ALVEOLAR RIDGE PRESERVATION USING FREE GINGIVAL GRAFTS. A REVIEW ARTICLE

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ABSTRACT

INTRODUCTION: Tissue preservation after tooth removal is crucial for the subsequent implant and/or prosthodontic rehabilitation. A variety of ridge preservation procedures have been suggested. Socket sealing surgery with free gingival grafts was introduced to minimize soft tissue volumetric alterations and protect the clot or the bone grafting material in the socket. However, the method has some disadvantages, such as postoperative patient discomfort and a need for a second-stage surgery.

AIM: This literature review aims to analyze, compare, and summarize the results on the application of free gingival grafts for ridge preservation and define the research gaps that necessitate further assessments.

MATERIALS AND METHODS: The present review is based on the existing scientific electronic database, including 42 articles. It provides a comparative analysis of the reported results on socket sealing with free gingival grafts

RESULTS: The database showed heterogeneity regarding graft survival and postoperative complications. Authors report that the method gives promising results and successfully preserves the hard and soft tissue volume. It is still disputable, however, whether it is superior to other ridge preservation procedures.

CONCLUSION: Further investigation based on randomized clinical trials and precise clinical, histologic, and radiological evaluation is needed to clarify the role of free gingival grafts as a method for ridge preservation. Its application in the different areas of the ridge should be carefully evaluated.

Keywords: *alveolar ridge preservation, socket sealing surgery, free gingival graft*

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INTRODUCTION

Alveolar ridge resorption and soft tissue shrinkage after tooth removal are inevitable. This necessitates the application of additional surgical techniques, known as alveolar ridge preservation (ARP), to preserve the surrounding tissues and create favorable conditions for implant placement (1,2,3,4,5). In cases with thin periodontal biotypes and high smile

lines, the preservation of the entire tissue volume is of great importance (6). Various techniques of soft tissue management around extraction sockets have been suggested, including pedicle flaps (7,8), coronally displaced flaps (9), and a modified tunneling technique with subgingival pontics (10). A major limitation of the above-mentioned methods is the reflection of flaps on the buccal side of the sockets. Such intense flap techniques during tooth extraction lead to additional dimensional changes due to the surgical trauma and denudation of the buccal bone (11). They may lead to retraction of the gingival margin of adjacent teeth, loss of keratinized tissues, and destruction of the interdental papillae. Therefore, flap dissection at the buccal aspect of the extraction sockets should be avoided (12). This could be achieved by sealing the socket with a barrier membrane or an autogenous free gingival graft (FGG). A socket sealing surgery (SSS) is mainly applied in the esthetic regions (13). It has given promising results in numerous clinical studies (14,15,16,17). A socket sealing surgery successfully preserves and increases the volume of keratinized tissues using FGG or collagen membrane.

AIM

The present review aims to observe the use of FGG for SSS according to the literature and summarize the results. The different techniques, their features, indications, and success rates were carefully analyzed to assess the advantages and reliability of the method. The research gaps are detected and further research is suggested.

MATERIALS AND METHODS

This review article is based on the existing electronic database, including 42 articles in search of a reference point for the application of FGG for SSS. The results were summarized and evaluated to identify how and whether the method is superior to the classic ARP procedures.

RESULTS

The free gingival graft was first introduced for SSS in 1994 when Landsberg and Bichacho (2,18,19,20) suggested a method in which the extraction socket is filled with bone graft and covered with an FGG to prevent bone resorption.

Studies in dogs demonstrated that placement of deproteinized bovine bone mineral (DBBM) into the extraction sockets and sealing them with FGG successfully prevented dimensional tissue loss (1,21). However, incomplete wound healing and necrosis of the graft are possible complications due to the limited blood supply (14).

Jung et al. (15) described a soft tissue punch technique. They filled the extraction socket with a bovine-derived bone substitute and placed a free epithelialized connective tissue graft. The authors reported improved soft tissue healing 6 weeks following the extraction.

The survival of the FGG depends on the nourishment from the blood clot in the socket beneath and from the gingival margin surrounding the graft (15). Landsberg et al. (18) recommended that the graft should be slightly larger than the orifice of the alveolus. Thus, a passive "press fit" of the punch could be achieved. However, a risk of incomplete healing and necrosis of the graft due to the limited blood supply was reported as well. Tal (14) found registered 26% non-vital and 31% partially vital grafts one week postoperatively.

An alternative approach to the onlay graft is a combined onlay-interpositional graft procedure (22). It was described by Seibert and Louis in 1996. Similarly, Simmelmayr et al. (23,24) utilized a combined epithelialized subepithelial connective tissue graft with two connective tissue portions, which were placed in supraperiosteal tunnels on the buccal and palatal sides of the socket. The authors reported that the buccal connective tissue portion thickened the buccal soft tissue and led to the local conversion of a thin gingival morphotype A into a thick type B. The combined epithelialized subepithelial connective tissue graft provided a secure primary seal, supported the papillae of the adjacent teeth, and preserved the initial place of the mucogingival junction (MGJ). The resultant volumetric tissue preservation facilitated future implant and prosthodontic treatment (23).

Karaca C. et al conducted a randomized clinical trial in order to compare the volumetric changes in maxillary extraction sockets that have healed spontaneously and those covered with FGG. The results suggested that the use of FGG can preserve the height of the buccal and lingual crestal plates. How-

ever, their widths exhibited similar resorption rates without statistical significance in both groups (25).

Kim et al. conducted a retrospective study to investigate the open membrane technique or SSS with collagen membranes (CM) or palatal gingival grafts. Immediate implant placement and guided bone regeneration (GBR) were performed following the extraction. The authors registered a 100% success rate of the implant placement in the follow-up period. There was no statistically significant difference regarding marginal bone loss between the palatal gingival graft group and the collagen membrane group. The authors concluded that SSS effectively minimizes the volumetric tissue loss. The complication rate in the palatal graft group was 27.3% (one case of periimplantitis and two cases of dehiscence), whereas in the other group (with CM) it was 35.7% (five cases of dehiscence). These results showed that there is no statistically significant difference between both groups (13).

Oghli and Steveling carried out research to compare ARP with three extraction protocols: natural healing after a classic atraumatic extraction technique, atraumatic extraction and SSS with autogenous graft, and SSS with collagen material impregnated with gentamicin and covered with FGG. A total of 173 extraction sites were evaluated. The results 3 months following the extractions showed no statistically significant difference. It appeared that bone resorption depends on the extraction technique, regardless of the ARP procedure—with FGG or bone substitutes (26).

Han et al. described a simple technique utilizing a bilaminar crescent-shaped FGG and bone grafting material to promote tissue regeneration. They performed immediate implant placement with or without immediate provisionalization. One year postoperatively the authors reported a stable gingival margin at 1 mm coronally to the original margin and a thick biotype without discoloration. The alveolar bone around the implant was stable as well (27).

Bruno Segnini et al. conducted a pilot study to assess the conjunction of FGG or collagen-matrix xenograft (CMX) with deproteinized bovine bone graft (DBBG) for socket preservation in sites with facial wall defects. They observed the effect of SSS/ARP on sixteen maxillary teeth with facial bone defects. Four months postoperatively they found that the FGG sockets showed better preservation of the bone width than those treated with CMX. There was no difference regarding biopsy composition. The authors concluded that regardless of the type of soft tissue graft/substitute, ARP with DBBG at sites with facial bone defects allowed for implant placement without further GBR. In this study, the graft was used only as a sealer above the socket and there was no increase in the labial tissue volume (28). In a previous study, however, a greater labial tissue volume in patients who received subepithelial connective tissue grafts than those with CMX was reported. This can be explained by the immediate implant placement and provisionalization and grafts situated on a labial pouch (29).

In 2011 Stimmelmayr et al published a case series on ARP and SSS for management of defects of the buccal bone plate. Extraction sites were immediately grafted with a combination of autogenous bone and a bone substitute and sealed with an epithelialized subepithelial connective tissue graft. In two of thirty-nine patients, partial necrosis of the soft tissue graft was registered. In all other cases, there was primary wound healing. The bone graft didn't consolidate in three of the patients. The mean bone graft resorption was comparable to those of delayed grafting procedures. After careful evaluation, the authors reported that this treatment protocol was successful and gave promising results (24).

In 2015 Stein and Hammächer introduced a technique for GBR with a DBBM xenograft and SSS utilizing a combined epithelized connective tissue graft. They applied a tunneling technique at 16 extraction sites in the anterior maxilla by undermining the buccal gingiva and the interdental papillae and placing the softtissue graft. In a five-month follow-up, they found a mean loss of 0.5 mm of the ridge width and a reduction in the height of the mesial and distal papillae by 0.2 mm and 0.4 mm, respectively. There was a 0.5 mm increase in the height of the buccogingival margin of the ridge. Therefore, the suggested method for SSS is appropriate for ARP in the esthetic region, especially in patients with thin a thin gingival biotype. However, the authors applied direct measurements by a periodontal probe and a caliper, which demands additional radiological assessment. Further research, using cone-beam computer tomography, should verify the reported re-

sults. Since tooth type and location affect the amount of RP (30), they should also be taken into account in further studies (31).

Based on optical scans, Thalmair et al. reported that the use of FGG for SSS can limit post-operative external contour alterations to a certain extent. Their study indicated that FGG gave statistically significant results in minimizing buccal contour resorption, irrespective of the use of xenografts. No complications regarding graft necrosis were observed (32). Younes and Khairallah (33) proposed an ARP technique applying a "one-piece" autologous bone and soft tissue graft, which was harvested from the maxillary tuberosity. They inserted the graft without flap elevation. By doing so, the periosteum remained intact and the MGJ was kept in its initial place. In fact, autologous grafts are still considered the gold standard in GBR due to their osteogenic, osteoinductive, and osteoconductive properties (34,35). The soft tissue from the maxillary tuberosity contains dense collagen fibers and well-keratinized epithelium. This contributes to the dimensional stability of the graft and stimulates its revascularization (36,37). Furthermore, tuberosity grafts heal fast with reduced patients' morbidity and show satisfactory color and contour (36). Using the "one-piece" technique for ARP demonstrated a reduction of bone resorption and an increase of soft tissue volume, thus providing an appropriate environment for implant-supported restoration in one simple approach. (33) As the authors suggest, future randomized control studies on this technique are necessary to present reliable results.

In 2021 Landsberg et al. published a retrospective study on ridge width alterations following SSS. The aim was to evaluate the changes in the ridge contour and the survival of the soft tissue grafts. The results showed that the mean resorption of the buccal width was 5.3%. In the incisor region, it was negligible and significantly less than in the canine and premolar areas. One week postoperatively about 2/3 (69%) of the grafts were vital, and 31% were partially vital. Complete necrosis was not reported. At 6 months following the extractions, the alveolar ridge invagination was 14%. The authors concluded that SSS is beneficial for ARP, especially in the incisor area. Within the limitations of their study, they report that SSS is effective in reducing post-extraction volumetric changes of the alveolar ridge. To confirm these results, additional research, comparing SSS to other ARP techniques, is needed (38).

DISCUSSION

The analyzed scientific database showed study heterogeneity. The results on graft survival and whether SSS with FGG give statistically significant results with regard to ARP, compared to other techniques, are controversial and remain disputable.

According to most of the studies, the application of FGG avoids the elevation of mucoperiosteal flaps, compensates for dimensional changes, and optimizes the conditions for ARP, immediate and late implant placement, and pontic site development (14,15,17). They serve as barriers, which cover the extraction sockets and isolate them from bacterial contamination (18). As for the esthetics, stability and color matching of FGGs into the surrounding tissues seem to meet this criterion. However, among the listed advantages, there are also some limitations of this method. First of all, the technique is considered to be technical skill sensitive. In addition, it leads to an increased treatment time and number of procedures. Considering the donor site, patients' morbidity should not be underestimated (17).

Further investigation based on randomized clinical trials and precise clinical, histologic, and radiological evaluation is needed to clarify the role of FGG as a method for ARP. Moreover, its application in the different areas of the ridge should be carefully evaluated.

CONCLUSION

Ridge resorption following extraction, especially in the anterior maxillary area, may cause functional, aesthetic, and phonetic complications. The use of FGG as socket sealers was introduced to limit the volumetric changes and allow for immediate or delayed implant placement or to create a satisfactory pontic site (18,39). They prevent the wound from bacterial contamination, outer migration of bone particles, and soft tissue cicatrization and displacement of the MGJ.

Besides the above-mentioned advantages, FGGs have several limitations. For instance, they require great surgical precision, increased surgical time, and may cause post-operative discomfort and pain (40,41). The reports on the survival rate of the

gingival grafts remain controversial (2,14,15,42) and we cannot be positive whether this method is superior to other ARP procedures and SSS in particular. Further research is needed to resolve the existing discrepancies.

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