

APPLICATION OF ALLOGENEIC GRAFTS FOR AUGMENTATION OF THE WIDTH OF ATTACHED GINGIVA IN PRE-PROSTHETIC SURGERY. A LITERATURE REVIEW

Elitsa Dzhongova, Velimira Georgieva

*Department of Oral and Maxillofacial Surgery, Faculty of Dental Medicine,
Medical University of Varna*

ABSTRACT

INTRODUCTION: Pre-prosthetic surgical procedures are intended to eliminate or improve any poor soft- and hard-tissue conditions in preparation of the prosthetic field. Vestibuloplasty continues to be regarded as a predictable and affordable procedure for increase of the prosthetic field, particularly in patients with removable dentures. With the introduction of dental implants, the need for pre-prosthetic surgical preparation of jaws has been considerably reduced, yet certain manipulations are still to be performed, such as increasing of the width of attached gingiva as well as correction of alveolar ridge defects using grafts.

AIM: The aim of the present paper is to discuss some of the allogeneic grafts used in soft-tissue augmentation for the purposes of pre-prosthetic surgery, as well as their advantages and disadvantages.

MATERIALS AND METHODS: The present study relied on dental literature data, concerning the application of various allogeneic grafts for enlarging the width of attached gingiva in pre-prosthetic surgery, found in PubMed and Google Scholar, from 1910 to 2021, published in the English language.

RESULTS: The publications addressed in this review provide information on the clinical features of allogeneic grafts as a substitute for autogenous grafts, especially in cases where larger size grafts are required or where their harvesting may be limited by various factors.

CONCLUSION: The application of autogenous grafts is supported by good clinical outcomes in the augmentation of the amount of attached keratinized gingiva. However, there are limitations associated with their harvesting. This necessitates the search for substitutes such as allogeneic or xenogeneic grafts, which could deliver similar clinical results.

Keywords: *allogeneic grafts, dura mater graft, amniotic membrane, acellular dermal matrix*

Address for correspondence:

*Elitsa Dzhongova
Faculty of Dental Medicine
Medical University of Varna
84 Tzar Osvoboditel Blvd
9002 Varna
e-mail: elica.djongova@mu-varna.bg*

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INTRODUCTION

Pre-prosthetic surgical procedures are intended to eliminate or improve any poor soft- and hard-tissue conditions in preparation of the prosthetic field. Vestibuloplasty continues to be regarded as a predictable and affordable procedure for increase of the prosthetic field, particularly in patients with removable dentures. With the introduction of dental im-

plants, the need for pre-prosthetic surgical preparation of jaws has been considerably reduced, yet certain manipulations still have to be performed, such as increasing of the width of attached gingiva as well as correction of alveolar ridge defects using grafts. The use of autogenous grafts involves the creation of a second wound as a donor site, thus increasing trauma and pain for the patient, particularly where a larger graft size is required. Furthermore, the operative time for harvesting an autogenous graft proves to be longer and the graft size is often quite limited. Therefore, the possibility of other donor tissue grafts is being considered to avoid the shortcomings of autogenous grafts.

AIM

The aim of the present paper is to discuss some of the allogeneic grafts used for soft-tissue augmentation in pre-prosthetic surgery.

MATERIALS AND METHODS

The present study relied on dental literature data concerning the application of various allogeneic grafts for enlarging the width of attached gingiva in pre-prosthetic surgery, found in PubMed and Google Scholar. All studies have been published in English, from 1910 to 2021.

One of the most commonly used techniques to enlarge the prosthetic field and increase the amount of attached gingiva is known as vestibuloplasty. However, in vestibuloplasty with secondary epithelialization, postoperative results may be compromised due to contracture of wound margins (1,2). For this reason, it is better to resort to the use of grafts (3,4,5). Since the application of autogenous grafts involves the creation of a second wound as a donor site, it leads to an increase in the trauma and pain for the patient, particularly where a larger graft size is required. This necessitates the clinical use of other donor tissues, such as allogeneic grafts.

Allogeneic transplants are grafts that are taken from one donor organism and transplanted into a recipient organism of the same species with a different genotype. Allogeneic grafts can be cells, tissues and organs, for example, skin, dura mater, amniotic membrane, etc.

Allogeneic grafts are tissue substitutes that must be biocompatible and must not trigger immune reac-

tions or be harmful. They must have the capacity to grow into the recipient site. Moreover, they must possess appropriate mechanical and physical properties such as stability, elasticity, flexibility and the ability to resorb to a degree corresponding to the tissue being replaced. Grafts are also required to allow strong cell adhesion and subsequent structural integrity. The ideal soft-tissue graft must help achieve hemostasis and must be resistant to infections, reduce pain and accelerate healing.

Dura Mater

In search of replacement materials for autogenous grafts, numerous studies have been performed using lyophilized dura mater in the attempt to increase the width of attached gingiva in mucogingival surgery (6,7,8,9). This type of graft is obtained from cadaveric donors with no evidence of past infectious diseases or malignancies. The grafts were treated with antibiotics for 24 hours at +4°C, then washed three times and dried at -80°C, placed in vacuum and sterilized in ethylene oxide. Prior to application, grafts are to be rehydrated in ambient saline for a minimum of 30 minutes (10). This dura mater graft has a mesh-like arrangement consisting of predominantly collagen fibers with gaps between them, without any cells (11).

Dental literature abounds in studies on the properties of the dura mater type of graft. One such study compared mucosal grafts and lyophilized dura mater and reported that the dura mater appeared to be an acceptable material for transplant procedures (12). Krekeler later applied it successfully in open vestibuloplasty (13). Reuter et al. recommended the use of lyophilized dura in preprosthetic surgery, especially in repairing larger mucosal defects (14). Another study clinically compared the use of free palatal mucosal autografts and homologous lyophilized dura in gingival extension procedures, indicating that the width of the zone of attached gingiva in the mucosal transplant group displayed significant decrease during the first 14 days, while the dura group gradually showed a marked decrease until 3 months after surgery (15). It also revealed that the surface of the newly formed attached gingiva resembled that of adjacent tissues, whereas palatal grafts differed significantly from the tissues of the recipient site.

Lyodura grafts have been used to limit epithelial migration for intraosseous periodontal defects and enabled the creation of new connective tissue attachment (16). Martis et al. (7) applied this type of allogeneic graft in preprosthetic surgery to assist secondary epithelial vestibuloplasty and found out that healing of the graft was observed by day 30 post-surgery, consisting largely of newly formed collagen fibers.

Bartolucci (11) examined the parameters of the width of attached gingiva in the mandibular arch using homologous lyophilized dura mater by conducting clinical observations over a 3-month postoperative period. The study reported the presence of connective tissue, entirely corresponding to adjacent tissues, covered with stratified squamous epithelium. These findings suggest that dura mater could serve as a biologic oral dressing for mucosal defects as effectively as palatal grafts in vestibuloplasty (17, 18).

As with autogenous grafts, significant postoperative contraction was also observed with lyophilized dura mater, ranging from 55% (13) to 63% (15). According to Barolucci the implanted graft evidenced a mean shrinkage of 46.7% (11).

Amniotic Membranes

Another allogeneic material previously used in preprosthetic surgery is the amniotic membrane (AM). It is the innermost layer of the placenta, which is a continuation of the ectoderm in the fetus. It has an inner layer of cells while its outer surface consists of mesenchymal stem cells. In the past AM was used primarily as a temporary wound dressing, particularly for burns (19), but it also found its application in vestibuloplasty for augmentation of the width of the attached gingiva at the prosthetic field (20, 21, 22). The amniotic membrane is obtained from seronegative mothers following cesarean deliveries where a section of the placenta is taken and treated. In order to be practical for clinical use, this type of allogeneic graft requires special storage conditions. Studies have shown that amnion can be maintained in viable condition for over 6 months when frozen at -70°C to -90°C or for up to 6 weeks if stored aseptically at -48°C in 0.5% silver nitrate solution, or in 20% glycerin solution (23). According to other studies, AMs can also be stored at ambient temperature after being sterilized by gamma radiation (24, 25).

When applying AM graft in mandibular vestibuloplasty, the results demonstrated that after surgery the graft hardly differed from the normal adjacent mucosa and the reduction in the depth of the buccal vestibule ranged from 7% to 40% after a 6-month follow-up (21).

Another study compared results from mandibular labial vestibuloplasty using standard Clark's technique with and without amnion as a graft material (Group I and Group II, respectively). The results showed that patients who received this allogeneic graft had a greater deepening of the vestibule: mean postoperative vestibular depth after 3 months in groups I and II were 10.0 ± 3.13 mm and 7.8 ± 0.63 mm, respectively. The reduction in the depth of the buccal vestibule in Group I was found to be 24.81% after a 3-month follow-up, while 42.22% reduction in the depth of the buccal vestibule was seen in Group II. The study lists some unique properties of this graft material, including good epithelialization initializations capacities, bacteriostatic and anti-adhesive effects against pathogenic microorganisms (26), low immunogenicity (27), pain-reduction properties as well as good revascularization (20). However, results from the studies of attached gingiva width reflect only a 3-month follow-up postoperatively without providing evidence for the recurrence rates after this period (22).

Güler et al. applied this graft material and claimed it was very suitable for vestibuloplasty, reporting the following results: on day 10, revascularization and epithelialization of the graft was observed and the amnion graft could not be differentiated; by day 14, the amnion had completely degraded; on day 21, the grafted areas were completely covered with oral mucosa (20).

Despite the relatively good clinical results (20, 22, 23, 26), AM as a graft material has its own disadvantages, especially its specific way of harvesting and subsequent freezing and storage. Apart from the sensitive harvesting technology, AM handling is not easy and demands considerable experience (28). In

view of the above considerations and due to moral controversies and limitations, this allogeneic graft has not gained much ground in clinical applications.

Acellular Dermal Matrices (ADMs)

The acellular dermal matrix (ADM) is derived from human skin tissue. It is freeze-dried and all dermal and epidermal cells are removed from it, preserving the collagen and elastic fibers. The acellular dermal matrix serves as an architectural scaffold to facilitate the migration of and repopulation by the host's fibroblasts and epithelial cells adjacent to the operative field (29). Acellular dermal matrices were introduced in 1992 to treat burns, and in 1994 such grafts were used in plastic and mucogingival surgery (30, 31). They are presented as a substitute for autogenous palatal grafts for increasing keratinized gingiva around dental implants (32, 33, 34, 35, 36). Many researchers carried out studies confirming ADM good clinical outcomes in covering exposed root surfaces in gingival recessions (37,38,39,40,41,42).

Hashemi et al. compared the application and effectiveness of ADM and mucosal graft for vestibuloplasty (43). Other authors also used it to increase the prosthetic field and found it to be a good alternative to autogenous grafts, especially when a larger size graft was required (44).

The question of the exact width of keratinized mucosa around dental implants for achieving long-term healing and aesthetic results has so far remained unanswered in relevant literature (45,46). According to some studies, the biological width is around 1 mm larger than that around natural teeth (47,48). Anderson et al. reported that allogeneic ADM grafting can be used successfully in the augmentation of soft- and hard-tissue defects in the aesthetic zone around dental implants and can lead to increased mucosal thickness, a reduction in concavity dimensions, and have a potential for recession reduction (34).

Another study examined the use of ADM to correct soft tissue defects and depressions in partially edentulous alveolar ridges. Although the study did not involve dental implants, the authors demonstrated the ADM potential for correcting them as well (49).

RESULTS

The publications addressed in this review provide information on the clinical features of allogeneic

grafts as a substitute for autogenous grafts, especially in cases where larger size grafts are required or where their harvesting may be limited by various factors.

DISCUSSION

The exploration of various grafts has been prompted by the disadvantages of autogenous grafting methods, such as insufficiency of the graft size for augmentation purposes, difficulties in their harvesting, donor site pain, discomfort and temporarily impaired quality of life. The presence of a thicker layer of attached keratinized gingiva acts as protective factor against inflammation of the marginal tissue in patients undergoing prosthetic treatment (50).

Despite the good clinical outcomes reported for the application of lyophilized dura mater (11, 13), some authors claim that significantly less shrinkage is obtained postoperatively using mucosal grafts (12, 15, 51), which is regarded as a disadvantage of the lyodura. Some researchers believe that the application of homologous lyophilized dura in gingival extension procedures is unjustifiable as it may not give predictable results (15), which is consistent with other clinical studies (13).

The amniotic membrane has limited application as a graft material in the oral cavity. A most recent comparative study (in 2021) was conducted focusing on the healing properties and vestibular depth relapse of ADM and the cryopreserved human AM. The observations of this study indicated faster postoperative healing with ADM compared to AM due to the higher level of infiltrating macrophages, the specific structure and porosity of ADM, providing a favorable anchorage for cell migration and fixation (52).

In spite of the reports about successful ADM application, a comparative study of the percentage shrinkage of grafts showed that the ADM site had significantly more shrinkage (76.6%) than the free gingival graft (FGG) site (49.7%) and a comparatively lesser gain in the width of attached gingiva than the FGG-treated sites (53). These findings are consistent with other studies (29, 32). In terms of aesthetic restoration, ADM grafts provide better results compared to FGGs (29,32,54,55) and similar performance to that of connective tissue grafts (56,57). However, the greater shrinkage makes this grafting material less effective and less predictable as opposed

to free autogenous mucosal grafts (58). Histological examinations suggested that the resultant tissue types of ADM grafts were similar to “scar” tissue and lacked the capability of differentiation of the covering epithelium (58).

CONCLUSION

The application of autogenous grafts is supported by good clinical outcomes in the augmentation of the amount of attached keratinized gingiva. However, there are limitations associated with their harvesting. This necessitates the search for substitutes such as allogeneic or xenogeneic grafts which could deliver similar clinical results.

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