Case Report

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Role of Regenerative Scaffold for Burns

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Abstract

Burn injuries are prevalent among all age groups and can result from thermal, scald, or electrical sources. Currently, various scaffolds are employed to enhance the healing process and minimize scar formation. Collagen serves as a scaffold, facilitating tissue regeneration and promoting the formation of new blood vessels. Additionally, scaffolds such as amniotic membrane aid in proper epithelialization and scar reduction, boasting unique anti-inflammatory and bacteriostatic properties. In our study, we utilized amniotic membrane allograft as a biological dressing for burn wounds on a adult patient's right thigh.

Keywords: Scaffold, Regenerative, Wound, Burns.

INTRODUCTION

The process of wound healing is a biological response to various forms of injury, encompassing physical, chemical, mechanical, or thermal damage. This process typically involves several sequential phases: homeostasis, inflammation, proliferation/ granulation, and remodelling/maturation[1]. However, deviations from the normal healing trajectory often result in stagnation during the inflammatory phase, particularly evident in cases of burns where standard healing mechanisms may be compromised[2]. In contemporary medicine, the utilization of scaffolds, whether natural or synthetic, has gained traction and recognition. An optimal scaffold should possess specific characteristics: appropriate physical and mechanical properties, a physiological background conducive to cellular adhesion, proliferation, and differentiation, high porosity, a favourable surface area to volume ratio, flexibility to conform to wound shapes, and ideally, biocompatibility and biodegradability[3]. Collagen, whether synthetic or natural, serves as a surrogate for the dermal matrix, facilitating epithelialization during wound healing[4]. Additionally, collagen degradation during this process contributes to neovascularization, thereby promoting angiogenesis. Amniotic membrane, a natural scaffold, exhibits distinctive properties such as anti-inflammatory, bacteriostatic, anti-fibrotic, anti-scarring, and epithelization-promoting

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qualities[6]. Its low immunogenicity and presence of progenitor cells make it an appealing choice for scaffold applications in wound healing. Silicone functions as a barrier, reducing mechanical friction and trans epidermal water loss, factors associated with infection severity. In vitro studies suggest that silicone may modulate inflammatory growth factors implicated in fibrosis and support acute wound healing, including key inflammatory markers like TNF-α, TGF-β, IL-1, and IL-6.This study highlights the role of regenerative scaffold for burns.

MATERIALS AND METHODS

This research was carried out at a Tertiary Care Centre within the Department of Plastic Surgery following approval from the department's ethical committee. Informed consent was duly obtained. The subject of this study was a eight years old female who sustained accidental second-degree thermal burns affecting the chest and the right upper limb (*fig 1*). Despite being promptly taken to a nearby hospital, initial resuscitation was inadequate within 30 minutes. She subsequently developed blistering, swelling around the chest region the following day, and presented to our centre with a delay of 12 hours. Upon admission to the tertiary burn care unit,she received initial resuscitation involving intravenous fluids, analgesics, and prophylactic antibiotics. On the fourth day post-burn, a two-layered scaffold dressing was prepared and applied to the deeper burn areas following dermabrasion-assisted tangential excision (*fig 2*). This scaffold comprised dry collagen sheet and silicone sheet directly contacting the wound. The dressing remained in place for seven days, during which time the collagen sheet was completely absorbed and the silicone sheet layer was also removed.

Fig. 1: Figure showing second-degree thermal burns affecting the chest and the right upper limb

Fig. 2: Figure showing two-layered scaffold dressing

RESULTS

Throughout both the intraoperative and postoperative phases, the patient experienced no notable events. Upon opening the dressing on the seventh day post-operation, substantial areas of re-epithelialization and healing were observed. Complete healing of all second-degree superficial burn wounds was achieved without any complications or adverse effects noted throughout the entire procedure (*fig 3*). BJWAT wound score improved from 32 at presentation to 13 after utilization of regenerative scaffold.

Fig. 3: Figure showing complete healing of all second-degree superficial burn wounds

DISCUSSION

Partial-thickness burn injuries have the potential to heal spontaneously, whereas full-thickness burns typically necessitate skin grafting to achieve complete wound closure. Historically, split-thickness skin autograft has been the preferred method for closing excised full-thickness burn wounds[5]. However, patients with extensive burn injuries may face challenges due to limited availability of donor sites for autograft harvesting, prompting consideration of alternative options such as skin substitutes. Engineered skin substitutes offer temporary coverage for wounds until donor sites are available for autografting or, if containing autologous cells can provide permanent closure[7]. While the availability of permanent skin substitutes remains limited, advancements in tissue engineering are anticipated to yield improved models, thus enhancing the options for managing burn wounds. For instance, the commercially available Dermal Regeneration Template comprises a two-layered system. The outer layer, composed of a thin silicone film, serves as a protective barrier against infection and regulates heat and moisture loss. The inner layer, consisting of a collagen glycosaminoglycan (GAG) thermal layer, acts as a biodegradable template facilitating dermal tissue regeneration. The porous nature of the template aids in skin regeneration by serving as a scaffold for tissue growth. Following regeneration of the dermal layer, the outer layer of the template is replaced with a thin epidermal skin graft, allowing for flexible, permanent skin regeneration and promoting faster wound healing with minimal scarring. Seeking to emulate this mechanism, we have developed an indigenous dermal regeneration scaffold using silicone sheet and dry collagen sheets[3]. This cost-effective scaffold can be readily prepared and utilized, particularly in hospital settings within developing countries where the affordability of commercial regeneration templates may be a concern.

CONCLUSION

The efficacy of employing a cost-effective regenerative scaffold dressing in treating second-degree scald burns has been demonstrated in this study. It accelerates the overall healing process of both superficial and deep second-degree wounds, thereby reducing hospitalization duration and infection rates. Nevertheless, further extensive multicenter, double-blinded controlled research incorporating statistical analysis is warranted.

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