

APPLICATION OF SUBEPITHELIAL CONNECTIVE TISSUE GRAFTS IN PRE-PROSTHETIC SURGERY AND GRAFT HARVESTING TECHNIQUES. A LITERATURE REVIEW

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ABSTRACT

INTRODUCTION: Subepithelial connective tissue grafts (SCTGs) have been largely applied to cover exposed root surfaces resulting from gingival recessions. Besides treating gingival recessions, SCTGs are also employed in adjusting soft-tissue contours of restorations in edentulous areas, around dental implants, in ridge-preservation procedures with immediate implant placement as well as in papilla reconstruction. Despite the wide application of various xenogeneic grafts, which eliminate the formation of a second wound surface apart from the donor site, autogenous grafts remain the preferred material for soft-tissue contouring, especially in esthetically demanding regions and in restoration of the masticatory apparatus by fixed prosthetics.

AIM: The aim of this study is to review the most commonly employed techniques for the procurement and application of subepithelial grafts for gingival augmentation in alveolar ridge contouring, as well as to identify their advantages and disadvantages.

MATERIALS AND METHODS: The present study relies on dental literature data available in PubMed and Google Scholar, from 1974 to 2019, published in the English language.

RESULTS: The literature review is based on publications whose aim to observe the data provided information on the main techniques for harvesting subepithelial grafts, as well as their application specifications for soft-tissue augmentation in pre-prosthetic surgery.

CONCLUSION: The publications explored in the present study reveal that the presence of appropriate and affordable techniques for obtaining subepithelial grafts, both for contour correction and soft-tissue augmentation in localized areas around single teeth, particularly in areas of higher esthetic sensitivity. However, when larger transplants are needed, alternative methods are to be sought, particularly in cases where the palate has unfavorable anatomic characteristics or the palatal mucosal thickness is insufficient.

Keywords: *subepithelial connective tissue grafts, pre-prosthetic soft tissue augmentation*

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INTRODUCTION

Subepithelial connective tissue grafts (SCTGs) have been largely applied to cover exposed root surfaces resulting from gingival recessions. Besides treating gingival recessions, SCTGs are also employed in adjusting soft-tissue contours of restorations in edentulous areas, around dental implants, in ridge-preservation procedures with immediate

implant placement as well as in papilla reconstruction. Despite the wide application of various xenogenic grafts, which eliminate the formation of a second wound surface apart from the donor site, autogenous grafts remain the preferred material for soft-tissue contouring, especially in esthetically demanding regions and in restoration of the masticatory apparatus by fixed prosthetics.

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The aim of the present study is to review the most commonly used techniques for the procurement and application of subepithelial grafts for gingival augmentation in alveolar ridge contouring as well as to identify their advantages and disadvantages.

MATERIALS AND METHODS

The present study relies on dental literature data available in PubMed and Google Scholar, from 1974 to 2019, published in the English language. The publications under study aim to establish the procurement and application of connective tissue grafts in soft-tissue correction, both in edentulous areas of the alveolar ridge and around natural teeth.

The most common donor site for subepithelial grafts is the palate. However, unlike the methods for treating recessions where the SCTG thickness is sufficient to cover the exposed root surface, defects in the alveolar ridges require a slightly thicker graft (1). For this reason, other intraoral donor sites are to be employed, such as edentulous areas or the maxillary tuberosity—the retromolar area.

Based on Seiber's classification (2) deformations or defects of the anterior part of the alveolar ridge are grouped as follows:

- ◆ Class I: Buccolingual loss of alveolar soft tissue with normal apicocoronal height.
- ◆ Class II: Apicocoronal loss of alveolar tissue with normal buccolingual width.
- ◆ Class III: Both buccolingual width and apicocoronal height loss of tissue.

The buccolingual width of the ridge is considered insufficient if it does not align with the contour of adjacent bone structures, whereas the apicocoronal height is defined as insufficient if it does not correspond to the gingival height of adjacent teeth. According to Abrams et al. the presence of deformities and irregularities in the alveolar ridge contour hap-

pens to be a common phenomenon, with Class III prevailing (55.8%), followed by Class I (32.8%), and the least common is Class II (2.9%) (3). Nowadays, various techniques for correcting alveolar crest defects have been proposed including guided bone regeneration, application of bone grafts, bone-restoring materials, in combination with a flap or tunnel technique as well as methods for repairing the alveolar ridge by soft-tissue augmentation (4).

Three main procedures have proved successful in the contour correction of a partially edentulous alveolar ridge using soft-tissue augmentation:

- full thickness free gingival graft (FGG) (2);
- free SCTG placed under the oral mucosa in the area of the defect using a tunnel or envelope technique, presented by Langer and Calagna (5) and further modified by Garber and Rosenberg (6);
- a palatal roll technique described by Abrams (7).

There are several techniques for harvesting SCTGs from the palate, all of which aim to procure a graft and at the same time to ensure primary healing of the donor site by preserving the originally dissected palatal flap, later adapted and re-sutured. These techniques are often considered the gold standard in graft harvesting for augmentation of the attached mucosa as they involve less pain than FGGs where the donor site heals by secondary epithelialization (8,9).

The **trap-door technique** is a palatal technique where one horizontal and two vertical incisions are undertaken to provide access to the connective tissue. The horizontal incision has the mesiodistal dimension of the graft and the two vertical incisions extend apically 1 mm above the apicocoronal height of the graft. Initially, the flap is dissected with a partial thickness to achieve equal thickness. The blade is then held parallel to the outer surface and moves apically. The periosteum of the bone must remain intact. After the graft is harvested, the flap is repositioned, adapted and sutured, hence the name of the technique with the raised flap acting as a "lid" or "hatch" from under which the graft is removed and the flap is reclosed. The technique was introduced by Edel in 1974 to facilitate the primary closure of the palatal donor site and appears to be the most widely approved and used to date (10). This method is ap-

appropriate when larger connective tissue grafts are required (11), particularly in the restoration of the soft-tissue contour in edentulous areas.

The L-shaped harvesting technique involves raising the mucosal flap by performing a horizontal and vertical incision to provide access to the palatal connective tissue. This method is very similar to the trap-door technique, yet it differs in that it does not include a distal vertical incision, it creates a triangular envelope-like flap. The advantage of this graft harvesting method is that there are fewer incisions, hence less pain for the patient, yet visibility and access are difficult, especially distally (11).

The single-incision technique is another palatal harvest technique in which the initial incision is made at 90° to the palatal bone in full thickness. Thereafter, the blade is angled to approximately 135°–180° to make an undermining dissection with a partial thickness below the mucosa but not more than 8 mm from the edge of the incision. An envelope-shaped flap is then formed and subepithelial graft is taken by medial, distal and apical incisions from the inside of the envelope-shaped donor site. This palatal method of obtaining subepithelial graft has the advantage that the wound at the donor site heals by primary intention. The technique was introduced by Hürzeler and Weng in 1999 (12).

In the **parallel-incision technique** two parallel horizontal incisions are made with approximately 2–4 mm distance from the gingival margin connected by two vertical relief incisions. The connective tissue located between the two parallel incisions is taken and the epithelial band can be removed to form SCTG or it can be left when there is a need of epithelialized subepithelial connective tissue graft (ESCTG) or partly epithelialized free gingival graft (PEFGG). There is a limitation in the graft size: the largest graft size that can be taken in this way measures 12 mm mesio-distally and 6 mm apicocoronally (11). The technique was introduced by Langer and Calagna (5) to augment concavities and irregularities in edentulous ridges where cosmetics are important as well as to treat single recessions.

These two methods of harvesting SCTGs are also known as “envelope techniques”. The main prerequisite for them is that the palatal mucosa thickness must not be less than 3 mm.

De-epithelialized gingival grafts (DGG). Subepithelial connective tissue grafts can also be obtained by de-epithelialization of epithelial connective tissue grafts, particularly in cases where the palatal mucosal thickness proves insufficient. This harvesting method is used specifically in cases where it is necessary to take larger grafts. Useful donor site is also the area around the premolars and molars, but while the mucosa in the molar area is rich in connective tissue, there is certain amount of glandular tissue in the premolars. The harvest technique consists of two horizontal and two vertical 1.0–1.5 mm-deep incisions while the blade is held perpendicular to the surface of the mucosa. Then the dissection of the graft starts by rotating the blade almost parallel to the mucosal surface and moved apically as far as required. De-epithelialization is performed with a sharp scalpel blade held parallel to the external graft surface. The donor site is covered with a collagen tape and is sutured with cross mattress sutures to reduce discomfort during healing (11,13).

There are other approaches for correction of deformities and concavities in the soft tissue of edentulous anterior maxilla. Kaldahl et al. (14) present two plastic surgical procedures using autogenous grafts of dense connective tissue. One technique is to dissect two partial-thickness parallel vertical incisions joint by a horizontal incision, encompassing the defect site, extending palatal to the crest of the ridge for approximately 10–15 mm and 1–2 mm away from adjacent teeth. The two initial incisions are extended superiorly from the crest of the edentulous ridge towards the labial vestibule and when they reach the mucogingival junction a second parallel incision is undertaken in the periosteum. The partial-thickness flap then becomes a full-thickness mucoperiosteal dissection, thus allowing for its elongation and creating a labial subperiosteal pouch where the harvested subepithelial palatal graft is inserted. This type of technique allows the graft to be supported in a more occlusal position, thus compensating for apical loss of alveolar ridge tissue of the alveolar ridge in addition to the labial loss.

An alternative technique as per Kaldahl et al. (14) is the single-vertical incision undertaken in the attached vestibular mucosa above the tooth adjacent to the defect, without reaching the marginal gingiva. A periosteal elevator is inserted through the incision

and the mucoperiosteal tissue is elevated over the deformity. Then the autogenous subepithelial graft is inserted through the incision into the internal space as in a pouch. However, the augmentation performed in this way has some limitations—it does not give the possibility of altering alveolar crestal height and this makes it applicable only if an increase in labial dimension is desired.

In 1980, Abrams (7) described the so-called “roll technique” in which a palatal flap is dissected, de-epithelialized, then rotated or rolled beneath the buccal mucosa to augment the soft tissue in the buccolingual dimension or to correct vestibular concavities over the alveolar ridge. This method has been approved over time as it became very successful. Based on the roll technique there are many modifications in use.

Scharf and Tarnow (15) refined the technique proposed by Abrams. In their modification, two primary vertical incisions are given, extending from the alveolar crest, joined by a parallel incision along the ridge to create a flap, which is not full thickness and mainly consists of epithelial tissue. After it is formed, an incision is made in the connective tissue to the base of the epithelial flap and a new flap is dissected, with a base at the ridge of the alveolar crest, mainly consisting of connective tissue. Once the connective tissue flap from the underlying alveolar bone is dissected from the underlying alveolar bone, it is then rolled beneath the buccal mucosa and sutured, while the epithelial flap is repositioned onto the exposed bone. According to Scharf and Tarnow, this modification, compared to the Abrams’ method, increases the amount of connective tissue that can be rotated and applied buccally, minimizes the amount of uncovered connective tissue or bone, hence reduces postsurgical discomfort. Abrams describes two types of flaps—full-thickness and partial-thickness flaps, which after de-epithelialization are rotated buccally. However, if partial-thickness flap is to be employed, the amount of connective tissue required for augmentation is limited. On the other hand, if full-thickness flap is used, the exposed alveolar bone will heal by secondary intention, which will increase pain.

For the correction of small defects in the alveolar crest using subepithelial grafts, in addition to those harvested from the palate, useful donor site can

be the maxillary tuberosity, using the distal-wedge technique. This procedure of harvesting connective tissue graft involves two mesio-distal apically diverging incisions undertaken behind the second molar so as to outline a rectangular or triangular graft shape from the occlusal view. The distal-wedge technique can be performed simultaneously with wisdom tooth extraction; however, it is preferable that the harvesting be performed approximately 2 months following tooth extraction for increased amount of connective tissue at the donor site. In most cases, closure of the donor site can be achieved after a slight split-thickness flap mobilization (16). The advantage of this donor site is that it may produce significant amounts of dense, fibrous connective tissue to correct contour defects in the alveolar ridge and achieve good aesthetic appearance (14). Soft tissue grafts harvested from the maxillary tuberosity provide a better option than donor grafts from the palate in terms of function and postsurgical pain (17), and at the same time present a greater percentage of denser lamina propria (more connective tissue) and less submucosal tissue (adipose and glandular tissue).

RESULTS

The literature review is based on publications, whose aim to observe the data provided information on the main techniques for harvesting subepithelial grafts as well as their application specifications for soft-tissue augmentation in pre-prosthetic surgery.

DISCUSSION

Irregularities in the contour of partially edentulous alveolar ridges, particularly in the anterior sections, appear to be a serious esthetic disturbance. The formation of black triangles on the alveolar ridge renders subsequent prosthetic restoration esthetically displeasing and give an unhealthy appearance. Therefore, surgical correction of localized defects of the alveolar crest is of great significance for the successful prosthetic treatment. These defects may be the result of traumatic extraction, facial injuries, congenital deformities such as cleft palate, dental apicoectomies, failed dental implant treatment or severe periodontal inflammation (2,6). As in the past, the most common approach nowadays to compensate for the dimensional discrepancy between the gingiva and the bridge pontic is to fill the

void with tissue-colored porcelain or acrylic resin as the bridge pontic may appear longer than the adjacent abutment teeth (14,18).

Autogenous grafts have been increasingly applied over the last 50 years with various soft-tissue interventions for the increase of the width of the keratinized mucosa or for soft-tissue augmentation purposes (19). In addition to the treatment of recessions, connective tissue grafts are also used in soft-tissues contour restoration around dental implants (20,21,22), in ridge-preservation procedures with immediate implant placement (23, 24, 25, 26, 27) as well as in papilla reconstruction (28, 29, 30).

Most harvesting techniques and their modifications are aimed at graft procurement and subsequent healing of the donor site by primary intention. Studies demonstrate that most connective tissue grafts taken from different sections of the palate are not uniform in the histologic composition (31). For this reason, Zuhr et al. (19) investigated the anatomy of different donor sites of the palate and divided them into anterior donor sites (starting from the mesial border of the first molar to the lateral incisor), posterior lateral donor sites (in the area of the first and second maxillary molars, and retromolar donor sites). According to the author, grafts from the retromolar area are preferred for augmentation of the alveolar ridge, as they provide more volume and are rich in connective tissue, whereas for the treatment of recessions it is more appropriate to harvest the posterior lateral portion of the palate.

Studer et al. (32) present a study of the thickness of the masticatory mucosa from two donor sites—the hard palate and the tuberosity as potential donor sites for ridge augmentation procedure. The researchers report that the tuberosity revealed a significantly more soft tissue thickness in comparison to the hard palate and that the mucosa over the palatal root of the maxillary first molar was significantly thinner. According to the authors this represented an anatomical barrier in graft harvesting and concluded that two different regions could be defined for soft tissue graft harvesting from an anatomic point of view: 1) Fairly wide and shallow grafts may be harvested in the canine-premolar region. 2) The tuberosity revealed a significantly more soft tissue thickness in comparison to the hard palate, which allows

the harvesting of deeper grafts for correction of the alveolar ridge contour. Molecular analysis also shows the different cellular and tissue properties of subepithelial grafts from the palate and from maxillary tuberosity (33). Based on their tendency for hyperplasia, grafts from the retromolar area may be suitably used to increase soft-tissue volume (34, 35).

The trap-door technique proposed by Edel (10) is one of the most commonly employed methods for obtaining subepithelial grafts, but in certain cases there is an unfavorable base-length relationship of the flap, leading to undesired discomfort in the patient (10,19 36, 37). Therefore, for the purpose of trauma reduction associated with additional incisions, Hürzeler and Weng introduced the simplified single-incision technique (SI) (12). Although smaller size grafts can be harvested using this approach, this method is better perceived by patients (9,38). The disadvantages with the SI technique include a greater likelihood of blood vessel damage and perforation of the epithelial flap while obtaining the graft due to reduced visibility of the donor site. Furthermore, fairly smaller grafts can be harvested to correct soft tissues around single teeth and dental implants. In general, the SI method is difficult to perform and require advanced skills of the operator (11).

The parallel-incision technique allows to obtain autogenous subepithelial grafts with or without an epithelium band to restore concavities and irregularities in alveolar ridges (5, 39). Harris modified this technique by reducing the vertical incisions to a minimal dimension just enough to achieve access to the underlying donor tissue (40). Harris' proposed modification aims at reducing trauma to the donor area, but can jeopardize the accessibility and visibility during the procedure. In contrast, Raetzke entirely abstained from vertical incisions and used two converging crescent-shaped horizontal incisions to procure a wedge-shaped graft (41).

Bruno (42) also proposed a technique for harvesting subepithelial grafts from the palate, avoiding vertical incisions which provided limited access but improved clinical outcome, lessened pain at the donor site and accelerated healing. However, the resulting grafts tend to be smaller in size, which limits their application in correction of alveolar ridge defects.

When subepithelial grafts are used for correcting defects in the alveolar ridge, they must possess sufficient thickness and contain dense and collagen-rich tissue. To prevent complications at the donor site, the thickness of the initially dissected flap must range from 0.5 to 0.7 mm and the graft intended for soft-tissue contour correction around metal crowns or implants must be at least 2 mm (11). By all means, there must be sufficient connective tissue at the palatal donor site.

CONCLUSION

The publications reviewed in the present study show the presence of appropriate and affordable techniques for harvesting subepithelial grafts for the purposes of contour correction and soft-tissue augmentation in localized areas around single teeth, particularly in areas of high esthetic demand. However, when larger transplants are required, alternative methods must be sought, especially in cases where the palate has unfavorable anatomic characteristics or the palatal mucosal thickness is insufficient.

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