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Utilizing Collagen and Dermal Matrix Extract Scaffold: Effective Regenerative Therapy for Burn Injuries

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Abstract

Tangential excision followed by immediate coverage using split skin grafts is considered the standard approach for treating deep burns, but it comes with its drawbacks. Challenges arise when there's a lack of donor area, and the grafts often lead to contraction and suboptimal aesthetic and functional results. While various biological and cellular substitutes have been developed, they tend to be costly and not always suitable for routine use in our demographic. Here, we present a new technique utilizing a collagen and dermal extract scaffold from full thickness skin graft (*Fig. 3*) obtained from abdominoplasty (*Fig. 2*) of the same patient for wound coverage. This scaffold offers safety, ease of preparation, affordability, and effectiveness in managing raw areas post-procedure.

Keywords: Dermal matrix scoffolding; Regenerative therapy; Thermal burns; Wound healing.

INTRODUCTION

The primary objective in managing patients with thermal injuries is the prompt closure or coverage of burn wounds, which significantly reduces morbidity and enhances functional recovery. Early excision of burn wounds, pioneered by Cope *et al*., has become the global standard of care for deep burns. The aim of this approach is to eliminate all necrotic tissue and prepare the wound bed for skin grafting. However, tangential excision has a notable drawback: significant intra operative blood loss, both from the excision site and the skin graft donor area. Harvesting split-thickness grafts, particularly in unstable patients, can exacerbate blood loss and worsen the patient's overall condition. In such circumstances, autografting by abdominoplasty may be considered. Collagen sheets, offer numerous advantages. They create a physiological interface between the wound and the environment, forming a barrier against bacterial invasion. Moreover, collagen is natural, non-immunogenic, nonpyrogenic, hypoallergenic, and painless. While collagen serves as a temporary cover until permanent split-thickness grafting can

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be performed, it prolongs the epithelialization process. The collagen-GAG scaffold facilitates regeneration of tissue simulating the function of dermis[2]. In this article, we emphasize the utilization of a novel scaffold composed of collagen and dermal extract[1]for wound bed coverage in a patient with 15% accidental thermal burns.

MATERIALS AND METHODS

A 70-year-old female patient was admitted to the JIPMER Tertiary Care Burns Centre following accidental thermal burns affecting bilateral gluteal region (*Fig. 1*). Upon admission, the patient received stabilization according to the ATLS protocol, and IV fluid resuscitation commenced as per the Parkland formula. Once stable, the burns were evaluated, revealing second-degree deep thermal burns over bilateral gluteal region.

Fig. 1: Showing the thermal burn wounds over gluteal region at time of presentation

On the fortieth day post-burn, the patient underwent dermal matrix scaffolding with collagen application, over bilateral gluteal regions. Following necrotic tissue removal, a scaffold composed of collagen and dermal extract was placed on the wound.

The preparation of the collagen and dermal extract scaffold involved several steps:

1. Obtaining informed consent
2. Selecting a site for dermal graft harvest, such as the groin, popliteal crease, or inferior abdominal skin
3. Sterile preparation of the surgical site and infiltration of tumescent solution
4. Removal of the epidermis over the dermal harvest site using a derma-abrader
5. Making an incision over the dermis, elevating it from the underlying tissue, and removing any excess subcutaneous tissue
6. Primary closure of the donor site
7. Mincing the harvested dermis into small pieces with a surgical blade
8. Crushing the dermal pieces to increase surface area (*Fig. 4*)
9. Spreading the dermal extract over the collagen sheet (*Fig. 5*)

Fig. 2: Showing abdominoplasty site from where dermal matrix scaffolding tissue has been harvested

Fig. 3: Showing the harvested full thickness skin graft by abdominoplasty from the same patient

Fig. 4: Showing the dermal matrix scaffolding which has been isolated from the full thickness skin graft

Fig. 5: Showing the application of collagen sheets over the dermal matrix scaffolding applied over the thermal burns wounds

The prepared scaffold was then placed on the wound, followed by the application of sterile dressing. Negative pressure wound therapy was applied (*Fig. 6*). The first postoperative dressing occurred on the fifth day, revealing wound contraction and the development of epithelial islands. Subsequent dressings with collagen were performed, and the wound score suggested improvement of wound status (*Fig. 7*).

Fig. 6: Showing negative pressure wound therapy being applied over the dressing of the wound

Fig. 7: Showing improvement in condition of the wound following application of collagen sheets over the dermal matrix scaffolding

RESULTS

Dermal matrix scaffolding has proven to be useful in healing of thermal burns wound and hastened the wound healing in our patient.

DISCUSSION

Autologous split-thickness skin grafting stands as the primary treatment method post tangential excision, yet the availability of donor areas can be inconsistent. Furthermore, functional and cosmesis outcomes with split-thickness skin grafts may not always meet expectations[4]. Consequently, over the past decade, researchers have delved into exploring artificial epithelial and dermal substitutes to address these challenges. An ideal substitute should possess certain characteristics, including being cost-effective, providing pain relief, having a prolonged shelf life, off-the-shelf usability, non-antigenic properties, durability, flexibility, prevention of water loss, antimicrobial properties, and the ability to conform to irregular wounds while being applicable in a single session[5].Various substitutes such as honey, collagen, biobrane, transcyte, and epicel have been trialed for burn applications, each with its own set of advantages and drawbacks[3]. Collagen, in particular, offers advantages such as ease of procurement in different sizes, painless removal, cost-effectiveness, hypoallergenic nature, long storage potential, and the capacity to integrate drugs and growth factors for controlled release[6]. Studies, like the one conducted by Lynch *et al*., have explored the use of dermal autografts in breast reconstruction with tissue expanders, highlighting the scaffold-like function of intact dermal matrix in promoting tissue ingrowth and angiogenesis. Meanwhile, various studies have utilized acellular dermal tissue matrix or cultured human dermis for diabetic ulcer treatment, leveraging the benefits

of autologous dermis for wound bed preparation. These procedures can be performed under local anesthesia as outpatient procedures, with primary closure of donor sites resulting in minimal scarring and avoiding antigenic reactions and inflammation associated with allogenic dermal matrix. Combining the advantages of collagen and dermal extracts in the same patient can effectively address issues such as limited donor area availability, heterogeneous material usage for wound covering, and cost concerns.

CONCLUSION

Biological skin substitutes, such as collagen, have been commonly employed for wound coverage post tangential excision. In this study, we propose the utilization of collagen in conjunction with dermal extract as a scaffold for wound coverage in thermal burns wounds. This approach, outlined in our article, offers accessibility and ease of preparation while effectively promoting early epithelialization in raw areas, thereby obviating the necessity for additional procedures like split skin grafting.

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