



## REVIEW ARTICLE

## Challenges in Root Coverage Procedure: A Narrative Review

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## ABSTRACT

In contemporary dentistry practices, root covering techniques have gained a lot of popularity. Despite the fact that these methods are thought to be safe, their surgical character may provide the clinician with a number of difficulties throughout treatment. While some of these difficulties can only be described as procedure-specific problems, others are therapy blunders. The main goal of this review is to outline treatment side effects that could occur at various stages of the root coverage therapy procedure.

**Keywords:** Gingival recession/surgery; Mucogingival surgery; Root coverage; Complications of root coverage

## 1 INTRODUCTION

The apical displacement of the soft tissue margin beyond the cemento-enamel junction, exposing the root surface, is referred to as gingival recession (GR). Both the gingiva and the underlying bone are affected by this degenerative process. Gingival recession will always occur in the context of bone dehiscence. Fenestration or dehiscence of the bone may be iatrogenic, pathogenic, traumatic, or anatomical. Gingival recessions are more common and progressed in older individuals, and they affect men far more frequently than women from an epidemiological perspective.<sup>(1)</sup> More than two-thirds of the population worldwide was found to be affected by GR (Population-based observational studies from 1991 to 2021). According to available data, gingival recession has a complex aetiology, and a number of factors should be considered during the diagnosis stage.<sup>(2)</sup>

## 2 ETIOLOGY

## 2.1 Anatomical / Developmental Factors

- Tooth malposition
- Thin gingival biotype

- Lack of attached gingiva
- Dehiscence / fenestrations
- Root-bone angle
- Mesio-distal curvature of the tooth surface<sup>(3)</sup>

## 2.2 Oral hygiene habits

- Faulty tooth brushing technique (gingival abrasion)
- Improper use of interdental cleansing aids<sup>(4)</sup>

## 2.3 Iatrogenic dentistry

- Overhanging dental restorations
- Placing restorative margins within the biologic width
- Improper orthodontic treatment
- Pressure from a poorly designed partial denture, such as an ill-fitting denture clasp, can cause gingival trauma and recession.<sup>(5)</sup>

## 2.4 Pathological factors

- Persistent gingival inflammation
- Periodontal disease

- Trauma from occlusion has been proposed in the past, though its exact mechanism remains unproven
- Abnormal frenum attachment
- Smoking, tobacco chewing, or mishri application<sup>(6)</sup>

### 3 CLASSIFICATION OF GINGIVAL RECESSION

#### 3.1 Sullivan and Atkins (1968)<sup>(6)</sup>

The initial classification of gingival recession was based on the depth and width of the defect.

The four categories are:

- Deep wide
- Shallow wide
- Deep narrow
- Shallow narrow<sup>(7)</sup>

#### 3.2 Miller (1985)<sup>(7)</sup>

This classification of gingival recession is primarily based on the following factors:

- A. The extent of gingival recession defects
- B. The degree of hard and soft tissue loss in the interdental areas surrounding the recession defects.

It is useful for predicting the final amount of root coverage achievable after a free gingival graft procedure.

Class I: Marginal tissue recession not extending to the mucogingival junction (MGJ) No loss of interdental bone or soft tissue. 100% root coverage can be anticipated.

Class II: Marginal recession extending to or beyond the mucogingival junction.

Class III: Marginal tissue recession extends to or beyond the MGJ. Loss of interdental bone or soft-tissue is apical to the CEJ, but coronal to the apical extent of the marginal tissue recession or there is a mild malpositioning of the tooth, this prevents the attempting 100% of root coverage.<sup>(8)</sup>

Class IV: marginal tissue recession extends to or beyond the MGJ. Loss of interdental bone extends to a level apical to the extent of the marginal tissue recession or malpositioning of tooth is so severe that root coverage cannot be anticipated.<sup>(8)</sup>

#### 3.3 Cairo et al. (2011)<sup>(9)</sup>

Based on the assessment of Clinical attachment loss at both buccal and interproximal sites.

- **Recession Type 1:** Gingival recession with no loss of interproximal attachment.

Interproximal CEJ is clinically not detectable at both mesial and distal aspects of the tooth.

- **Recession Type 2:** Gingival recession associated with loss of interproximal attachment.

The amount of interproximal attachment loss (measured from the interproximal CEJ to the dept of the interproximal pocket) is less than or equal to the buccal attachment loss.

- **Recession Type 3:** Gingival recession associated with loss of interproximal attachment.

The amount of interproximal attachment loss is higher than buccal attachment loss.

It does not consider the remaining width of attached gingiva, relationship of gingival margin.

### 4 TREATMENT OF GINGIVAL RECESSION

- Oral hygiene advice:
  - manual tooth brushing
  - electric tooth brushing
- Correction of traumatic habits
- Habit counselling
- Treatment of periodontal disease
- Partial denture design and restorations:
  - good support of dentures
  - supra-gingival restorations where possible
  - regular review and maintenance of restoration and prosthesis.<sup>(10,11)</sup>
- Management of recession if patient has complaints of dentine hypersensitivity.
  - (a) Dietary advice
  - (b) Anti-sensitivity dentifrices
  - (c) Topical products for professional application: (i) Sealants; restorations. (ii) Other (e.g. containing chlorhexidine and thymol).<sup>(12)</sup>

### 5 SURGICAL APPROACHES FOR MANAGING GINGIVAL RECESSION

#### 5.1 Criteria For Selection of Mucogingival Techniques

- The surgical site should be free of plaque, calculus, and inflammation.
- The anatomy of the recipient and donor sites should be considered.
- Adequate blood supply to the donor tissue.
- There should be minimal trauma to the surgical site.
- Stability of the grafted tissue to the recipient site should be maintained.<sup>(13,14)</sup>

#### 5.2 Surgical Techniques

Pedicle grafts: Named for the way they stay connected to the donor site even after being inserted into the recipient site.<sup>(15–17)</sup>

- Laterally repositioned flap
- Double papilla flap
- Oblique rotational flap
- Free grafts: these are completely deprived of their connection with the donor area.
- Epithelialized gingival grafts

- Sub epithelial connective tissue graft

→ Tarnow gave a description of the semilunar coronally positioned flap in 1986. The goal of this one-stage, coronally relocated flap procedure is to treat minor gingival recessions without the need for sutures.

→ To address shallow marginal recessions, Allen and Miller (1989) described the application of a one-stage, coronally positioned ap linked to citric acid root conditioning.

### 5.3 Complications Associated with Recession Coverage Procedures

- Patient related factor

**Smoking:** Smoking is a known risk factor for periodontal disease. patient with history of smoking has shown adverse healing outcome post root coverage therapy<sup>(18)</sup>.

**Poor oral hygiene:** poor oral hygiene and non-compliance generally considered as a contraindication to root coverage procedures.

**Medical conditions:** Uncontrolled diabetes, Uncontrolled hypertension, immunocompromising conditions, or bleeding disorders said to have of post operative complication to root coverage procedures.<sup>(18)</sup>

Other complications of root coverage procedures include: Pain, Swelling, Bleeding, Bruising, Infection, Increased tooth sensitivity, Transient, but rarely, permanent numbness of the jaw, tongue, teeth, lip, or gingiva.<sup>(19)</sup>

- Potential Complications Associated with the Use of Pedicle Soft Tissue Grafts

To address recession-type deformities, pedicle soft tissue graft techniques such advanced or rotating flaps can be used either alone or in conjunction with connective tissue grafts. These surgical methods cover the exposed root surface with soft tissue close to the recession defect. Pedicle flap approaches often yield satisfactory results and have the benefit of requiring only one surgical site.<sup>(20)</sup>

Incomplete root coverage as a result of marginal tissue retraction is the most frequent side effect of this method. Numerous factors related to the patient, the specific site, and the technique used have been shown to influence the expected outcomes of root coverage procedures.<sup>(21)</sup>

Among patient-related factors, smoking has been linked to poorer outcomes following root coverage procedures. Additionally, the recurrence of gingival margin recession has been associated with the resumption of traumatic toothbrushing habits at treated sites. Site-related factors that may impact treatment outcomes include interproximal bone height and attachment level (as classified by the Miller classification), defect size, presence of frenum attachment, tooth malposition, cervical lesions, vestibular depth, and tissue thickness.<sup>(22)</sup>

Because they can affect the extent of root coverage, technique-related aspects such flap stability, gingival margin location, the use of vertical releasing incisions, and the incorporation of microsurgical techniques should be taken into account. Another potential complication of pedicle flap procedures is flap margin necrosis due to compromised blood supply. In areas with thin tissue, partial-thickness flaps may disrupt the flap's vascularity, increasing the risk of necrosis. A delicate, thin gingival biotype is particularly vulnerable to intraoperative damage and postoperative complications.<sup>(23)</sup>

- Potential Complications Associated with the Use of Free Soft Tissue Grafts

Since the 1960s, free gingival grafts (FGGs) have been used extensively to augment keratinised tissue and perform root coverage treatments. Using this method, tissue is transferred as a non-vascularized graft from a palatal donor site to a recipient area that has been prepped. However, the FGG technique is no longer the preferred option for root coverage due to its low predictability and suboptimal aesthetic results.<sup>(24)</sup>

### 5.4 Donor Site Complication

This technique's main disadvantage is that donor tissue harvesting leaves an open incision that may take two to four weeks to heal because to secondary intention. Significant pain and discomfort are frequently experienced during this procedure, and in certain situations, wound healing may be delayed. Studies have shown that patients undergoing an FGG procedure are three times more likely to experience postsurgical pain or bleeding compared to other root coverage techniques.<sup>(25,26)</sup>

Del Pizzo et al., (2008),<sup>(27)</sup> showed that during the first week following surgery, all patients who had the FGG graft harvesting procedure had pain at the palatal donor site. Additionally, 33% of the FGG patients experienced postoperative bleeding within the first week.

Kerner et al.,<sup>(28)</sup> discovered that three weeks following surgery, only 50% of patients had complete epithelialisation of the donor site. Wessel and Tatakis., (2007),<sup>(26)</sup> found that 90% of patients who underwent FGG procedures experienced postoperative discomfort at the donor site during the first week. This increased pain was also linked to higher analgesic use.<sup>(26,28,29)</sup>

In a study by Hatipoğlu et al.,<sup>(30)</sup> 33% of FGG patients experienced bleeding at the donor site 10 days after surgery, while 20% reported pain. Additionally, 33% of donor sites showed signs of paresthesia at the 10-day postoperative mark.

### 5.5 Recipient Site Complication

A common clinical occurrence following FGG procedures is the postoperative shrinkage of the graft. Studies have shown

that shrinkage is more pronounced in the vertical dimension compared to the horizontal, and thinner grafts tend to shrink more than thicker ones. The ideal thickness for FGG was determined to be between 1 and 2 mm.

Mörmann et al.<sup>(31)</sup> observed an average vertical shrinkage of 42.3% in thin FGGs (less than 1 mm thick) over a 12-month period. However, it has been shown that most shrinkage occurs within the first month after surgery, with the amount of keratinized tissue remaining stable in the long term.

Potential complications of free gingival graft (FGG) procedures include excessive bleeding, postoperative bone exposure at the palatal donor site, the development of recurrent herpetic lesions on the palate, inadequate graft stabilization to the underlying tissue, and graft failure. Rare and uncommon complications include mucocele formation on the hard palate, the development of an arteriovenous shunt after donor tissue removal, and spontaneous pigmentation of the palatal donor sites.<sup>(32)</sup>

### 5.6 Subepithelial Connective Tissue Graft

The current gold standard for treating gingival recession is the subepithelial connective tissue graft (CTG) procedure, which provides the best root coverage results in clinical practice. The benefit of a twofold blood supply provided by the CTG in conjunction with a pedicle flap raises the likelihood of graft survival. When compared to the FGG, this approach also offers a better colour match with the surrounding tissues. Additionally, primary closure of the palatal donor site is made possible by the CTG method, which shortens the healing period and lessens patient discomfort. Nevertheless, there are certain difficulties with the CTG technique even though it is very predictable and well-tolerated.<sup>(32,33)</sup> Griffin et al.<sup>(34)</sup> showed that the most frequent issues related to CTG operations happened in the first postoperative phase and.<sup>(35)</sup>

Nonetheless, in the majority of instances, the postoperative problems were classified as mild or moderate in severity. 500 CTG procedures were used to assess the frequency and seriousness of problems by Harris et al.<sup>(35)</sup> Postoperative discomfort (18.6%) was the most frequently reported consequence, followed by swelling (5.4%), bleeding (3.0%), and infection (0.8%). The rate and severity of postoperative complications were tolerable and clinically acceptable overall, according to the authors' conclusion. Postoperative discomfort was reported by 91.6% of respondents after 3 days and 50% of subjects at 3 weeks after CTG treatments, according to research by Wessel and Tatakis.<sup>(26)</sup> During the course of the three-week research, the patients' average visual analogue scale (VAS) pain score dropped from 3.5 to 1.6, indicating minimal levels of pain experienced.<sup>(36)</sup>

### 5.7 Donor Site Complication

The majority of complications following CTG procedures are linked to the palatal donor site and are strongly associated with the graft harvesting technique. Over time, various CTG harvesting methods have been developed to promote primary wound healing and reduce patient discomfort.<sup>(37)</sup>

Most complications following connective tissue graft (CTG) procedures are related to the palatal donor site and are closely tied to the graft harvesting technique. Excessive undermining of the palatal flap can negatively impact wound healing or lead to tissue necrosis due to impaired vascularization.<sup>(36)</sup>

Jahnke et al.<sup>(38)</sup> reported that more than half of the patients who underwent connective tissue graft (CTG) harvesting using the trap door approach experienced necrosis of the palatal flap. Similarly, Zucchelli et al.<sup>(36)</sup> found that within one week of using this technique, 28% of patients suffered from dehiscence or necrosis of the primary palatal flap. This complication led to delayed secondary wound healing and increased the need for analgesics. Therefore, it is important to acknowledge that the trap door technique for graft harvesting may be associated with postoperative discomfort due to sloughing of the palatal flap. Currently, the single-incision technique is regarded as one of the least traumatic methods for harvesting CTG, offering better early wound healing and reduced patient discomfort compared to the trap door approach.<sup>(38)</sup>

Compared to trap door and FGG treatments, Del Pizzo et al.<sup>(27)</sup> showed quicker re-epithelialization of the donor area employing the single-incision approach. In the context of restricted mucosal thickness at the palatal donor site, it has been suggested more recently to extraorally de-epithelialize a FGG in order to obtain a CTG.<sup>(27)</sup>

Moreover, this method enables the secure extraction of CTGs free of glandular and fatty tissue. However, this procedure will leave a palatal wound that may cause pain and discomfort after surgery and heals related to the injury. However, Zucchelli et al.<sup>(36)</sup> found that obtaining FGGs with decreased thickness (<2 mm) and height (4 mm) can lead to lower patient morbidity. Similarly, Burkhardt et al.<sup>(39)</sup> showed that the graft thickness (wound depth) at the palatal donor site was correlated with postoperative pain perception after FGG harvesting.<sup>(39)</sup>

It has been found that the bleeding rate among patients after CTG harvesting varies from 1.2 to 33%. Therefore, in order to avoid harming the larger palatine artery and the ensuing bleeding issues, some anatomical precautions need to be made. The average distance from the gingival edge to the larger palatine artery varied from 12.1 mm in the canine area to 14.7 mm at the second molar level, according to measurements made on plaster models by Monnet-Corti et al.<sup>(40)</sup> The authors deduced from their findings that in all cases, the premolar area permitted the extraction of a CTG with a height of 5 mm.<sup>(40)</sup>

It is important to recognize that a shallow palatal vault or thin mucosal tissue increases the risk of neurovascular injury and bleeding. However, even with careful attention to anatomical considerations, individual variations in the path of the greater palatine artery may still occur. To mitigate the risk of postoperative bleeding, several strategies have been suggested. These include harvesting techniques that enable primary wound closure, the use of different suturing methods, periodontal dressings, palatal stents, and the application of hemostatic agents.<sup>(41)</sup>

- **Potential Complications Associated with the Use of Soft Tissue Graft Substitutes**

Soft tissue graft substitutes, such as acellular dermal matrices and xenogeneic collagen matrices, are considered a safe and effective alternative to autogenous grafts for root coverage procedures. Their main clinical benefits include avoiding donor site surgery and its related complications, offering an unlimited supply of graft material, and shortening surgical time. Unlike autogenous grafts, these substitutes avoid the potential complications related to palatal donor site surgery.<sup>(42)</sup>

Soft tissue graft substitutes can have many advantages, including:

- Improved aesthetics, Reduced sensitivity, Reduced bone loss, shortened surgical time, Tissue regeneration: Soft tissue substitutes can act as scaffolds to stimulate healing and tissue regeneration.

Some disadvantages of soft tissue graft substitutes include:

- Pain and discomfort, Postoperative complications, Decreased vascular supply, Complications with artificial bone graft substitutes<sup>(43)</sup>.

Griffin et al.<sup>(34)</sup>: It has been shown that using an acellular dermal matrix (ADM) graft as a substitute for autogenous soft tissue significantly reduces the risk of postoperative swelling and bleeding following gingival augmentation procedures. The authors credited this reduction in complications to the avoidance of a second surgical site.<sup>(34)</sup>

Aroca et al.<sup>(44)</sup> reported that using a porcine collagen matrix (CM) to treat gingival recession defects resulted in significantly reduced surgical time and lower patient morbidity compared to connective tissue grafts (CTG). Similarly, McGuire and Scheyer, in a randomized controlled split-mouth study, demonstrated that CM offers a viable and long-lasting alternative to CTG for root coverage procedures, without the need for graft harvesting and the associated patient discomfort. While soft tissue substitutes like CM address certain limitations of autogenous grafts and improve patient satisfaction, they are not without complications. The success of these non-vital grafts relies on sufficient revascularization at the recipient site and

effective integration with the surrounding tissue. If the grafts are exposed too early during healing, it can hinder cell repopulation and revascularization, potentially resulting in graft resorption and less predictable root coverage outcomes.

Ensuring that the tissue graft is immobilized within the recipient site and completely covered by the gingival flap during the healing phase is essential. It is also important to recognize that non-vital grafts generally heal more slowly than autogenous grafts. Additionally, a potential complication with soft tissue graft substitutes is the risk of graft shrinkage during healing. Wei et al. compared the clinical efficacy of acellular dermal matrix (ADM) to free gingival grafts (FGGs) in increasing the width of attached gingiva and found that ADM grafts experienced significantly more shrinkage (71%) than autogenous FGGs (16%) over a 6-month period.<sup>(45)</sup>

In another study, Vieira Ede et al.<sup>(46)</sup> reported that ADM grafts exhibited an average shrinkage of 90% three months after a gingival augmentation procedure. While infection is a potential complication, it is relatively rare with soft tissue graft substitutes. Overall, the use of these substitutes in periodontal plastic surgery significantly reduces postoperative complications by eliminating the need for a second surgical site. However, they tend to be more technique-sensitive and less forgiving compared to autogenous grafts.

- **Complications of minimally invasive surgical technique for root coverage**

The modified minimally invasive surgical technique (M-MIST), which also included the idea of space provision for regeneration, further enforced the aspects of wound and blood clot stability and primary wound closure for blood clot protection that were stressed by the minimally invasive surgical technique (MIST).<sup>(47)</sup> However, like any surgical procedure, they are not without potential complications. Here are some common complications associated with minimally invasive techniques for root coverage:

- **Graft Failure**

If the grafted tissue does not integrate well, it can lead to partial or complete failure of the root coverage. Poor vascularization, inadequate stabilization, or tension on the graft are contributing factors.

- **Incomplete root coverage**

While the goal is complete root coverage, sometimes only partial coverage is achieved. This may result from insufficient tension-free adaptation of the tissue or improper handling of the graft.

- **Recession Recurrence**

Even after successful coverage, some patients experience a recurrence of gingival recession, particularly if contributing factors like trauma from brushing, poor oral hygiene, or occlusal issues are not addressed.<sup>(48)</sup>

## 6 CONCLUSIONS

Root coverage procedures play a critical role in aesthetic dentistry that aims to improve the appearance of teeth with exposed roots and thereby enhancing the overall aesthetics. The majority of autogenous soft tissue graft problems usually occur at the donor site and can include bleeding, tissue necrosis, pain, discomfort, and infection. To reduce these concerns, a comprehensive preoperative evaluation of the palatal donor region is essential. Furthermore, smoking and the duration of the surgical operation might have a detrimental effect on wound healing and raise the risk of problems following the procedure. By removing the requirement for a second surgical site, the use of soft tissue replacements in place of autogenous grafts has further reduced complications.

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