CASE REPORT

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Role of Functional Regenerative Four Layered Scaffold Dressing in Wound Bed Preparation

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ABSTRACT

The understanding of wound healing has led to the inclusion of tissue regeneration therapy as an armamentarium to deal with both acute and chronic wounds. The bio constructs that aid in wound regeneration was made using natural, artificial, or a combination of both, widely known as regeneration scaffolds. The components of regeneration scaffolds promote the inherent self-renewal property of the skin and speed up the healing process by providing growth factors/stem cells. The scaffolds are in use for so many years. But the commercially available scaffolds are very expensive. Hence an indigenous scaffold was made use of multiple components like amniotic membrane, collagen, and silicone. Which was found to be in no way inferior to any of the commercially available scaffolds.

KEYWORDS

• Regeneration Scaffold • Post Burn Raw area • Dermal Regeneration • Regenerative Therapy: Amniotic membrane

INTRODUCTION

The World Health Organization (WHO) estimates that, annually, over 3 lakh deaths are due to burn injuries. Millions are suffering from the physical and emotional consequences of burns.[1] 6.5 million individuals suffer from chronic skin ulcers caused by prolonged pressure, venous stasis, or diabetes mellitus.[2]

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Regeneration therapy is a good option that can be considered in the management of wounds. Regeneration of wounds is done by stimulating the innate ability of the skin for self-renewal. The gradual understanding of the biological processes of wound healing has led to the development of biological constructs that actively promote tissue regeneration using regeneration platforms, or scaffolds, as well as the incorporation of cell-signaling elements such as Growth Factors and Stem Cells. However the commercially available Regeneration scaffolds are very expensive, the cost may range between ₹ 20000 to ₹ 30000. Hence, we decided to make an indigenous regenerative scaffold using the materials available in the ward. In this article, we share our experience of making a regenerative scaffold with four layers in the management of a post-burn raw area patient.

MATERIALS AND METHODS

This study was conducted in the Department of Plastic Surgery at a tertiary care center after getting the departmental ethical committee approval. Informed written consent was taken from the patient's attender. The details of the patient in the study are as follows: A 11-month-old female was admitted with a history of scald burns involving 6% TBSA second-degree superficial. The burns involved anterior trunk. After the initial fluid resuscitation, she was initially managed with dry collagen heterografting, and later the dry collagen was replaced with a 4-layer regeneration scaffold. The regeneration scaffold was prepared in the Department of Plastic Surgery using materials already available in the department.

Three consecutive days of four layered scaffold dressing was done, following which epithelialization occurred.

The four layers from outer to inner are as follows:

1. Polyurethane Foam
2. Urgotul AG (Silver impregnated non stick dressing)
3. Dry Collagen
4. Human amniotic membrane

Amniotic membrane was harvested from the Obstetrics Department of the same institution. The amniotic membrane was taken from a healthy woman, who had a healthy pregnancy, who was screened for Hepatitis B and C, HIV 1 and 2, and VDRL, taken after normal vaginal delivery. The amniotic membrane was irrigated with Saline and treated with Heparin, antimicrobials, antifungals, and stored in glycerol under refrigeration

Other layers dry collagen, urgotul and polyurethane available commercially.

RESULT

The Four layers regeneration scaffold is effective in regenerating the wound following the scald burns

The length of hospital stay was almost identical to patients who underwent allografting. No complications were noted during the study.

DISCUSSION

Burn wounds have been divided into three zones by Jackson; Zone of coagulation, Zone of stasis, Zone of hyperemia. Inadequate fluid resuscitation wound infection or poor perfusion can lead to a superficial burn developing into a more severe and deeper wound. The treatment of the wound may be conservative or surgical, usually surgical treatments are excision of eschar to prevent wound infection, and wound coverage with an autologous split-thickness skin graft. In case of larger parts of the total body surface area have been involved then, autologous skin grafts meshed to enlarge the size of the graft.

The disadvantages of such practices are morbidity, like pain at the donor site and corrugated scar at the recipient site. In cases of total or near-total full-thickness skin injuries, donor sites may be inadequate. In that case, other treatment options like allograft, or heterograft are used. Such allografts represent temporary measures for immediate wound coverage in the acute stages post-injury. Allografts can be live donor skin grafting or cadaveric skin grafts. Disadvantages of using allografts with live or cadaveric human skin are donor shortage, limited availability, moral objections, risk of viral transmission, etc. All these disadvantages of allografts make space

for fully synthetic, biocompatible skin bio-construct which can help in the regeneration of scar-free skin. Tissue-engineered skin grafts aim to enable complete and natural and accelerated wound regeneration.

A scaffold or template is a 3-dimensional supporting framework for tissue regeneration, preventing wound bed contraction throughout the stages of healing.[3] The framework, or scaffold, should further serve as a platform for cellular localization, adhesion, and differentiation, as well as guide the development of new functional tissues.[4] Scaffold materials may be of natural, synthetic, or composite origin. The mixing of materials of different classes to obtain composite scaffolds helps to overcome the individual limitations of a single material scaffold.[5] The ideal skin regeneration scaffold should actively direct tissue formation and prevent scarring. Thus, much focus has been channeled into creating suitable biomimetic structures that can act as delivery vehicles for steam cells or Growth factors.

The synergistic tissue regenerating effects of a smart scaffold cocktail comprise scaffold surface patterns, growth factors, and stem cells which have the realistic potential of overcoming current barriers and enabling fast and complete skin regeneration. During natural wound healing, interactions between components of the extracellular matrix and surrounding cell-signaling molecules are responsible for the expression of growth factors and cytokines. These interactions elicit cellular responses that ultimately lead to new tissue formation. Overwhelming activation of the inflammatory system and prolific recruitment of contractile cells typically leads to scar formation, often resulting in disfigurement and functional disability. Nowadays, some wounds are closed aseptically using sutures that obviate the need for a vigorous contractile response, creating more time for complete tissue regeneration. Here, external modulation of cell-signaling events via a finely tuned delivery of Growth factors or stem cells is thought to alter the wound environment, enabling orderly regeneration.

In our study, we have materials of different origins to make a composite scaffold which can help to overcome the limitations of each. All four components are already well-documented and proven.

Figure 1: Raw area chest and abdomen

Figure 2: Regenerative scaffold with 4 layers

Figure 3: Wound healing post regenerative therapy

CONCLUSION

The four-layer regeneration scaffold is simple, cost-effective, easy to prepare, and without any complications. The length of hospital stay was almost identical to the patients who were treated with allograft. The quality of scar formed is good

But a multi-center and larger volume study is required to comment on the exact findings.

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All authors made contributions to the article

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