Managing Soft Tissue Fenestrations in Bone Grafting Surgery with an Acellular Dermal Matrix: A Case Report

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The success of bone grafting procedures depends largely on the management and integrity of the gingival flaps. Soft tissues aid in the protection of the bone graft, participate in the revascularization of the newly formed hard tissues, and play an important role in the esthetic outcome of the reconstructive phase. Acellular dermal matrix (ADM) is a material obtained from human skin and used in plastic and reconstructive surgery as an allograft. It acts as a bioactive substrate for cell attachment and proliferation. The outcome of the use of ADM as a dressing material to treat flap fenestrations in bone grafting surgery is presented. (INT J ORAL MAXILLOFAC IMPLANTS 2001;16:875–879)

Key words: *biocompatible materials, dental implants, extracellular matrix, homologous transplantation, maxillofacial surgery, reconstructive surgical procedures, surgical flaps, treatment outcome, wound healing*

The integrity of soft tissues is an important aspect of successful reconstructive and plastic surgical procedures.[1] A soft tissue flap with appropriate thickness and blood supply is of primary importance for graft survival, protection, and revascularization.[2,3] Achievement of such goals may sometimes be impaired by surgical limitations related to anatomic factors. In this regard, the known variability of anatomic features such as the thickness of soft tissues[4] and bony contours[5] may increase the risk of accidental soft tissue perforations or dehiscence. Management of such flap complications often demands suturing of the adjoining edges of the soft tissue, and in these situations the use of autogenous bone grafts[2] or particulate bone substitute materials[6] may increase the likelihood of graft exposure and particle loss, respectively.

Acellular dermal matrix (ADM; AlloDerm, LifeCell, The Woodlands, TX) is an allograft obtained from human skin and has only recently been introduced in oral surgery for reconstruction of soft tissues. This material has been employed in reconstructive and plastic surgery as a substitute for autogenous skin grafts with good results.[7,8] Its potential as a material for oral reconstructive purposes has been demonstrated in association with root coverage procedures,[9] mucogingival surgery,[10] and in the treatment of soft tissue ridge defects.[11] After processing, a number of connective tissue extracellular matrix and basement membrane components are salvaged in the material[12]; they are capable of interacting with the receptor tissues, thus serving as a bioactive scaffold for migration of fibroblasts and epithelial cells.[13–15]

The aim of this report was to present the outcome of patient treatment in which ADM was used as a soft tissue dressing material for coverage of autogenous bone grafts after 3 fenestrations were accidentally produced in the flap because of uneven topography of the buccal bony plate with thin mucosa.

CASE REPORT

A 55-year-old, nonsmoking female patient with no contributory systemic history was scheduled to receive 4 endosseous implants in the maxillary anterior area and a bar-and-clip–supported overdenture

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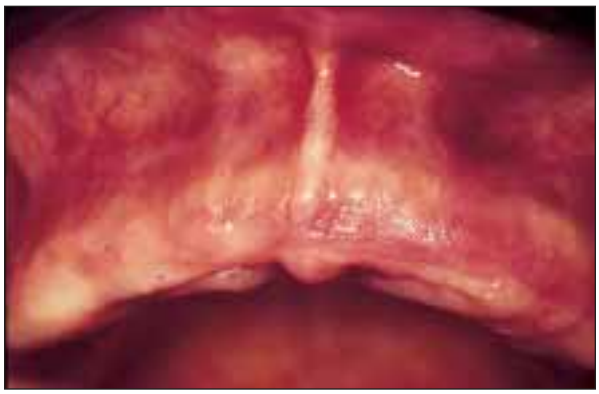

Fig 1 Preoperative aspect of the area candidate for the placement of endosseous implants. Although the band of keratinized tissue appears sufficient, the thickness is reduced.

(Fig 1). A computed tomographic scan revealed the atrophic condition, and a bone graft was planned before the placement of implants. During elevation of the mucoperiosteal flap, the unfavorable topography of the buccal bone plate and the presence of bone irregularities, along with the thin pattern of the soft tissue, resulted in the production of 3 perforations in the flap.

Cortical perforations were prepared in the receptor area to expose the marrow and improve vascularization and contact with osteogenic marrow components. After onlay bone grafts were harvested from the chin, they were positioned on the premaxilla and fixed with screws (Ace Surgical, Brockton, MA) (Fig 2a), and the intervening area was then filled with bone marrow blended with demineralized freeze-dried bone allografts (DFDBA). Replacement of the flap to its original position would cause portions of the grafted bone to remain exposed in the areas of fenestrations and loss of the particulate filling materials and DFDBA. Also, a membrane for guided bone regeneration would be highly contraindicated considering the risks of progressive exposure and infection.[16]

Therefore, to protect the bone graft and DFDBA from being exposed, two 2×4-cm pieces of ADM were used. First, the material was reconstituted with saline (50 mL) for 10 minutes. This procedure was repeated after the saline was replaced to rehydrate the material and remove trace amounts of antibiotic used in the manufacturing process. After reconstitution, the appearance of the material resembled that of a connective tissue graft, which makes it very easy to handle. The material has 2 sides; one corresponds to the basement membrane (epithelial side) and the other is the counterpart of the connective tissue side of the skin. After the margins of the ADM were trimmed with Goldman-Fox scissors (Hu-Friedy, Chicago, IL), the fit was checked and the material was placed with its connective tissue side in direct contact with the bone grafts and the epithelial side facing outward (Fig 2b). After fenestration of the periosteum at the base of the flap, the material was sutured to completely cover the ADM. Care was taken not to create excessive tension or to promote its displacement (Fig 3a). No direct stabilization of the material with periosteal sutures or screws was carried out in this case. The material remained exposed in the areas of fenestrations, with its epithelial surface exposed, and no signs of bone grafts or DFDBA were observed. The patient was placed on a routine systemic antimicrobial prescription (amoxicillin 500 mg every 8 hours for 15 days) and chlorhexidine digluconate 0.12% (Colgate Periogard, São Paulo, Brazil) every 12 hours for 10 days. Chlorhexidine was discontinued after this period because of its reported fibroblast toxicity,[17] which could hamper cell proliferation through the exposed pieces of material.

Sutures were removed at 10 days and at this time the material was attached to the borders of the flap, although it was not completely covered by tissue (Fig 3b). The patient was instructed to refrain from using the prosthesis for 10 days. The maxillary anterior area of the prosthesis was then thoroughly relieved, and a thin layer of tissue conditioner (Coe-Soft, GC America, Chicago, IL) was applied. The patient was instructed to eat soft food until complete coverage of the material was achieved. Examinations were made every week for 2 months and no adverse reactions were observed during this period. After 45 days, the material had been completely covered by the surrounding epithelial and connective tissues, and the color and clinical characteristics of the tissues were compatible with a healthy condition (Fig 3c).

After 9 months, the area was reevaluated through a computed tomographic scan and reentered to place the implants. A new mucoperiosteal flap was raised. No signs of fibrous tissue were observed over the bone plate, and a significant horizontal gain had been obtained. No difference regarding tissue consistency was observed during incision and flap elevation, and 4 threaded hydroxyapatite-coated implants (Steri-Oss Replace, Nobel Biocare, Yorba Linda, CA) were placed in the area.

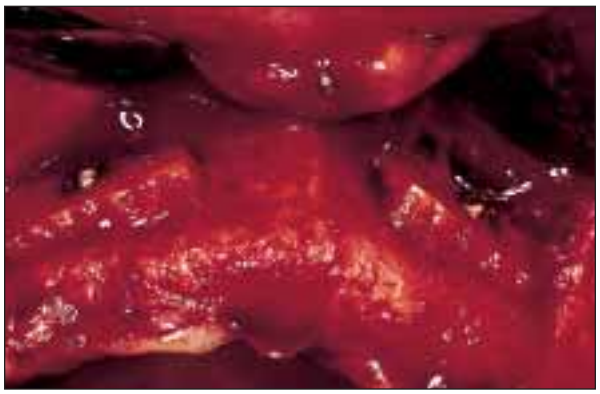

Fig 2a Onlay bone grafts were harvested from the chin and stabilized with labial screws. The area between grafts was filled with bone marrow from the chin blended with DFDBA.

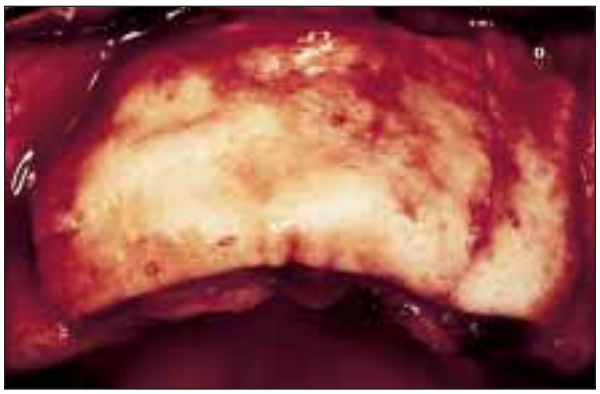

Fig 2b After reconstitution with sterile saline, two 2×4-cm pieces of ADM were placed to completely cover the grafts.

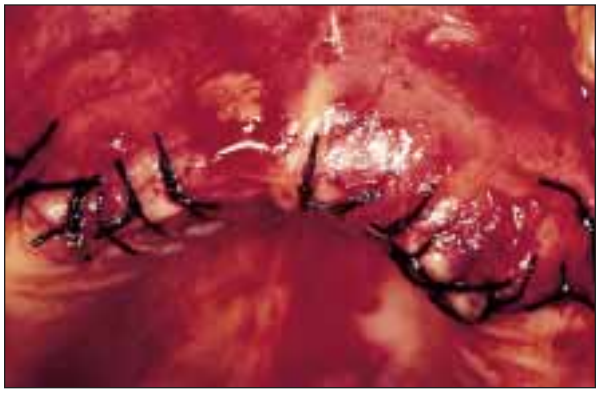

Fig 3a After suturing, the material was completely covered by the flap. Fenestrations were observed in 3 different locations.

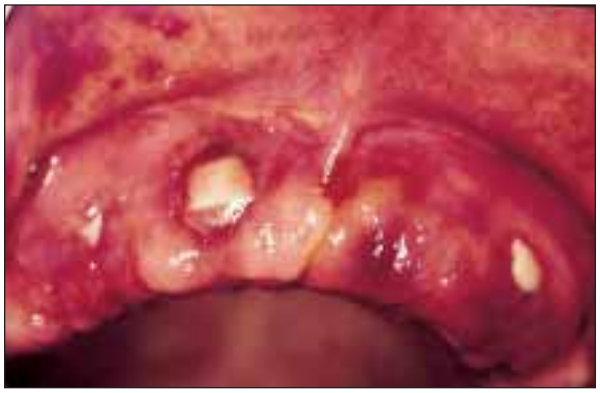

Fig 3b After 10 days, sutures were removed. The material under the flap and the fenestrations seemed to be even more severe because of flap contraction.

DISCUSSION

The matter of soft tissue management has only recently gained increased attention. Together with esthetic concerns, it has proven to be an important issue in the outcome of reconstructive procedures.[18] The present patient report showed that a skin allograft could be used as a dressing material in the management of soft tissue injuries that could hamper the outcome of a bone grafting approach. Acellular dermal matrix has shown good results in ophthalmic surgery,[19] plastic surgery,[20] and reconstructive surgery of burned patients.[13,14] Its immunogenic potential and inflammatory-induced reactions are not significant,[15,19,21] which is basically ascribed to the fact that it is deprived of cells and major histocompatibility complex (MHC) molecules.[12] Some of the basic features that seem to remain in the material are collagens, proteoglycans, and extracellular matrix glycoproteins associated with cell attachment, such

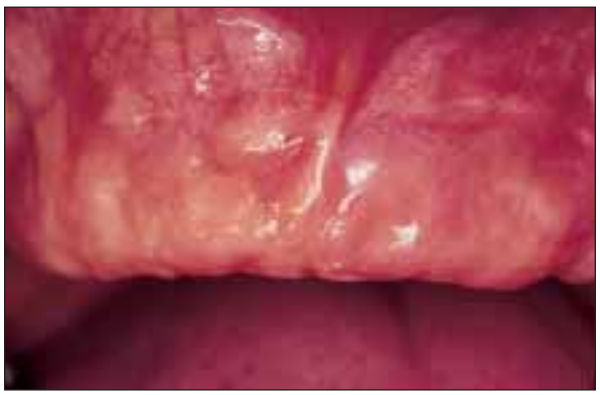

Fig 3c Aspect of the area after 45 days, showing complete coverage of the previously exposed ADM. A slight difference in tissue texture can be seen in the areas of former fenestrations.

as laminin.[12] The material thus seems to act as a bioactive scaffold onto and into which fibroblasts and epithelial cells can migrate, attach, and repopulate, provided that the appropriate blood supply is present underneath the material. This blood supply will allow nourishment for the incoming cells, which seems to be an important issue in the successful use of this material.

Thus, during healing the material is incorporated by the tissues and remodeled, and according to the results presented here and elsewhere,[9,11,13] no clinical differences were observed between the material and the surrounding tissues, although histologic evidence indicates that differences may exist, at least when the material is grafted on gingival tissue.[9] It is also noteworthy to mention that in this situation any pressure on the material should be avoided because of the fact that movement might impair proper cell interaction with the material. The negative effects of pressure have been demonstrated by the delayed healing observed in soft tissue ridge defects in which contact was present with the material during the healing phase.[11] Adverse side effects of commercial preparations of chlorhexidine[16] used for prolonged periods should not be discounted as well, especially when portions of the material remain exposed.

An interesting property of ADM is that, when appropriately handled and used, portions of the material may be left exposed. In fact, 1 of the applications of ADM in periodontal surgery is to augment the band of keratinized tissue and deepen the vestibule in a nonsubmerged fashion. Although this is a critical situation related to the fact that the material remains completely exposed, the technique has proved to be somewhat effective,[10,22] and as long as it remains in total contact with the connective tissue bed, it will integrate. In contrast, root recession treatment seems to require complete coverage (submerged fashion) of the material by the flap because the root surface does not contribute to the blood supply of the incoming cells. More studies are necessary to better understand the behavior of this material within the oral tissues and its potential application in different situations.

The risk of infection of this material in some procedures has been regarded as being less critical because of the fact that it is soft and easily handled compared to other materials[7] and thus can be more predictably covered by soft tissue.[21] In the present case, however, some parts of the material remained exposed, even after antibiotics and chlorhexidine were stopped (at 15 and 10 days, respectively). No signs of infection or exacerbated inflammation were seen, and it is possible that the trace amounts of antibiotics present in the material itself, even after reconstitution, may have some lasting bacteriostatic effect.[11]

In the case presented, the use of a conventional barrier membrane for guided bone regeneration would likely be less than optimal, considering the risk of infection and the likelihood of its progressive exposure. Acellular dermal matrix aided in protecting the graft, as a dressing material, and also served as an artificial substrate containing extracellular matrix (ECM) components for tissue repair. No attempts to evaluate its potential as a barrier for guided bone regeneration were made in the present situation, although this effect may also be possible. In this regard, controlled studies with large samples are warranted.

Another aspect to be considered is the safety of a graft obtained from postmortem material. Despite the relative efficiency of different processes in neutralizing viruses and other sources of infection in bone banking,[23] strict protocols used for donor eligibility seem to be one of the main features of allograft safety.[24,25] Although reports associating ADM with the transmission of diseases are currently unknown and strict protocols are employed in skin processing and donor procurement, it is a relatively new material and the patient must be aware of its origin.

In the patient treatment described, the therapeutic procedure of choice should be directed toward protecting the bone graft from being exposed and creating a favorable environment for soft tissue healing. Based on the results of this single case report and other referenced data, ADM seems to be a useful tool for oral soft tissue reconstruction, and the possible array of applications deserves consideration.

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