# Application of Acellular Dermal Matrix for Resolving impaired Wound Healing

Sang Wha Kim. M.D., PhD.
Department of Plastic and reconstructive Surgery, College of Medicine, Seoul National University Hospital, Seoul, Korea

## Background

Wound healing is a well-coordinated process involving inflammation, proliferation, and remodeling, characterized by interactions between cells and their microenvironment. One of most important elements in wound healing is the extracellular matrix (ECM). The ECM is the largest component in the dermal layer, which is a network of extracellular macromolecules involving collagen, enzymes, and glycoproteins.
The application of acellular dermal matrix (ADM) has been suggested as a substitute for the ECM. ADM is a biomaterial derived from human or bovine tissues that has been used clinically as a dermal replacement material, to facilitate wound healing and dermis formation. ADM was typically used in sheet form, but a paste-type ADM has recently been introduced. This study investigated the clinical utility and wound healing effects of a paste-type ADM in patients presenting with chronic wounds with various causes.

## Methods

Patients with non-healing wounds were included in this study. All of the patients had chronic non-healing wounds for more than 1 month, despite conventional wound management. All wounds were normally treated for a month before the clinical study began.
Before applying the ADM, debridement was performed and wound status was evaluated. Proper debridement was implemented if there was a necrotizing wound. ADM was applied at 0 (baseline), 2, and 4 weeks. After applying the ADM, conventional dressing was performed using polyurethane foam.
Wound healing was assessed at 0 (baseline), 1, 2, 4, 8, and 12 weeks after initial treatment. Wound size, granulation tissue formation, epithelization, complete healing status, and adverse events were recorded at each follow-up visit.

**Table 1. Demographic characteristics (n=18)**

| Characteristic | Value |
|---|---|
| Age, year, mean±SD | 56.00±16.16 |
| **Sex, n (%)** | |
| Male | 8 (44.4) |
| Female | 10 (55.6) |
| **Hypertension, n (%)** | |
| Yes | 5 (27.8) |
| No | 13 (72.2) |
| **Diabetes, n (%)** | |
| Yes | 3 (16.7) |
| No | 15 (83.3) |
| **Dialysis, n (%)** | |
| Yes | 2 (11.1) |
| No | 16 (88.9) |
| **Autoimmune disease, n (%)** | |
| Yes | 1 (5.6) |
| No | 17 (94.4) |
| **Vascular disease, n (%)** | |
| Yes | 2 (11.1) |
| No | 16 (88.9) |
| Wound size, $cm^2$, mean±SD | 17.42±10.06 |
| **Wound location, n (%)** | |
| Upper extremity | 2 (11.1) |
| Lower extremity (except foot) | 6 (33.3) |
| Foot | 10 (55.6) |

SD—standard deviation

## Results

Eighteen patients participated in this study, (8 males, 10 females), with a mean age of 56 ± 16.16 years. The wound area decreased from 17.42 ± 10.04 to 12.73 ± 7.60 by week 1 ($p<0.05$), 10.16 ± 7.00 by week 2 ($p<0.0005$), 5.56 ± 5.25 by week 4 ($p<0.0001$), 2.77 ± 5.15 by week 8 ($p<0.0001$), and 2.07 ± 4.78 by week 12 ($p<0.0001$) (Fig. 1). The granulation formation rate in the wound bed was classified as, no granulation, ≤ 25% of the wound, > 25 and ≤ 75% of the wound, > 75% of the wound. The number of patients with > 75% granulation increased, albeit not significantly, over time, being 3 at week 1, 6 at week 2, 11 at week 4, 13 at week 8, and 15 at week 12 (Fig. 2). The number of patients who had > 75% epithelization also increased, albeit not significantly, over time, being 2 at week 2, 5 at week 4, 11 at week 8, and 13 at week 12 (Fig. 3). The number of patients showing complete wound healing was 2  at week 4, 9 at week 8, and 12 at week 12 (Fig. 4).

**Fig 1.** Wound area reduction

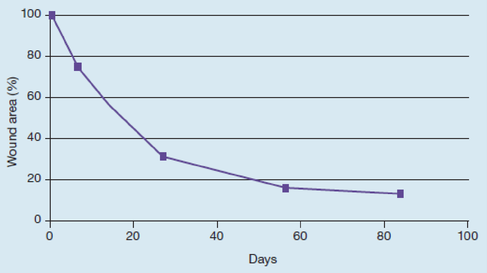


**Fig 2.** Percentage of patients with >75% granulation

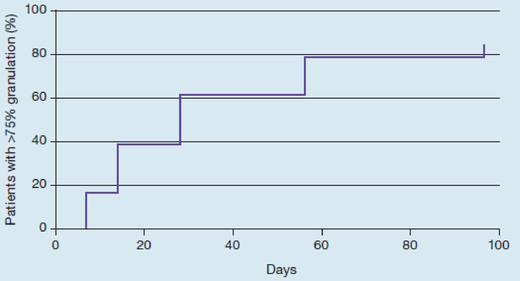


**Fig 3.** Percentage of patients who had >75% re-epithelialisation

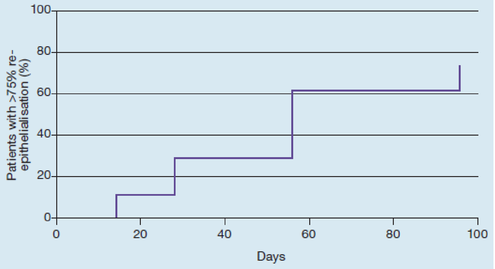


**Fig 4.** Percentage of patients showing complete wound healing

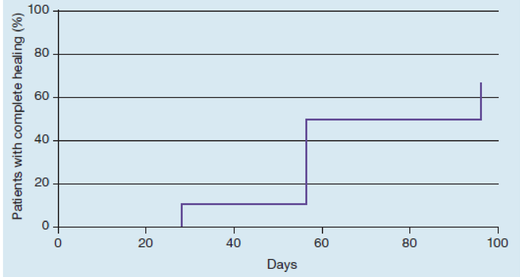


**Fig 5.** Case 1: A 56-year-old male patient with a 8×5cm open wound on his heel after a varicose vein procedure. Wound after radical debridement **(a)**. After one week, wound size reduced to 4×3.5cm with 90% granulation tissue **(b)**. By week two, wound size reduced to 3×2.5cm **(c)**. By week four, wound size reduced to 2.5×2.0cm **(d)**. By week 12 the wound had completely healed **(e)**


**Fig 6.** Case 2: A 65-year-old female patient with a 10×4cm skin defect on the lateral side of the left ankle was observed after debridement **(a)**. At 12 weeks, the wound was almost healed, no contracture deformity was observed and a good aesthetic outcome was achieved **(b)**


## Conclusion

ADM is a useful option for wound healing; it can help the hospital stay, and promote faster recovery and return to normal life activities. Moreover, the use of ADM could help avoid the need for difficult surgical procedures, such as skin graft or flap surgery performed under general anesthesia, which may be particularly useful in elderly cases or those for which anesthesia is considered higher-risk. ADM must be applied in other populations in comparative, long-term studies to validate its usefulness for treating chronic non-healing wounds.