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Role of Dried Allogenic Amniotic Membrane in Second Degree Scald Burns

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Abstract

Burn injuries represent a significant portion of common injuries, stemming from thermal, scalding, or electrical incidents. Among these, scald injuries stand out as the predominant type in children under five years old, constituting a majority, with over 65% of cases falling under this category. Currently, various scaffolds are employed to enhance the healing process and mitigate scar formation. Collagen plays a crucial role as a scaffold, facilitating tissue regeneration and supporting the formation of new blood vessels. Additionally, alternative scaffolds like the amniotic membrane contribute to proper epithelialization and diminish scarring, boasting distinctive anti-inflammatory and bacteriostatic properties. In our study, we opted to utilize amniotic membrane heterograft as a biological dressing for a patient grappling with a second-degree scald burn wound. This choice aligns with the contemporary approach of harnessing innovative solutions to optimize patient outcomes in burn care. By leveraging the unique attributes of amniotic membrane, we aimed to not only accelerate the healing process but also to minimize scarring and promote a favorable recovery trajectory for the individual. Such advancements underscore the ongoing pursuit within the medical field to explore and integrate novel therapies that promise enhanced efficacy and improved patient experiences in managing burn injuries.

Keywords: Amniotic membrane, regenerative, second degree scald burns, injuries, collagen

INTRODUCTION

Wound healing is a physiological response of a living being to physical, chemical, mechanical or thermal injury. The wound healing process consists of several phases: homeostasis, inflammation, proliferation/granulation, and remodeling/maturation. Still, when the healing course deviates from the normal path, the healing does not advance past the inflammatory phase. In case of burns, there will be deficiency in normal healing. In modern medicine, usage of scaffolds either natural or synthetic has become popular and been recognized.

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An ideal scaffold should consist of these key features: fitting physical, mechanical properties, physiological background to enable cell adhesion, proliferation and differentiation, a high porosity, a large surface area to volume ratio and to be flexible enough to accommodate the shape of the wound and preferably biocompatible and biodegradable.

Collagen, synthetic or natural acts as an substitute for the dermal matrix through which epithelialization occur [1]. In the process of wound healing, degradation of collagen aids in the formation of new vessels, thereby it also helps in angiogenesis.

Amniotic membrane which is a natural scaffold has its own properties which includes its anti inflammatory, bacteriostatic, anti fibrotic, anti scarring and promotion of epithelization as well [2]. Since it has low immunogenicity and has its own progenitor cells, it can be an ideal choice in terms of usage of scaffolds for healing of wounds .

Silicon act as a barrier by reducing mechanical friction and transepidermal water loss which have been shown to be associated with the severity of a subsequent infection [3]. In vitro study shows silicone may regulate the inflammatory growth factors that cause fibrosis and promote acute wound healing. Important elements in this process include inflammatory markers such as TNF-α, TGF-β, IL-1, and IL-6 that are also implicated in acute inflammation.

MATERIALS AND METHODS

This study was conducted in Tertiary Care Centre in Department of Plastic Surgery after getting the department ethical committee approval. Informed consent was obtained. The subject was a 49years - old male who had accidental second degree scald burn injury (Figure 1) which involves over chest, abdomen, right hand region. He didn't show in any hospital after that and next day came to JIPMER. Delay of 12 hrs. He was admitted in tertiary burn care unit and initial resuscitation with intravenous fluids, analgesics and prophylactic antibiotics started. On the day of admission patient underwent Regenerative scaffold + RONPWT (Figure 2) under topical heparin irrigation (Figure 3) patient was assesed by digital planimetry (Figure 4) autologous platelet rich plasma was given (Figure 5). low level laser therapy was given (Figure 6). On postburn day 3, the three layered scaffold dressing was made and applied over deeper burn areas after dermabrasion assisted tangential excision. Split skin grafting was done (Figure 7) The three layers of scaffold was made by sterile amniotic membrane (Figure 8), dry collagen sheet and silicone sheet. The layer of amniotic membrane was in direct contact with the wound. Amniotic membrane was harvested from freshly delivered placenta. It is thoroughly washed and stored in antibiotic solution in refrigerator. The dressing was kept intact for 7 days. On the 7th postoperative day, the amniotic membrane was completely resorbed and the silicon sheet layer was also removed.

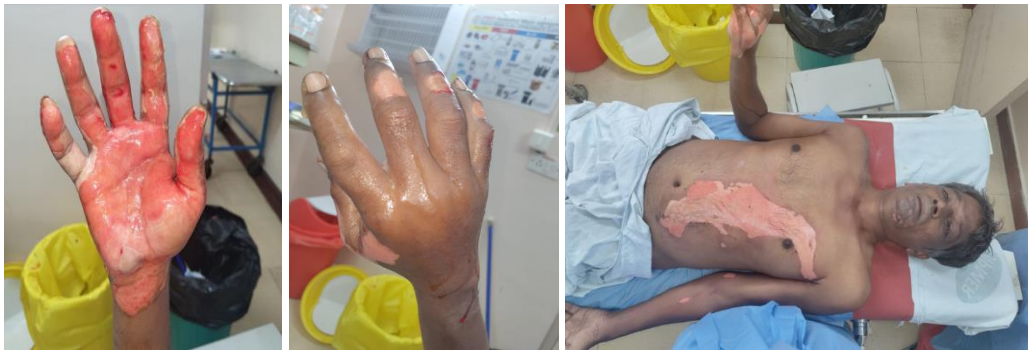

Figure 1. On admission.

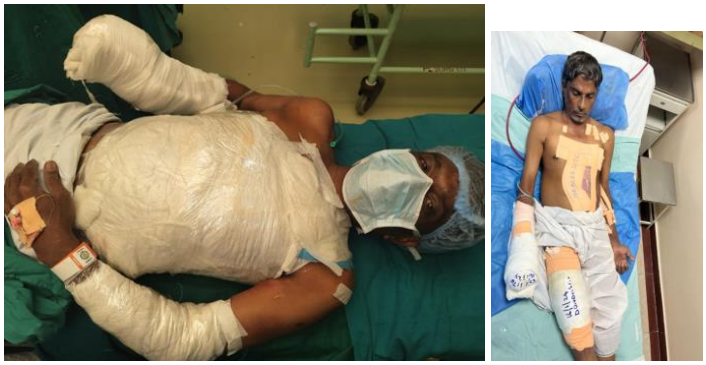

Figure 2. Negative pressure wound therapy.

Figure 3. Application of collagen and heparin saline irrigation.

Figure 4. Digital Planimetry of Raw Area.

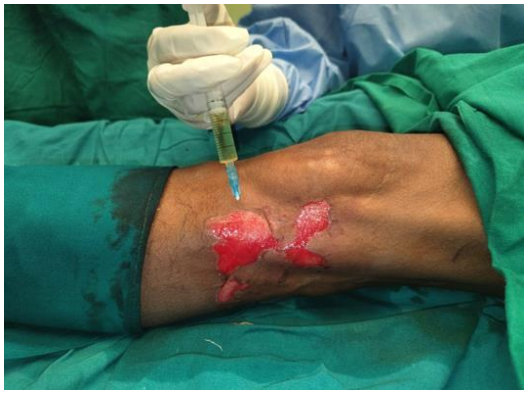

Figure 5. Autologous Platelet Rich Plasma Therapy.

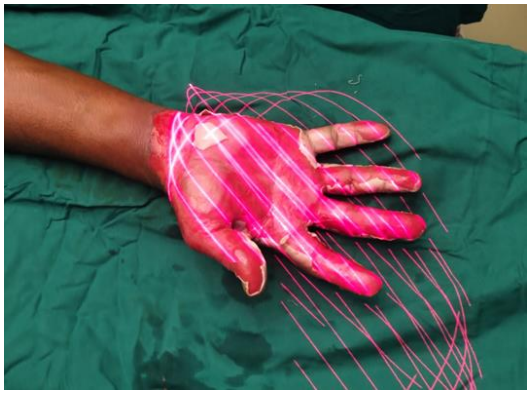

Figure 6. Low level laser therapy of wound**.**

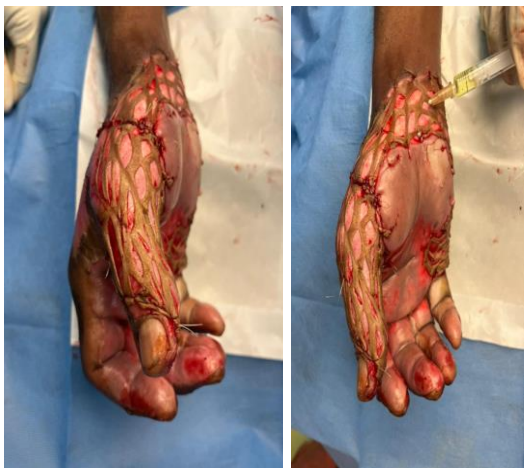

Figure 7. Split Skin Grafting for Hand

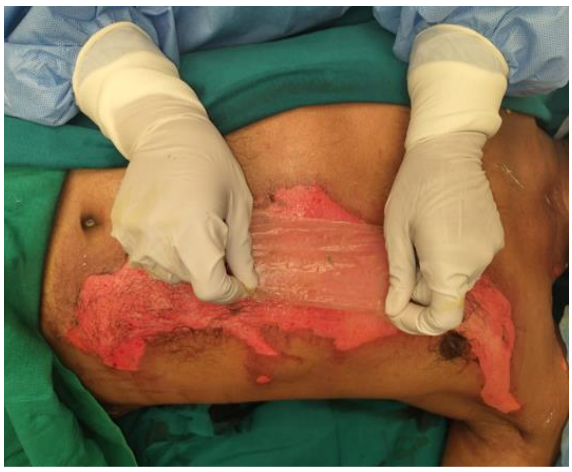

Figure 8. Dried amniotic membrane over raw area.

RESULTS

The patient experienced smooth intraoperative and postoperative phases without any complications. By the seventh day following the operation, the dressing was removed, revealing substantial areas of re-epithelialization and evident signs of healing. Notably, all second-degree superficial burn wounds exhibited complete healing, as illustrated in Figure 4. No complications or adverse effects were reported throughout the entire procedure [4].

During both the intraoperative and postoperative periods, the patient encountered no noteworthy events, indicating a seamless recovery process. Upon the removal of the dressing on the seventh postoperative day, encouraging progress was evident, with significant re-epithelialization and evident signs of tissue healing observed. It is noteworthy that all second-degree superficial burn wounds exhibited complete resolution, as depicted in Figure 4. Importantly, the absence of any complications or adverse reactions underscores the successful outcome and safety of the entire procedure [5].

Throughout the intraoperative and postoperative phases, the patient's recovery remained uneventful, with no complications arising. By the seventh day following the operation, the dressing was removed, revealing substantial re-epithelialization and marked progress in wound healing. Notably, all second-degree superficial burn wounds had completely healed, as depicted in Figure 4. Not a single instance of complications or side effects was recorded throughout the entire duration of the procedure, highlighting its successful execution and the patient's favorable response to treatment [6].

The patient had a smooth recovery without any complications throughout both the intraoperative and postoperative phases. Upon examination on the seventh day post-surgery, the dressing revealed significant areas of re-epithelialization and notable progress in healing. Importantly, all second-degree superficial burn wounds exhibited complete healing, as evidenced in Figure-4. Remarkably, no complications or adverse effects were encountered throughout the entire procedure, indicating its safety and efficacy in promoting successful wound resolution.

Throughout the patient's journey, spanning from the intraoperative to the postoperative phase, no complications were encountered. By the seventh day following the operation, upon removal of the dressing, it was evident that substantial re-epithelialization and effective healing had occurred. Notably, all second-degree superficial burn wounds had fully healed, as illustrated in Figure 4. Importantly, the absence of complications or side effects throughout the entirety of the procedure underscores its successful execution and the patient's favorable response to treatment.

DISCUSSION

Partial-thickness burn wounds can heal spontaneously, whereas full-thickness burn wounds require skin grafting for definitive wound closure. Historically, the gold standard for closure of excised full-thickness burn wounds is split-thickness skin autograft. Patients with very large burn wounds have limited donor sites for harvesting of autograft and may benefit from the use of skin substitutes. Engineered skin substitutes that may provide temporary wound coverage until donor sites are ready to be reharvested for autograft, or if they contain autologous cells, may provide permanent wound closure. Relatively few permanent skin substitutes are currently available, but developments in tissue engineering of human skin are expected to soon provide improved models for increased availability and enhanced healing of burn wounds [7]. Commercially available Dermal Regeneration Template is a two-layered skin regeneration system [8]. The outer layer of this system is made of thin silicone film act as the epidermis of skin. This layer helps in protecting wound from infection and controls in loss of both heat and moisture. The outer collagen glycosaminoglycan (GAG) thermal layer functions as a biodegradable template that helps in regeneration of dermal tissue neodermis by the body [9].

The inner layer of dermal regeneration template is made of complex matrix of cross-linked fibers. The porous material of the template helps in regeneration of skin. The cross-linked fiber material of dermal regeneration template acts a scaffold for the regrowth of skin layer. Once the dermal skin layer

is regenerated, the outer layer of template is removed and is replaced with a thin epidermal skin graft. This procedure leaves the wound to a flexible, growing and allows permanent regeneration of skin. It allows faster healing of wound with minimum scarring. Here we have tried to replicate the same mechanism in our indigenously made dermal regeneration scaffold [10]. The indigenous dermal regeneration scaffold prepared from silicone sheet, dry collagen sheets and amnion is cost-effective and can be easily prepared and used on wounds. Thus, it can be used in hospital settings in developing countries where the affordability of commercial regeneration template is doubtful.

CONCLUSION

The implementation of the affordable regenerative scaffold dressing derived from amniotic membrane has demonstrated its effectiveness in treating second-degree scald burns, as evidenced by the results of this study. This intervention significantly expedites the healing process for both superficial and deep second-degree wounds, achieving remarkable improvement within a week. Consequently, it holds potential for reducing the duration of hospitalization and lowering infection rates associated with such burns. However, it is crucial to emphasize the necessity for further validation through a large-scale multicenter trial employing a double-blinded controlled methodology and robust statistical analyses.

The utilization of a cost-effective regenerative scaffold dressing utilizing amniotic membrane has proven to be an effective approach in addressing second-degree scald burns, as indicated by the findings of this study. This intervention accelerates the healing trajectory for both superficial and deep wounds of this nature, achieving significant progress within a relatively short timeframe. Consequently, it offers the promise of reducing hospitalization duration and minimizing the incidence of infections linked to such burn injuries. Nonetheless, it is vital to underscore the importance of conducting a comprehensive multicenter study with a double-blinded control design and rigorous statistical analysis to further validate these findings.

The adoption of an economically viable regenerative scaffold dressing incorporating amniotic membrane has been shown to be effective in managing second-degree scald burns, as demonstrated by the outcomes of this study. This intervention expedites the healing process for both superficial and deep wounds of this type, resulting in notable improvement within a week. Consequently, it holds potential for shortening hospital stays and reducing infection rates associated with such burns. However, it is essential to recognize the need for further validation through a large-scale multicenter trial employing a double-blinded control methodology and robust statistical analyses.

The implementation of a cost-effective regenerative scaffold dressing based on amniotic membrane has proven effective in treating second-degree scald burns, as demonstrated in this study. This intervention accelerates the overall healing process for both superficial and deep wounds of this nature, achieving significant progress within a week. Consequently, it holds the promise of reducing hospitalization durations and lowering infection rates linked to such burns. Nonetheless, further validation through a large multicenter trial with a double-blinded control and rigorous statistical analysis is warranted.

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