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Complications Of Palatal Soft Tissue Harvesting – A Narrative Review

Dr. Varshini.S*[1], Dr. K. Malathi[2], Dr. G. Sandhya[3], Dr. Hima Bindu Reddy. C[4]
[1,3,4]Postgraduate Student, [2]Professor & Head,
Department of Periodontology,
Tamilnadu Government Dental College and Hospital, Chennai

***Corresponding Author:**
Dr. Varshini.S
Postgraduate Student, Department of Periodontology,
Tamilnadu Government Dental College and Hospital, Chennai

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Abstract

The prevalence of mucogingival deformities affecting the natural dentition and dental implants, such as recession and keratinized mucosal deficiency, have been increasing in the recent years. A demand for soft-tissue esthetics and stability demands predictable and less onerous techniques to treat these conditions. Discrete types of grafting materials have been utilized for the correction of mucogingival conditions, of which autogenous grafts are the best option. Autogenous grafts namely free gingival grafts and subepithelial connective tissue grafts harvested from the palate are associated with inherent complications, some of which can be sidestepped with modifications in the protocol and meticulous execution of the procedure. Therefore, a complete understanding of the palatal anatomy, harvesting protocol, and knowledge of all possible complications is indispensable, which is dealt in brief in this narrative review.

Keywords: complications, intraoperative, postoperative, management, graft, soft tissue injury

Introduction

A surgical complication is any undesirable, unintended, and direct result of an operation affecting the patient, which would not have occurred had the operation gone as well as could reasonably be hoped[1]. Any surgical complication irrespective of its severity may negatively impact patient's quality of life and willingness to undergo future surgical procedure.

Mucogingival surgical procedures such as root coverage, soft tissue augmentation around teeth, peri-implant soft tissue dehiscence corrections and peri-implant papillae reconstruction involves the utilization of graft materials. Despite the availability of various graft materials including Acellular dermal or collagen matrices, biologic agents, and living cellular constructs, autogenous grafts remains the superior treatment option for correction of mucogingival deformities[2]. The palate is the standard donor site for harvesting autogenous grafts in the form of either connective tissue grafts or free gingival grafts.

Several treatment protocols have been developed to restrict intra-operative and post-operative complications of palatal soft-tissue harvesting. Right from the harvesting protocol various factors including graft height, residual flap thickness, and intra-operative trauma, influence the post-operative conditions. Understanding the dynamics of palatal soft-tissue, wound healing reduces the patient's discomfort and other complications. This review discusses the complications of palatal harvesting techniques and their management.

Complications After Palatal Harvesting

Depending on the time of occurrence, complications can be intra-operative or post-operative. Table 1 lists the complications of palatal soft-tissue harvesting.

Before discussing the complications of palatal harvesting, a brief review of harvesting approaches and wound healing is presented.

Harvesting Approaches

1. Bjorn in 1963, introduced soft-tissue palatal harvesting to obtain epithelialized free gingival grafts (FGG) which left the donor site to heal by secondary intention[3].
2. To achieve healing by primary intention, Edel in 1974 described a trapdoor technique involving two vertical incisions to retain an epithelial flap at the donor site, thus harvesting a subepithelial connective-tissue graft (SCTG)[4].
3. In 1985, Langer and Langer developed a method that precluded extensive vertical incisions and facilitated connective-tissue extraction by including a small band of epithelium during removal[5].
4. Several modifications to these approaches have been proposed.
5. Hurzeler et al (1999) and Lorenzana et al (2000) further introduced the single-incision technique that employs one horizontal cut to harvest deeper connective tissue with a more consistent thickness[6,7].
6. Connective-tissue grafts can be obtained from scalpel-, bur- or laser assisted de-epithelialization of free gingival grafts; such grafts are mainly composed of lamina propria, contain less fatty and glandular tissue than conventionally harvested connective-tissue grafts.
7. The maxillary tuberosity can be an alternative to the lateral side of the palate as a donor site owing to its comparatively minimal post-operative morbidity. A connective-tissue graft derived from the tuberosity can be harvested via external bevel gingivectomy or distal wedge; and is de-epithelialized.

Palatal Wound Healing

Healing occurs in four partially overlapping phases:

1. Hemostasis,
2. Inflammatory,
3. Granulation,
4. Maturation.

The wound healing by primary intention and secondary intention in SCTG and FGG harvesting techniques respectively, and their distinguishing features are explained in table 2 and represented in figure 1.

Intra-Operative Complications

Greater Palatine Artery Injury:

Injury to the greater palatine artery can result in excessive intra-operative bleeding, a very common complication of palatal harvesting. A thorough knowledge of palatal anatomy is fundamental to avoid severing the greater palatine artery or its branches.

A safety zone for palatal harvesting was proposed by Tavelli et al (2019) based on the average distances from the neurovascular bundle to the gingival margins which ranges about 13.9 ± 1 mm in the second molar region and 9.9 ± 2.9 mm in the canine region[8]. Moreover, the shape of the palatal vault influences the position of the neurovascular bundle. Mean distances from the cementoenamel junction to the bundle are 7 mm, 12 mm, and 17 mm in shallow/flat, average, and high/“U-shaped” vaults, respectively[9].

Recommendations to prevent injury to greater palatine artery are:

1. Respecting the guidelines provided by the literature – limiting the surgical area to safety zone for palatal harvesting,
2. Identifying the greater palatal foramen by palpation,
3. Presurgical assessment of the course of the greater palatine artery using noninvasive technologies, such as ultrasonography, magnetic resonance imaging, and near-infrared vein visualization[2].

Management of injuries to the greater palatine artery:

1. applying pressure on the wound for several minutes,
2. using a local anesthetic with a vasoconstrictor, or
3. electrocauterizing the vessel.
4. If the bleeding persists, deep compression sutures should be placed distal to the palatal donor site[2].

Volume 7, Issue 2; March-April 2024; Page No 01-09

Excessive Bleeding Unrelated To Direct Greater Palatine Artery Injury

Prolonged or excessive bleeding at the donor site may occur in patients with bleeding disorders or using anticoagulants or from certain flap designs. Harvesting a free gingival graft, which is more superficial, evades injury to the deeper palatal vessels, whereas collecting a connective-tissue graft risks damaging the neurovascular bundle, resulting in approximately four times more bleeding[2]. Palate with thin mucosa or shallower vault can cause more leakage.

Hemostasis may be achieved by

1. Packing the palatal wound with wet gauze and applying pressure on the site for a few minutes.
2. Microfibrillar collagen hemostat, oxidized regenerated cellulose and absorbable gelatin sponge can be applied instead of gauze.
3. Hemostatic agents (eg, aluminum chloride, ferric sulfate), local anesthetic with epinephrine, or acrylic palatal stent can be used.
4. Cyanoacrylate tissue glue (hemostatic, bacteriostatic, and tissue-compatible properties).

Primary Flap Laceration

Inadvertent flap laceration may occur during subepithelial connective-tissue graft harvesting. Lacerated or excessively thin primary palatal flaps increase post-operative pain and risk of sloughing or necrosis. To prevent complications, a thickness of at least 3 mm palatal fibromucosa (1 mm of the overlying palatal flap and 1-2 mm for the graft) is needed when subepithelial connective-tissue graft harvesting approaches are performed. In thin palatal donor sites, de-epithelialization of free gingival grafts may be the most conservative way to collect connective tissue.

Minor flap lacerations may not affect the healing of the palatal wound and do not require additional treatments. A major flap laceration compromises primary intention healing. Applying a hemostatic collagen sponge underneath the tear flap is advocated to prevent bone exposure in the case that the flap undergoes necrosis.

Inadequate Graft Dimension

A connective-tissue graft thickness of approximately 1 mm is needed for root coverage procedures and to decrease post-operative pain. Transgingival probing or ultrasonography can be used to measure the thickness of the palate, thereby determining the best location and flap design for harvesting.

Free gingival graft harvesting is preferred when thin palatal mucosa (less than 3 mm) is present to prevent primary palatal flap over-thinning or obtaining a suboptimal connective-tissue graft. When an inadequate graft is obtained, additional autogenous graft from the maxillary tuberosity or the contralateral palate can be harvested; apart from this, use of acellular dermal or collagen matrix is also recommended.

Inadequate Graft Quality

Although clinical differences arising from the composition of graft have not been confirmed, a firmer and more stable tissue graft, which is abundant in fibrous connective tissue is easier to manipulate than a graft rich in fatty or glandular tissue. Improved handling properties dictate better outcomes of the surgical procedure.

The harvesting technique affects connective tissue graft composition. A connective-tissue graft derived from de-epithelialization of a free gingival graft is mainly composed of lamina propria, whereas conventionally harvested connective-tissue graft incorporates submucosa with abundant glandular and adipose structures.

Azar et al in a histologic human study noted that connective tissue derived from free gingival grafts is primarily composed of dense connective tissue (89%), along with minimal adipose tissue (1%), vascular tissue (3%), and epithelial remnants (6%), whereas conventional subepithelial connective-tissue grafts contain 59% dense connective tissue, 32% adipose tissue, and 8% vascular tissue[10]. Taking this into consideration, the maxillary tuberosity may represent a valid alternative to the lateral palate, as it is mainly composed of lamina propria with a minimal submucosa. The limited tuberosity width can be compensated for by creating accordion graft slits that allow the tissue to be expanded to cover multiple sites. However, maxillary tuberosity grafts have unique characteristics and tend to become hyperplastic; hence better suited for soft-tissue volume augmentation or papilla reconstruction rather than for recession coverage.

Volume 7, Issue 2; March-April 2024; Page No 01-09

Post-Operative Complications

Pain

Pain is defined as "An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" [11]. It is the most common post-operative complication following palatal harvesting.

Causes of post-operative pain:

1. Smoking
2. Palatal thickness <4 mm
3. Graft thickness >2 mm
4. Increased apico-coronal graft height
5. Reduced residual palatal thickness
6. Accidental trauma to a donor site healing by secondary intention during the first few days[2].

A thin palatal flap may induce dehiscence or necrosis during the healing period, thereby increasing morbidity following subepithelial connective-tissue graft harvesting. A residual palatal flap thickness of at least 1 mm has to be preserved, when possible, for reducing patient discomfort and enhancing the healing.

Subepithelial connective-tissue harvesting techniques where donor site heals by primary intention, have been associated with less discomfort than free gingival graft harvesting. Free gingival graft harvested site protected using platelet-rich fibrin seems to improve wound healing and patient comfort. Zucchelli et al in a comparative study substantiated no difference in pain reported after trap-door CTG and FGG harvesting when the donor site is protected with an absorbable collagen matrix in FGG technique[12].

Recommendations for minimizing postsurgical donor-site pain:

1. Reducing the size of the graft
2. Applying protective materials such as stent, retainers, periodontal dressing on the donor site
3. Hemostatic agents including collagen matrix, gelatin sponge, cyanoacrylate
4. Using wound-healing enhancers namely platelet-rich fibrin, autogenous fibrin glue, platelet rich plasma, laser photobiomodulation, ozone therapy and hyaluronic acid gel
5. Prescribing analgesics[2].

Amin et al in a split mouth study advocated that harvesting from the maxillary tuberosity was associated with significantly less morbidity compared with the lateral palate[13].

Prolonged Post-Operative Bleeding

Post-operative donor-site bleeding commonly ensues from

1. inadequate closure of the primary palatal flap,
2. mismanagement of the de-epithelialized mucosa,
3. nonachievement of complete hemostasis immediately following surgery,
4. accidental postsurgical trauma,
5. bleeding disorders, or anticoagulant use[2].

Griffin et al described a threefold higher incidence of post-operative bleeding in the free gingival graft group than in the subepithelial connective tissue cohort[14].

Recommendations to prevent post-operative hemorrhage:

1. Complete hemostasis of the donor site must be ensured immediately following surgery,
2. Use of protective materials along with hemostatic agents,
3. Detailed oral and written post-operative instructions to be followed during the 2-3 weeks following surgery:
   a) adherence to a soft food diet,
   b) avoidance of excessive physical exertion, brushing, flossing, or other trauma adjacent to the surgical sites,
   c) vigorous mouth rinsing,
   d) smoking,
   e) negative pressure (suction or expectoration) [2].

Flap Sloughing Or Necrosis

Flap sloughing or necrosis is one of the causes of post-surgical pain. Sloughing or necrosis of the primary flap following subepithelial connective-tissue graft harvesting, most often presents centrally, and is influenced by the harvesting approach.

Weinberg et al (2020) in an animal study, speculated that healing of the palate follows a "**zipper" pattern**, where one zipper is closing the wound from the anterior portion and the other from the posterior[15]. Keskiner et al (2016) in a human study confirmed that the periphery of the palatal wounds filled earlier

Volume 7, Issue 2; March-April 2024; Page No 01-09

and to a greater extent than the central region of the wounds[16].

Palatal flap dehiscence can occur with or without necrosis. A thin primary flap may increase the risk of flap dehiscence or necrosis, as they lack intact vascular structures, reduced perfusion, and may be perforated during surgical handling.

Bone exposure is more likely to occur at exostoses, particularly when a deep connective-tissue graft has been harvested and a thin primary palatal flap is present. An additional intervention to remove sharp bone ledges may be necessary to prevent flap necrosis.

With the current use of minimally invasive surgical approaches, such as microsurgery and flap designs that preserve blood supply and ease tissue manipulation, the incidence of flap sloughing is relatively lower compared to articles published before 2010.

Recommendation for preventing flap sloughing or necrosis:

- Performing a single-incision harvesting approach ensuring a minimal palatal thickness of 1 mm,
- The use of the free gingival graft harvesting technique in the presence of thin palatal mucosa[2].

In the presence of flap sloughing, additional analgesics and chlorhexidine rinsing are suggested.

Infection

Post-operative infection is a rare following periodontal surgery. Harris et al reported a 0.8% incidence of donor-site infection following subepithelial connective-tissue grafting, where the infection was at the palatal wound sutures[17]. The treatment of post-operative infections includes oral or topical antibiotics, chlorhexidine rinsing, and wound irrigation with saline.

Ulcers from herpetic reactivation can develop on the palate following tissue harvesting and may relate to surgical stress or the administration of local anesthetic. Such lesions may be initially painful but are self-limiting in 7-14 days. It is prudent to prescribe a prophylactic antiviral medication (such as acyclovir) to patients who have persistent herpetic recurrence.

Sensory Dysfunction

Patients may experience temporary sensory dysfunction following palatal harvesting, as free nerve endings might be severed intra-operatively. According to Del Pizzo et al, sensory disorders were present in all patients 2 weeks after free gingival graft harvesting; all patients regained normal sensation after 8 weeks[18]. There are no differences between harvesting methods (free gingival, trapdoor connective tissue, or single-incision connective tissue) with respect to sensory dysfunction incidence.

Epithelial Cyst Formation

Though rare, epithelial cyst development after subepithelial or de-epithelialized connective-tissue grafting has been documented, occurring several months after the surgical procedure. Epithelial cysts appear as an esthetically unpleasant bump at the grafted site; fluid discharge from a punctured cyst can be bothering the patient[2].

Gordon et al speculated that invagination of epithelial tissue between the graft and recipient bed via surgical introduction or auto-marsupialization—following free gingival grafting could result in cyst formation[19]. Residual epithelium left on a connective-tissue graft, especially one derived from free gingival graft de-epithelialization, may seed a cyst.

Despite high levels of epithelial remnants in connective-tissue grafts, up to 80- 100% in biopsied samples, cysts does not commonly occur. Few case reports that described the occurrence of epithelial cysts, have stated that gingivoplasty seems to be effective in removing the bulkiness of the soft tissue and in preventing its recurrence.

Factors Influencing Palatal Wound Healing

As with any wound healing, local factors such as oxygenation, venous sufficiency, infection, foreign bodies, and systemic factors including increased age, nutritional deficiencies, obesity, alcohol use, smoking, diabetes, stress can modify palatal wound healing[20].

1. Oxygenation is essential for cell metabolism and wound healing, promotes angiogenesis, stimulates keratinocytes and fibroblasts, and contracts wounds.

Volume 7, Issue 2; March-April 2024; Page No 01-09

2. Hypoxia, ischemia, and venous stasis disease impair healing.
3. Infection or the presence of foreign bodies prolongs the inflammatory phase, delaying wound repair.
4. Silva et al demonstrated that patients who smoke display wounds that undergo delayed epithelialization.
5. Diabetes generates advanced glycation end products, which slow cell turnover, decrease circulation, and alter inflammatory cell function.
6. Psychologic factors, such as stress and depression, may also negatively affect palatal mucosal healing.

Palatal Wound Healing Enhancers

1. Certain biologic agents such as epithelial growth factor, enamel matrix derivative, and synthetic proline-rich peptide have been suggested to accelerate palatal wound healing by stimulating particular cells, cytokines or genes and by suppressing inflammatory response.
2. Topical erythropoietin, hyaluronic acid and platelet-rich fibrin have reported faster re-epithelialization in clinical studies.
3. Platelet-rich fibrin elicits the continuous release of platelets, leukocytes and growth factors critical to palatal wound healing. One randomized controlled trial suggested that platelet-rich fibrin may improve feeding habits (ability to eat hard or warm foods) during the 2 weeks following free gingival graft harvesting.
4. Photobiomodulation, the biostimulation of tissue with low level laser irradiation may accelerate wound healing by stimulating fibroblasts, reducing production of reactive oxygen species, facilitating angiogenesis, promoting provisional matrix formation and boost endogenous growth factor expression and release.
5. Low-level microcurrent electrotherapy may expedite palatal wound healing after free gingival graft harvesting via fueling cell migration and proliferation and modulating growth factor release.

However, no treatment protocol obtained complete re-epithelialization after 1 week. Regardless of the treatment performed, complete re-epithelialization of the wound was observed in nearly all cases after 4 weeks. Therefore, Tavelli et al insisted on further studies to recommend the use of potential modifiers considering the magnitude of effect and cost/benefit ratio of these adjunctives.

Decision-Making On Choice Of Donor-Site Location And Technique For Soft-Tissue Harvesting Based On Risk For Complications

Table 3 describes the severity of risk of complications with different palatal harvesting techniques.

Conclusion

Autogenous grafts are routinely performed for periodontal and peri-implant soft-tissue reconstruction. Although certain complications of the surgical procedure are inexorable, adherence to recommended guidelines can alleviate the severity of such complications. “An ounce of prevention is better than a pound of cure”. In the light of innumerable modifications in the harvesting protocol and prerequisites of these techniques, the use of the free gingival graft harvesting technique from the palate or tuberosity with appropriate donor-site management is preferred over the conventional subepithelial connective-tissue graft approach in several clinical scenarios.

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Volume 7, Issue 2; March-April 2024; Page No 01-09

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Table 1 - Complications of palatal soft-tissue harvesting.

Intra-operative complications	
Incisions	• Greater palatine artery injury • Bleeding
Flap preparation	• Greater palatine artery injury • Flap laceration
Graft harvesting	Inadequate graft quantity or quality
Hemostasis	Bleeding
Post-operative complications	
Early	• Bleeding • Flap sloughing or necrosis

Volume 7, Issue 2; March-April 2024; Page No 01-09

	• Bone exposure • Infection • Change of feeding habits • Sensory disorders
Late	• Persistent sensory dysfunction • Epithelial cyst formation

Table 2 – differences between healing following SCTG and FGG techniques

Primary intention healing	Secondary intention healing
During the first 24 hours, inflammatory cells, mainly neutrophils and monocytes, are recruited to populate the clot; they function to cleanse the wound from bacteria and necrotic tissue.	
The process of epithelialization is initiated within a few hours, starting from the basal layer.	Inflammatory phase is more enhanced. Granulation tissue formation is initiated.
Macrophages migrate into the wound area and secrete several growth factors and cytokines that stimulate the other cells, particularly fibroblasts.	
Platelets, neutrophils, and red blood cells aggregate to form a provisional fibrin clot. Epithelial cells migrating from the basal layer through the fibrin clot seal the laceration within 24-48 hours	Granulation will represent the main bulk for the proliferation of epithelia.
Within 5 days, a new multilayered oral mucosa is formed.	Inflammatory infiltrate is still present; cells from the basal layer of the epithelium actively migrate to close the wound.
Tissue maturation and remodeling with reduction in blood vessels and cell population and alternating of extracellular matrix synthesis and degradation	Myofibroblasts play a key role in wound contraction, facilitating the complete epithelialization of the wound, usually observed after the third week.
Complete healing of the wound in about 4 to 6 weeks.	

Table 3 - Decision making on palatal harvesting technique. Adapted from Tavelli et al (2022) [2].

	Subepithelial connective tissue graft harvesting	**Free gingival graft harvesting**	**Maxillary tuberosity soft-tissue graft harvesting**
Greater palatine artery injury	high	moderate	low

Volume 7, Issue 2; March-April 2024; Page No 01-09

Excessive bleeding	high	moderate	low
Inadequate graft quantity	moderate	low	high
Inadequate graft quality	high	low	low
Prolonged post-operative bleeding	low	high	moderate
Pain and discomfort	moderate	moderate	low

Figure 1- Wound healing events after subepithelial connective-tissue graft (SCTG) harvesting using the single-incision or free gingival graft (FGG) technique. Courtesy: Tavelli et al (2022) [2].

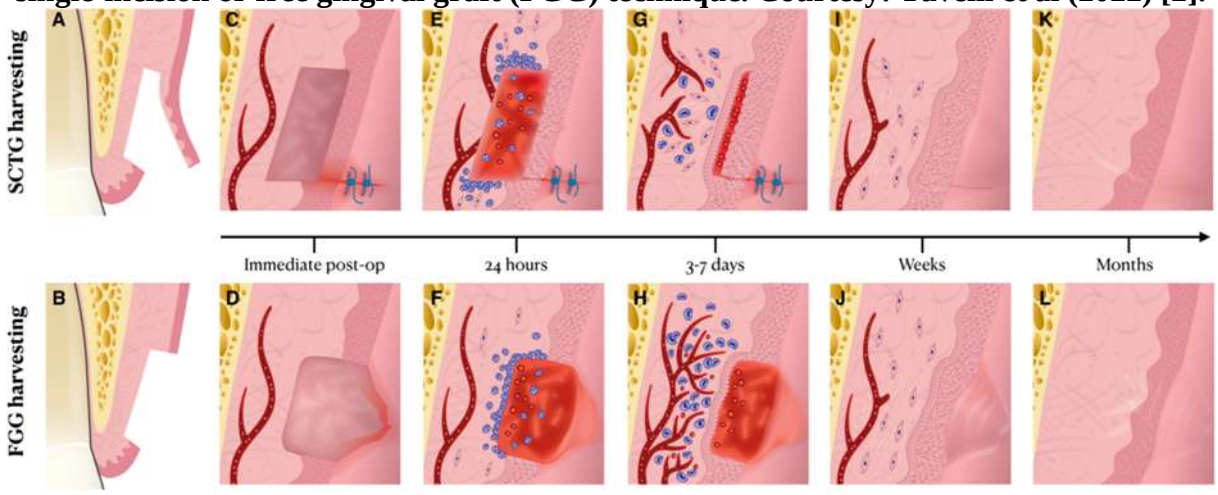
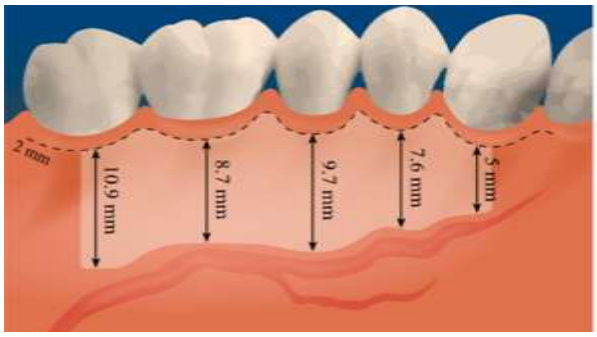


Figure 2 – Safety zone for palatal harvesting; Courtesy: Tavelli et al (2019)[8]



Volume 7, Issue 2; March-April 2024; Page No 01-09