional blood supply increase the potential for graft survival?

Mormann and coworkers\textsuperscript{23, 24} have clearly demonstrated that the anterior gingival tissues receive their major source of perfusion in an apicocoronal direction. Customary incisions, therefore, would seem to have little effect on the blood supply to commonly encountered recipient areas. Several reports, however, suggest that papillary and lateral blood supplies may contribute substantially to gingival perfusion.\textsuperscript{22-27}

Tarnow\textsuperscript{25} was able to coronally position existing gingiva successfully over multiple adjacent areas of recession by releasing tissue with continuous horizontal semilunar incisions severing the apicocoronal blood supply within attached gingiva and below the area of recession. Sumner,\textsuperscript{26} using a similar technique for treatment of recession on maxillary canines, stated that the coronally positioned gingiva survived "by its continued connection to the mesial and distal tissues." Miller\textsuperscript{2} has advocated "butt joint" junctions with the papillary and lateral tissues as important factors in gingival graft survival. More recently, Tinti et al\textsuperscript{27} reported success using a semilunar horizontal incision to release tissues coronally over microporous membranes covering areas of recession. These reports suggest that lateral and, to a lesser extent, papillary blood supplies have clinical significance and therefore may enhance graft nutrition within the supraperiosteal envelope.

Envelope design does not permit coronal positioning of gingival tissues over the graft. Bilaminar flap and pedicle procedures bolster nutrition to the graft by coronally positioning external gingival tissues. Whether this advantage is offset by increased blood supply from lateral and papillary tissues is unknown. Clearly, intact papillary tissues permitted by the envelope design promote ease of suturing, firm graft fixation, and maintenance of anterior esthetics.

The palatal zone between the maxillary first molar and the canine is advocated for optimal graft harvesting. Dense connective tissue is frequently more plentiful and uncompromised by palatal exostoses often encountered close to the surface further posteriorly. Submucosal elements are also present in this area. A balanced combination of these two connective tissue components within the graft may act synergistically in the recipient site to produce optimal results.

Several reports\textsuperscript{28, 29} have indicated that surface keratinization is directed by the underlying connective tissue. Therefore, the graft must contain dense lamina propria coronally to produce fully keratinized tissue in the "gingival zone" of the recipient area. The apical portion of the graft often contains submucosal elements that are submerged within the envelope.

The submucosa and contiguous deep connective tissues may contribute to critical early healing events.\textsuperscript{17, 30} Caltuna et al\textsuperscript{30} credit the abundant number of capillaries in the deeper layers of the graft lamina propria for the presence of
valuable nutrients and prompt reestablishment of circulation. In his discussion of full-thickness onlay grafts, Selbert\textsuperscript{17} has suggested that the loosely organized adipose and glandular tissue of the submucosa may readily accept plasma diffusion and capillary ingrowth, fostering prompt revascularization and graft survival. Additionally, when combined with the overlying lamina propria in a full-thickness graft, the submucosa may enhance a return to full vascularity and esthetic color blending with adjacent tissues. Current graft procurement techniques may be used to harvest appropriate ratios of lamina propria and submucosa to produce the desired result.\textsuperscript{10,12-14}

Bevelled graft edges are advocated for use within the supraperiosteal envelope. Although "butt joint" relationships in the recipient site appear to foster gingival graft survival, the envelope design invites bevelled edges to ensure intimate bilaminar contact of the involved tissues. Raetzke\textsuperscript{12} has recommended gradually converging semilunar incisions for use in procuring palatal donor tissue for isolated areas of recession. The resulting semilunar shape seems to adapt well in the recipient envelope. The Langer procurement approach\textsuperscript{10} is used when multiple adjacent areas of recession are present, because graft thickness and contour seem more difficult to control when attempting semilunar incisions with longer grafts. The parallel blade handle introduced by Harris\textsuperscript{14} holds promise for consistent graft harvesting. In these instances, graft beveling is accomplished after procurement from the palate.

A minimum graft thickness of 1.5 mm over root surfaces is compatible with previous recommendations.\textsuperscript{3,13,14} Graft thickness may be increased in wide areas of recession as deemed appropriate to clinical circumstances and tissue survival. As indicated by Langer and Langer,\textsuperscript{10} second-stage gingivoplasty is a predictable choice if resultant contours are unsatisfactory.

Graft design and suturing techniques create slight tension on the tissue at completion. Holbrook and Oschenbein\textsuperscript{3} have reported that tension thus induced may facilitate anastomosis of vessels in the recipient site with those of the graft. Raetzke\textsuperscript{12} advocated the use of a tissue adhesive for graft fixation. The use of cyanoacrylate would result in a passive relationship between the graft and the envelope. More research is indicated to clarify the effect of graft "stretching" on early healing events and graft survival.

The rationale for use of the supraperiosteal envelope in soft tissue grafting for root coverage has been discussed in detail. Surgical modifications have been proposed that simplify techniques while retaining elements responsible for success. Indications have been expanded to include multiple adjacent areas of recession. The supraperiosteal envelope appears to have several advantages in the treatment of recession when compared to bilaminar flap and pedicle approaches:

1. Surgical trauma to the recipient area is minimal.
2. Graft nutrition is augmented by mobilization of lateral and papillary vascular supplies from adjacent overlying gingiva.
3. Integrity of involved papillae is maintained, favoring preservation of esthetics.
4. Envelope design permits relative ease of suturing while ensuring firm graft fixation and confinement within the recipient site.

More research is needed to compare results and further delineate indications for various bilaminar approaches currently in use.
References


