



A novel use for the biodegradable temporizing matrix

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Abstract

Biodegradable Temporising Matrix (BTM), a skin substitute, has been recently developed as a novel adjunct to the plastic surgeon's reconstructive repertoire. Its use has been described in literature in a variety of settings and complex wounds, including those that previously would have been described as "non-graftable", with favourable outcomes. We present the case of a patient with a wound to the right foot and ankle following extravasation injury. Following surgical debridement, this injury was managed with BTM, which allowed granulation and production of a "neo-dermis". A split-thickness skin graft was subsequently applied. The characteristics of the BTM allowed the resulting skin graft and scar to be pliable, avoiding tendon tethering and joint contracture. To the authors' knowledge, this skin substitute has not been reported in a wound of this aetiology before. It is our hope that this report will provide evidence to colleagues that this is a valuable adjunct that may be used in complex wounds.

Level of evidence: Level V, therapeutic study.

Keywords Biodegradable temporizing matrix · Skin graft · Tendon tethering

Introduction

Biodegradable temporizing matrix (BTM) is a biosynthetic skin substitute which consists of a wound-facing biodegradable polymer foam, bonded to a non-biodegradable transparent sealing membrane [1, 2].

In 2017, Greenwood described the development of BTM for use in burn injuries to temporise the wound while awaiting composite cultured skin. This development and study included observing the use of this novel resource in more controlled surgical wounds, i.e. free flap donor sites, prior to its use in burn wounds. The outcomes of the use of BTM prior to grafting provided positive functional and aesthetic results [3]. Since then, various papers have been published detailing the beneficial properties and outcomes in patients with wounds of varying aetiology and condition. This includes use in flap donor sites, overexposed bone (including calvarium) and tendons (including those with paratenon denuded) following trauma or cancer excision, grade II and

IV pressure sores, mastectomy skin flap necrosis, wound dehiscence, debridement following necrotising fasciitis; in addition to complex burn wounds [4–10].

A PubMed search for BTM (or Biodegradable Temporising Matrix) and extravasation returned no results so, to our knowledge, BTM has not been utilised in any injuries of this particular aetiology.

Dextrose solutions, of 10% concentration or greater, are hypertonic. Extravasation of such agents drives intracellular fluid out of cells, dehydrating and directly damaging cells, which can result in skin necrosis [11].

Extravasation injuries can be managed in a variety of ways and are often referred to plastic surgery for support of wound management and, in some instances, debridement of necrotic tissue with wound coverage or reconstruction based on clinical judgment [12]. We present the case of a 28-year-old male who received Novosorb Biodegradable Temporising Matrix™ (BTM) application to an extravasation wound on the dorsum of his right foot and ankle.

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Fig. 1 Eschar on the dorsum of the right foot prior to debridement



Fig. 2 Wound base following debridement

Case report

A 28-year-old, type 2 diabetic male patient was admitted to intensive care following an alleged insulin overdose. The patient subsequently suffered an extravasation injury to the dorsum of his right foot and ankle, with dextrose (> 10% concentration) being the suspected agent, resulting in a full-thickness injury of around 1.5% total body surface area (Fig. 1). Clinically, this had appearance very similar to a full-thickness burn. The patient also suffered from cerebral palsy and obstructive sleep apnoea, and had a suprapubic catheter and ileostomy, with reduced mobility.

Given positioning of this injury, in addition to the exposed tendon, it was felt that isolated split-thickness skin grafting (SSG) would likely be unsuccessful. As such, the patient proceeded to theatre for debridement and application of BTM (Figs. 2 and 3). The BTM was fenestrated further to facilitate contouring and secured with skin staples and non-absorbable quilting sutures. On day 3 post-operatively, the BTM was found to be firmly adhered, and the patient was discharged with oral antibiotic cover, with outpatient review by specialist nurses from our Burns and Plastic Surgery Outreach Service (Fig. 4). The patient continued to have silver-based mesh dressings applied.

Ordinarily, SSG can be applied to the BTM in the wound once there has been sufficient integration of the granulation

tissue from the wound bed, which is typically around 3 weeks. In this patient, we feel clinically, application of SSG would have been appropriate from around 3 weeks after application of BTM. Unfortunately, return to theatre was delayed due to limited theatre access due to the COVID-19 pandemic. On day 59, the patient returned to theatre for delamination of the BTM, curettage debridement and application of a meshed split-thickness skin graft. Owing to the biodegradable nature, there was no issue with the delay to SSG application. By the time the patient returned to theatre, the BTM was fully integrated and even had some overgranulation. In addition, it is likely the BTM had been mostly broken down by hydrolysis by this stage and so the SSG was applied to predominantly autologous tissue. A Plaster of Paris splint was utilised to restrict ankle movement for



Fig. 3 Application of BTM dermal substitute

1 week until his first graft check. He was discharged the following day with continued specialist nursing outreach. The graft was reviewed at day 8 following graft application, with 100% take of skin graft seen (Fig. 5). Four months after graft application, the patient was seen and found to have a healthy



Fig. 4 Outpatient review of BTM day 45. Highlighted area indicates a collection of yellow-coloured fluid, however on lancing, this drained a serous fluid only. There was no pus and no clinical signs of infection. Good evidence of granulation



Fig. 5 Outreach review of graft on the 8th day after graft application. 100% take



Fig. 6 Outpatient review of graft at 4 months, 13 days post graft application. Healthy, pliable skin

graft, with pliable skin, with no interference or impact on his usual function or activity (Fig. 6, Fig. 7 and Video).

Discussion

BTM has been described for use in burn injuries, as well as various other defects, such as those resulting from trauma or necrotising fasciitis. While initially developed to provide a robust “neodermis” for the application of split-thickness skin grafts or composite cultured skin [3,

13], BTM has since been found to have other beneficial properties. This includes use in overexposed bone and tendons (including those with paratenon denuded), creating suitable beds in wounds which would otherwise have been unsuitable for immediate skin graft application[4, 5].

This case presented a defect similar to those previously described in literature, but of a different aetiology (extravasation), as well as a defect spanning a peripheral joint (i.e. the anterior surface of the ankle). This injury showed similarity in appearance to a full-thickness burn, with necrosis that demarcated into a dry, adhered eschar.



Fig. 7 Outpatient review of graft at 4 months, 13 days post graft application. Healthy, pliable skin demonstrated with skin pinch

The use of BTM has been well described in burn injuries, as highlighted in our literature review. The rationale for use of BTM in this case was desire for a robust base for skin grafting, avoidance of tendon tethering and contracture over a joint, as well as avoiding any long-term prosthesis that might become infected. At the 4-month outpatient follow-up, this desired outcome had been achieved.

This case is presented to illustrate the benefit of the BTM dermal substitute, both in extravasation injuries, as well as

those defects that span a joint or have exposed tendon, where split-thickness skin grafting outcomes may be poorer.

Conclusions

This report describes the positive outcomes following use of BTM and split-thickness skin graft for a full-thickness defect following extravasation spanning a joint. To our knowledge, such a use has not been described before.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00238-022-01964-z>.

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Declarations

Institutional review board statement Not applicable.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No ethical approval was required beyond patient consent for this case report.

Informed consent Informed and written consent has been obtained from the patient to utilise their clinical photography and videography in this publication.

Conflict of interest The supervising author (G. J. Offer) owns shares in PolyNovo, the company which produces the product described in this article, NovoSorb® BTM. Stephen R. Frost and Avinash Deodhar declare no competing interests.

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