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REVIEWS

COMPARISON OF SOFT TISSUE GRAFTS HARVESTED FROM THE MAXILLARY TUBEROSITY AND THE HARD PALATE: A REVIEW

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ABSTRACT

INTRODUCTION: Autologous soft tissue grafts were first used for keratinized tissue (KT) augmentation around teeth. They have been considered an excellent alternative to tissue regeneration materials for their stable, long-term results.

AIM: This review aims to compare soft tissue grafts harvested from two different donor sites—the maxillary tuberosity and the hard palate, evaluate their advantages and disadvantages, and summarize the indications and limitations for their use.

MATERIALS AND METHODS: An electronic search using PubMed, Web of Science, Scopus, and Google Scholar databases was conducted until June 2024. This review includes 32 articles. It summarizes the knowledge on soft tissue grafts harvested from the hard palate and maxillary tuberosity.

RESULTS AND DISCUSSION: The palate and the maxillary tuberosity are the most common donor sites for soft tissue grafting in the oral cavity. They have various applications, such as soft tissue augmentation around teeth and implants, treatment of gingival recessions, and peri-implant dehiscence, and recently they have been suggested as a method for alveolar ridge preservation. The main differences between these grafts are their availability and structural and histological features.

CONCLUSION: The present review summarizes the advantages, disadvantages, applications, and limitations of soft tissue grafts harvested from the palate and the maxillary tuberosity. Various clinical assessments and histological and molecular analyses have highlighted their differences in structure and behavior.

Keywords: *soft tissue graft, free gingival graft, maxillary tuberosity, hard palate*

INTRODUCTION

Free gingival grafts (FGGs) are donor tissues that aim to cover denuded root services or increase soft tissue thickness in the recipient site (1).

Autologous soft tissue grafts were first used for keratinized tissue (KT) augmentation around teeth. They have been considered an excellent alternative to tissue regeneration materials for their stable, long-term results. Full-thickness FGGs can increase the vestibular depth, augment the keratinized mucosa, and cover gingival recessions. Recently, they have been used mainly for soft-tissue augmentation in implant dentistry (2).

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Connective tissue grafts (CTGs), on the other hand, are a method of choice for root coverage. They increase the width and thickness of KT, preserve their texture, and act as biological scaffolds (2).

Connective tissue grafts stabilize the flaps to the surface of the roots. When they are rich in lamina propria and collagen fibers, they can successfully induce the keratinization process of the epithelium (3). However, CTG harvested from the deep palate (pCTG) contains a greater amount of glandular and fat tissues, which could disturb the plasmatic circulation and revascularization of the graft (4) and, thus, the keratinization of the epithelium.

It remains controversial which is the optimal donor site and which harvesting technique causes less postoperative patient morbidity.

Recently, efforts have been turned toward establishing an ideal harvesting technique that minimizes post-operative pain and provides first-intention healing at the donor site (2).

AIM

This review aims to compare soft tissue grafts harvested from two different donor sites—the maxillary tuberosity and the hard palate, evaluate their advantages and disadvantages, and summarize the indications and limitations for their use.

MATERIALS AND METHODS

Search strategies were applied via four electronic databases: Pubmed, Scopus, Web of Science, and Google Scholar. Articles that contained the selected keywords were screened and assessed for eligibility by two independent reviewers. Discrepancies between them were resolved by discussion and consensus. This review article includes 32 studies.

RESULTS

Soft tissue grafts have various applications: treatment of gingival recessions (root coverage) and soft tissue dehiscence around implants, soft tissue augmentation before or during implant placement, ridge preservation after tooth extraction, etc. (5). They show excellent results in improving the esthetics and harmony of peri-implant soft tissues (6).

The selection of a donor site and harvesting approach usually depends on the anatomical features of the donor area (course of the greater palatine artery, soft tissue amount, and thickness, shape of the palatal vault, palatal rugae pattern, presence of third molars, and so on), and the needed graft size, texture, and thickness (7).

The most popular intraoral donor sites for soft tissue grafting are the maxillary tuberosity (thicker grafts) and the palate (grafts with a larger surface) (8).

Grafts harvested from different donor sites demonstrate different histological features. Palatal grafts have varying thicknesses and distribution of submucosal tissues, while tuberosity grafts are composed of dense collagen fibers, covered with a layer of keratinized epithelium. These structural differences are a key factor for the survival and behavior of grafts. The composition of grafts determines their revascularization and dimensional stability (8).

It has been recently reported that the origin and composition of soft tissue autografts may influence their integration and behavior, e.g., tuberosity grafts respond with hyperplastic reactions (9).

Zuhr et al. (10) have suggested that the graft shape and structure depend on the characteristics of the donor site. For instance, glandular and adipose tissue in palatal grafts may impair plasmatic diffusion and vascularization during the early stages of healing (2). For this reason, some clinicians prefer the maxillary tuberosity and the superficial palate as donor sites since they are composed of greater amounts of lamina propria and less submucosa than the grafts from the deep plate (11,12).

Soft tissue grafts from the maxillary tuberosity have demonstrated excellent properties. First, they are mainly composed of connective tissue fibers and contain little adipose and glandular tissue. Second, the harvesting approach poses minimal risk of intraoperative complications, such as bleeding. Third, they show reduced postoperative discomfort compared to palatal grafts. The reason that patients report higher pain levels at palatal donor sites could be due to the limited residual tissues (13) and the exposure of the palate to friction. It comes in direct contact with the tongue during speech, mastication, and swallowing (14). In addition, the thickest masticatory mucosa is found in the tuberosity (15). Accordingly, Zucchelli et al. have demonstrated that the consumption of analgesics was related to the amount of

residual soft tissues at the donor site. No sufficient difference in patient morbidity was registered after using the traditional technique for harvesting CTG and FGG and de-epithelializing it for the same treatment purpose (13).

The lateral palate is the ideal donor site for root coverage indications since it has the appropriate structural features and thickness necessary for good esthetic outcomes. However, when grafts with greater tissue thickness are required, the maxillary tuberosity is a preferable donor site. Furthermore, the grafts from the tuberosity lack adipose and glandular tissue and are rich in fibrous connective tissue, which makes them suitable for peri-implant volume augmentation (16).

Some authors suggest using de-epithelialized palatal grafts with removed glandular and adipose layers from their internal side (13,17). These grafts consist mainly of lamina propria and also show successful results in treating soft tissue deficiencies around dental implants (12).

Palatal grafts harvested from the area closest to the gingival margin consist mainly of lamina propria (about 65%), while grafts from the apical regions have greater amounts of fatty and glandular tissues (16,18).

Amin et al. (14) conducted a split-mouth clinical study to compare tuberosity and palatal donor sites regarding postoperative morbidity and surgical outcomes. They recruited 20 patients (non-smokers, in good general health) who needed bilateral soft tissue grafts. Half of the patients underwent the FGG procedure and the other half—a coronally advanced flap (CAF) combined with CTG. Both groups were additionally divided. Half of the FGGs and CTGs were obtained from the maxillary tuberosity and the other 10—from the palate. Pain levels were registered using a scale of zero to ten during the first two weeks. It was significantly lower at the tuberosity donor sites than at the palatal donor sites. The greater residual tissue thickness at the tuberosity donor sites might have contributed to this phenomenon.

These findings are consistent with those of Zucchelli et al. (13) who reported a correlation between postoperative pain and the thickness of the grafts and the remaining tissues at the donor sites. In addition, tuberosity grafts led to greater gingival thickness than the palatal grafts (2.9±0.5 mm vs. 2.3±0.6 mm in the CTG-CAF groups and 2.7±0.7 vs. 2.1±0.7 for FGG from the tuberosity and the palate, respectively).

However, there was no difference in the width and length of the grafted sites in both groups after 8 weeks. The mean percentages of root coverage from both donor sites were similar (67±12% for the tuberosity grafts vs. 62±13% for the palatal grafts). These results support the findings of Harris from 2003 (18) who reported that root coverage is not affected by the consistency of lamina propria and the presence of submucosal tissues.

A CTG harvested from the maxillary tuberosity (tCTG) has the following advantages: minimal risk of complications; reduced graft shrinkage; and simplicity of the surgical protocol. They share similar widths with palatal grafts but with greater thickness (2).

A tCTG could be split "like a book" and used for coverage of multiple defects (19). However, it is possible to face limitations in harvesting when there is a third molar. Then the amount of soft tissues is limited, and even if not, access is difficult.

Histological and molecular evaluation of the behavior of tCTG and pCTG, harvested from the deep palate, has been performed (9,16). Lamina propria in tCTG was denser (72.79% vs. 51.08%), whereas pCTG had a larger amount of submucosa rich in glandular and adipose tissue (25,27% vs. 4.89% in tCTG).

As previously demonstrated, grafts rich in submucosal tissues experience more shrinkage, limited volume gain, and minimal epithelial keratinization (2, 10, 20). Therefore, tCTG could be regarded as the better alternative when compared to pCTG, especially from the deep palate (5).

On a molecular level, tCTG has demonstrated lower mRNA levels of collagen type 1 and 3 than pCTG, as well as upregulated mRNA levels of long lysyl hydroxylase 2. Furthermore, it seemed that collagen in tCTG was less commonly degraded by the matrix metalloproteinases (9). This could be a possible reason for the collagen accumulation in the recipient sites. Moreover, tCTG demonstrated high expression of antibodies, typical for fibrotic tissues (16).

To sum up, tCTG and pCTG have different amounts of lamina propria and submucosa and dif-

ferent gene expressions. The latter could be the reason for their different clinical behavior—volume and KT gain, hyperplastic reaction, etc.

Sanz-Martin et al. have compared the structural and histological characteristics of tCTG and pCTG. The authors conducted histological, histomorphometric, and immunohistochemical analyses. Tuberosity CTG demonstrated a greater amount of lamina propria (72.79% vs. 51.08% in the pCTG group). The total collagen content was similar in both groups, while the antibody expression was higher in the tuberosity grafts. All the antibodies were concentrated in the epithelial layer and rete ridges.

When grafts harvested from both maxillary tuberosity and lateral palate were used for coverage of peri-implant dehiscence, tCTG resulted in better KT width and apical tissue thickness (20).

It has been suggested that simultaneous implant placement and grafting with a tCTG could successfully prevent mid-buccal recessions (21, 22). Zuidervelt et al. (22) reported a 0.5 mm loss of mid-buccal soft tissues when no grafts were used versus a 0.1 mm gain in the grafted sites. However, the pink esthetic score and patient satisfaction were similar between both groups.

A major disadvantage of the tCTG is its tendency for fibrotic reactions, which may impair the esthetic results and require a second plastic surgery (15,23).

Dehiscence coverages of 89.6% and 96.3%, respectively, were reported when tCTGs (24) and CTG from the superficial palate (12) were used. In contrast, when pCTG harvested from the deep palate was used, the mean dehiscence coverage was less with a noted tendency of graft shrinkage (24, 24).

Several authors (26, 27, 28) reported greater post-operative pain after treatment with free gingival grafts compared with subepithelial connective tissue grafts. In contrast, others suggested that post-operative morbidity is related to the graft thickness and the remaining amount of soft tissues at the donor site, rather than the type of healing (13, 29).

Even if the harvested grafts from both palate and tuberosity have the same thickness, the palatal grafts may shrink more due to the presence of glandular and adipose tissues. These findings are consistent with the hypothesis that dense connective tissue leads to less shrinkage (10).

Kotsailidi et al. (30) conducted a study to compare soft tissue augmentation during implant placement. They used connective tissue grafts harvested from both palatal and tuberosity areas. Digital impressions were performed preoperatively and at 2 and 12 months after treatment. The authors evaluated soft tissue thickness, marginal bone level, pain during the first 2 weeks, pink esthetic score, and patient-reported outcomes. The results were similar in both groups, except for postoperative pain perception during the first week.

Dellavia et al. (9) reported different results when tuberosity and palatal grafts were used. The authors used 3.5 mm thick connective tissue grafts for ridge augmentation. The tCTGs showed a tendency for hyperplastic reactions while pCTGs remained stable. The histologic explanation for these findings was that tCTGs demonstrated collagen-crosslinking and resistance to degradation. The study heterogeneity concerning soft-tissue grafts harvested from the maxillary tuberosity could be related to the varying graft thickness the researchers used (30).

In 2019, a novel four-layer graft technique for soft and hard tissue augmentation with simultaneous implant placement was introduced (31). A combined epithelialized-subepithelial connective tissue graft and cortical-cancellous bone which was used to restore a defect of the buccal wall of the postextraction socket. The method demonstrated successful results. However, it should be noted that it is technically demanding with difficult visibility and access to the donor site.

The following year, Younes and Khairallah presented a socket preservation technique using a one-piece autologous bone and soft tissue graft from the maxillary tuberosity (32).

Palatal and tuberosity grafts exhibit numerous similarities and differences. Further research is needed to compare their stability over time. Histological evaluation of the post-operative healing at the donor sites can be used to determine more precisely how the presence of adipose tissue affects the clinical outcomes. It has been suggested that different pain levels at the donor sites may be associated with the types of nerve endings and their distribution (14).

Future assessments are necessary to determine their role in pain perception.

CONCLUSION

The palate and the maxillary tuberosity are the most common donor sites for soft tissue grafting in the oral cavity. They have various applications, such as soft tissue augmentation around teeth and implants, treatment of gingival recessions, and peri-implant dehiscence, and recently they have been suggested as a method for alveolar ridge preservation. The main differences between these grafts are their availability and structural and histological features. For instance, tuberosity grafts contain greater amounts of lamina propria and collagen fibers while palatal grafts are richer in adipose and glandular tissues, and contain more vascular structures.

The present review summarizes the advantages, disadvantages, applications, and limitations of soft tissue grafts harvested from the palate and the maxillary tuberosity. Various clinical assessments and histological and molecular analyses have highlighted their differences in structure and behavior.

There is evidence that grafts harvested from the maxillary tuberosity demonstrate reduced postoperative discomfort, and gain in soft tissue volume and width of keratinized tissues. Their main limitation is the possible hyperplastic reactions they could provoke, thus, their application in the esthetic areas requires consideration and careful planning.

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