Informational Paper

Oral Reconstructive and Corrective Considerations in Periodontal Therapy*

This paper was prepared by the Research, Science and Therapy Committee of the American Academy of Periodontology. It is intended to provide information for the dental profession and other interested parties. The purpose of this paper is to provide a general overview of oral reconstructive and corrective procedures used in periodontal therapy. It is not intended to be a comprehensive review of this subject. *J Periodontol 2005;76:1588-1600.*

In 1989, the American Medical Association adopted the following definition which is used in this paper: Reconstructive surgery is performed on abnormal structures of the body caused by congenital defects, developmental abnormalities, trauma, infection, tumors or disease. It is generally performed to improve function, but may also be done to approximate a normal appearance.

Periodontal reconstructive surgery consists of a variety of mucogingival procedures including root coverage, tooth exposure, crown exposure, vestibular deepening, papilla reconstruction, ridge augmentation, and ridge preservation. While the primary goal of these procedures is to benefit periodontal health through the reconstruction of lost hard and soft tissues or by preventing additional loss, they also enhance the patient's appearance. Crown exposure procedures are an exception. They involve removal of periodontal tissues to optimize the symmetry and display of clinical crowns, thereby enhancing the appearance of the smile. Each procedure can be performed using a variety of surgical techniques that are selected based on their advantages and disadvantages relative to the specific clinical presentation of the defect. The most critical factor is the technique's predictability. The discussion of these procedures will be divided into six sections: 1) recession prevalence and pathogenesis; 2) recession classification; 3) root coverage techniques and predictability; 4) tooth exposure; 5) crown exposure; and 6) papilla reconstruction.

RECESSION PREVALENCE AND PATHOGENESIS

There are two types of gingival recession, one due to periodontitis and the other primarily related to mechanical factors, especially toothbrushing.[1] Recession due to periodontitis can affect all tooth surfaces and is irreversible. In contrast, facial recession due to mechanical factors is often reversible, or partially reversible, with periodontal reconstructive procedures. In general complete coverage of facial recession defects can be achieved when there is no loss of interproximal bone or soft tissue.[2] Facial recession occurs in patients with a high level of personal and professional dental care, while chronic periodontitis, with its more generalized recession, is a disease associated with plaque and calculus. Other factors that can predispose to gingival recession include tooth malposition; bone dehiscence; thin marginal soft tissue; high frenulum attachment; inflammation; inflammatory viral eruption; and dental restorative, orthodontic, or periodontal treatments.[3-8]

Recession increases with age and studies show a substantial increase for each decade of life.[1,9-15] By age 60 almost 90% of Americans have at least one site with ≥1 mm of recession, while about 40% have at least one site with ≥3 mm of recession.[12,15] Sites with recession are likely to progress.[13] Untreated recession sites in patients not receiving regular dental care are more likely to progress than sites treated with a gingival augmentation procedure.[16] One cross-sectional study reported that mean dehiscence depth exceeded recession depth by 2.76 mm, or approximately the distance occupied by biologic width.[17] Since additional gingival recession increases attachment loss, appropriate treatment is indicated at progressing sites to prevent additional loss of periodontal tissues as well as to improve function and approximate a normal appearance.

Recession Defect Classification

There have been several attempts to classify recession defects.[2,7,18,19] The two most enduring classifications have both assessed recession defects with respect to parameters that provide predictive guidelines for achieving complete root coverage.[2,19] The first of these emphasized the relative importance of vertical and horizontal defect dimensions as predictors of final defect coverage.[19] Four categories were utilized: shallow narrow, shallow wide, deep narrow, and deep wide. These

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are still important dimensions to consider when assessing the difficulty of achieving complete root coverage. The second of these classifications focused on the importance of interproximal bone and soft tissue levels as the primary predictors when assessing the possibility of achieving complete root coverage.[2] One hundred percent root coverage was considered achievable at sites with no loss of interproximal bone or soft tissue and were designated as either Class I or II depending on the location of the soft tissue margin relative to the mucogingival junction. Partial or no root coverage was considered achievable at sites with interproximal bone or soft tissue loss or tooth malposition, depending on the severity of these factors. These defects were designated as Class III or IV. A more recent classification,[7] which does not give predictive guidelines, is unique in its thoroughness with respect to characterization of vertical and horizontal defect dimensions and may be most useful as an epidemiologic tool.

ROOT COVERAGE TECHNIQUES AND PREDICTABILITY

Laterally Positioned Flap Technique

Early attempts to gain root coverage were focused on the laterally positioned flap (LPF) technique.[20,21] It was originally described as a "sliding flap" that started as full thickness then became split thickness at the mucogingival junction.[20] The LPF was primarily indicated for isolated recession defects on mandibular teeth. The tooth adjacent to the recession defect served as the donor site for a flap that was moved laterally to cover the recession defect. The LPF technique had the disadvantage of often leaving recession at the donor site.[22] Flap design was subsequently modified to leave the marginal tissue at the donor site intact; however, this technique was limited to sites with an adequate amount of adjacent keratinized donor tissue.[23] Only the apical portion of the keratinized tissue was included in the flap, leaving the coronal portion intact to protect the osseous crest and gingival margin, thus preventing donor site recession. Other techniques to prevent donor site recession included placing a free gingival graft at the donor site after lateral positioning or using an edentulous area as the donor site.[24-26]

A stimulated osteoperiosteal laterally positioned flap was proposed as a means of gaining bone in addition to soft tissue when attempting root coverage.[27,28] About 3 weeks prior to flap elevation, a needle was used to penetrate and slightly elevate the periosteum at multiple sites in "pincushion" fashion. This stimulated osteoblast proliferation and osteoid production, which peaked around 3 weeks later. At that time the periosteum and stimulated osseous layer, or "osteoperiosteal" flap, was elevated and laterally positioned to cover the recession defect. This technique was limited to sites with an adequate thickness of facial bone.

Other rotational flaps that can be classified with the laterally positioned flap include: 1) the double papilla repositioned flap; 2) the oblique rotated flap; 3) the rotation flap; and 4) the papilla rotation flap.[29-33] The free rotated papilla autograft may also be included with this group although it actually involves a coronally positioned flap to cover an excised and inverted papilla that is placed as a free graft over a shallow recession defect.[34] In general, papilla procedures take tissue from the papilla and move it to the mid-facial area. These techniques eliminate the risk of facial recession on the adjacent tooth since the papilla is the donor site, not the mid-facial tissue. These procedures work best when the donor papilla is wide.

Investigations of the LPF technique show a mean defect coverage ranging from 61% to 74% with a mean for all studies of 67%.[35-39] This indicates limited success with this procedure. Final root exposure ranged from 0.8 to 1.8 mm with a mean of 1.3 mm relative to mean initial recession of 3.9 mm. Unfortunately, no studies have examined the predictability of this technique. Rotational flaps from the papilla, in general, have not been systematically evaluated. This may be due to the limited indications for their use.

Thin Free Gingival Graft Technique

The thin free gingival graft (FGG) technique, like the LPF, was one of the earliest techniques used for root coverage.[19,40,41] It was believed that free gingival grafts would survive better over the avascular root surface if they were thin, probably about 1 mm in thickness. The technique worked best on shallow, narrow defects but overall the procedure was a failure. The concept was flawed and the technique unreliable, particularly for larger defects. One study attributed most of the defect coverage achieved, then known as "bridging," not to immediate surgical results but instead to creeping attachment that occurred within 1 year.[41]

There are few studies of the thin FGG since its usefulness was considered questionable. Studies show mean defect coverage ranged from 12% to 66% with a mean for all studies of 41%.[40,41] Percent defect coverage was strongly, and inversely, correlated with the initial recession depth. Final root exposure ranged from 0.8 to 4.6 mm with a mean of 2.4 mm relative to mean initial recession of 3.6 mm. Predictability data indicated that 90% or greater defect coverage was achieved only 16% of the time.[40,41]

Thick Free Gingival Graft Technique

Predictability finally came to root coverage grafting when it was established that a thick free gingival graft was more likely to revascularize and survive on an avascular root surface than a thin graft.[42-47] The "thin graft" concept was finally corrected but the procedure was technique sensitive. Some authors reported good defect coverage but others had mediocre or poor results.[45,48-52] A recession classification based on interproximal bone and soft tissue loss was devised to help identify indications for the thick FGG.[2] The thick FGG technique utilized a graft that was at least 2 mm in thickness. Site preparation included butt joint margins between the papilla base and the graft at the level of the cemento-enamel junction to facilitate graft revascularization.[43] Revascularization was also dependent on contact with an adequate amount of vascular base, 75% to 80%, which often required a very large graft.[53] Suturing designed to ensure intimate contact with the vascular base and to provide graft stability was essential. The disadvantages of this procedure were a large, slow healing donor site and often an unfavorable color match.

Reports show mean defect coverage ranged from 39% to 100% with a mean for all studies of 69%.[45,48-52] Final root exposure ranged from 0.0 to 1.8 mm, with a mean of 0.9 mm relative to mean initial recession of 3.2 mm. A limited number of studies with predictability data showed that 90% of the defect was covered 84% of the time.[45,49]

Connective Tissue Graft Techniques

The subepithelial connective tissue graft (CTG) is a highly predictable procedure that lacks the esthetic disadvantages of the thick free gingival graft.[54,55] It was first reported in 1980[56] as a ridge augmentation procedure, then subsequently in 1982[54] as a root coverage procedure. Successful defect coverage can be achieved with less donor tissue since revascularization occurs from both the periosteal or osseous base and the overlying flap. This dual blood supply is responsible for the increased predictability of CTG procedures. The overlying flap ensures an excellent color match when the graft is completely covered; however, mucosal tissue will not necessarily take on a keratinized appearance. When the graft is partially exposed, the color of the exposed tissue will not necessarily match the flap, but the exposed tissue does become keratinized, thereby increasing the zone of keratinized tissue. The harvesting techniques for connective tissue produce less postoperative morbidity than for thick free gingival grafts. Many iterations of this technique have appeared in the literature, each subtly different, all with a dual blood supply and each with its own advantages for the varied clinical presentations of recession defects.[54,55,57-65]

The subepithelial connective tissue graft technique involves a split thickness flap technique and utilizes vertical incisions while preserving facial tissue and papillae.[54,55] Donor connective tissue is immobilized with sutures and then the flap is sutured to cover as much of the graft as possible. The pouch procedure is similar but does not include vertical incisions.[57] Some marginal tissue is excised during the split thickness pouch preparation. The connective tissue graft is then placed into the pouch and a surgical adhesive is recommended instead of sutures. The subpedicle and double pedicle techniques take subpapilla tissue and move it to the mid-facial area so that the CTG has at least one blood supply over the avascular root surface.[58,59] Other distinct connective tissue graft techniques include the supraperiosteal envelope or "tunnel," and a coronally positioned envelope.[60-62] Aside from these distinct procedures, there are hybrid methods that combine elements of different techniques described above.[63-65] A unique modification of the tunnel technique involves freeing adjacent subpapilla tissue and laterally positioning it to provide increased graft coverage and blood supply.[65] This tissue can also be coronally positioned to provide the same blood supply advantage and to facilitate placing a graft at multiple sites. Keeping some papillae intact serves to prevent flap retraction that can lead to incomplete root coverage.

While a large, thick graft was required to obtain root coverage with a free gingival graft, it has recently been demonstrated that smaller, thinner connective tissue grafts work as well as larger, thicker grafts when the graft is completely covered by a coronally positioned flap.[66] This concept merits further study to confirm the finding and to compare the long-term stability of thick versus thin connective tissue grafts.

Studies show mean defect coverage ranging from 57% to 98% with a mean for all studies of 84%.[34,51,52,57,59,61,64,66-105] Final root exposure ranged from 0.1 to 1.7 mm, with a mean of 0.6 mm relative to a mean initial recession of 3.7 mm. Outlier values to some extent distort the mean final root exposure and 44 of 54 studies evaluated had mean values less than 1 mm. Predictability data indicated that 90% or greater defect coverage was achieved 68% of the time.[34,59,61,67,77,82,97,99] Connective tissue graft procedures have clearly been established as a highly effective means of covering recession defects.

Free Gingival Graft/Coronally Positioned Flap Technique

The free gingival graft (FGG) followed by a coronally positioned flap (CPF) first augmented the zone of keratinized tissue using an FGG.[106] This was considered necessary to achieve successful root coverage. About 2 months later a flap was raised and coronally positioned. Flap design included new papilla tips located apical to the original tip by a distance equal to the millimeters of recession.[106] The flap was full thickness to approximately the mucogingival junction, at which point it was split, then coronally positioned. Existing papilla were deepithelialized, then overlaid by the newly created papilla tip. A disadvantage of this technique is that the free graft may heal as scar tissue and then be difficult to elevate by blunt dissection. This complication requires sharp dissection that can lead to excessive thinning or flap perforation.

Studies show mean defect coverage ranging from 36% to 71% with a mean for all studies of 61%.[50,106-112] Final root exposure ranged from 0.8 to 2.3 mm, with a mean of 1.4 mm relative to a mean initial recession of 3.9 mm. No studies have examined the predictability of this technique.

Coronally Positioned Flap Technique

The coronally positioned flap is an old procedure in periodontics. The current surgical approach for the coronally positioned flap alone often follows the previously described[106] technique, although other variations are used.[113-119] The double lateral bridging flap is a type of CPF that combines the Edlan-Mejchar vestibuloplasty procedure and a coronally positioned flap.[113] This technique attempted root coverage without increasing the zone of keratinized tissue. Another unique approach, the semilunar coronally positioned flap, is a split thickness technique that primarily involves the mid-facial tissue and utilizes an apically placed semilunar releasing incision.[114] This procedure has advantages in many situations and is particularly useful for covering exposed crown margins. A unique full thickness CPF with a horizontal vestibular releasing incision designed to facilitate coronal positioning and to prevent flap retraction may be important in the presence of a shallow vestibule where it is extremely difficult to prevent flap retraction.[120] Another unique CPF technique, best for shallow recessions, involves oblique incisions in the papillae, which can then be rotated to facilitate coronal positioning.[121]

The coronally positioned flap is a predictable means of root coverage under defined conditions.[115,122] These conditions include: 1) shallow recession of ≤4 mm; 2) Miller Class I recession; 3) keratinized tissue width ≥3 mm; and 4) gingival thickness of ≥1 mm.[115] One study attributes success primarily to marginal thickness alone, which they reported should be ≥0.8 mm.[119] Other reports have evaluated the influence of various factors on CPF technique and show slightly better results for sites that received polishing alone compared to those receiving root planing and flaps sutured with no tension compared to those with tension.[123,124] One study has shown that papilla area and height were not related to root coverage but that papilla height was related to complete root coverage.[125] A recent report indicates that a smaller, thinner graft may work as well as a larger, thicker graft as long as it is completely covered by a coronally positioned flap.[66]

Substantially improved defect coverage was reported in studies that had either flap thickness or keratinized tissue width requirements in selecting sites for inclusion or when the flap was underlaid with a connective tissue graft. When these criteria were observed, defect coverage approached 100%.[73,115,122] What has been learned from these techniques is that multiple defects can be treated with a long span coronally positioned flap and that sites with thin margins should be underlaid with connective tissue, while those with thicker margins will achieve coverage with coronal advancement alone.

Studies show mean defect coverage ranging from 50% to 98% with a mean for all studies of 78%.[73,103,115-117,119,123-132] Final root exposure ranged from 0.1 to 1.7 mm, with a mean of 0.8 mm relative to a mean initial recession of 3.4 mm. Predictability data indicated that 90% or greater defect coverage was achieved 39% of the time.[116,123,124,126,127,132]

Guided Tissue Regeneration Technique

Numerous studies of recession defect coverage utilized the principles of guided tissue regeneration (GTR) and employed either bioabsorbable[71,75,76,79-82,85,86,89,91,92,94,101,118,128,133-147] or non-resorbable[72,77,80,111,112,130,136,148-155] membranes. The membrane is sutured into place, then covered with a coronally positioned flap. Complete coverage of the membrane is preferred at the time of surgery and throughout the healing period since membrane exposure can compromise the result. An advantage of this technique is that it is theoretically possible to regenerate bone and periodontal ligament rather than just gain soft tissue coverage alone. Another advantage is that a secondary surgical site to obtain donor tissue is not needed. One report indicates that deeper recession defects respond better to GTR than shallow defects.[111] The addition of the

glycoprotein fibronectin to GTR treatment did not enhance the defect coverage.[153] Future work in this area with growth factors may increase the predictability of these procedures.

Bioabsorbable membranes studies show mean defect coverage ranging from 45% to 94% with a mean for all studies of 72%.[71,75,76,79-82,85,86,89,91,92,94,101,118,128,133-147] Final root exposure ranged from 0.3 to 1.8 mm, with a mean of 1.0 mm relative to a mean initial recession of 3.8 mm. Predictability data indicated that 90% or greater defect coverage was achieved 35% of the time.[79,82,133-138,140,142,144] For non-resorbable membranes, studies show mean defect coverage ranging from 45% to 91% with a mean for all studies of 73%.[72,77,80,111,112,130,136,148-155] Final root exposure ranged from 0.4 to 2.0 mm, with a mean of 1.3 mm relative to a mean initial recession of 4.8 mm. Predictability data indicated that 90% or greater defect coverage was achieved 39% of the time.[77,136,148,149,154]

Acellular Dermal Matrix Technique

The use of acellular dermal matrix (ADM) as a substitute for connective tissue when covered by a coronally positioned flap is a relatively new approach that allows coverage of multiple sites and does not require autogenous donor tissue.[84,87,90,95,97,132,156-160] The ability to cover an unlimited number of sites without the need for a second surgical site to obtain donor tissue is a significant advantage for this material. ADM is obtained from human dermis harvested and treated to remove all cells while preserving the intact structure of the extracellular matrix, including an intact vascular network. Currently, controlled studies show stable results for up to 1 year; however, additional studies are needed to confirm the long-term stability of this treatment.[95,97,159]

Studies show mean defect coverage ranging from 66% to 99% with a mean for all studies of 86%.[84,87,90,95,97,132,159,160] Mean final root exposure ranged from 0.2 to 1.1 mm relative to a mean initial recession of 3.7 mm. Predictability data indicated that 90% or greater defect coverage was achieved 74% of the time.[97,132,159]

Enamel Matrix Derivative

Enamel matrix derivative applied to a coronally positioned flap may enhance root coverage, although some studies show no advantage to its use.[105,127,129,131,161,162] While this is not GTR, it may also have the potential to enhance regeneration of bone and periodontal ligament.

Studies show mean defect coverage ranging from 72% to 94% with a mean for all studies of 86%.[105,127,129,131,161,162] Mean final root exposure ranged from 0.2 to 1.2 mm relative to a mean initial recession of 3.9 mm. Predictability data indicated that 90% or greater defect coverage was achieved 53% of the time.[127,161,162]

Factors Affecting Predictability

For years an adequate width of keratinized tissue was considered necessary to prevent recession. In general, this concept was not supported by the literature if the patients had good oral hygiene and were on recall. Similarly, some consider an adequate width of keratinized tissue necessary to achieve complete recession defect coverage. Others have been able to achieve defect coverage irrespective of the width of keratinized tissue.

Recent data indicate that soft tissue thickness ≥0.8 mm is needed for complete coverage with a coronally positioned flap, while tissue <0.8 mm in thickness more often results in incomplete coverage.[119] Another study that used thickness as a criteria for site selection reported that sites treated with GTR are more likely to get complete coverage when thick tissue is present.[75] A recent study indicates that increasing tissue thickness results in complete root coverage irrespective of width of keratinized tissue or any other site characteristics, including recession depth.[132] Additional research is needed to determine if tissue thickness is the predominant factor affecting the predictability of root coverage.

Adequate vascular supply is essential to achieve complete root coverage. This may be obtained from the bone, periosteum, and periodontal ligament underlying the graft and from flap tissue overlying the graft. The thick free gingival graft has primarily a single blood supply from underlying bone, periosteum, and periodontal ligament, while most connective tissue procedures also derive blood supply from overlying flap tissue. Dual blood supply is desirable and undoubtedly contributes to the increased predictability of root coverage by subepithelial graft techniques when compared to the thick free gingival graft technique.

Flap retraction will decrease the predictability of subepithelial graft or coronally positioned flap techniques. It has been clearly shown that the increased flap tension decreases the predictability of complete root coverage.[124] It is essential that flaps are designed to be tension free so that retraction during healing will not compromise the result. Suturing techniques that will prevent or minimize flap retraction are also necessary. Another technique to prevent flap retraction is to use a tunnel type procedure that keeps the papilla intact.[61,65]

The choice of surgical procedure can compromise the predictability of complete root coverage. For example, coronally positioning a thin flap decreases the chances of obtaining complete root coverage. When a shallow vestibule is present, flap procedures may lead to flap retraction, while tunnel procedures can ensure that flap retraction will not occur. Careful planning and choosing an appropriate surgical procedure for the specific clinical presentation is essential to achieving a high degree of predictability with root coverage procedures.

Histologic Evaluations of Attachment

There are histologic evaluations of the attachment obtained with the laterally positioned flap, coronally positioned flap, free gingival graft for root coverage, connective tissue graft, guided tissue regeneration, acellular dermal matrix, and enamel matrix derivative procedures, most often by case reports.[157,163-183] Some reports show long junctional epithelium, some connective tissue attachment, while others show small amounts of regeneration.[157,163-183] One report indicates that the bulk of the attachment is composed of connective tissue adhesion.[171] Often a report will show more than one attachment mode. The type of attachment may be dependent on the type of procedure and the proximity of the epithelium to the wound margin. Studies of root coverage tend to show healing with shallow probing depths and gain of attachment similar to the amount of defect coverage obtained. The type of attachment, therefore, may not have a significant impact on the clinical result, particularly since longer term studies of 3 years or more show that the result is stable over time for connective tissue, free gingival graft, coronally positioned flap, and non-resorbable membrane techniques.[41,53,98,99,112,116]

Conclusions of Recent Reviews

Recent reviews that have been systematic, evidence-based, or meta-analysis have demonstrated that connective tissue grafting is an effective means of root coverage.[48,184-187] One review noted that only a limited number of studies have reported raw data.[53] When raw data are available, reviewers can obtain frequency data and more detailed information about the predictability of each procedure. The importance of reporting individual patient data was emphasized in a recent meta-analysis to allow reviewers to better assess the factors affecting predictability.[186]

TOOTH EXPOSURE

Permanent teeth that fail to erupt may require surgical exposure and orthodontic eruption to move them into their proper position in the dental arch.[188-197] The surgical procedure may be a gingivectomy, pedicle flap, apically positioned flap with or without a soft tissue graft, replaced flap with a soft tissue window leaving the tooth exposed, or replaced flap followed by closed subflap eruption or tunnel traction eruption. The choice of surgical procedure will depend on the amount of keratinized gingiva, corono-apical tooth position, and/or buccal-lingual tooth position. The goals of the surgery are to 1) expose adequate tooth structure to permit placement of an orthodontic bracket and application of appropriate orthodontic force vectors; 2) avoid creation of periodontal defects on adjacent teeth or minimize damage from existing periodontal defects; and 3) preserve or create adequate keratinized tissue. Studies indicate that the surgical procedures mentioned above successfully preserve or create adequate keratinized tissue and that this result is stable over the long term and comparable to normally erupting contralateral teeth.[192–197]

CROWN EXPOSURE

Excessive gingival display results primarily from three conditions: 1) altered passive eruption which gives the appearance of short clinical crowns; 2) gingival overgrowth with resulting short clinical crowns; and 3) skeletal deformity resulting in vertical maxillary excess, giving the appearance of a high lipline.[198-201] Altered passive eruption may be treated by an external or internal bevel gingivectomy or by a flap procedure with or without osseous recontouring.[202] The choice of the surgical procedure will depend on the amount of keratinized tissue, the location of the osseous crest relative to the cemento-enamel junction, or the extent of the osseous surgery. Gingival overgrowth due to medications, orthodontic therapy, or plaque can be treated with an external or internal bevel gingivectomy with a scalpel or laser. Vertical maxillary excess requires careful diagnosis and may involve interdisciplinary treatment, possibly including periodontics, orthodontics, and/or orthognathic surgery.

PAPILLA RECONSTRUCTION

Loss of the interproximal papilla may create phonetic problems or predispose to interproximal food entrapment and is esthetically displeasing. An interproximal contact point and an adequate level of bone support are essential for maintenance of a healthy papilla that completely fills the interproximal space. If certain vertical or horizontal interproximal dimensions are exceeded, the papilla may be either partially or totally lost. For example, with excessive horizontal spacing,

a diastema can develop and the papilla will be lost; vertically, the likelihood that the papilla will fill the interproximal space decreases as the alveolar crest to contact point distance increases beyond 5 mm.[203] Surgical therapy to reconstruct the papilla is a promising area of development that is surgically challenging due to the small size of the interproximal site and the lack of blood supply.[204] Regeneration of lost papilla height with periodic curettage has been reported in cases of necrotizing ulcerative gingivitis.[205] Orthodontic therapy to establish or lengthen a contact is useful in certain situations.[206] Surgical techniques that have been utilized to reconstruct a lost papilla include a modification of the roll technique; soft tissue grafting, sometimes accompanied by a semilunar coronally positioned flap; or a combination of hard tissue and soft tissue grafting.[204,207-211] At this point only case reports exist and no single technique has been systematically evaluated in a controlled study. Papilla defects present in a variety of ways and the surgical approach must be tailored to the challenges faced with each different presentation. This makes systematic study difficult. Additional work is needed to develop predictable papilla reconstruction techniques.

SUMMARY

Root coverage is a successful and predictable procedure in periodontics, employing a variety of techniques. This is an area of rapid change and new techniques are constantly being reported.

Connective tissue graft procedures are the most extensively documented. Newer techniques allow root coverage without use of palatal donor tissue. This facilitates treating a larger number of sites in one surgical appointment. These procedures are documented up to 1 year. Further testing is needed to confirm their long-term stability.

Tooth exposure and crown exposure are successful and predictable periodontal procedures that provide a significant patient benefit. They are a routine part of periodontal practice and the techniques are well established.

Papilla reconstruction techniques are an exciting area of development in periodontal therapy. There are numerous reports of successful procedures but there are no controlled clinical trials at this time. Additional research is needed in this promising and rapidly developing area of periodontal surgery.

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