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Acellular Dermal Matrix Augmented Peri-Implant Mucosa: A Histological Analysis

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Abstract : An essential component for the success of dental implants is adequacy of keratinized tissue. Autografts have been used successfully to augment deficient keratinised mucosa around implant with predictable results but additionally require surgical intervention at donor site. Acellular Dermal Matrix (ADM) provides an alternative treatment option while negating the disadvantages associated with additional surgical site.

A grafted tissue or material undergoes transformation during wound healing and this can be best evaluated histologically. In this case report, we evaluated an ADM augmented peri implant mucosa site at 6-months interval to assess the soft tissue healing and its composition prior to implant loading.

The acellular dermal graft site showed keratinised mucosa and connective tissue evidence of elastin fibres and various cellular (predominantly fibroblasts) and vascular elements.

Keywords -*Acellular Dermal Matrix, Graft, Dermacell*

I. INTRODUCTION

Acellular Dermal Matrix (ADM), a type of surgical mesh, is developed from human skin (such as FlexHD, AlloMax, AlloDerm) or animal skin (such as SurgiMend), in which the cells are removed and the support structure is left in situ [1]. The acellular dermal matrix allograft (ADMA) has been widely studied and used as a substitute for autogenous grafts in periodontal soft tissue surgeries, although it was originally developed for the treatment of full-thickness burn wounds (Yan et al., 2006; Barros et al., 2004; Cummings et al., 2005; De Queiroz Côrtes et al., 2004) [2].

There are several benefits of using ADM in periodontal soft tissue reconstruction, like avoiding the palatal donor site, treating multiple gingival recessions in a single visit, unlimited tissue availability, high-quality donor tissue, results that are comparable to or better

than those of autogenous palatal tissue grafts, a higher case acceptance rate, and reduced postoperative discomfort. (Silc and Petrungaro, 2013) [2].

II. CASE REPORT

Case presentation:

A 40-year-old systemically healthy female patient reported for a second stage surgery post implant placement at edentulous 36 region after a healing period of 6 months. On clinical evaluation the surgical site revealed deficient keratinised tissue zone, shallow vestibule depth and high attached mucosal fold extending till crest of alveolar ridge. (Fig 1)

Surgical phase:

Under local anaesthesia, using a # 15 blade a horizontal partial thickness incision was made extending from 35 – 37 region 2mm from the gingival margins. At implant site the incision was kept para-crestal toward lingual of the edentulous crest to ensure complete displacement of mucosal fold. From incision line, flap was carefully reflected without exposing the implant surface and apically displaced and secured with 5- 0 resorbable interrupted periosteal sutures. A partial thickness lingual flap was also raised to create a pouch lingually for stabilization of the dermal matrix.

The surgical site was measured mesio-distally and bucco-lingually to ascertain the shape and design of ADM. ADM was trimmed to fit the recipient surgical bed with lingual extension submerged under lingual flap and secured using horizontal mattress suture. On the buccal side ADM was secured with interrupted periosteal sutures using 5-0 vicryl (Fig 2).

Follow-up:

During post op follow up the ADM showed signs of superficial sloughing but stable base. At 2 weeks sutures were removed and surgical site showed epithelialization of the periphery of the surgical site.

At 6 weeks follow up the surgical site was completely epithelialized and showed increased KTW and apically displaced mucosal fold with deepening of vestibule.

Patient was recalled at 6 months interval for implant exposure and further prosthetic rehabilitation of edentulous site. Punch technique was used to expose the implant and also obtain tissue specimen for histological assessment.

III. HISTOLOGICAL ANALYSIS

Two samples were submitted for histopathological evaluation to oral pathologist, the first sample was ADM tissue left unused post-surgery and second sample from ADM recipient site after 6 months.

Histologically, the first ACDM sample showed no cellular and vascular components and consisted of only bundles of collagen fibres under light microscopy (after staining with haematoxylin and eosin).

The second sample showed cellular and vascular components on H&E staining. Sirius red and resorcin-fuchsin stain & transmission electron microscopy displays typical cross

bands similar to the intact fibers within the native dermis [3,4]. The distinguishing component of ADM, when compared histologically to human gingival tissue, is its abundance of elastin. Although elastin is present in the oral mucosal tissues, it is not present in gingiva [4].

IV. FIGURES AND TABLES

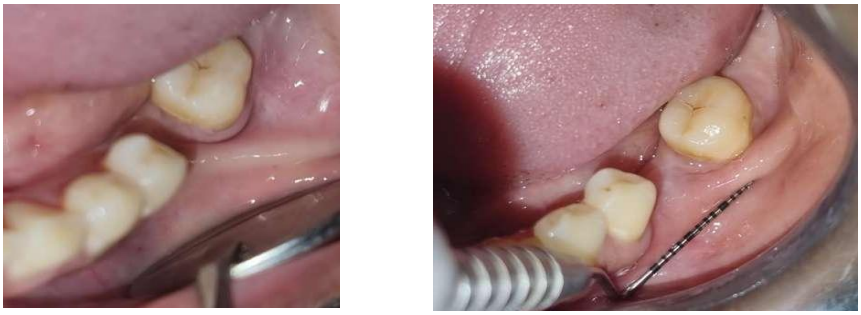


Fig 1: Baseline clinical image: Post implant placement showing inadequacy of keratinized tissue irt edentulous 36 region with a high attached mucosal fold and a shallow vestibule.

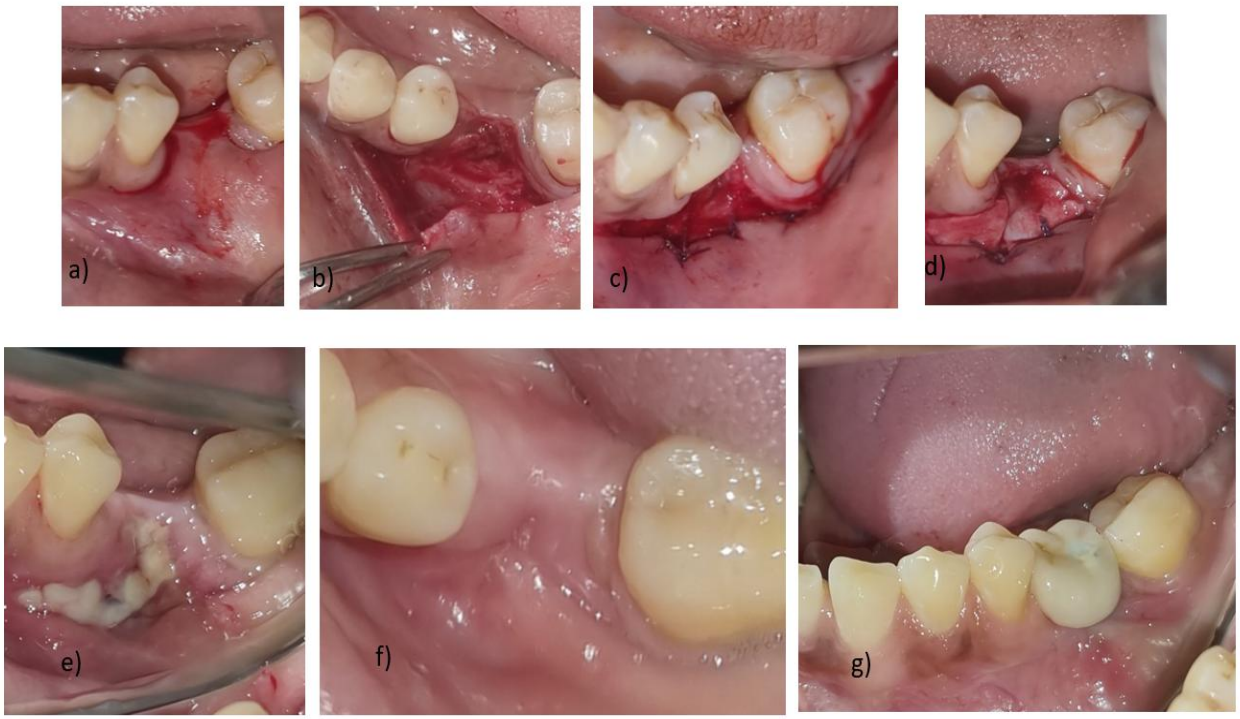


Figure 2: a) Incision; b) Partial thickness flap reflection; c) Flap displaced apically and secured; d) Placement of the Acellular Dermal Matrix; e) 2weeks follow-up after suture removal; f) 6 weeks follow-up images showing increased width and bulk in keratinized tissue with apically displaced mucosal fold g) Clinical post op

Fig 3 a) Histology of ACDM Fig 3 b) Punch biopsy taken at 6 months at time of 2nd stage surgery

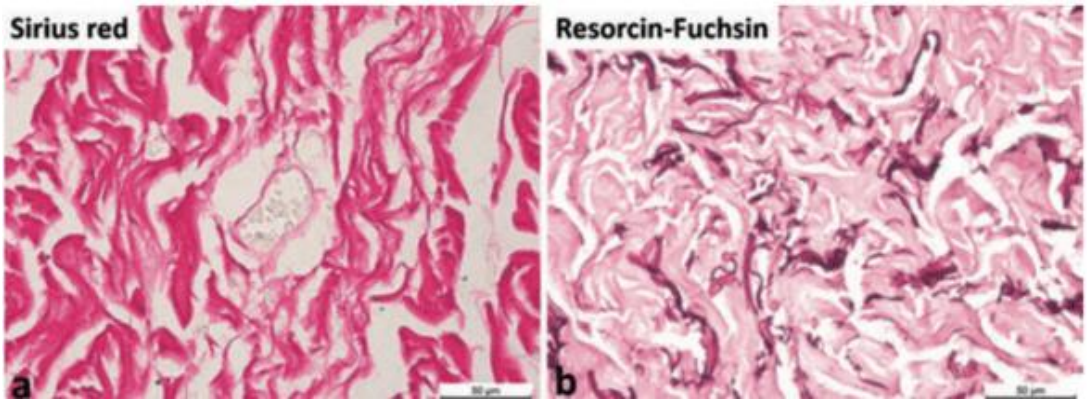
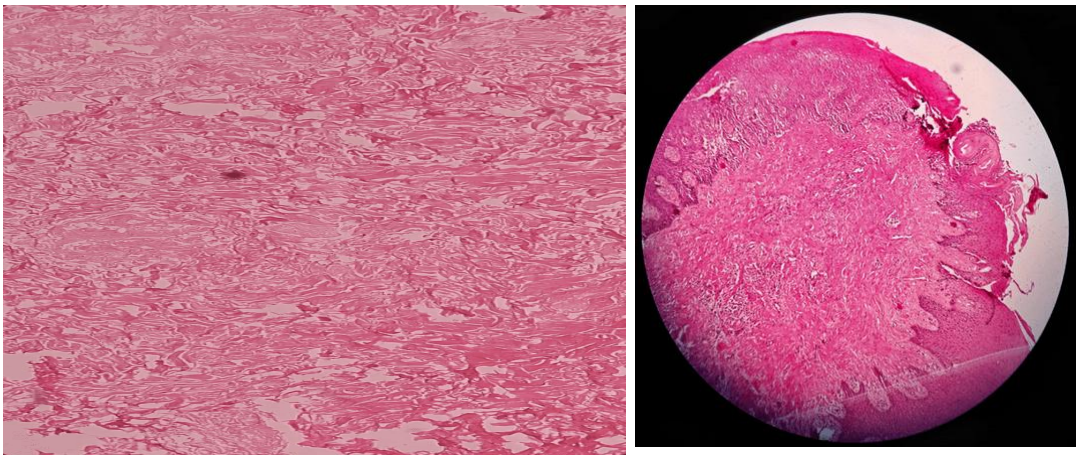


Fig 4: a) Newly formed collagen fibres around blood vessels b) Longer less fragmented elastic fibres.



V. DISCUSSION

Tissue engineering is an important adjuvant in the treatment of oral wounds. In the triad of cells, scaffold and regulatory factors, scaffolds have been the subject of much research and major advances [5,6]. However, even with recent advances, scientific evidence from experimental studies on the effects and functions of matrices in the healing process is of fundamental importance for expanding the clinical indications of different dermal matrices. Biocompatible matrices can simulate the extracellular matrix of native tissue, providing a porous structure and an environment favorable to cell growth, proliferation and differentiation, which are partly responsible for wound healing [7].

There is a need for an “adequate” zone of keratinized mucosa around dental implants to prevent soft-tissue recession and to facilitate oral hygiene measures [8]. An "inadequate" dimension is typically characterized as having less than 2 mm of keratinized mucosa in a study on the connection between the breadth of keratinized mucosa and the health of the soft tissues at teeth and around implants. Furthermore, it is claimed that the keratinized tissue inhibits bone resorption in the presence of plaque-associated inflammation. Therefore, it is

suggested that "keratinized tissue should be created with mucogingival surgical techniques prior to implant placement if not present in adequate amounts" [9].

Several months post-implantation, ADM acquires a loose connective tissue appearance, and heterogeneous cell populations associated with it, most abundant cells being fibroblasts which were proteo-synthetically more active than the native tissue, possessing a large pale nucleus (suggesting a significant amount of euchromatin), a well-developed nucleolus, and dilated cisterns and sacs of rough endoplasmic reticulum. Additionally, cells of lymphoid and myeloid lineages, as well as plasma cells/large lymphocytes, macrophages, granulocytes, and mast cells were also found indicating ADM being completely colonized by numerous types of cells, a characteristic phenomenon observed in loose connective tissues [3].

Light microscopy demonstrated thin, wavy newly manufactured collagen fibres around newly formed blood vessels and confirmed presence of fibroblasts and blood vessels within originally acellular matrix [3,4]. Immunohistochemistry and histochemistry confirms presence of blood and lymph vessels and diverse cell types inside implanted ADM [3]. This vascularisation accounts for nutrients and oxygen supply for epidermal cell maintenance and proliferation [10].

Collagen fibers of the native overlying connective tissue and underlying area corresponding to the implanted ADM are found to be similarly dense and incorporated such that it is difficult to differentiate the two with standard H&E. On staining with Verhoeff's solution, abundance of elastin contained within the band of densely arranged collagen fibers associated with the ADM graft is seen. The graft displays a greater quantity of elastin than the overlying native connective tissue of the mucosa and the collagen arrangement of the ADM appeared denser than that of the adjacent mucosa. This distinct difference in the organization of elastin and collagen fibers allowed a differentiation of the graft from the overlying gingival and mucosal tissues. The outer portion of the ADM approximating the overlying mucosal flap shows inter-digitating collagen fibers spanning between the matrix to the more loosely arranged mucosal tissue [4].

VI. CONCLUSION

Compared to the surgical morbidity associated with autogenous tissue graft, ADM presents a successful alternative markedly reducing the recovery time with less likelihood of swelling and bleeding. Apically positioned flap is best evidence-based approach to enhance the KTW, the chief concern in our case. The ADM graft integrated well with the native tissue providing significant gain in KTW despite of the known shrinkage rate of 56 to 71% as it was left uncovered.

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