SCIENTIFIC ARTICLE

Comparative Skin Evaluation After Split-Thickness Skin Grafts Using 2 Different Acellular Dermal Matrices to Cover Composite Forearm Defects

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Purpose The combination of acellular dermal matrix (ADM) and split-thickness skin graft (STSG) has been widely adopted to overcome functional and cosmetic limitations of conventional STSG. In this study, we evaluated the efficacy of this combination using 2 types of ADM: cadaveric acellular dermal matrix (CDM) and bovine acellular dermal matrix (BDM).

Methods We recruited 72 patients undergoing autologous STSG to cover radial forearm free flap donor sites. They were included in 1 of 3 therapeutic groups: group 1, STSG using CDM (n = 29); group 2, STSG using BDM (n = 20); and group 3, STSG only (n = 23). Functional skin values for skin elasticity, humidification, transepidermal water loss, and color were determined. Values were compared between graft sites and adjacent normal (control) skin, and between grafted areas of each group.

Results All skin defects were successfully reconstructed without graft loss. Groups 1 and 2 demonstrated better elasticity than did group 3, based on the analysis using the ratio of grafted area to control. Grafted areas in all 3 groups exhibited less moisture than did control normal skin. There was less transepidermal water loss in group 1 than in group 3, which implied that CDM application had better barrier capacity against water evaporation. Graft sites of groups 1 and 3 exhibited darker and redder color compared with control areas.

Conclusions Composite forearm defects were successfully restored and exhibited acceptable quality after treatment with an ADM plus STSG. Applying either CDM or BDM under a STSG was a suitable procedure, as verified by objective measurements. Elasticity was well preserved in CDM and BDM groups. However, both ADMs revealed functional impairment of humidification. *(J Hand Surg Am. 2017;■(■):1.e1-e10. Copyright © 2017 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Acellular dermal matrix, radial forearm flap donor site, functional skin value.

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Composite tissue defects of the forearm are an inevitable consequence of the radial forearm free flap (RFFF) procedure, which is used in various fields of reconstructive surgery. When split-thickness skin graft (STSG) is applied at the donor site, the defect may be accompanied by morbidity owing to delayed wound healing, scar contracture, loss of elasticity, dryness, and impaired sensation.[1–10] To overcome these limitations, alternative methods have been attempted, such as regional flaps, full-thickness skin grafts (FTSGs), cultured human epithelium, or the use of acellular dermal matrix (ADM).[1,2,4–8,10–14] To obtain pliable and durable skin after a graft, reconstructive options have focused on restoring the dermal component.[15] Full-thickness skin grafts and ADM grafts were designed as alternatives to STSGs to provide a stable dermal matrix to minimize contractures and adhesions.

Cadaveric acellular dermal matrix (CDM) or bovine acellular dermal matrix (BDM) graft combined with autologous STSGs are the 2 most commonly used techniques. The efficacy and advantages of CDM and BDM have been well documented.[5,6,15–19] A recent study using the Vancouver Scar Scale as the main outcome reported that the use of CDM with autologous STSG showed superior vascularity and pliability, and less scar elevation than STSG alone.[20] Bovine acellular dermal matrix grafts have resulted in excellent pliability and full range of motion when used in severe burn injuries of the hand.[18]

In this study, we evaluated the outcomes after reconstruction of composite tissue defects on the forearm area covered by STSG in combination with CDM, BDM, or only STSG, using several parameters: skin elasticity, humidification, transepidermal water loss, and color. These parameters are all quantitative and reproducible objective methods to evaluate outcomes of grafted skin.[21–23] The 2 null hypotheses studied were: (1) there is no difference between the STSG site with (or without) ADM use and an adjacent control area; and (2) there is no difference among measurements between groups treated with CDM, BDM, and only STSG.

MATERIALS AND METHODS

We retrospectively reviewed the medical records of patients who underwent autologous STSG combined with CDM (MegaDerm; L&C BIO, Seongnam-Si, Gyeonggi-Do, Korea), BDM (MatriDerm; MedSkin Solutions Dr. Suwelack AG, Billerbeck, Germany) graft or only STSG to repair an RFFF donor site defect. A single surgeon performed the procedures. The Yonsei University College of Medicine institutional review board approved this study and the study protocol conformed to the ethical guidelines of the Declaration of Helsinki, as reflected in the approval by the Yonsei University College of Medicine human research review committee.

Data were collected for 84 patients who underwent an RFFF between January 2006 and March 2014. Twelve patients were excluded owing to loss of follow-up (9 patients) or death (3 patients). We studied the remaining 72 patients who had records for functional skin values from forearm donor sites and included them in 1 of 3 therapeutic groups: group 1, STSG using CDM (n = 29); group 2, STSG using BDM (n = 20); and group 3, STSG only (n = 23). The surgical technique among 3 methods was selected according to surgeons' preference; nonetheless the selection did not depend on patients' demographics and defect sites. Mean patient age was 57 years (60 years in group 1, 52 in group 2, and 58 in group 3) at the time of measurement (Table 1). Patients' defects were the result of reconstruction after tumor ablation surgery in the head and neck area.

Surgical procedures

A fasciocutaneous flap was harvested in all patients. The palmaris longus tendon was sacrificed if the defect was too large to allow the tendon to be covered with surrounding muscles. Exposed flexor carpi radialis tendons were covered with the flexor pollicis longus muscle, and advancement of the flexor digitorum superficialis muscle belly was performed using a buried horizontal mattress method with absorbable sutures. Along the wound margin, a buried dermal suture was used between the dermis of the wound margin and muscular bed to cover the brachioradialis tendon and superficial branch of the radial nerve. This anchoring suture effectively served as a purse string suture to decrease the wound size. The ADM (CDM or BDM) grafts were anchored using several absorbable sutures at the wound margin to protect the graft from the shearing forces of underlying muscle movement. A thin STSG (8/1000 to 10/1000 in) was harvested from the lateral thigh, and several small stab incisions were made to allow ventilation and exudation. The ADM graft and STSG were performed at a single stage. A bolster tie-over dressing was used to secure the grafts, and a short-arm orthosis was applied to prevent wrist movement for approximately 2 weeks (10 to 15 days).