



# Techniques of Harvesting Connective Tissue Graft for Regenerative purpose: A review

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## Abstract:

Connective tissue graft (CTG) is considered the gold standard for soft tissue augmentation procedures, but it requires a secondary donor area and its associated complications. The palatal masticatory mucosa is widely used as a connective tissue donor site in periodontal plastic surgery. Over the last few years, the SCTG has been used for various treatment options for gingival recession coverage, existing or impending ridge deficiencies, management of periimplant tissue anomalies, and treatment of furcation involvement and papillary loss. The objective of the present article is to review the number of modifications in the harvesting methods since the time it was introduced by Edel in 1974.

**Key words:** Periodontitis, Sub epithelial Connective tissue graft, Root coverage, Soft tissue augmentation, Donor site anatomy, Harvesting methods.

## Introduction:

Periodontal plastic surgery encompass several surgical techniques for the management of soft tissue deformities. They include treatment of insufficient clinical crown length, asymmetric gingival margins, improper gingival margin relationship, localized alveolar ridge deficiencies, gingival melanin pigmentation, exposure of unerupted teeth and localized marginal tissue recession. Among these, gingival recession is a long-notable condition that has been addressed and variant techniques have been put forward for its management. The primary objective in managing gingival recession is dealt with root surface sensitivity, root caries, marginal tissue irritation, esthetic concerns.

The connective tissue graft is a common and popular procedure for root coverage which favours esthetics and improves the outcome. Edel was the first to address these concerns by obtaining subepithelial connective tissue graft (SCTG) for

the augmentation of keratinized gingiva. Later Langer and Calagna proposed SCTG procedure for augmentation of soft tissue and the combination of SCTG with pedicle graft for root coverage was developed by Langer and Langer. Various updates in incision techniques and equipments have resulted improvements in harvesting CTG with procurement of the largest volume of tissue possible while minimizing associated trauma, postoperative pain, and the risk of complications at the same time. To meet these requirements and overcome the challenges, various modifications of CTG harvest have been proposed till date. Broadly, they can be subdivided into techniques with or without vertical incisions and techniques that provide CTGs with or without a remaining collar of keratinized epithelium, with the first incision being partial thickness or full thickness. Major advantages of the SCTG are that it is inexpensive, versatile, and easily available; it provides successful outcomes.

### Benefits of CTG

- 1) The graft has a dual blood supply.
- 2) The CTG provides better color matching.
- 3) The donor site heals with primary intention.
- 4) The CTG has greater predictability.
- 5) The CTG is a versatile procedure. It has multiple applications, ranging from extensive soft tissue ridge augmentation to procedures as small as papilla reconstruction and management of peri-implant tissues.

### Indications for CTG

- 1) Management of soft tissue recession around teeth and implants
- 2) Increasing the zone of keratinized gingiva
- 4) Preservation of the ridge with the implant and fixed partial dentures procedure

- 5) Augmentation of gingival thickness following or before orthodontic therapy
- 6) Augmentation of gingival thickness following or prior to restorative therapy
- 7) Reconstruction of soft tissue and coverage of maxillary defects
- 8) Surgical reconstruction of interdental papilla
- 9) Management of peri-implant tissues
- 10) Closure of defects following an apicoectomy
- 11) Intraosseous subperiosteal connective tissue graft for reduction of pockets and management of furcations as combined procedures
- 12) Correction of localized gingival pigmentation
- 13) Masking of discoloured roots or visible implant components

### Limitations for harvesting CTG

Excessively glandular or fatty palatal submucosa

Inadequate thickness of donor site.

Insufficient height of interdental bone and soft tissue.

Harvesting the graft is contraindicated in the presence of a narrow palatal vault, or bony exostosis.

Existence of a second surgical site increase patient morbidity.

### Why palate is the routinely used donor site?

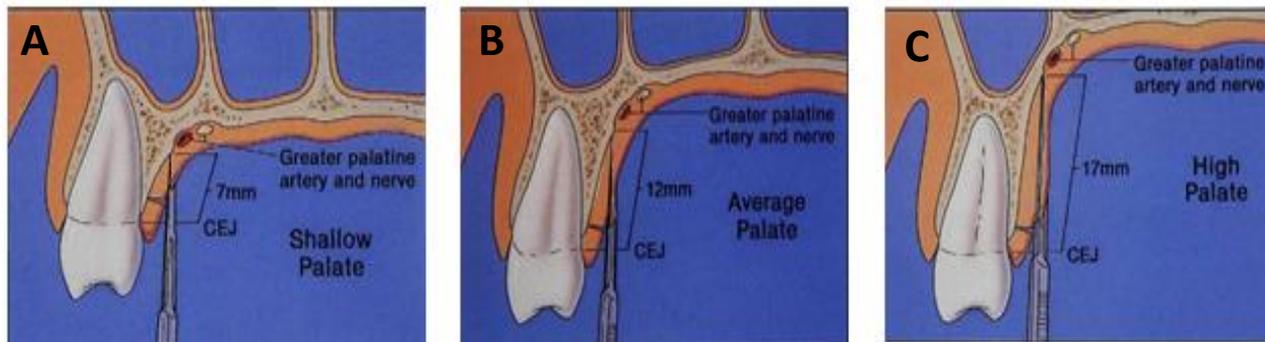
CTG can be procured from the edentulous ridges, maxillary tuberosity, and palate, with palate being the most frequently used donor site due to the obtainment of large dimensions of tissue. Overall the presence of histological similarity between the palatal mucosa and keratinized attached mucosa of alveolar ridge makes the palate the most predictable site for harvesting CTG.

### Surgical and Anatomical Considerations of Palate

- The hard palate is comprises the horizontal process of the palatal bone and the palatine process of the maxillary bone covered by masticatory mucosa.
- The extension of soft tissue arises above from the cemento-enamel junction (CEJ) of upper posterior teeth. Dense lamina propria is of 2 to 4 mm. At the midline, glandular and adipose tissue present in connective tissue.
- Thickest tissue is present in the area from the line angle of the mesial side of the palatal root of the first molar to the distal side of the canine.
- Greater and lesser palatine nerves and blood vessels pass via greater and lesser palatine foramina into the palate. These nerves and vessels course anteriorly within a bony groove. The groove is easiest to palpate at its most posterior extent.

Variations in the anatomy (size and shape) of the palate may affect the proportion of graft harvested, and also the position of the greater palatine nerve and vessel must be known before planning for palatal surgery. The entry of greater and lesser palatine nerves and vessels on the palate occurs through their respective palatine foramina and they course anteriorly within a bony groove. The groove depicts the maximum apical (superior) placement of the incision that is possible before violating the neurovascular bundle.

Depending on the distance between neurovascular bundle and cemento-enamel junction, Reiser *et al.* classified palatal vault into shallow (flat), average, and high (U shaped).

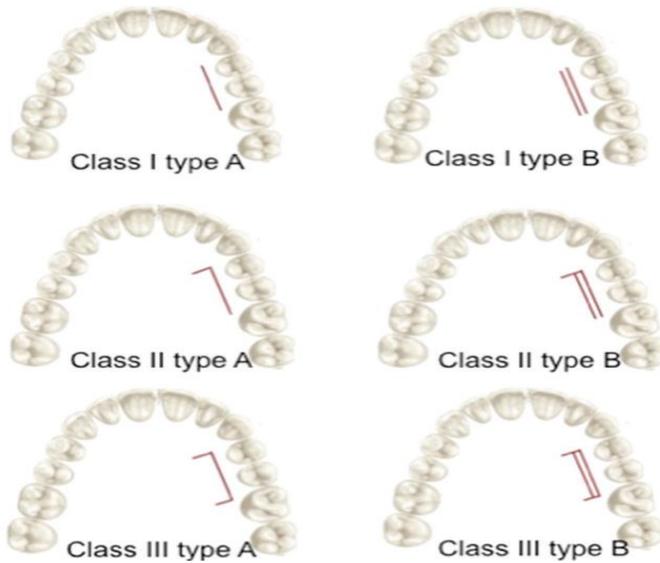


The distance from CEJ to neurovascular bundle A) shallow (flat) (7 mm), B) average (12 mm), and C) high (U shaped) (17 mm).

The shallower the palatal vault, the closer the palatine artery gets to the palatal gingival margin. Care must be taken not to violate the neurovascular bundle when obtaining the donor tissue, particularly when the palate is shallow. Incisions should be restricted to the distal surface of canine to avoid greater palatine nerve and artery as they descent closer to the cemento-enamel junction in the anterior area and persist approximately 2 mm from the margin of the gingiva.

### Classification of incision design

Liu and Weisgold proposed a categorization of design of incisions on the palatal donor site depending on the anatomy of palatal vault (shallow/average/high), size of graft required, existence of exostosis, postsurgical discomfort, wound healing (primary/secondary intention), blood supply, requirement of sutures/stents/hemostatic agents, and visibility to decide the most appropriate incision design for graft harvest. The classification includes



**Factors to be considered for Palatal incision**  
 The graft size required by the recipient site.  
 The anatomy of the palatal vault  
 The possibility of an exostosis  
 Wound healing from the donor site  
 Blood supply for the overlying flap  
 Postoperative discomfort  
 Whether sutures, stents, or hemostatic agents are required  
 Visibility of the procedure

Class I: One incision line      Class II: Two incision lines (L shape)      Class III: Three incision lines (U shape).  
 Subclassification includes (horizontal incision):  
 Type A: One horizontal incision      Type B: Two horizontal incisions.

The palatal portion opposite to the molars is selected for harvesting the graft. A primary incision is given near gingival margin to the long axis of the teeth. For harvesting graft, 1 horizontal and 2 vertical incisions given. The incision under the surface of an edentulous region can also be used for harvesting the graft.



Advantage:

Need for similar graft size and incision design, to increase visibility, easy to execute.

Complete wound closure is obtained, more visibility and accessibility, healing by primary intention as compared to FGG.

Disadvantage:

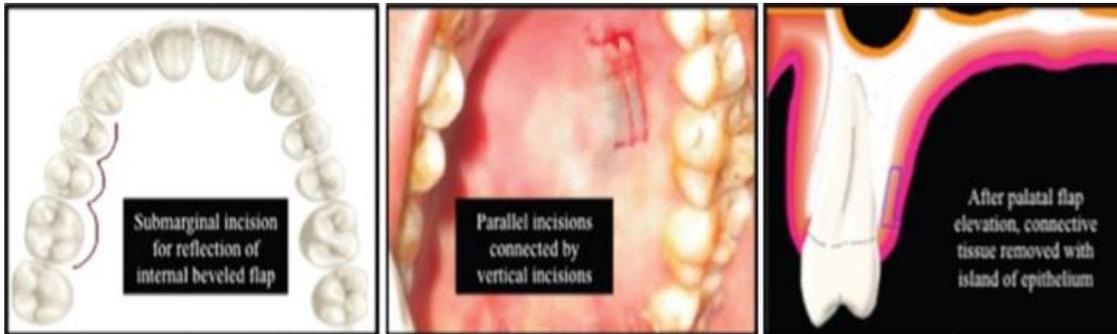
It was common to observe flap necrosis, prolonged pain and discomfort. Vertical

incisions may compromise blood supply and lead to sloughing; more number of incisions

require more number of sutures.

### ***Langer and Calagna- Internal bevel flap and parallel incision technique 1980***

A horizontal incision is given on palate 1mm apical to gingival margin of posterior teeth followed by vertical incision at either end for SCTG harvesting. If there is a presence of periodontal pocket elimination, an internal bevel incision given for pocket removal. From the excised pocket wall, connective tissue and epithelium are recovered. The band of the epithelium in the harvested tissue is discarded, while connective tissue is retained.



Advantages:

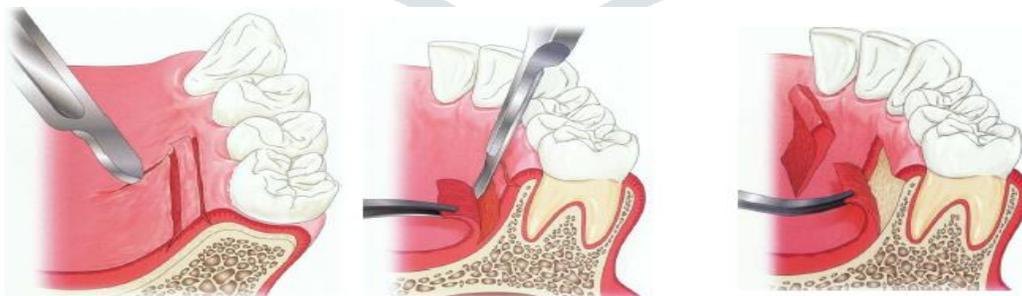
It helps in augmentation of concavities and irregularities in edentulous ridges for cosmetic purpose

Disadvantages:

1. Height and contour of pontics of the temporary prosthesis must be altered after surgical procedure.
2. For the esthetic purpose, gingivoplasty may be essential to decrease irregularity.

### ***Langer and Langer -Parallel incision technique 1985***

Two horizontal and two vertical incisions are given, a rectangular design which results in an SCTG with an epithelial collar of 1.5-2.0 mm in width.



Advantage:

Donor site heals with less discomfort  
Not require a periodontal pack  
The gain in root coverage 2-6mm

Disadvantage:

This technique performed in patients with an excellent level of plaque control.

***Raetzke - Envelope technique 1985***

Method of choice for single/ localized recession defect

This technique employs no vertical incisions but 2 converging horizontal, crescent-shaped incisions intersect deeply in the palate.

A wedge of tissue is removed and the small band of epithelium is excised.

**Advantage:**

The gain of keratinized gingiva

Donor site heals with less discomfort

**Disadvantage:**

Healing is not achieved through primary closure of the wound.

This technique provides a better healing wound than the trapdoor technique but makes it difficult to obtain CT grafts of ample size to solve large defects.

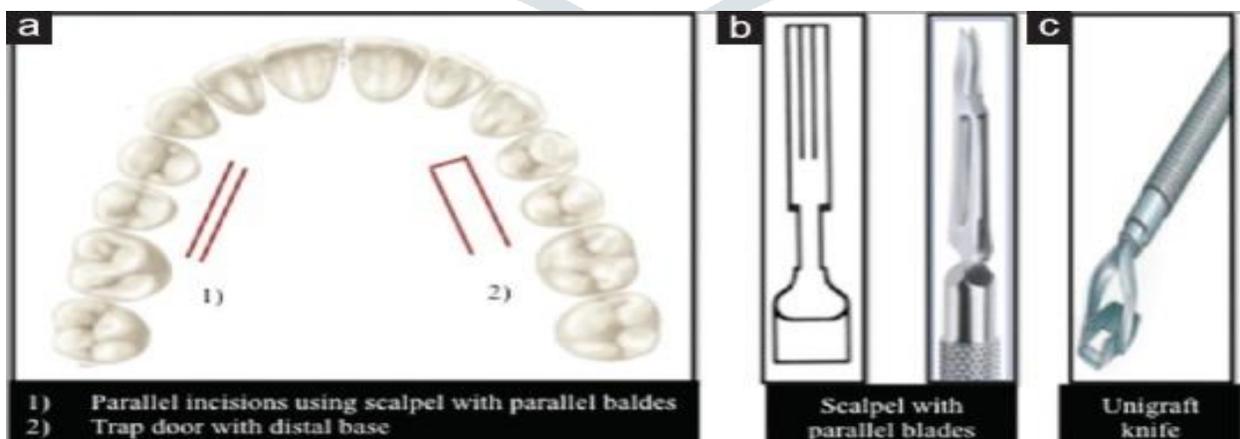
Complete primary closure of the wound cannot predictably be obtained.

***Harris- Graft knife technique/Harris double-blade technique 1992***

This modification of the original trapdoor technique was done to raise partial-thickness flap by use of graft knife.

The knife is placed at the distal portion of connective tissue and then pulled mesially under the trapdoor flap, to elevate a connective tissue.

The technique can be simplified by utilizing a Harris double-bladed graft knife in which two blades are mounted 1.5 mm apart.



**Advantage:**

It provides a graft of predictable and uniform width.

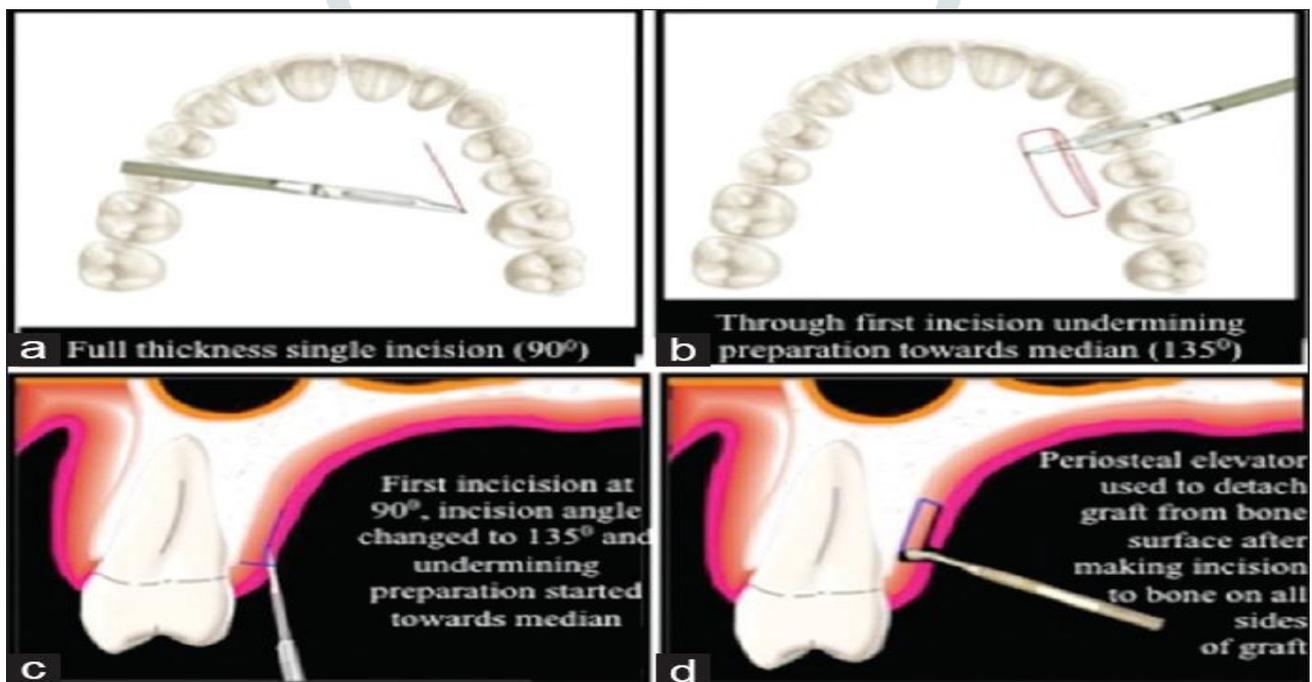
**Disadvantage:**

It is, however, difficult to perform in one single stroke following the palatal vault curvature, and some connective tissue is lost while removing the epithelium.

CTG with parts of the epithelium leaves an uncovered part of the donor area that has to heal by secondary intention. This is because of the rigidity of the palatal masticatory mucosa, which does not allow for a complete closure of the donor site.

***Hürzeler and Weng- single incision technique 1999***

First single-incision technique; healing by primary intention; no vertical incisions, so no compromised blood supply; reduced number of sutures; technique is applicable for different anatomic situations of the palatal vault

**Advantages:**

- Optimal vascularization of the cover flap
- A small number of the suture is required
- Painless wound healing
- Possibility of obtaining grafts of variable dimension
- Postoperative healing is better.
- Patient morbidity is decreased.

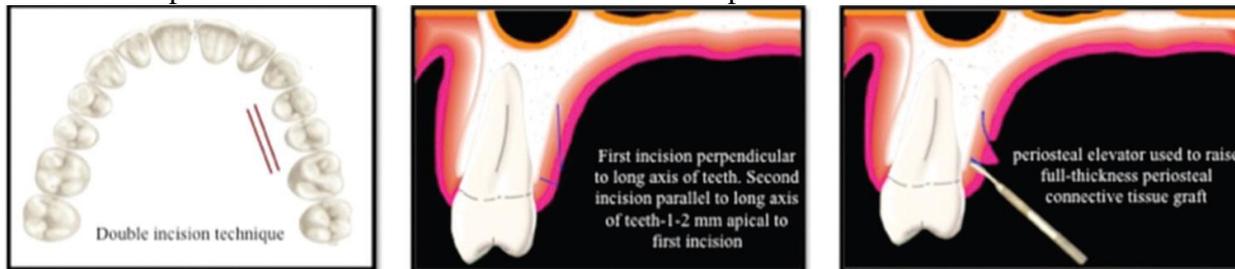
**Disadvantages:**

- Reduced visibility due to single incision.
- As the first incision is directed to bone, bleeding can jeopardize accessibility and visibility.

### **Bruno - Double-incision technique 1994**

The first incision is given 2-3 mm below the gingival margin of upper teeth, falling just short of bone. The second incision is given 1-2 mm below to 1st incision and made angulation parallel to the long axis of the teeth.

A small size periosteal elevator was used to raise a mucoperiosteal SCTG.



#### **Advantages:**

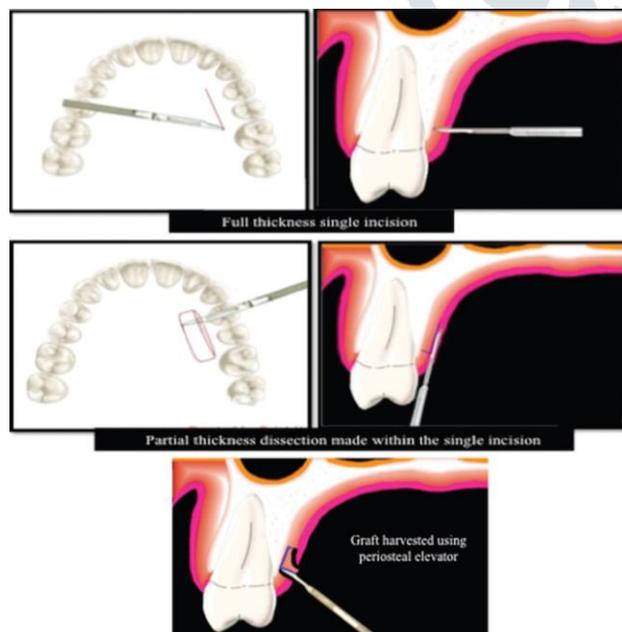
Prevents lifting of the mucosal flap  
Minimizes post-operative complications  
Promotes rapid healing

#### **Disadvantages:**

Avoiding the use of vertical incision increases the difficulty of procedure

### **Lorenzana and Allen- single incision technique 2000**

One horizontal incision was made perpendicular to the bone around 2–3 mm apical to the gingival margin on the palate depending on the desired graft size. Through this incision, a split-thickness flap was then elevated by incising parallel to long axis of teeth. Thereafter, connective tissue along with periosteum was raised using a small Molt or Buser elevator (Hu-Friedy). Careful manipulation of the graft with Corn suture pliers (Hu-Friedy) or other delicate tissue forceps may be required, but compression or tearing of the graft should be avoided. Palatal wound was sutured.



#### **Advantages:**

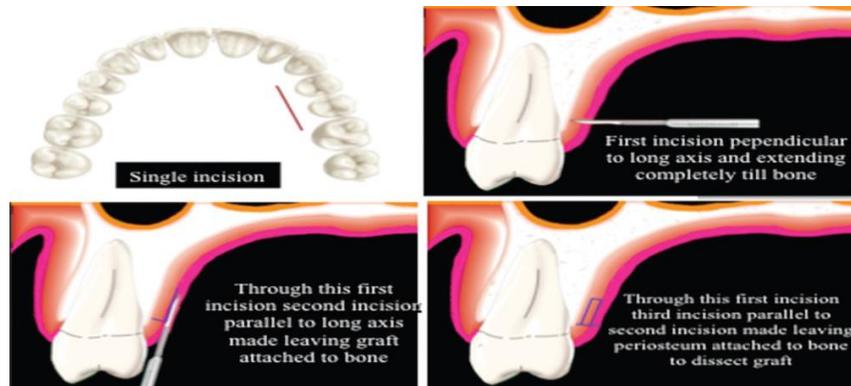
Healing by primary intention;  
large amounts of graft can be obtained with rapid healing and minimal discomfort to patient.

#### **Disadvantages:**

Since no vertical incisions are used, adequate extension of the first horizontal incision is necessary to obtain the desired graft dimensions; reduced visibility

***Del Pizzo et al- Single incision technique in 2002***

This technique is similar to Lorenzana and Allen. In this, after reflecting split-thickness flap, when the connective tissue is adhered to the bone, a deep sharp dissection through first incision, but parallel to second incision, was made to dissect the graft from the underlying bone. Periosteum was not removed along with connective tissue as it aids in granulation tissue formation and hastens wound healing.

**Advantages:**

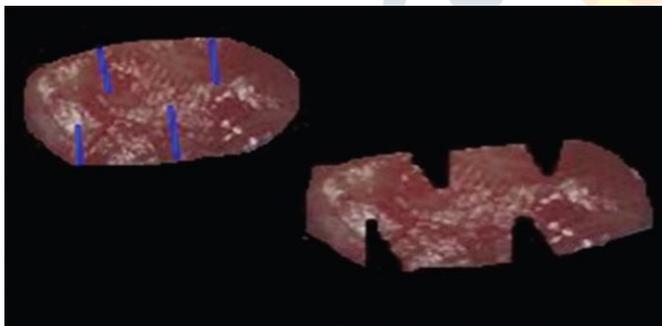
Faster epithelization, achieved at 3 weeks postoperatively  
Complete sensibility was recovered

**Disadvantages:**

Postoperative discomfort due to the palatal wound  
Reduced visibility due to reduced number of incision.

***Cetiner et al - expanded mesh CTG technique in 2004***

The main aim of this technique is to solve the drawback of limited supply and avoid another/extensive surgery for obtaining larger graft. Trapdoor technique was used to procure CTG. After harvesting the graft, alternating incisions were given to enlarge the mesh graft up to 1.5 times greater than the one obtained

**Advantages:**

Treatment of multiple recession defects with limited donor tissue in one surgery.

**Disadvantage:**

Thick graft is necessary and obtaining an intact and thick graft is not always possible could result in perforation/separation of graft

***Bosco and Bosco - CTG from thin palate in 2007***

Partial-thickness flap was reflected from edges, 1.5-mm incision given by keeping the periosteum intact. A thick connective tissue graft is harvested which consists of connective tissue with epithelium. The graft is placed on sterile cloth and bisected. One half consists of the epithelium with connective tissue, while the other consists only of connective tissue. The epithelial graft is repositioned at donor site like a free gingival graft and periodontal dressing is placed.

**Advantages:**

It demonstrates the viability and safety of obtaining large graft in patients with thin palatal mucosa.

Avoids injury to palatal vessels;

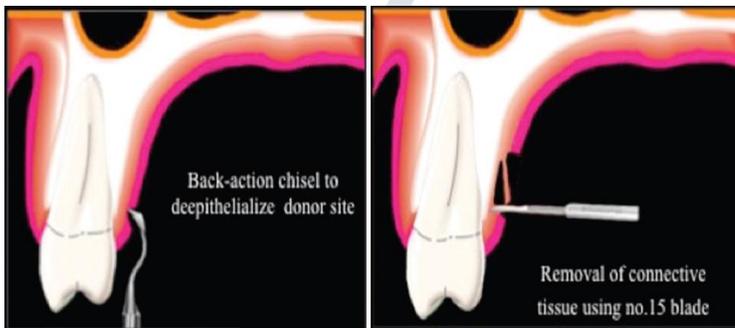
Allows harvesting of graft with minimal amount of adipose and glandular tissue of submucosa.

**Disadvantage:**

Technique sensitive procedure.

**McLeod et al. 2009**

A sharp back-action chisel helps in deep epithelialization of palatal site from the mesial side of canine to distal side of 1st molar. After deep epithelialization, the SCTG is harvested with a surgical blade in the manner used to harvest a conventional free gingival graft.

**Advantage:**

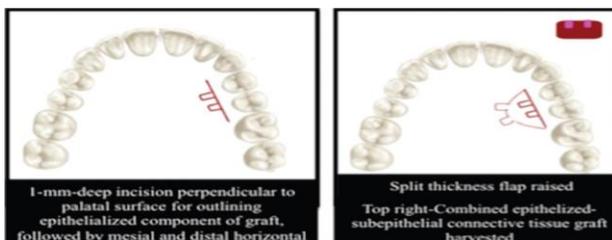
Procurement of thin uniform and abundant CT graft from the palate

**Disadvantage:**

As the harvesting approaches the palatal midline, care should be taken because the mucosal tissue in the midline is thinner, and the collateral blood vessels in the area may lead to profuse bleeding; healing by secondary intention

**Stimmelmayer et al. epithelized-subepithelial connective tissue graft in 2011**

A similar technique to be used in tunnel technique of recession coverage. Template of desired graft size was measured and transferred to the palate. For outlining the epithelialized component of the graft, a 1-mm deep incision flap toward the midline was done, and the exposed graft was outlined with incision directed toward the bone. After that, a partial-thickness flap parallel to the palatal bone was raised to harvest the graft without periosteum.

**Advantage:**

Possible reduction of graft necrosis over the root surface because of the epithelial layer on the exposed portion of the graft; it appears to protect the underlying connective tissue over the exposed root surface

**Disadvantage:**

Increased donor site morbidity due to healing by secondary intention in open wound area

**Ramakrishnan et al 2011 epithelial embossed CTG" for root coverage**

Template of required graft size was placed on the donor site. Incision was made around the template and also extended 3 mm close to the gingival margin on either side. Thereafter, epithelium was undermined 3 mm from the incision made around template on all the sides. Releasing incision was given to separate the connective tissue of the surrounding 3 mm. Then, the graft was harvested which had connective tissue on all the sides, and the center region was embossed with epithelium that matched the defect exactly.

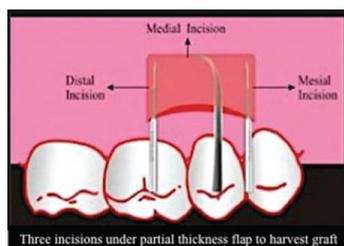


**Advantage:**  
Retained embossed epithelium on the coronal border of the subepithelial connective tissue graft which exactly fits the defect to be treated.

**Disadvantage:**  
Portion of donor site is left open to heal by secondary intention

***Kumar et al- Modified Hurzeler and Weng single incision technique in 2013***

A single incision is given 2 mm below to the margin of the gingiva. For 1st incision, the blade was placed parallel along the long axis of the palatal surface for the elevation of the split-thickness flap. Then, through the same incision angle of the blade made perpendicular to the palatal tissue surface and continued to the bone. Followed by this incision, subepithelial connective tissue graft was harvested from the bone with the use of the periosteal elevator. Then at the mesial and distal side of graft, 2 vertical incisions were given followed by one horizontal medial incision made underlying split-thickness flap, to separate it from the adjacent tissue. The ‘Barraquer cataract knives’ and ‘AVS blade’ are the special blades used to make vertical and horizontal incisions.

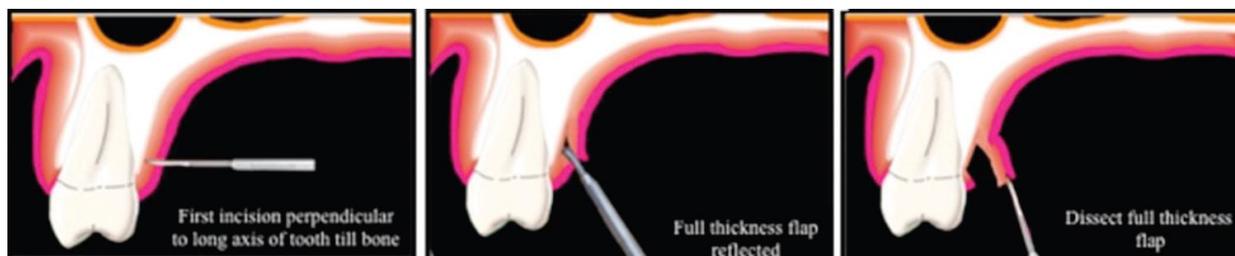


**Advantage:**  
Initially, little bleeding occurred. The flap was thick enough to reduce the chances of damaging and sloughing.

**Disadvantage:**  
Special instruments are required

***Reino et al. Palatal harvesting technique in 2013***

The incision was placed according to the modified single incision technique suggested by Lorenzana. Determination of length of incision was done through graft dimension required. Reflection of the mucoperiosteal flap of 1-2 mm was done with the help of a small elevator followed by split-thickness flap reflection. By keeping the periosteum intact on bone and part of connective tissue with mucoperiosteal or split-thickness flap in respect to maintain the graft thickness. Approximately 1.5 mm wide graft harvested



**Advantage:**  
This technique yields a good amount of healing and provides minimum discomfort to the patients. It allows higher control over the graft thickness. It permits primary wound closure and better control of graft thickness.

Diadvantage:

Technique might be difficult to execute for new clinicians as raised full-thickness flap was dissected to separate a partial-thickness connective tissue flap.

### *Aguirre-Zorzano et al- UPV/EHU technique in 2017*

A new “UPV/EHU technique,” acronym for the name of their university (Universidad del País Vasco/Euskal Herriko Unibertsitatea) for palatal donor tissue harvest. On the palatal surface, using a number 12 blade, intrasulcular incisions were made while preserving the papillae in the interproximal spaces and a full-thickness flap was raised. In order to harvest CTG, 15c scalpel was used to dissect the reflected full-thickness flap by holding it with tissue forcep. Epithelium and a thin layer of connective tissue were left in the remaining flap, which were sutured back.



Advantage:

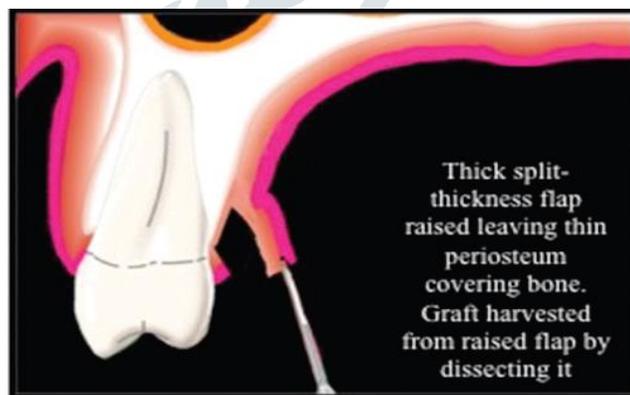
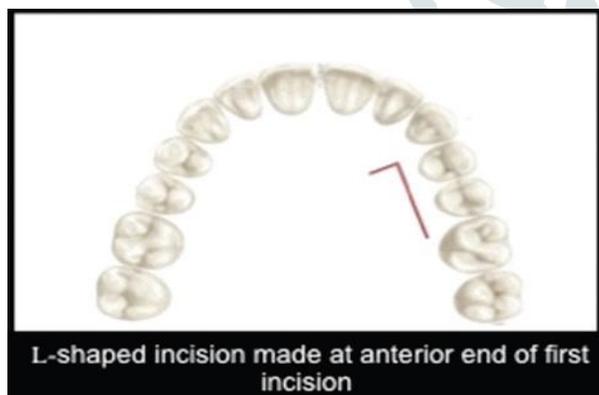
Minimizes the occurrence of postoperative complications as compared to trapdoor technique.

Disadvantage:

Demanding technique in terms of the operator's skills as compared to trapdoor technique

### *Bhatavadekar and Gharpure Controlled Palatal Harvest Techniquein 2018*

A number 15 blade was used to make one horizontal incision, 2 mm submarginally, extending anteriorly from the first molar. A vertical L-shaped incision was made at the anterior end of the first incision. A thick split-thickness flap was raised from the edges of the incision leaving behind a thin periosteum covering the palatal bone. Reflected flap was held with a tissue forceps, and the graft was harvested by dissecting it from the raised flap, leaving a 1.5-mm-thick flap for requisite flap healing.



Advantage:

Adequate control due to good visibility, good predictability in ensuring adequate graft and flap thickness, ability to obtain uniform graft and flap thickness, and less chance of leaving behind a thin flap for closure at the donor site thereby minimizing necrosis and flap sloughing and improving grafting success.

Disadvantage:

It is technique-sensitive and requires a surgeon's skill

For harvesting; it depends on the thickness of the palatal mucosa.

**Conclusion:**

A connective tissue graft is a skilful treatment method in periodontal plastic surgery and peri-implant soft tissue plastic surgery. Harvesting techniques that are minimally traumatic but aimed at maximizing tissue volume ensure multi-purpose usability of connective tissue graft. The unique nature of this tissue enables its use in multiple clinical scenarios. The easy availability, low cost, and proven efficacy of SCTGs compared to other regenerative techniques have made this a valuable approach to periodontal plastic surgery. The superior esthetics and predictable outcomes obtained through SCTG is the gold standard for treatment of root coverage. The latest techniques are minimally invasive with reduced incision lines, less compromised blood supply, accelerated healing, no sloughing of overlying flap, but are technique sensitive which require higher expertise to execute. Therefore, the operator must be well versed with varied aspects of the graft harvesting procedures, including handling of the tissue, involved potential limitations, and complications associated with the technique.

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