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Role of Biodegradable Temporising Matrix (BTM) in Electrical Burns

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Research

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Abstract

Aim of this case report is to assess the role of in management of Biodegradable Temporising Matrix (BTM) in non-healing ulcer due to electrical burns. Clinical examination of the non-healing ulcer before and after use Biodegradable Temporising Matrix (BTM) was done.

Key Words: Biodegradable Temporising Matrix (BTM), electrical burns, wound, ulcer, non-healing ulcer, management.

Introduction

The NovoSorb® Biodegradable Temporising Matrix (BTM) (PolyNovo Biomaterials Pty Ltd., Port Melbourne, VIC, Australia) is a fully synthetic dermal matrix that can be used to reconstruct complex wounds. It consists of a 2-mm thick NovoSorb biodegradable polyurethane open cell foam covered by a non-biodegradable sealing membrane. The open cell matrix allows for infiltration of cellular materials and acts as a scaffold for the neo-dermis. The sealing membrane provides physiological wound closure but also contains small fenestrations to prevent the accumulation underneath the material[1]. The application of BTM involves a two-stage procedure.In the first stage, the BTM is laid onto a clean wound bed. Cells and blood vessels migrate into the BTM during the integration phase and a vascularised neo-dermis is formed. Capillary refill can be seen from as early as 2 weeks. The polyurethane matrix is biodegradable and breaks down via hydrolysis[2]. In the second stage, the sealing membrane is removed and a split-skin graft (SSG) is applied to the neo-dermis.BTM differs from the traditional SSG in that it helps to replace the natural thickness of the dermis, minimises contracture, prevents tethering to the underlying structures and allows for the rapid temporising of large total body surface area wounds[3].Unlike other artificial dermal templates that are comprised of allogenic or xenogenic materials, the fully synthetic BTM eliminates the possibility of inter-species immune rejection or disease transmission and avoids ethical or cultural obstacles[4].Early in vitro studies confirmed the biocompatibility of BTM[5]. *In vivo* studies utilising rats and porcine models demonstrated adequate reconstruction of full-thickness wounds with a high resistance to wound contracture and an absence of systemic toxic effects[6,7]. Comparisons between BTM and Integra® (Life Sciences Corp., Plainsboro, NJ, USA) in animal models highlighted the effectiveness of the BTM in providing a stable and flexible wound reconstruction[8]. The first use in humans was trialled as a polyurethane foam (NovoPore™, Polynovo) in negative-pressure wound therapy (NPWT) for pressure ulcers[9]. This showed that short-term implantation in patients did not cause adverse reactions. Following this, the use of a prototype bilayer device consisting of NovoSorb foam with a non-biodegradable sealing matrix in free flap donor wounds showed promising results[10]. Further modification of the sealing membrane including the thickness, bonding layer and the introduction of fenestrations produced superior results in subsequent studies[11]. The use of BTM in burns demonstrated that it could successfully treat large total body surface area burns with excellent cosmetic and functional results[12]. This success led to its use in necrotising soft tissue infections to provide pliable wound coverage [13,14]. Here, we report a consecutive case series of 35 wounds describing the use of BTM in a range of challenging

wounds which would otherwise require more complex reconstructions.

Materials and Methods

Master Thy Nadin (Immigrant from Cambodia Passport number: N 01705811) aged 8 years, Male, Hospital No. J-576887, Son of Sony Chim (Immigrant from Cambodia Passport number: N 1126505) residing at 5C, 1 E Kalpana Community, Crown Road, Auroville, Villupuram Dist-605101 attended JIPMER Hospital, Emergency Services with electrocution burn injury (High voltage) sustaining 35 percent burns to the scalp (Figure 1), face, neck, chest, abdomen, bilateral upper limb and bilateral lower limb with deep burn injury to the scalp (entry wound) and right great toe (exit wound). The patient was admitted to Jipmer burns centre under Plastic Surgery. He underwent wound debridement of the burns under general anaesthesia. Regenerative therapy using multiple modalities was done. There was a persistent raw area over the scalp electrical burn wound (Figure 2) indicating a non-healing ulcer. BTM use was planned, and implemented. First stage of reconstruction involved the inset of BTM. After the application of BTM, collagen scaffold was applied over the BTM and either secured with NPWT between 50 and 75 mmHg or dressed with gauze, crepe to provide compression. The external dressing was changed once or twice weekly. The BTM was evaluated weekly for integration by assessing for capillary refill. Excess fluid was expressed through the fenestrations before re-dressing.

The wound bed was not completely ready for the second stage that is the reconstruction of the defect, hence the first stage was planned to be continued till the wound bed is ready.

Results

Biodegradable Temporising Matrix helped in wound bed preparation of non-healing electrical burns ulcer (Figure 3,4)

Discussion

BTM has demonstrated its reliability and versatility in the reconstruction of complex wounds in patient with multiple comorbidities. Most cases were successfully grafted at 3–4 weeks post-operatively, ranging from 2 to 10 weeks. Furthermore, the dermal matrix was robust enough to heal in the setting of partial graft loss. Advantages of BTM include the ability to convert a wound bed into a surface suitable for skin graft, such as exposed bone or tendon. In the cases of exposed tendons, this also allows preservation of the tendon function. In patients with multiple morbidities, it provides a robust and simple reconstructive option for complex wounds. The operation can be performed under local or regional anaesthesia and has an overall low complication profile and donor site morbidity. The sensory regeneration of the wounds reconstructed with BTM can significantly influence the patients' quality of life after the reconstruction. This is particularly important when BTM is used in the weight-bearing portion of the lower limb. A sensate reconstruction can maintain function and also help in preventing further injury to the area. In our cases, early results are promising, with most patients regaining partial sensation over the majority of their wounds. This may provide further benefits over more complex reconstructions. Further studies with longer follow-up and more in-depth sensory assessment would be beneficial. The POSAS score also suggest overall good aesthetic result with BTM reconstruction. It matches the thickness of most defects without the need for further revision or debulking. Disadvantages of BTM include potential failure to integrate especially in cases of borderline vascularity or infection, as well as the staged nature of the reconstruction. These limitations are, however, common to all dermal matrices. Prior radiation, especially in the scalp, poses high risk of failure to integrate in our series. Four patients with scalp malignancies that involved burring of the outer table and radiotherapy had either partial graft failure or, in one case, complete failure of integration of BTM. This may form the basis of future studies.

Conclusion

Biodegradable Temporising Matrix is an effective measure for enhancing the wound bed preparation of non-healing electrical burns ulcer.

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Figures

Figure 1: Electrical burns non healing ulcer over scalp

Figure 2: Raw area- non healing ulcer of electrical burns wound on scalp

Figure 3: BTM over Raw area- non healing ulcer of electrical burns wound on scalp.

Figure 4: Improved wound after BTM application.

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