# DERMAL SUBSTITUTE IN THE WOUND MANAGEMENT: OUR INSTITUTIONAL EXPERIENCE


## ABSTRACT

**Background:** Wound management has advanced significantly with the introduction of dermal substitutes, offering improved healing outcomes and patient care. This study evaluates the effectiveness and integration of two dermal substitutes — Matriderm and Biodegradable Temporizing Matrix (BTM) — in the management of full-thickness burns and post-traumatic wounds.

**Methods:** This institutional study included 14 patients with full-thickness burns or post-traumatic wounds, divided into two groups of seven each. Matriderm and BTM were applied following standard wound bed preparation procedures, and grafting was performed after 15-21 days. Primary outcomes measured were integration with host tissue, infection rates, time to complete wound healing, and scar quality. Secondary outcomes included cost-effectiveness, patient satisfaction and adverse reactions.

**Results:** Both Matriderm and BTM showed similar integration rates with host tissue and comparable healing times. Infection rates were equivalent between the groups. Matriderm resulted in superior scar quality, leading to higher patient satisfaction. BTM demonstrated greater cost-effectiveness, making it an attractive option from an institutional perspective.

**Conclusion:** Matriderm and BTM are both effective in managing complex wounds. Matriderm excels in providing superior scar quality, while BTM offers significant cost advantages. The integration of these dermal substitutes into clinical practice enhances wound care outcomes, emphasizing the importance of tailored approaches based on individual patient needs and specific wound characteristics.



**Keywords:** *Wound management, dermal substitutes, Matriderm, Biodegradable Temporizing Matrix, full-thickness burns, post-traumatic wounds, wound healing, scar quality, cost-effectiveness*.

## INTRODUCTION

Wound management has rapidly evolved due to advancements in biomedical research and technology, presenting new challenges and opportunities in clinical medicine. Dermal substitutes represent a significant innovation, offering alternatives to traditional methods and aiming to improve healing outcomes and patient care.[1]

### Biological Dermal Substitutes:

#### How Biological Dermal Substitutes Act?

Biological dermal substitutes act as scaffolds resembling the natural skin extracellular matrix. They are composed of collagen fibers and elastin to facilitate natural healing and avoid unstructured scarring.[2] These substitutes enhance cell migration and reconstruction of new dermis, triggering early vascularization by elastin, which reduces infection risk and improves skin elasticity. The absence of chemical cross-linking prevents the release of cytotoxic substances, promoting cellular growth and supporting structured healing by guiding fibroblasts and forming a neo-dermis. They also promote neovascularization for blood supply and graft success, ultimately reducing scarring.[3,4,5]

### Synthetic Dermal Substitutes:

#### Regenerative Requirements and Functions

Synthetic dermal substitutes, such as the Biodegradable Temporizing Matrix (BTM), perform several key functions:

- **Seal the Wound:** BTM's outer membrane provides a barrier to prevent tissue overgrowth, reduce evaporative water loss, and remain robust in the presence of infection.[6]
- **Minimize Inflammation:** The biocompatible polymer reduces excessive foreign body response.
- **Scar-less Regenerative Healing:** BTM compartmentalizes a macrowound into interconnected microwounds under 1mm, promoting organized regenerative healing.
- **Foreign Body Response:** BTM elicits a mild foreign body response characterized by a thin layer of foreign body giant cells adjacent to the polymer.[7,8]
- **Cellular Migration and Neovascularization:** BTM's 95% porous open architecture allows for mechanical fluid flow, containing nutrients, fibrin, chemo-attractants, macrophages, fibroblasts, and stem cells.
- **Bioabsorbability and Biocompatibility:** BTM degrades slowly via hydrolysis, forming products like L-lactic acid, resorbed/excreted within 18 months.
- **Minimize Contracture:** The sealing membrane reduces evaporative water loss, and foam struts prevent myofibroblasts from laying down a contiguous collagenous network beyond each chamber, retaining microstructure for over 6 months.[9]

## MATERIALS AND METHODS

**Inclusion Criteria:** Patients with full-thickness burns and post-traumatic wounds, up to 15 cm × 15 cm.

**Exclusion Criteria:** Patients with superficial burns, allergies to bovine/synthetic products, or larger defects.

**Sample Size:** Fourteen patients, with seven in each group.

**Study Duration:** One year (April 2023 to March 2024).

### Application Process

- **Matriderm:** Prepared according to wound dimensions, applied after wound bed preparation with options for layering based on severity, followed by VAC application and grafting after 15 days.
- **BTM:** Applied similarly following strict guidelines for wound debridement, with grafting done after the desired wound bed condition is achieved (between 15-21 days).

### Post-Application Care

Emphasis on dressing management to minimize shear and promote substitute integration with host tissues.

### Outcome Measures

#### Primary Outcomes

Integration with host tissue, infection rates, time to complete wound healing and scar quality.

#### Secondary Outcomes

Cost-effectiveness, patient satisfaction and adverse reactions to treatments.

## RESULTS

#### Matriderm vs. BTM

Both Matriderm and BTM showed similar integration rates and healing times. Infection rates were comparable between the groups. However, Matriderm resulted in superior scar quality, leading to higher patient satisfaction.

#### Cost-Effectiveness Analysis

BTM proved more cost-effective than Matriderm, considering treatment costs and outcomes, enhancing its appeal from an institutional perspective.

**Institutional Experience with Dermal Substitutes**

**Impact on Practices:** The use of dermal substitutes has significantly shaped our treatment protocols and patient outcomes.

**Lessons Learned:** Insights gained emphasize tailored approaches based on individual patient needs and specific wound characteristics.

## CLINICAL PHOTOS

**Fig 1- PRE OP PICTURE OF PATIENT 1**

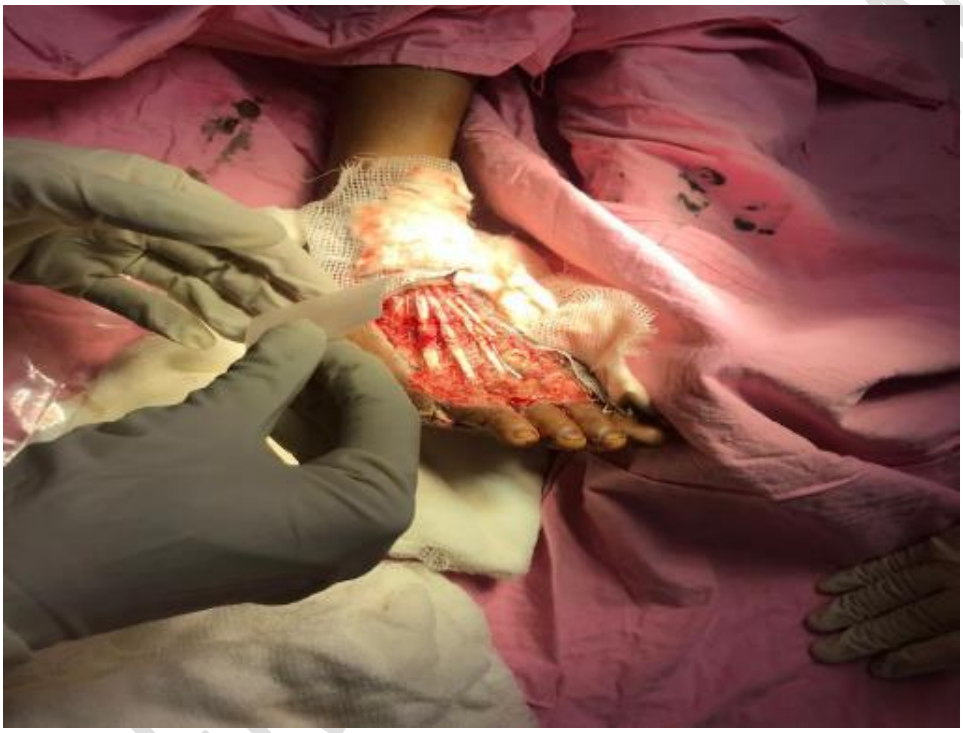


**Fig 2- 5 DAYS OF BTM APPLICATION**

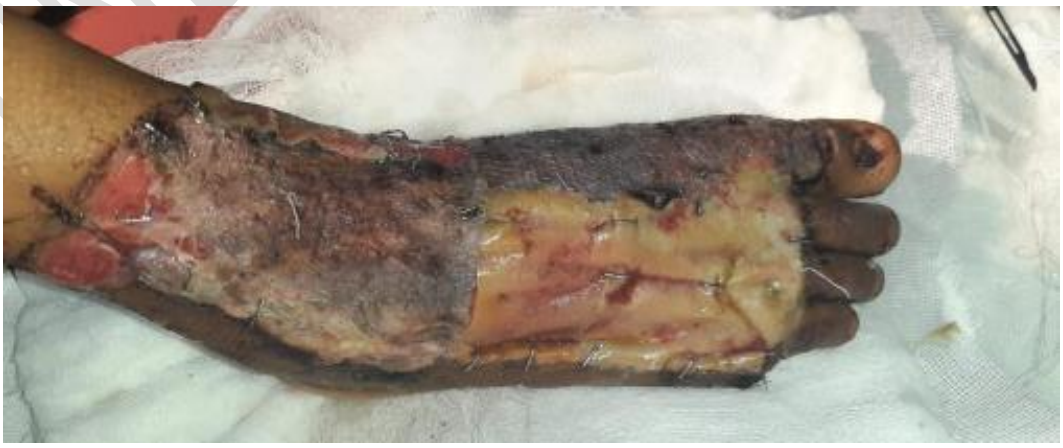


**Fig 3- 15 DAYS OF BTM APPLICATION**

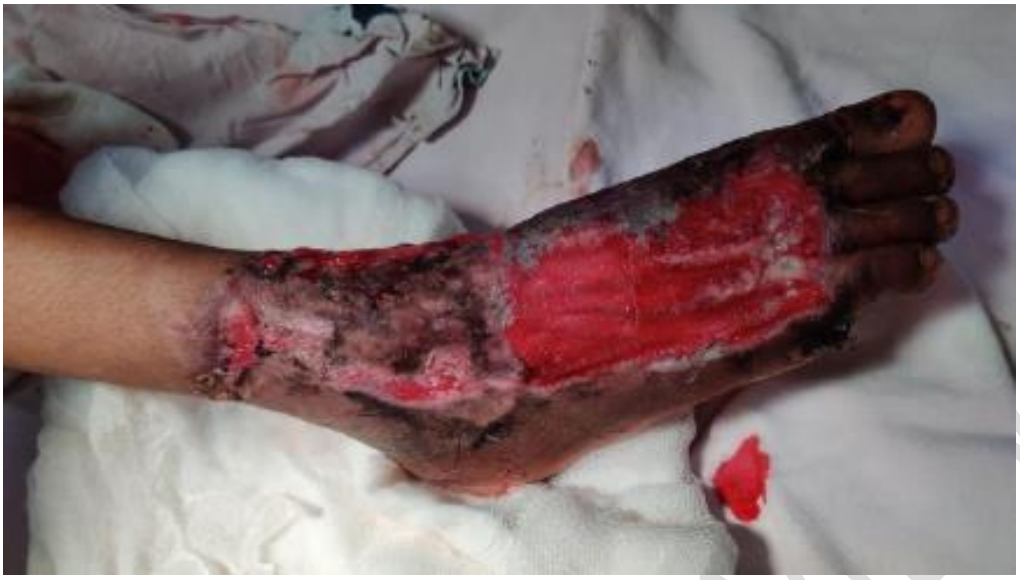


**Fig 4- AFTER GRAFTING**

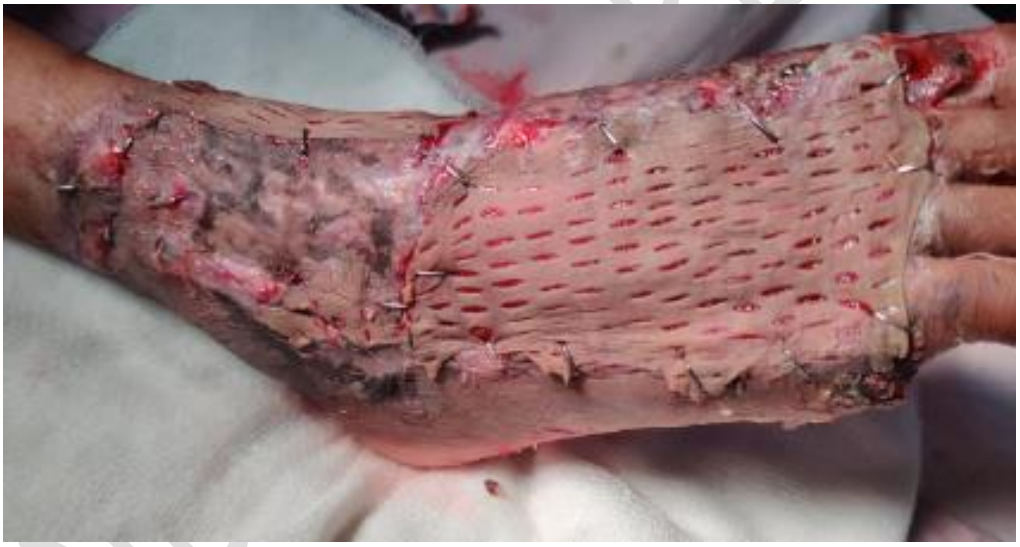


**Fig 5- 1 MONTH AFTER GRAFTING**

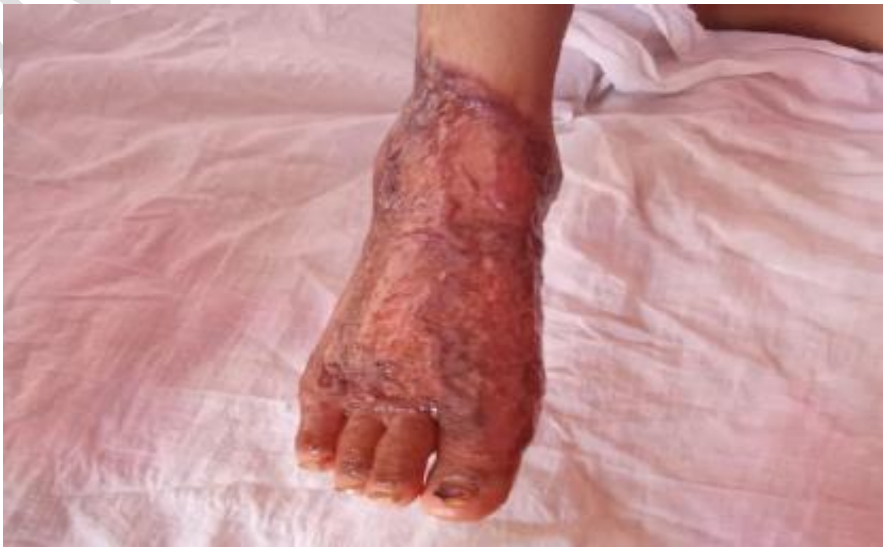


**Fig 6- PRE OP PICTURE OF PATIENT-2**

**Fig 7- AFTER BTM APPLICATION**

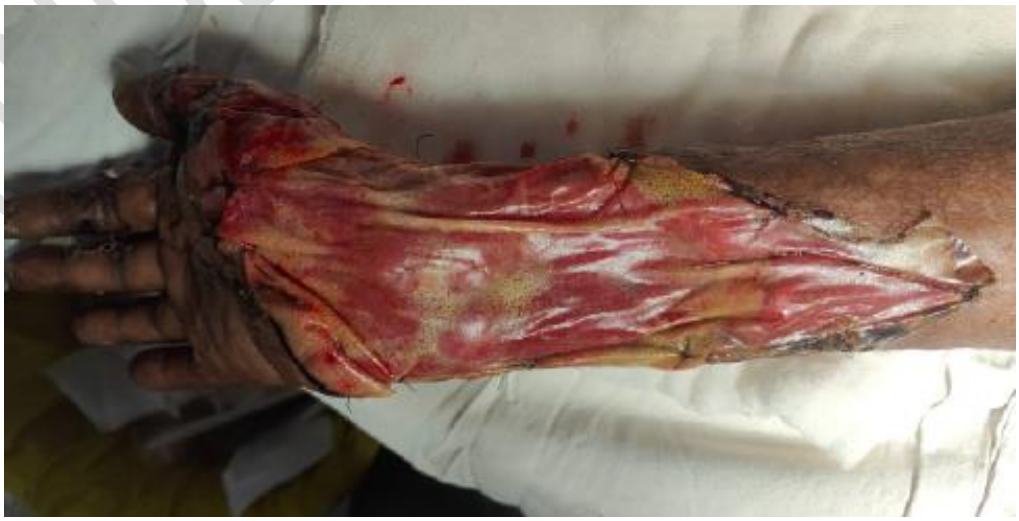


**Fig 8- AFTER GRAFTING**

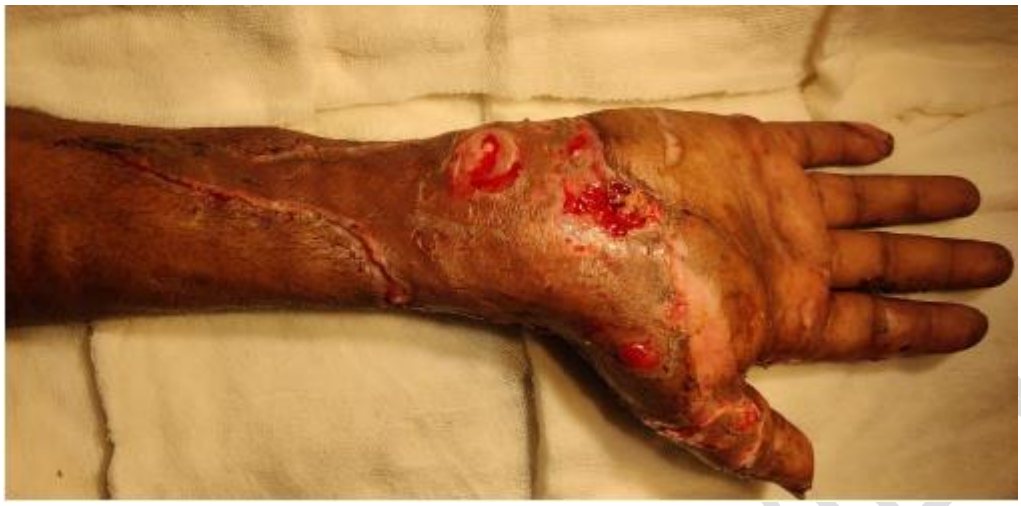


**Fig 9- 1 MONTH POST GRAFTING**

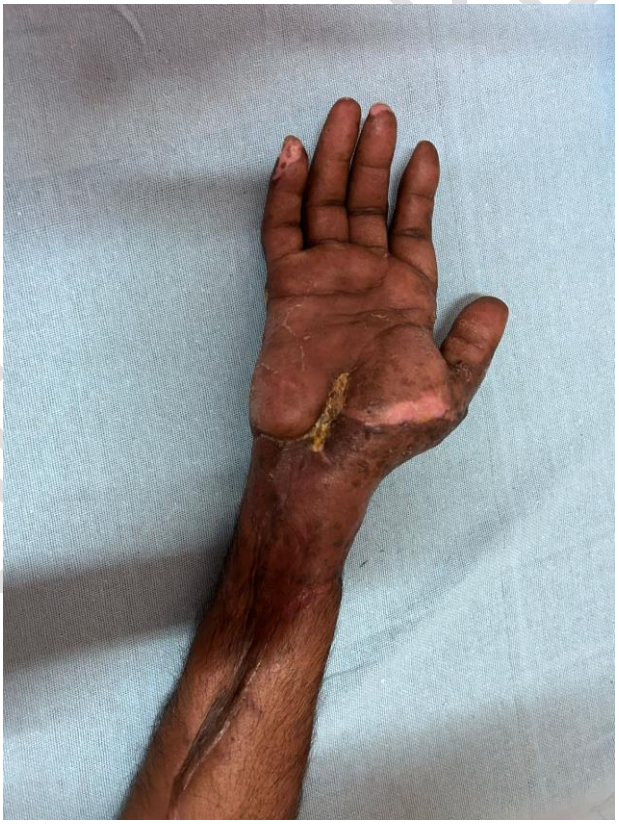


**Fig 10-PATIENT 3: UNSTABLE SCAR AT HEEL**

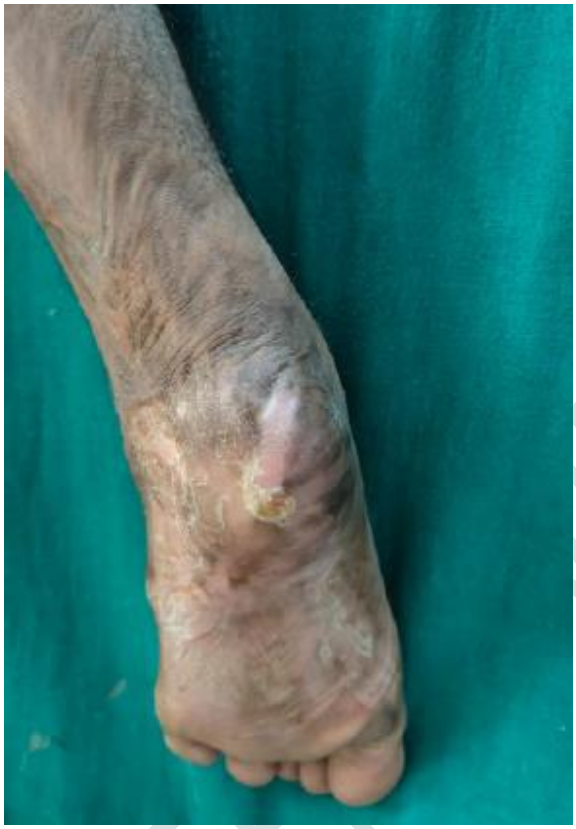
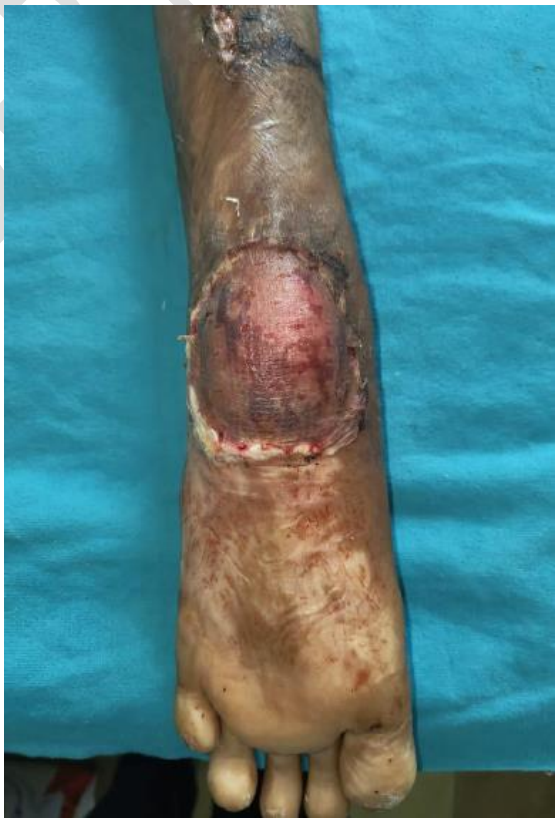


**Fig 11- POST OP DAY 7 AFTER MATRIDERM APPLICATION FOLLOWED BY GRAFTING**



## DISCUSSION

The findings from our institutional study highlight the significant potential of both Matriderm and the Biodegradable Temporizing Matrix (BTM) in the management of full-thickness burns and post-traumatic wounds. This discussion aims to provide an in-depth analysis of the results, focusing on clinical implications, the comparative effectiveness of the two dermal substitutes, and future research directions.[10]

### Clinical Implications:

The primary goal in wound management is to achieve rapid and effective healing while minimizing complications such as infection and scarring. Both Matriderm and BTM have demonstrated their ability to support these goals effectively. Matriderm, with its collagen and elastin composition, provides a robust scaffold for natural healing, promoting cell migration and dermal reconstruction. This leads to superior scar quality, which is a critical outcome for patient satisfaction and long-term functional and aesthetic results.[11,12]

BTM, on the other hand, offers several advantages, particularly in terms of cost-effectiveness and ease of application. The synthetic nature of BTM allows for standardized use across various wound conditions, ensuring consistency in treatment. Its 95% porous architecture facilitates cellular migration and neovascularization, crucial for effective wound healing. The biocompatible polymer minimizes the foreign body response, further reducing the risk of complications.[13,14]

### Comparative Effectiveness:

The study results show that both Matriderm and BTM have similar integration rates with host tissue and comparable healing times. Infection rates were also similar between the groups, indicating that both substitutes are equally effective in creating an environment conducive to healing. However, Matriderm provided superior scar quality, which can be attributed to its biological composition closely mimicking natural skin extracellular matrix.[15]
BTM's cost-effectiveness emerged as a significant advantage, making it a more appealing option from an institutional perspective. Given the high costs associated with advanced wound care, the use of BTM could result in substantial savings without compromising clinical outcomes. This is particularly relevant in healthcare settings with limited resources, where cost-effective solutions are essential.[16]

### Future directions:

While this study provides valuable insights, further research is necessary to fully understand the long-term implications of using these dermal substitutes. Future studies should focus on larger patient populations and longer follow-up periods to assess the durability and long-term outcomes of wound healing. Additionally, comparative studies involving other emerging dermal substitutes could provide a broader perspective on the best practices in wound management.

## CONCLUSION

In conclusion, our study supports the use of both Matriderm and BTM as effective options for managing full-thickness burns and post-traumatic wounds. While Matriderm excels

in scar quality, BTM offers notable cost advantages. The integration of these technologies into clinical practice represents a significant advancement in wound care, emphasizing the need for continued research and innovation in this field to optimize patient outcomes.

**REFERENCES**


1. Shahrokhi S, Arno A, Jeschke MG. The use of dermal substitutes in burn surgery: acute phase. Wound Repair Regen: Off Publ Wound Heal Soc Eur Tissue Repair Soc 2014;22:14–22.
2. Pham C, Greenwood J, Cleland H, Woodruff P, Maddern G. Bioengineered skin substitutes for the management of burns: a systematic review. Burns: J Int Soc Burn Inj 2007;33:946–57.
3. Chan ES, Lam PK, Liew CT, Lau HC, Yen RS, King WW. A new technique to resurface wounds with composite biocompatible epidermal graft and artificial skin. J Trauma 2001;50:358–62.
4. Chou TD, Chen SL, Lee TW, Chen SG, Cheng TY, Lee CH, et al. Reconstruction of burn scar of the upper extremities with artificial skin. PlastReconstrSurg 2001;108:378–84.
5. Moiemen NS, Staiano JJ, Ojeh NO, Thway Y, Frame JD. Reconstructive surgery with a dermal regeneration template: clinical and histologic study. PlastReconstrSurg 2001;108:93–103.
6. Ryan CM, Schoenfeld DA, Malloy M, Schulz 3rd JT, Sheridan RL, Tompkins RG. Use of Integra artificial skin is associated with decreased length of stay for severely injured adult burn survivors. J Burn Care Rehabil 2002;23:311–7.
7. Heimbach DM, Warden GD, Luterman A, Jordan MH, Ozobia N, Ryan CM, et al. Multicenter post approval clinical trial of Integra dermal regeneration template for burn treatment. J Burn Care Rehabil 2003;24:42–8.
8. Branski LK, Herndon DN, Pereira C, Mlcak RP, Celis MM, Lee JO, et al. Longitudinal assessment of Integra in primary burn management: a randomized pediatric clinical trial. Crit Care Med 2007;35:2615–23.
9. Muangman P, Deubner H, Honari S, Heimbach DM, Engrav LH, Klein MB, et al. Correlation of clinical outcome of Integra application with microbiologic and pathological biopsies. J Trauma 2006;61:1212–7.
10. Moiemen N, Yarrow J, Hodgson E, Constantinides J, Chipp E, Oakley H, et al. Long-term clinical and histological analysis of Integra dermal regeneration template. PlastReconstrSurg 2011;127:1149–54.
11. Yannas IV, Lee E, Orgill DP, Skrabut EM, Murphy GF. Synthesis and characterization of a model extracellular matrix that induces partial regeneration of adult mammalian skin. Proc Natl Acad Sci U S A 1989;86:933–7.
12. King WW, Lam PK, Liew CT, Ho WS, Li AK. Evaluation of artificial skin (Integra) in a rodent model. Burns: J Int Soc Burn Inj 1997;23(Suppl 1):S30–2.
13. Grant I, Green C, Martin R. Strategies to improve the take of commercially available collagen/glycosaminoglycan wound repair material investigated in an animal model. Burns: J Int Soc Burn Inj 2001;27:699–707.

14. Shaterian A, Borboa A, Sawada R, Costantini T, Potenza B, Coimbra R, et al. Real-time analysis of the kinetics of angiogenesis and vascular permeability in an animal model of wound healing. Burns: J Int Soc Burn Inj 2009;35:811–7.
15. Capito AE, Tholpady SS, Agrawal H, Drake DB, Katz AJ. Evaluation of host tissue integration, revascularization, and cellular infiltration within various dermal substrates. Ann PlastSurg 2012;68:495–500.
16. Greenwood JE, Dearman BL, Li A, Moore TG. Evaluation of NovoSorbTM novel biodegradable polymer for the generation of a dermal matrix. Part 1: in-vitro studies. Wound Pract Res 2010;18:14–22.