International Journal of Research in Medical Sciences
Shah SD et al. Int J Res Med Sci. 2025 Jun;13(6):2607-2612
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20251652

Case Series

Experience with a synthetic bilayer biodegradable temporising matrix in complex wounds

Sankit D. Shah, Ankit N. Shah, Nilesh B. Ghelani, Virank V. Shah*, Chintan A. Godhani, Nupoor H. Pathak

Department of Burns, Plastic and Reconstructive Surgery, Shardaben General Hospital, NHL Municipal Medical College, Ahmedabad, Gujarat, India

Received: 22 April 2025
Revised: 14 May 2025
Accepted: 22 May 2025

***Correspondence:**
Dr. Virank V. Shah,
E-mail: virankshah@gmail.com

ABSTRACT

Background: Bilayer Biodegradable Temporising Matrix (BTM) is a synthetic polyurethane dermal matrix used to reconstruct complex wound with exposed bone and tendon, chronic wound. We hope to further explore its potential applications in this series. Patients who received BTM application across our centres over a 12-months period were included. Patients were followed up to assess BTM and graft take, substitute for flap in small wound, stable coverage, cover in trophic ulcer and prevent recurrence. A total 15 patients with wounds were identified with a range of aetiologies. wounds had 100% integration of BTM at the time of sealing membrane removal. Two wounds had partial graft loss that later healed by secondary intention. BTM offers a safe and reliable reconstructive option in challenging wounds that would otherwise require more complex operations.

Keywords: Bilayer biodegradable temporising matrix, Synthetic dermal matrix, Wound reconstruction

INTRODUCTION

The biodegradable temporising matrix (BTM) is a fully synthetic dermal matrix that can be used to reconstruct complex wounds. It consists of a 2 mm thick 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.[1] 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.[1] 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 xenogeneic materials, the fully synthetic BTM eliminates the possibility of inter-species immune rejection or disease transmission and avoids ethical or cultural obstacles.[4]

The first use in humans was trialled as a polyurethane foam in negative-pressure wound therapy (NPWT) for pressure ulcers.[5] This showed that short-term implantation in patients did not cause adverse reactions. Following this, the use of a prototype bilayer device consisting of polyurethane foam with a non-biodegradable sealing matrix in free flap donor wounds showed promising results.[6] Further modification of the sealing membrane including the thickness, bonding layer and the introduction of fenestrations produced superior results in subsequent

studies.[7] The use of BTM in burns demonstrated that it could successfully treat large total body surface area burns with excellent cosmetic and functional results.[3,8] Here, we report a consecutive 15 case series of wounds describing the use of BTM in a range of challenging wounds which would otherwise require more complex reconstructions..

CASE SERIES

The study was case series involving 15 patients with complex wounds from January 2024 to December 2024. consents obtained from all patients. Patient demographics, indications for BTM, surgical details and outpatient follow-up were recorded.

Inclusion criteria included complex wounds with exposure of a critical structure such as tendon and bone, failure of previous skin graft and wound bed where not expect a traditional SSG to take, trophic ulcers in Diabetes mellitus. Exclusion criteria included active infection or residual malignancy.

Outcomes measured included percentage of BTM take at the time of grafting, percentage of SSG take, scar features measured by the Patient and Observer Scar Assessment Scale (POSAS).[10] Surgical management included initial debridement to remove all devitalised and infected tissue prior to reconstruction with BTM. First stage of reconstruction involved the inset of BTM with sutures.

Quilting sutures were utilised to maximise contact between the BTM and the wound bed. After the application of BTM, jelonet was applied over the BTM and dressed with gauze. In wounds that involved the limbs or joints, a plaster or orthotic splint was applied for the first post-operative week. 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. This continued until the BTM was deemed ready for the second stage, which varied from 2 to 10 weeks. Second stage of reconstruction involved delamination of the sealing membrane and coverage with SSG. Graft fix with either stapler or suture. Dressings included a combination of Jelonet followed by gauze or foam with crepe bandage or tape. If the wound involved a limb or joint, immobilisation was applied until graft check at 5–7 days post-operation.

The patients' ages ranged from 2 to 70 years, comprising 12 male and 3 women. A total of 15 wounds were documented, including 12 on the lower limbs, 1 heel pressure sore, 2 on the upper limbs. A summary of the findings is presented in Table 1. At the time of secondary reconstruction, 13 wounds exhibited full (100%) integration of the BTM. However, in two case BTM have 90% integration but well take of split thickness skin graft. In second stage, a split-thickness skin graft (SSG) was successfully applied over the 90% integrated area, while the remaining portion underwent secondary healing.

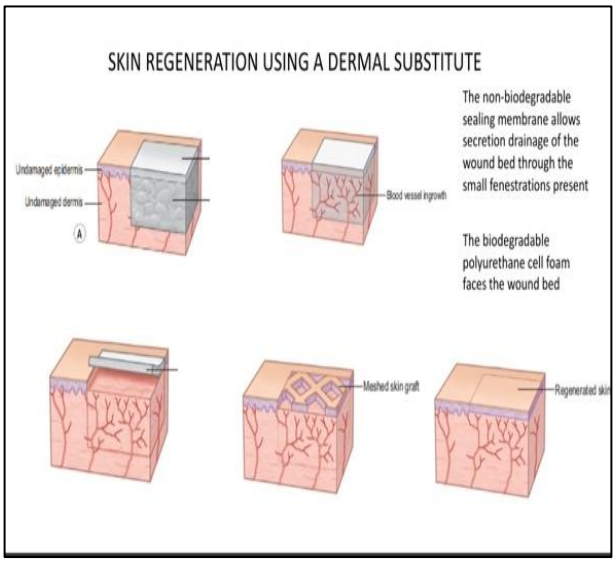

Figure 1: Skin regeneration using a BTM.[9]

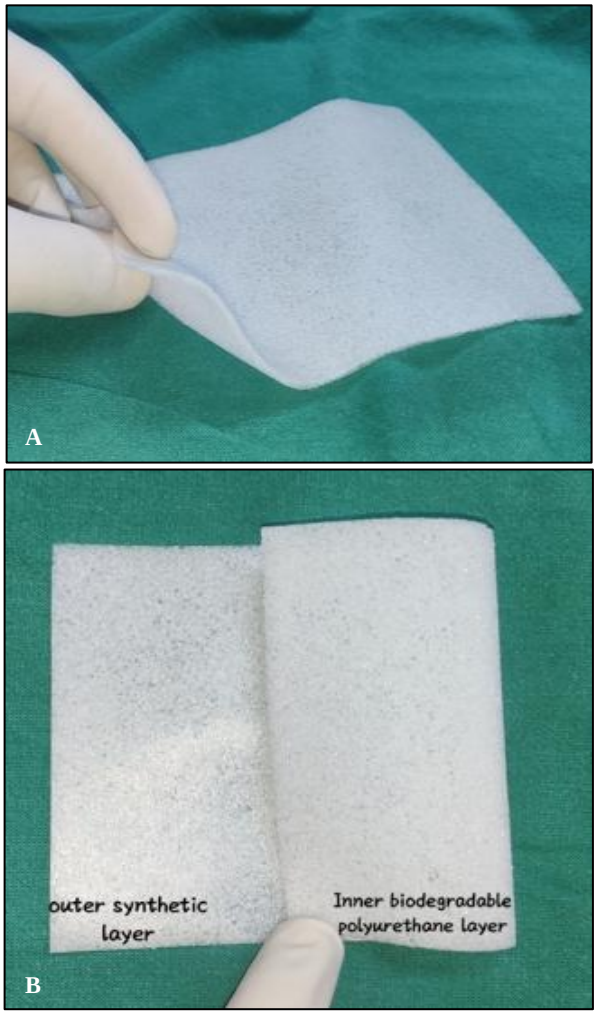

Figure 2 (A and B): Synthetic bilayer biodegradable temporising matrix.

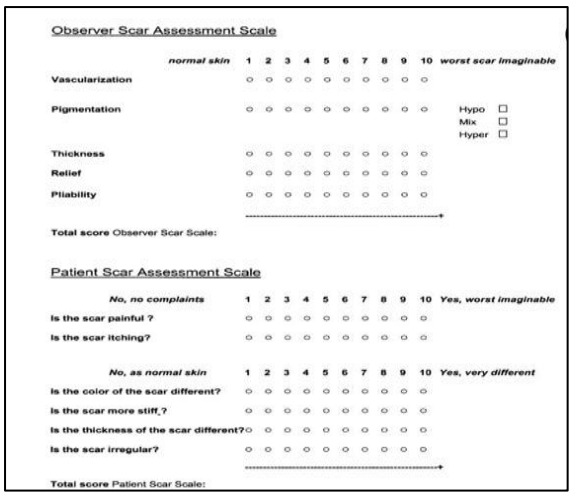

Figure 3: POSAS score.

Figure 4 (A-D): Case of recurrent pressure sore over heal after flap also wound dehiscence, so plan for BTM placement and wound is healed very well.

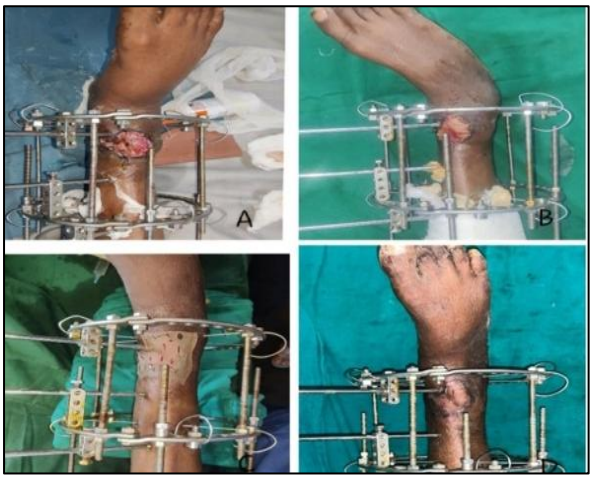

Figure 5 (A-D): Case of defect over ankle with exposed Tibialis anterior and no flap is advisable due to his condition.

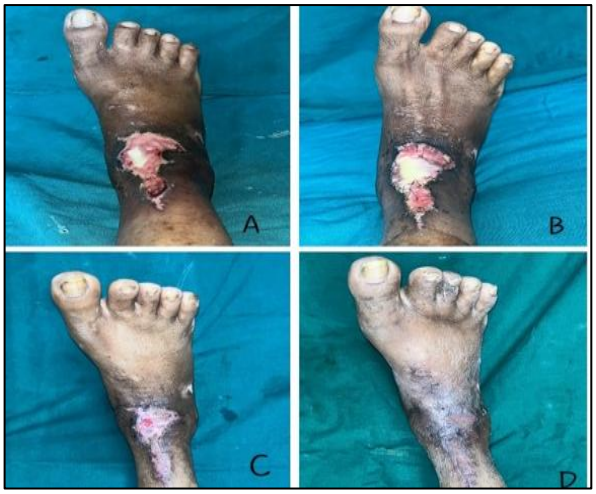

Figure 6 (A-D): Case of defect over ankle with exposed Tibialis anterior and no flap is advisable due to his condition.

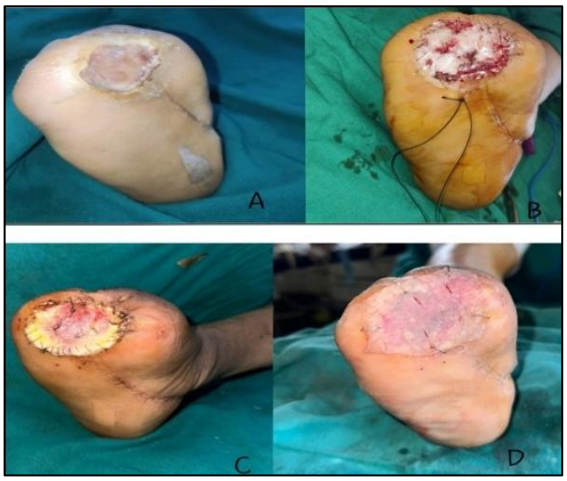

Figure 7 (A-D): Patient with recurrent ulcer over plantar foot with known case of diabetes, heal with BTM.

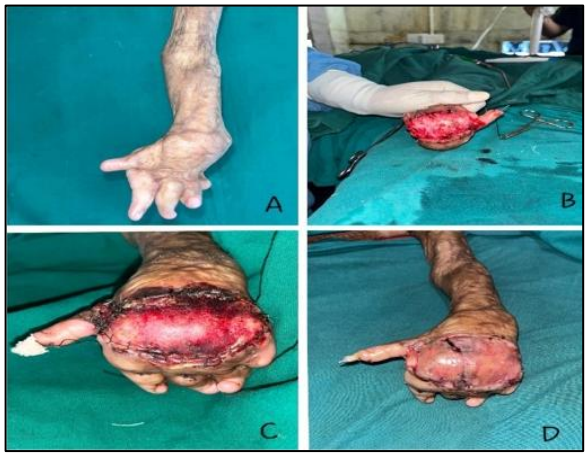

Figure 8 (A-D): 2-year girl have right upper limb post burns contracture, defect after contracture release cover with BTM.

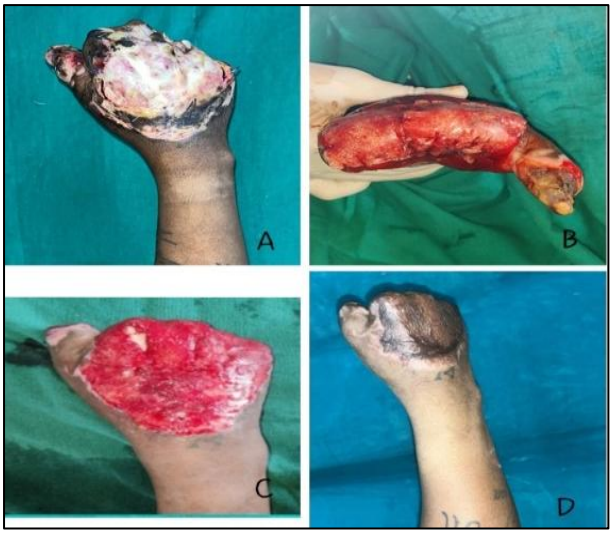

Figure 9 (A-D): Patient having right hand crush injury with amputation of all finger at MCP joint, after debridement BTM placed and then skin grafting done.

Scar assessment was conducted using the POSAS scale[10]

The POSAS (Patient and Observer Scar Assessment Scale) is a comprehensive scar evaluation tool that includes both clinician (observer) and patient perspectives.

Observer scar assessment scale

Assessed by a medical professional, it includes six parameters vascularization, pigmentation (with options for Hypo, Mix, Hyper), thickness, relief. Pliability Each is rated from 1 (normal skin) to 10 (worst scar imaginable). Scores are summed for a total observer score.

Patient scar assessment scale

Completed by the patient, it evaluates pain, itching, colour difference, stiffness, thickness. Irregularity each item is rated from 1 (no issue/normal skin) to 10 (worst imaginable/very different). Scores are summed for a total patient score.

The average patient POSAS score is 9.14±1.04 out of a maximum of 60, which indicates an excellent scar outcome from the patient's perspective. Since lower scores represent better scar quality, this low mean score suggests that patients are highly satisfied, experiencing minimal discomfort, itchiness, pain, related to their scars. The low standard deviation also reflects consistent satisfaction across the group.

The mean observer POSAS score is 6.00±0.66 out of a maximum of 50, indicating that the observed scars are very close to normal skin in terms of vascularity, thickness, pliability, relief and pigmentation. The low standard deviation shows consistency among observations. Overall, this reflects a high-quality scar outcome with BTM. The section delves into illustrative case studies, providing deeper insights into individual outcomes.

Table 1: Summary of result (n=15).

Parameter	N	%
Sex		
Male	12	80
Female	3	20
Wound location		
Lower limbs	12	80
Upper limbs	2	13.3
Heel pressure sore	1	6.7
BTM integration at second stage		
100% integration	13	86.7
90% integration	2	13.3
STG Take (at 1 month)		
Full (100%) take	12	80
Partial (90%) take	3	20
POSAS-patient score (Mean±SD)	-	9.14±1.04
POSAS-observer score (Mean±SD)	-	6.00±0.66

DISCUSSION

BTM (Biodegradable Temporising Matrix) has demonstrated its reliability and versatility in the reconstruction of complex wounds, particularly in patients with multiple comorbidities. Most cases were successfully grafted at 3–4 weeks post-operatively, with a range from 2 to 10 weeks. Importantly, BTM has shown resilience even in instances of partial graft loss, where the dermal matrix continued to support wound healing. One of the major advantages of BTM is its ability to convert otherwise non-viable wound beds such as those with exposed bone or tendon into a surface amenable to grafting. Notably, in cases involving exposed tendons, BTM preserves tendon gliding and function, a critical factor in limb preservation and functional outcomes.

BTM's utility in patients with significant comorbidities is particularly noteworthy. The procedure is relatively straightforward and can be performed under local or regional anaesthesia, reducing perioperative risks. The low complication and donor site morbidity further enhance its appeal, particularly for patients who may not tolerate more extensive reconstructive procedures. In some of our cases, full re-epithelisation was achieved without the need for skin grafting a phenomenon not widely reported in the current literature. This highlights a potentially unique advantage of BTM and provides fertile ground for future investigations.

When comparing BTM to other dermal matrices such as MatriDerm, Integra and collagen-based products, several distinctions emerge. Integra, a bilayer dermal regeneration template, has long been a standard in complex wound management. While it provides a stable neodermis, it often

requires a longer integration period and is more sensitive to infection. Additionally, Integra tends to be more expensive.[11] MatriDerm, a single-stage dermal substitute, incorporates collagen and elastin and can be used with immediate split-thickness skin grafting. While this offers the advantage of single-stage reconstruction, it may not be ideal for wounds with poor vascularity or exposed bone or tendon, where a temporising matrix like BTM provides a more suitable environment for granulation and delayed grafting. MatriDerm also carries the risk of increased contraction and may offer less long-term structural support than BTM.[16] Collagen-based substitutes, while cost-effective and widely available, are often limited by their mechanical strength and rapid biodegradation. These are typically more suitable for superficial wounds and less effective in larger, full-thickness defects or in patients with compromised healing potential.

In contrast, BTM offers a robust neodermis, resists infection better than many other matrices due to its closed pore architecture and provides a controlled biodegradation profile.[18] POSAS (Patient and Observer Scar Assessment Scale) scores reflect favourable aesthetic outcomes, with good scar pliability, colour match and thickness. The matrix appears to match the depth of most defects well, reducing the need for further contouring procedures like debulking or flap revision.

Nonetheless, disadvantages remain. As with all dermal matrices, BTM's integration can be compromised in cases of borderline vascularity or local infection. The staged nature of its application, though manageable, may be seen as a drawback in time-sensitive situations. These limitations, however, are not unique to BTM and underscore the need for careful patient selection and wound bed preparation.

CONCLUSION

The study demonstrates that Bilayer Biodegradable Temporising Matrix (BTM) is a safe and effective reconstructive option for complex wounds that would typically require more invasive procedures. The results showed high integration rates, with 100% BTM take in most cases and successful grafting outcomes. Additionally, BTM facilitated wound bed preparation over exposed bone and tendon while preserving function and aesthetics. Patients experienced good aesthetic and functional recovery, as indicated by POSAS scores, suggesting skin grafting after BTM provides good functional outcomes with, pliable scar, and less chances of recurrence. The study also highlighted cases where wounds healed entirely without skin grafting, which has not been widely reported in existing literature.

Despite its advantages, BTM has limitations, including the need for a staged approach and potential integration failures in cases with compromised vascularity or infection. Future research with extended follow-up and larger sample sizes could further validate these findings and refine BTM applications in reconstructive surgery.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Greenwood J. The evolution of acute burn care–retiring the split skin graft. Ann R Coll Surg Engl. 2017;99:432–8.
2. Greenwood J, Li A, Dearman B, Moore TG. Evaluation of Novo Sorb novel biodegradable polymer for the generation of a dermal matrix part 1: in-vitro studies. Wound Pract Res. 2010;18:14.
3. Greenwood JE, Schmitt BJ, Wagstaff MJ. Experience with a synthetic bilayer Biodegradable Temporising Matrix in significant burn injury. Burns Open. 2018;2:17–34.
4. Cheshire PA, Herson MR, Cleland H, Akbarzadeh S. Artificial dermal templates: a comparative study of NovoSorb Biodegradable Temporising Matrix (BTM) and Integra(R) Dermal Regeneration Template (DRT). Burns. 2016;42:1088–96.
5. Wagstaff MJD, Driver S, Coghlan P, Greenwood JE. A randomized, controlled trial of negative pressure wound therapy of pressure ulcers via a novel polyurethane foam. Wound Repair Regen. 2014;22:205–11.
6. Wagstaff MJ, Schmitt BJ, Coghlan P, Finkemeyer JP, Caplash Y, Greenwood JE. A biodegradable polyurethane dermal matrix in reconstruction of free flap donor sites: a pilot study. Eplasty. 2015;15:13.
7. Wagstaff MJ, Schmitt BJ, Caplash Y, Greenwood JE. Free flap donor site reconstruction: a prospective case series using an optimized polyurethane biodegradable temporizing matrix. Eplasty. 2015;15:27.
8. Greenwood JE, Wagstaff MJ, Rooke M. Reconstruction of extensive calvarial exposure after major burn injury in 2 stages using a biodegradable polyurethane matrix. Eplasty. 2016;16:17.
9. Greenwood JE. Clinical application of NovoSorb BTM in acute burns. Burns Open. 2018;2:17–34.
10. Draaijers LJ, Tempelman FR, Botman YA, Tuinebreijer WE, Middelkoop E, Kreis RW. The patient and observer scar assessment scale: a reliable and feasible tool for scar evaluation. Plast Reconstr Surg. 2004;113:1960–5.
11. Wood FM, Giles N, Stevenson A, Rea S, Fear M. Characterisation of the cell extract from the dermal component of an artificial skin. Burns. 2005;31(6):693–701.
12. Moiemen NS, Mathonnet M, Smailes S. Use of dermal regeneration templates in complex burns and wounds: A UK expert consensus. Scars Burn Heal. 2019;5:2059513119860401.
13. Li A, Dearman BL, Clover AJ, Greenwood JE. In vivo evaluation of a novel biodegradable temporising

matrix for dermal reconstruction. J Wound Care. 2017;26(12):764–72.
14. Heimbach D, Luterman A, Burke J. Artificial dermis for major burns. A multi-center randomized clinical trial. Ann Surg. 1988;208(3):313-20.
15. Ryssel H, Gazyakan E, Germann G, Oehlbauer M. The use of MatriDerm in early excision and simultaneous autologous skin grafting in burns: a pilot study. Burns. 2008;34(1):93–7.
16. Shevchenko RV, James SL, James SE. A review of tissue-engineered skin bioconstructs available for skin reconstruction. J R Soc Interface. 2010;7(43):229–58.
17. Yannas IV, Burke JF. Design of an artificial skin. I. Basic design principles. J Biomed Mater Res. 1980;14(1):65–81.
18. Sreedharan S, Morrison E, Cleland H, Ricketts S, Bruscino-Raiola F. Biodegradable temporising matrix for necrotising soft tissue infections: a case report. Aust J Plast Surg. 2019;2:106–9.

Cite this article as: Shah SD, Shah AN, Ghelani NB, Shah VV, Godhani CA, Pathak NH. Experience with a synthetic bilayer biodegradable temporising matrix in complex wounds. Int J Res Med Sci 2025;13:2607-12.