

Advancement Skin Grafting: A Retrospective Comparative Study of Donor-Site Morbidity Following Split-Thickness Skin Grafting

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Abstract

Background

Split-thickness skin grafting (STSG) remains a widely used reconstruction option for large cutaneous defects, yet donor-site morbidity—including delayed healing, hypertrophic scarring, and pruritus—limits its utility. While autologous resurfacing of the donor site has been proposed, the role of a pedicled advancement flap has not been systematically evaluated.

Methods

We conducted a retrospective, single-center cohort study of patients undergoing single-stage STSG between 2010 and 2023. Patients receiving a novel advancement skin grafting technique (Group A, n = 16, 24 procedures) were compared to those receiving conventional STSG (Group B, n = 16, 22 procedures). Outcomes including time to complete donor-site epithelialization without drainage, Vancouver Scar Scale (VSS) scores, and Dermatology Life Quality Index (DLQI) were assessed postoperatively.

Results

Baseline demographic and relevant clinical characteristics were comparable between groups. Compared with conventional STSG, the advancement technique significantly shortened healing time by a mean of 11.87 days (21.54 ± 3.20 vs. 33.41 ± 4.15 days, $p < 0.05$) and reduced DLQI scores (8.50 ± 2.72 vs. 15.27 ± 3.84 , $p < 0.05$). Total VSS scores were lower in Group A (5.17 ± 1.55 vs. 7.73 ± 1.45 , $p < 0.05$), driven by improvements in vascularity, height, and pliability. Pigmentation scores did not differ significantly (1.54 ± 0.72 vs. 1.86 ± 0.35 , $p = 0.09$).

Conclusions

Advancement skin grafting was associated with shorter donor-site healing time and better scar outcomes compared with conventional STSG. This technique offers a viable option for select patients—particularly those with abdominal skin laxity—where minimizing donor-site morbidity is a clinical priority.

1. Background

Skin grafting is an important technique for repairing skin defects after the excision of cancer, infection, or trauma [1]. Although primary closure and local flaps are minimally invasive surgical options, they are not suitable for large defects [2]. According to the thickness of the donor-site skin, skin grafts are divided into split-thickness skin grafts (STSGs) and full-thickness skin grafts (FTSGs). STSGs involve the

epidermis and a portion of the dermis. The donor site of an STSG retains portions of the dermis, including dermal appendages, enabling the regrowth of new skin within 2–3 weeks [3].

However, donor-site morbidity associated with STSGs remains a major concern, causing various inconveniences for both patients and clinicians. Reported complications at the donor site include hyperpigmentation, dyschromia, hypertrophic scarring, and itching [4].

To mitigate these sequelae, recent studies have explored resurfacing the donor defect with harvested remnant skin, either as free grafts or micrografts [5–7]. However, these techniques often require meticulous fixation and may compromise the viability of the replaced tissue. An alternative strategy is to advance the adjacent, uninjured skin as a pedicled flap to close the donor site primarily.

Accordingly, we introduce the advancement skin grafting technique, a method that utilizes a pedicled local flap to resurface the STSG donor site immediately. We hypothesized that this approach would reduce the open wound area, decrease inflammation, and thus improve healing time and scar quality. We compare this technique against conventional STSG using objective (VSS) and subjective (DLQI) measures to define its role in modern reconstructive practice.

2. Materials and Methods

2.1. Patients

We conducted a retrospective chart review of patients who underwent single-stage split-thickness skin grafting at the Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, between 2010 and 2023. Ethical approval was obtained from the Medical Ethics Review Board of Plastic Surgery Hospital, Chinese Academy of Medical Sciences (2023[321]). A total of 16 patients (24 procedures) in the advancement skin grafting group and 16 (22 procedures) in the conventional treatment group were included. Written consent was obtained from all patients before surgery. Patient demographics included sex, age, body mass index (BMI), duration of hospital stay, comorbidities, smoking history, and alcohol consumption history (Table 1). The surgical and follow-up data collected included follow-up time, harvested skin size, and harvested skin region (Table 2). Written informed consent was obtained from all patients for the use and publication of their medical case and image data.

Table 1
Demographic and Baseline Characteristics

Characteristic	Advancement STSG	Conventional STSG	p value
Patient number	16	16	—
Sex			1.00
Male	15	16	
Female	1	0	
Age (yrs)	27.3 ± 10.29	32.69 ± 10.29	0.155
BMI (kg/m²)	26.98 ± 4.54	27.05 ± 3.52	0.966
Length of stay (d)	15.88 ± 4.43	19.50 ± 7.70	0.201
Comorbidities			1.00
Yes	2	1	
No	14	15	
Smoking history			1.00
Yes	8	9	
No	8	7	
Alcohol consumption			0.654
Yes	2	4	
No	14	12	

Table 2
Perioperative and Follow-up Characteristics

Characteristic	Advancement STSG	Conventional STSG	p value
Procedures	24	22	—
Follow-up time (months)	15.46 ± 6.59	19.95 ± 17.83	0.91
Harvested skin size (cm ²)	159.17 ± 39.11	151.36 ± 60.58	0.41
Harvested skin region			0.17
Abdomen	24	19	
Chest	0	2	
Back	0	1	
Ratio (harvest : preserve)	1 : 1.475 ± 0.53	—	—
Wound healing time (days)	21.54 ± 3.20	33.41 ± 4.15	< 0.05
DLQI	8.50 ± 2.72	15.27 ± 3.84	< 0.05

2.2. Surgical Procedure

A 20 cm × 10 cm rectangular area was demarcated on the abdomen (Fig. 1A). This area was partitioned into a harvest segment (abb'a') and a preservation segment (a'b'dc) at a ratio of approximately 1:2, with a maximum of 1:1.

Using a dermatome set to 0.8 mm, the split-thickness harvest was taken from segment abb'a', maintaining the preservation segment as a pedicled flap based laterally. Once harvested, the graft was set aside in moist saline gauze. To facilitate advancement, transverse perforations were created within the preservation segment to release tension. The distal edge (a'b') was then advanced medially to align with the proximal edge (ab) and closed primarily with interrupted sutures. The donor site was dressed with oil gauze, common gauze and an elastic abdominal binder.

In the conventional group, the entire 20 cm × 10 cm area was harvested from line ab to line cd. Hemostasis was achieved using epinephrine saline gauze (1:20). The harvested area was subsequently dressed with oil silk, gauze, and an abdominal binder for compressive dressing.

2.3. Postoperative Assessment

Preoperative and postoperative photographs were recorded in both groups (Figs. 2 and 3). Wound healing time was defined as the interval from the day of surgery to the day of complete wound healing (Table 2). VSS and DLQI were completed by all patients at least 6 months postoperatively to assess scarring, quality of life, and postoperative discomfort. VSS parameters (pigmentation, vascularity, height, and pliability) were assessed independently by two dermatologists (Table 3). Quality of life was evaluated using the DLQI (Table 2).

Table 3
Comparison of Vancouver Scar Scale (VSS) Outcomes at 6 Months

VSS Parameter (range)	Advancement STSG	Conventional STSG	p value
Procedures	24	22	—
Pigmentation (0–2)	1.54 ± 0.72	1.86 ± 0.35	0.09
Vascularity (0–3)	0.92 ± 0.50	1.68 ± 0.65	< 0.05
Height (0–3)	1.00 ± 0.42	1.68 ± 0.57	< 0.05
Pliability (0–5)	1.71 ± 0.55	2.50 ± 0.51	< 0.05
Total VSS score	5.17 ± 1.55	7.73 ± 1.45	< 0.05

3. Results

3.1. Demographics

There were 16 patients in both the advancement skin grafting group (Group A) and the conventional skin grafting group (Group B). In Group A, 14 cases of hidradenitis suppurativa and 2 cases of scarring were diagnosed. In Group B, 13 cases of hidradenitis suppurativa, 1 case of scarring, 1 case of port-wine stain, and 1 case of verrucous nevi were diagnosed. Patient demographic characteristics are presented in Table 1. No significant differences were observed between the groups in terms of sex, age, BMI, hospitalization duration, comorbidities, smoking status, or alcohol consumption.

3.2. Surgical and Follow-up Characteristics

A total of 24 advancement skin grafting procedures and 22 conventional skin grafting procedures were performed. There were no significant differences between Groups A and B in terms of the average follow-up time (15.46 vs. 19.95 months, $p = 0.91$), average harvested skin size (159.17 vs. 151.36 cm², $p = 0.41$), or harvested skin region. Compared with conventional skin grafting, the advancement technique was associated with a shorter wound healing time (21.54 vs. 33.41 days, $p < 0.05$) and a lower DLQI score (8.50 vs. 15.27, $p < 0.05$) (Table 2).

3.3. Vancouver Scar Scale

At six months, VSS parameters favored the advancement group. Vascularity (0.92 ± 0.50 vs. 1.68 ± 0.65, $p < 0.05$), height (1.00 ± 0.42 vs. 1.68 ± 0.57, $p < 0.05$), pliability (1.71 ± 0.55 vs. 2.50 ± 0.51, $p < 0.05$), and total VSS scores (5.17 ± 1.55 vs. 7.73 ± 1.45, $p < 0.05$) were significantly lower in Group A. Although pigmentation scores were slightly reduced in the advancement group (1.54 ± 0.72 vs. 1.86 ± 0.35), this difference did not reach statistical significance ($p = 0.09$) (Table 3).

4. Discussion

This study introduces the advancement skin grafting technique as a modification of conventional STSG to address donor-site morbidity. Our data demonstrate that advancing a pedicled flap from the preservation segment reduces healing time by nearly 12 days and significantly improves both aesthetic (VSS) and quality-of-life (DLQI) outcomes.

The superiority of this technique likely stems from two mechanisms. First, by primarily closing the donor defect with autologous skin, the surface area requiring secondary-intention healing is minimized. Second, the use of native skin rather than exogenous dressings may attenuate the local inflammatory response, explaining the significant improvements in vascularity and pliability observed in Group A. While pigmentation trended lower in the advancement group, the lack of statistical significance aligns with prior literature suggesting that pigmentation is heavily influenced by individual melanocyte responses to inflammation rather than mechanical coverage alone [8–10].

Our technique was primarily applied to STSG, which is widely used in the repair of wounds caused by burns and other traumatic injuries [11, 12]. However, obtaining an STSG inevitably causes iatrogenic injury at the donor site, necessitating additional wound care to ensure healing and reduce scarring [13, 14].

The healing of the donor site depends on re-epithelialization of the residual dermis, and good re-epithelialization usually predicts better scar prognosis [15]. Traditional wound care after STSG includes an occlusive three-layered dressing: a nonadherent contact layer, followed by an adsorbent layer and a restrictive layer [4]. Other donor-site dressings that may promote re-epithelialization have been reported, yet an ideal dressing has not been identified [16, 17]. In addition to accelerating re-epithelialization with specialized dressings, narrowing the donor-site defect—such as by immediate regrafting of harvested skin—has been proposed as an alternative solution [5–7]. Even after the harvested skin is regenerated, residual wounds can still cause postoperative exudation and require frequent dressing changes. In this context, our team considered complete coverage of the donor-site wound with autologous skin to facilitate postoperative care and reduce scarring. After advancement skin grafting, a traditional three-layer dressing with a routine frequency of dressing changes (e.g., twice weekly) is adequate. Furthermore, the very small areas requiring secondary re-epithelialization ensure an aesthetically pleasing appearance postoperatively.

A critical determinant of this technique's feasibility is the harvest-to-preservation ratio. We found that a 1:2 ratio is optimal for patients with abdominal laxity (e.g., post-partum or obese individuals), allowing a proportionally larger graft. To mimic the meshing technique, transverse perforations were introduced in the preserved section to enhance tension release. To minimize the postoperative “stamp” or “fish scale” appearance, fewer but adequate transverse perforations are recommended. However, as the ratio approaches 1:1, the effective donor-site area doubles, potentially increasing tension at the suture line and the risk of cosmetic deterioration. In our series, patients who underwent advancement skin grafting exhibited only mild wound pigmentation, which can be improved with laser therapy.

In some patients, we observed hypertrophic scarring at the three edges of the donor area, corresponding to the suture line. Hypertrophic scars are influenced by multiple biomechanical forces, particularly tension [18]. In our cases, two factors contributed to increased wound tension: the inconsistent thickness between the advanced flap and the recipient bed, and the intrinsic contractility of the skin itself. To reduce wound tension and prevent scarring, compression bandages, dressings with wet adhesion properties and stiffness, and other methods can be employed [19, 20]. Moreover, the use of nondamaging nylon sutures can effectively reduce scar hyperplasia at the pinhole sites.

This study is subject to several limitations. First, the retrospective nature of the study introduces inherent drawbacks, including recall bias and inconsistent data collection. Second, the relatively small sample size limits the generalizability of our results. Third, the donor area was predominantly the abdomen, and the anatomical diversity was low; some skin regions may not be suitable for this method. Finally, the absence of serial follow-up evaluations at 1, 3, and 6 months postoperatively precludes a dynamic analysis of scar maturation.

5. Conclusion

The advancement skin grafting technique offers a pragmatic approach to reducing donor-site morbidity following STSG. By utilizing a pedicled local flap, surgeons can significantly shorten healing time and improve scar aesthetics compared to conventional methods. While best suited for areas with sufficient laxity, such as the abdomen, this technique represents a valuable addition to the reconstructive surgeon's armamentarium for optimizing patient outcomes.

Abbreviations

STSG, split-thickness skin grafts;

FTSG, full-thickness skin grafts;

VSS, Vancouver Scar Scale;

DLQI, Dermatology Life Quality Index;

BMI, body mass index.

Declarations

Ethics approval and consent to participate

Ethics committee: Medical Ethics Review Board of Plastic Surgery Hospital, Chinese Academy of Medical Sciences.

Clinical trial number: 2023[321].

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YC and YG wrote the main manuscript text and prepared tables 1-3 and figures 1-3. S L, YX, and LK collected patients' information. NM, SC, PL, ZY and YL carried out these surgeries. All authors read and approved the final manuscript.

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Figures

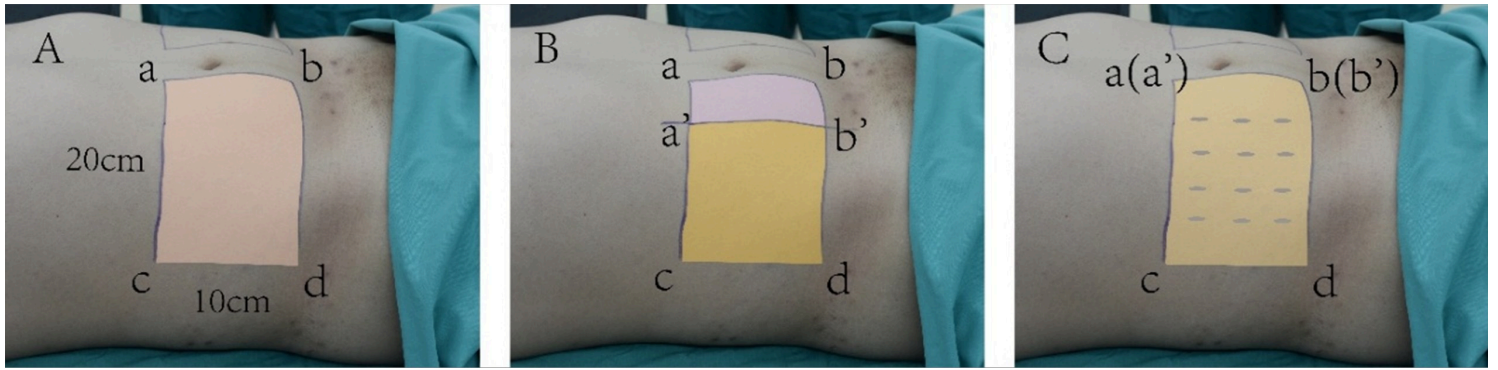


Figure 1

(A) A 20 × 10 cm rectangular area is demarcated on the abdomen. (B) The area is partitioned into a harvest segment (abb'a') and a preservation segment (a'b'dc) at a ratio of approximately 1:2. The harvest segment is taken with a 0.8-mm dermatome while maintaining the preservation segment as a pedicled flap. (C) After harvest, the distal edge (a'b') is advanced medially to align with the proximal edge (ab) and closed with interrupted sutures.



Figure 2

Surgical outcomes of advancement skin grafting at 6 months postoperatively.

(A) Preoperative view. (B) Front postoperative outcome. (C) Outcome on the left abdomen. (D) Outcome on the right abdomen.

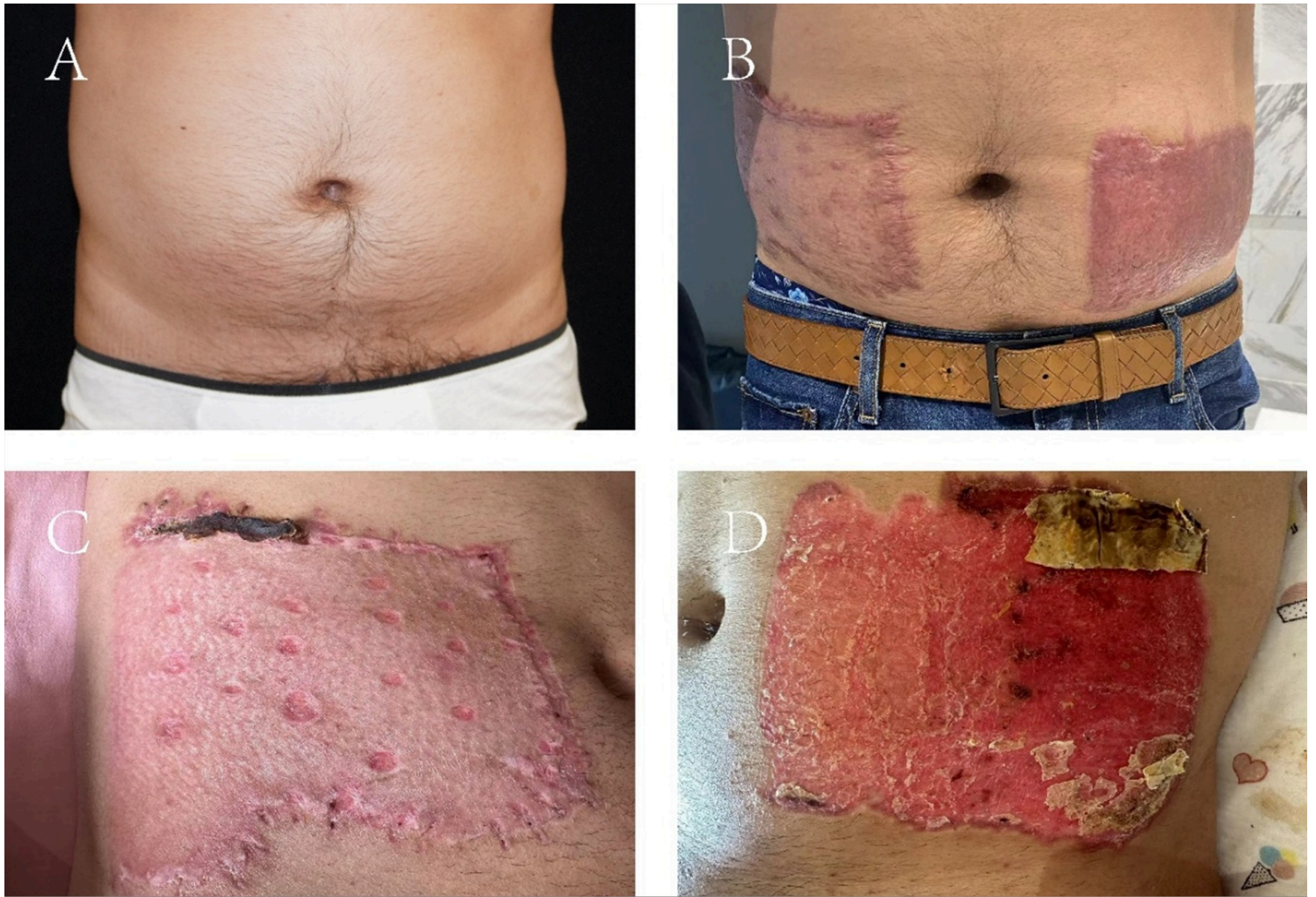


Figure 3

Comparison of surgical outcomes between advancement skin grafting and conventional skin grafting.

(A) Preoperative view. (B) Front outcome 3 months postoperatively. (C) Outcome of advancement skin grafting 21 days postoperatively. (D) Outcome of conventional skin grafting 21 days postoperatively.