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Case Series

Initial Experience Using a Biosynthetic Wound Matrix for Full-Thickness Wound Temporization

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Abstract

Immediate autografting is a fundamental principle of acute burn care. However, not all patients can undergo early autografting and temporary dressings can seal and protect the wound bed until graft readiness. The aim was to evaluate a temporary, bilayer, biosynthetic wound matrix for wound temporization in lieu of frozen cadaveric tissue. A retrospective chart review was conducted for the first 7 patients treated with acute mixed depth and full-thickness wounds resulting from surgical excision of necrotic burn tissue and were not ready for immediate autografting. Patient demographics and outcomes reported included days from hospital presentation until biosynthetic wound matrix application, days until autograft readiness, autograft healing, and complications. Median time from arrival at the hospital to placement of the biosynthetic wound matrix was 2 days. Median time to graft readiness was 11 days (IQR 9-13) and the median time to autograft healing was 11 days (IQR 5.5-15.5). One patient developed a small hematoma, which did not affect adherence. No other complications were reported. Although a direct comparison was not made to cadaveric tissue, the biosynthetic wound matrix was easy to incorporate into practice and provided operative efficiencies. It serves as a viable alternative to cadaveric allograft, delivering similar clinical outcomes while offering the advantages of simplified storage, reduced cost, easier application, and streamlined post-operative management. Additionally, its transparency allows for direct wound assessment, further enhancing its utility in clinical practice. Our initial experience indicates it is a safe and effective option for temporizing the wound bed until grafting is feasible.

Keywords: Biosynthetic wound matrix; Burns; Temporary dressings; Wounds; Wound temporization

Introduction

Although immediate placement of an autograft is a fundamental principle of acute burn care, not all wounds or patients can undergo early skin grafting due to a myriad of reasons. Temporary dressings serve as a tool to seal the wound bed and function as a protective layer when circumstances for autografting are unsafe or not possible due to patient instability, minimal donor sites, limited resources, or mass casualty situations. [1,2] Temporizing the wound bed facilitates retention of electrolytes and moisture. Especially for patients with larger injuries, this helps maintain thermoregulation and ameliorate the hypermetabolic response which saves energy expenditure. [3] Upon adherence of temporary dressings, patients can mobilize and typically experience a reduction in pain. [2,3] Temporary dressings can also be used as a test graft or detect if remaining necrotic tissue is present. Additionally, in less severe

injuries, temporary dressings have been shown to facilitate re-epithelialization in areas of indeterminate depth. Currently, frozen cadaveric tissue is often used as an effective dressing for temporary coverage, but has limitations including cost, application time, small sizes, and potential for disease transmission [1].

Similar to frozen cadaveric tissue, biosynthetic skin substitutes can provide both an effective physical barrier and temporary covering until definitive wound closure is possible with autografting. [4] A prior prospective multi-center study compared a biosynthetic skin substitute to frozen cadaveric tissue for wound temporization of excised full-thickness burn wounds and found comparable outcomes in terms of dressing changes and autograft take. Investigators concluded that the biosynthetic skin substitute was as effective as frozen cadaveric tissue. [5] A different comparative study examined both the cost and procedural time between a biosynthetic skin substitute and frozen cadaveric tissue. They determined superiority of the biosynthetic skin substitute over frozen cadaveric tissue as it exhibited both cost savings and reduction in procedural time allotment due to being able to cover larger surface areas faster. [1] Another benefit of biosynthetic skin substitutes is that they may remain intact longer as they do not undergo immune rejection like allograft [4].

One such skin substitute is a temporary, bilayer, biosynthetic wound matrix (BWM, PermeaDerm®, Stedical Scientific, Inc., Carlsbad, CA). It is comprised of an outer silicone layer which serves as an epidermal analogue and has variable porosity to allow for customizable moisture management. The inner layer is comprised of a tri-filament nylon matrix biocoated with collagen and aloe. Additionally, it is stable at room temperature and can be rapidly applied. [6] This is the first documented report of the use of a temporary bilayer BWM comprised of an outer silicone layer with variable porosity and an inner tri-filament nylon matrix biocoated with collagen and aloe in lieu of frozen cadaveric tissue.

Materials and Methods

A retrospective chart review was conducted for the initial patients who had application of the BWM treated in our verified burn center between August 2024 and November 2024. Included patients had acute mixed depth and full-thickness wounds resulting from surgical excision of necrotic burn tissue and were not ready for immediate autografting. Those excluded had superficial burns and did not require surgical excision or had deeper burns but were ready for immediate autografting. Following operative debridement, the BWM was secured in place with skin staples (Figure 1) and dressed with a standard dressing regimen for all patients which included an absorbent pad, gauze roll, and compression wrap. For the first 48 hours post-operatively, there were no dressing changes. Thereafter, the outer dressings were replaced daily until autografting readiness was determined by BWM adherence and visualization of a well-vascularized wound bed through the transparent BWM layers. Patient demographics were noted including age, sex, and race. Burn etiology, burn Total Body Surface Area (TBSA), and anatomical location treated were also documented. Outcomes included days from hospital presentation until BWM application, days until autograft readiness, autograft healing (Figure 2), and complications.

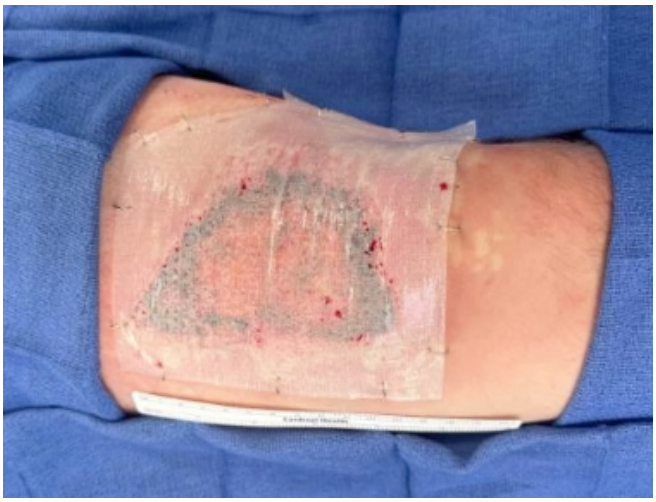

Figure 1: Intraoperative Application of the Biosynthetic Wound Matrix.

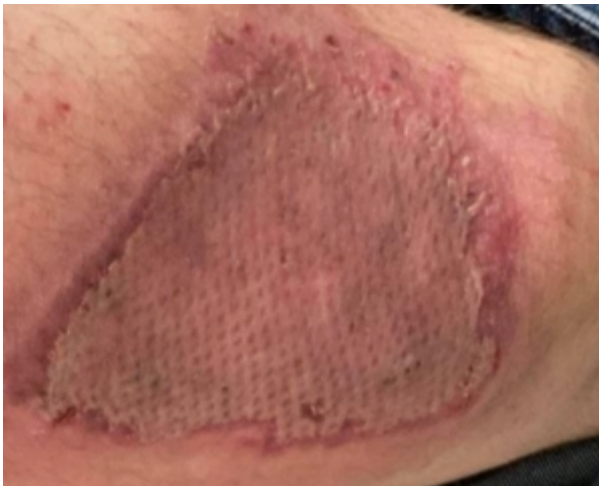

Figure 2: Healed Autograft.

It was also recorded whether the patients were discharged home before autografting or remained as inpatients. For those remaining as inpatients, hospital length of stay, intensive care unit length of stay, and number of ventilator days was documented. Providers were surveyed and their responses were also recorded based on

operative setting handling, application, and aftercare experience of the BWM. Patients were interviewed post-BWM application about ease of aftercare and asked to rate pain scores pre-application versus post-application.

Results

Seven patients were treated with the BWM. The cohort consisted of 57.1% male and 42.9% female patients. Racially, 85.7% were non-Hispanic White and 14.3% were Southeast Asian. The median age of the study participants was 44 years (IQR 31-57.5). The mechanism of burn injury included flame burns (57.1%), contact burns (14.3%), flash flame burns (14.3%), and chemical burns (14.3%). TBSA affected by burns ranged from 2 to 31%. Only one patient was treated in the outpatient setting while the remaining six patients were treated as inpatients. The median length of hospital stay was 13 days (IQR 7.5-35.5). Three patients required Intensive Care Unit (ICU) admission, with a median ICU stay of 0 days (IQR 0-28.5). Four patients required mechanical ventilation with a median duration of 0 days (IQR 0-10). Only one patient died from septic shock secondary to pneumonia during the study period. The median time between arrival at the hospital and placement of the BWM was 2 days (IQR 1-5.5). The BWM was applied to the upper and lower extremities, as well as the trunk. Median time to graft readiness was 11 days (IQR 9-13) and the median time to autograft healing was 11 days (IQR 5.5-15.5). One patient developed a small hematoma, which did not affect BWM adherence. No other complications related to the BWM were reported.

In post-application evaluations, all burn surgeons reported a preference for the BWM over frozen cadaveric allograft. Key advantages cited included the lack of requirement for cryogenic storage, subjective reduction in operative time due to the absence of thawing, and greater ease of handling during application. Providers post-survey also noted rapid BWM application as it is larger and has a variety of sizes. In post-application interviews, patients found the aftercare process to be straightforward and reported decreased pain post-application compared to pre-application.

Discussion

In this retrospective chart review, a temporary bilayer BWM was used as an alternative to cadaveric skin grafts in patients with deep partial-thickness and full-thickness burns. In the operative setting, the application process for the BWM closely mirrors that of cadaveric skin. The wound bed is prepared through tangential excision, followed by securing the BWM to the surgical site using staples, sutures, Steri-Strips, or surgical glue. All burn surgeons involved in this study reported that the application of the BWM was more efficient and simpler to execute compared to cadaveric allograft, likely due to its availability in various sheet sizes, with dimensions up to 2900 cm^2 and storage at room temperature. This enhanced efficiency in the operative setting led to reduced operative times, benefiting both patients and the hospital system by lowering hospital costs and increasing operating room availability.

Noted benefits of the BWM's design extend into the post-operative period. The product simplifies wound care, requiring only daily dressing changes starting after wound adherence in 48-72 hours post-application. Its transparent nature allows for continuous visual assessment of the wound bed outside of the operative setting. The ease of application and simplicity of post-operative care were exemplified in two patient cases: one outpatient treated with the BWM, and a second patient staged for definitive autografting with the BWM applied as a temporary cover. Both patients experienced minimal pain, had no issues or confusion regarding BWM aftercare, demonstrated adequate graft take, and did not experience any complications at the surgical site. The BWM meets several key criteria for an ideal skin substitute: it provides a protective barrier against environmental factors and bacteria contamination, supports the healing process by promoting growth factors in the wound bed, optimizes moisture management, and is cost-effective. [1,3,7] The BWM adheres well, even over articulating joints, and is approximately one-third the cost of cadaveric skin. [8] Additionally, the BWM does not require stringent storage protocols or the use of cryogenic freezers, which contributes to reduced handling costs and distribution fees. [5,6,8-10] In contrast, the supply of cadaveric skin is limited by donor availability, regulatory concerns, and the risk of infectious disease transmission [9,10].

This study adds to the growing body of evidence supporting the use of alternative skin substitutes for wound bed temporization. Previous research by Shores et al, has shown that products like porcine skin, collagen, and silicone-based matrices significantly reduced procedure times and overall costs when compared to cadaveric skin. [1,11] This study is limited by its retrospective design and single institution setting. As a descriptive study, it cannot draw definitive conclusions about the superiority of the temporary, bilayer, biosynthetic wound matrix over other skin substitutes or its impact on patient outcomes.

Conclusions

Our initial experience indicates that the BWM is safe and is an effective option for temporizing the wound bed until grafting is feasible. It serves as a viable alternative to frozen cadaveric tissue, delivering similar clinical outcomes while offering the advantages of simplified storage, reduced cost, easier application, and streamlined post-operative management. Additionally, its transparency allows for direct wound assessment, further enhancing its utility in clinical practice. Overall, the BWM represents a cost-effective and efficient solution for managing burns.

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Ethical Guidelines: This was a retrospective review, and all patients provided release of information for research consent.

Conflicts of Interest: Rachel Penny is an employee of AVITA Medical.

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