Original Article

New Indian Journal of Surgery
Volume 13 Number 3/July-September 2022
DOI: https://dx.doi.org/10.21088/nijs.0976.4747.13322.6

Role of Indigenous Cost Effective Two Layer Regenerative Scaffold in Wound Bed Preparation

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How to cite this article:
K Sriharsha Reddy, Ravi Kumar Chittoria, Nishad K, Neijo Thomas/Role of Indigenous Cost Effective Two Layer Regenerative Scaffold in Wound Bed Preparation/New Indian J Surg. 2022;13(3): 127–129.

Abstract

The quality of skin wound healing can be improved by the application of collagen scaffolds as biological dermal substitutes. Dermal extract helps to improves wound healing and quality of the scars. They serve as a scaffold into which cells can migrate and repair the injury. In the current scenario where in many biological and cellular engineering skin substitutes are available, wound management is a multimodality treatment with use of multiple available methods to augment wound healing at various levels. An excellent dermal substitute should be affordable, long-lasting, ready-to-use, analgesic, durable, flexible, non-antigenic, stops water loss, conforms to uneven wounds, anti-microbial, and may be applied in one sitting. In this study, we attempted to mimic the same technique in our two-layered regenerative scaffold, which is created locally and is cost-effective.

Keywords: Two-layered scaffold; Regenerative scaffold; Knee defect.

Introduction

The quality of skin wound healing can be improved by the application of collagen scaffolds as biological dermal substitutes. Dermal extract helps to improves wound healing and quality of the scars. They serve as a scaffold into which cells can migrate and repair the injury. In the current scenario where in many biological and cellular engineering skin substitutes are available, wound management is a multimodality treatment with use of multiple available methods to augment wound healing at various levels. Dermal substitute is defined as biomatrices which fulfill function of cutaneous dermal layer and provides matrices and scaffold for new tissue growth and thus increases rate of wound healing.[1] The collagen-GAG scaffold helps in supporting the in-growth of connective-tissue cell, thus causing regeneration of tissue providing the critical physiological functions of dermis.[2] In this article we have described the role of two-layered regenerative scaffold in wound bed preparation.

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E-mail: drchittoria@yahoo.com
Received on: 02.03.2022
Accepted on: 19.04.2022

Materials and Methods

This study was conducted in the Department of Plastic surgery in a Tertiary care center in South India. Departmental ethical clearance and consent from the subject were obtained. The details of the patient in study are as follows: 24 year old male with alleged history of RTA following which he sustained left open type 3C (Gustillo-Anderson) proximal tibia fracture. He had undergone Illizarov with CC screw fixation for fracture tibia. He now presented to our department with complaints of

a defect over left knee joint with underlying bone exposed (figure 1).



Fig. 1: Defect over left knee at initial presentation.

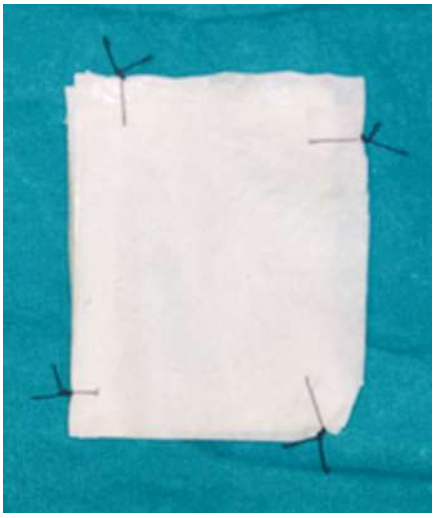


Fig. 2: Indigenous two-layered regenerative scaffold.



Fig. 3: Regenerative scaffold applied over the defect.



Fig. 4: Defect after 1 week of scaffold application.



Fig. 5: Defect after 2 weeks of scaffold application.

We created a two-layered regenerative scaffold from silicone sheet and collagen. The silicone gel sheet and dry collagen sheet used were of hospital supply. A silicone sheet with multiple layers of collagen sheets were used, which was sutured over the silicone gel sheet with absorbable sutures like poliglecaprone or polyglycolic acid (Figure 2). This template was meshed to allow the collections to come out. This template was then applied over raw area (Figure 3) and conventional dressing with gauze and cotton pad was done over it. The dressing was opened every 3rd day and only the outer layer of gauze and cotton pad was changed. On the 7th postoperative day, the collagen layer had completely resorbed and the silicon sheet layer was removed (Figure 4). This regenerative scaffold was applied for 2 sittings.

Result

The dermal regeneration template use in the raw areas helped in expediting the healing of wound with healthy granulation tissue formation within the defect (Figure 5).

Discussion

In their seminal work on the fundamental requirements of artificial dermal replacements, Yannas and Burke emphasized the utilization of wound healing. Collagen scaffolds, synthetic polymers, and cadaveric skin are some of the dermal substitutes available.[3] Engineered skin substitutes may provide temporary wound coverage until donor sites are ready to be collected for autograft, or may provide permanent wound closure if they contain autologous cells. There are now just a few permanent skin substitutes accessible, but advances in human skin tissue engineering are likely to soon produce improved models for expanded availability and wound healing.[6]

An excellent dermal substitute should be affordable, long-lasting, ready-to-use, analgesic, durable, flexible, non-antigenic, stops water loss,

conforms to uneven wounds, anti-microbial, and may be applied in one sitting.[4] Collagen is well known for its benefits, which include simplicity of removal, low cost, painless application, hypoallergenic properties, a wide range of sizes, the ability to store for three years, and the ability to combine medications and growth factors that are delivered in a regulated manner.[5]

Acellular dermal matrix *Integra*® Dermal Regeneration Template is well-known and widely used. Although it aids in the resolution of many difficult difficulties in reconstructive surgery, the product cost may make it a more expensive option than other reconstruction methods.[7] Since the 1980s, the Integra dermal regeneration template has been available for purchase. Burke and a colleague first described its use in 1981.[8] It's becoming a common treatment option for burns and scar contracture.[9,10]

A two-layered skin regeneration mechanism is the dermal regeneration template. The dermal regeneration template's exterior layer is constructed of a thin silicone film that mimics the epidermis of skin. The outer layer of the dermal regeneration template protects the wound from infection and regulates heat and moisture loss. The outer collagen Glycosaminoglycan (GAG) thermal layer acts as a biodegradable template, allowing the body to regenerate dermal tissue neodermis. A complex matrix of cross-linked fibers makes up the inner layer of the dermal regeneration template. The template's porous substance aids in skin regeneration.

The dermal regeneration template's cross-linked fiber material functions as a scaffold for the skin layer's rebuilding. The outer layer of the template is removed and replaced with a thin epidermal skin graft once the dermal skin layer has been regenerated. This treatment leaves the wound flexible and developing, allowing for long-term skin regeneration. It enables for rapid wound healing with minimum scarring.

We attempted to mimic the same technique in our two-layered regenerative scaffold, which is created locally and is cost-effective. The indigenous dermal regeneration template, which is made of silicone sheets and dried collagen sheets, is inexpensive and simple to make and apply to wounds. As a result, it can be employed in hospitals in developing nations where the cost of a commercial regeneration template is a big consideration.

Conclusion

The adoption of an indigenous, cost-efficient two-layered regenerative scaffold in wound bed preparation has been proven to be effective in this preliminary study. To confirm the findings, a large multicentric, double-blinded control research with statistical analysis is needed.

Conflicts of interest: None

Authors' contributions: All authors made contributions to the article

Availability of data and materials: Not applicable

Financial support and sponsorship: None

Consent for publication: Not applicable

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