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Original Article

Immediate Regrafting of Over-Harvested Skin at Donor Sites for Split-Thickness Skin Grafting in Elderly Patients

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SUMMARY

Background: The complication of donor site in skin grafting often acts as a causing factor for extended treatment period. The elderly individuals tend to be afflicted by impaired wound healing. Herein, we presented the outcome of skin regrafting in the elderly patients.
Methods: Patients who aging over 60 had anterior thigh split-thickness skin grafting (STSG) donor sites as part of any reconstructive surgery were included. In experimental group, the over-harvest skin back was replaced on the donor site in island type, and Alleyvn (Smith & Nephew) was put upon the regrafting skin as fixation. In the control group, the donor site was only covered by Alleyvn (Smith & Nephew). Variables extracted included demographics, intra-operative data and post-operative outcomes. Vancouver scar scale (VSS) was used to evaluate scar condition in donor site in post-operative 3 months.
Results: Twenty-six patients with 15 re-grafting versus 11 non-regrafting were analyzed. There was a significantly shorter in the healing time of donor site in the re-grafting group than the non regrafting group (28.33 vs. 39.91, $p = 0.03$). All the parameters of VSS were significant difference between regrafting versus non-regrafting groups, for the mean scores of vascularity (0.36 ± 0.34 vs. 1.64 ± 0.61, $p < 0.01$), pigmentation (0.52 ± 0.31 vs. 1.98 ± 0.44, $p < 0.01$), pliability (0.48 ± 0.26 vs. 1.49 ± 0.51, $p < 0.01$), height (0.23 ± 0.20 vs. 0.98 ± 0.39, $p < 0.01$).
Conclusions: Compared with artificial dressing only, immediate regrafting of over-harvest skin on the donor site in STSG is a reliable method to provide faster healing time and better scar formation in the elderly.

1. Introduction

Split-thickness skin graft (STSG) surgery is the most common method for open-wound coverage. Postoperative care should focus on both the recipient site and donor site. Donor site complications are often the cause of an extended treatment period. Elderly individuals, and those with diabetes mellitus, or immune-compromised can be adversely affected by the creation of a second festering wound if donor-site reepithelialization were to be impaired.[1–3] Thus, facilitation and protection of donor site reepithelialization are also main points in postoperative care after skin graft surgery.

Generally, after STSG to treat skin wounds, the skin graft donor site is treated with a moist, hydrofiber or occlusive dressing using foam dressing materials and polyurethane with a silicone membrane.[4–8] An ideal STSG donor-site dressing must be readily available, economical, hemostatic, non-immunogenic, antibacterial, and still able to promote optimal reepithelialization.[3,5,9–13] Although multiple studies have investigated dressing methods to heal wounds and leave minimal scars at donor sites, a proven and universally applicable method has yet to be reported.[14] Theoretically, the best STSG recipient site is obviously its donor site, and as a corollary, an autograft would rightfully be the best potential dressing. A recent study reported that an immediate skin graft facilitates epithelialization and wound healing along with a reduction in pain.[5] Another larger prospective study also confirmed that an immediate skin graft not only diminishes hypertrophic scarring but also reduces healing times.[14] However, those study individuals were not limited to the elderly.

Accordingly, this study's primary purpose was to compare re-epithelialization and scar formation of two methods of donor site dressing using a polyurethane dressing (Alleyvn, Smith, & Nephew) and over-harvested skin in elderly patients. Second, we asked four plastic surgeons to independently conduct blinded evaluations of scar formation at the donor site based on the Vancouver Scar Scale (VSS).

2. Patients and methods

2.1. Patients and data

A prospective consecutive patient study with Institutional Re-

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view Board approval was performed from May 2017 to July 2019 in Wan Fang Hospital (Taipei Medical University, Taipei, Taiwan). All the patients aged over 60 years were discussed about the donor site for skin graft surgery. Pros and cons in choosing scalp, back and thigh as the donor site were told to patients in details. Patients who chose anterior thigh as STSG donor site as part of any reconstructive surgery were included. All STSGs were harvested from the anterior upper thigh using a standard motorized dermatome. Typical graft thickness was 7000–8000ths of an inch. The study population was divided into two groups: a regraft group (experimental group) and a non-regraft group (control group). A total of 30 patients were included in this study, of which 15 patients were treated with re-grafting (experimental group), and 15 patients were treated with regular wound dressing (control group). Patients were assigned randomly in a 1:1 ratio to two groups after informed consent. Assignment of patients to the treatment was made by a study nurse by randomization (sequentially numbered, opaque sealed envelopes). In the experimental group, the operative plan was to consider taking a 15% larger amount than necessary and replace over-harvested skin back onto the donor site in an island manner. Any remaining skin graft was returned to the donor site and a polyurethane dressing [Alleyvn, Smith, & Nephew] was placed on the regrafted skin for fixation (Figure 1). In the control group, the donor site was only covered by a polyurethane dressing [Alleyvn, Smith, & Nephew] according to its availability in the hospital (Figure 2).

Postoperative donor-site healing was then evaluated at office visits, usually once weekly. A healed donor site was defined as one that had completely reepithelialized. Variables of interest included demographics, intraoperative data, and postoperative outcomes. Demographics included patient age and comorbidities which are known to affect wound healing, including age (≥ 60 years), diabetes mellitus, hypertension, and the body-mass index (BMI).

The Vancouver Scar Scale (VSS) was used to evaluate the scar's condition at the donor site at postoperative 1 and 3 months. Four board-certificated plastic surgeons were invited to independently evaluate the VSS according to a color picture. And the parameters of VSS were recorded as the mean and standard deviation (SD).

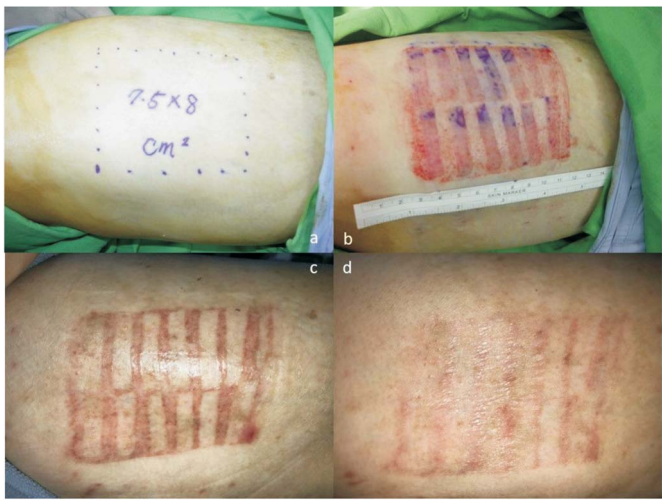

Figure 1. (a) The skin defect in this 85-year-old female measured 7.5 × 8 cm^2. About 15% larger amount (69 cm^2) split-thickness skin was harvested from right anterior thigh. In addition, the skin was also expanded by 1:1.5 mesh. So that there was much more skin remnant can put back in donor site. (b) Immediate skin regrafting with Alleyvn (Smith & Nephew) put upon the regrafting skin as fixation. (c) Complete wound healing in day 41 of postoperative follow-up. (d) Day 90 of postoperative follow-up. The wound healed well, and the scar presented nearly invisible.

2.2. Statistical analysis

Descriptive statistical analyses including the mean and SD are reported for demographic and outcome data. Statistically significant differences between the two subgroups (regrafted versus non-regrafted) were tested by Student's *t*-test or Chi-squared test when appropriate. Statistical significance was accepted at $p < 0.05$ for all comparisons. Statistical tests were carried out using SPSS v23 (IBM, Armonk, NY, USA).

3. Results

3.1. Demographics (Table 1)

There were 4 patients in control group who lost follow up (all due to difficult transportation). In total, 26 skin graft procedures (15 re-grafting vs. 11 non-regrafting) were performed on 26 elderly patients. There were 14 females and 12 males with an average age of 72.54 ± 7.15 years. The average BMI was 23.96 ± 4.97 kg/m^2 at the time of the skin graft procedure. The mean follow-up time was 124.92 ± 68.21 days. There were no significant differences between regrafting and non-regrafting patients with respect to demographic or comorbid variables.

3.2. Surgical characteristics (Table 1)

The average harvested skin size from the donor site was 90.9 ± 96.93 cm^2. There were no significant differences in the sizes of donor site defects between the regrafting and non-regrafting groups (71.43 vs. 117.45 cm^2, $p = 0.23$). Comparing healing times of the donor site, it was significantly shorter in the re-grafting group than the non-regrafting group (28.33 vs. 39.91 days, $p = 0.03$). The follow-up time was no significant difference between the regrafting group than the non-regrafting group (139.33 vs. 105.27 days, $p = 0.20$).

3.3. Vancouver Scar Scale (Table 2)

All parameters of the VSS significantly differed between the regrafting and non-regrafting groups, including mean scores of vascularity (0.36 ± 0.34 vs. 1.64 ± 0.61, $p < 0.01$), pigmentation (0.52 ±

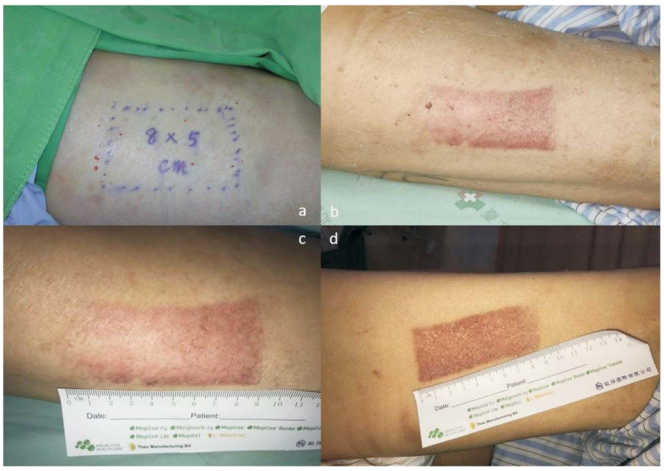

Figure 2. (a) The split-thickness skin, measured about 8 × 5 cm, was harvested from right anterior thigh in a 68-year-old male. Only Alleyvn (Smith & Nephew) put upon the donor site without immediate skin regrafting. (b) Complete wound healing in day 46 of postoperative follow-up. (c) Day 61 of postoperative follow-up. (d) Day 82 of postoperative follow-up. The wound healed well, but the scar presented hyperpigmentation and mild hypervascularity.

Table 1
Demographics and surgical characteristics.

	Total	Skin re-grafting	No skin re-grafting	p value
No of patients	26	15	11	
Age (yrs)	72.54 (SD 7.15)	72.07 (SD 5.92)	73.18 (SD 8.52)	0.698
BMI	23.96 (SD 4.97)	25.66 (SD 5.33)	22.06(SD 2.79)	0.0528
Hypertension	21 (80.77%)	13 (86.67%)	8 (72.73%)	0.3822
Diabetes	16 (61.54%)	9 (60%)	7 (63.64%)	0.8534
Surgical characteristics				
Size of skin grafting (cm^2)	90.90 (SD 96.93)	71.43 (SD 70.73)	117.45 (SD 119.01)	0.229
Healing time of donor site (days)	33.23 (SD 14.25)	28.33 (SD 9.78)	39.91 (SD 16.56)	0.0262*
Follow-up time (days)	124.92 (SD 68.21)	139.33 (SD 83.0)	105.27 (SD 25.27)	0.2023

* $p < 0.05$.

0.31 vs. 1.98 ± 0.44, $p < 0.01$), pliability (0.48 ± 0.26 vs. 1.49 ± 0.51, $p < 0.01$), and height (0.23 ± 0.20 vs. 0.98 ± 0.39, respectively, $p < 0.01$).

4. Discussion

In the clinic, many reasons can lead to delayed wound healing of skin graft donor sites, which prolong the treatment period, causing problems for both patients and physicians. Delayed wound healing of donor sites can be as high as 20% in elderly patients.[15] Age is a significant risk factor, with 85% of non-healing wounds occurring in patients older than 65 years.[16] Fatah and Wood previously showed in a prospective study that advanced age alone delays wound healing when sites in patients are not regrafted.[1,15] Delayed donor site healing might also result in aesthetic problems, such as pain, irregularities, undesirable pigmentation, and hypertrophic scarring.[17,18] Therefore, in our study, we analyzed the benefits and cosmetic concerns of over-harvested skin grafts in the elderly.

4.1. Comparison of complete healing times

The overarching goals of managing STSG donor sites are to prevent infection, minimize pain, and preserve aesthetic appearances as much as possible. These are achieved by providing a moist wound environment, preventing disruption to allow for reepithelialization, and ensuring healing in the shortest time possible.[19] The healing process of donor sites consists of activation, migration, and proliferation of keratinocytes across the wound surface from the wound margin, the basal layer of the surrounding epidermis, and adnexal structures in the dermal layer, such as sebaceous glands and hair follicles.[20,21] A split-thickness graft (0.25–0.3 mm) contains the dermis, adnexal structures, and basal layer of the epidermis. Thus, in addition to keratinocytes, it also includes stem cells located in adnexal structures.[22] Thus, if we can replace over-harvested skin onto the donor site, the wound-healing process would expect to be faster than conventional dressing methods.

There are a few publications regarding ways of using autologous skin to accelerate healing and reduce pain at donor sites. Thompson was the first to describe the value of placing thin autologous skin grafts on donor sites to improve healing.[23] He noted that donor sites with no grafts had a propensity for hypertrophic scarring that was cosmetically unfavorable, and that donor sites with thin grafts healed much more quickly and with better quality healing.

Ablaza et al. suggested covering the wound with half of the harvested skin and covering the donor site with the remainder using a 1:1.5 mesh skin graft.[24] They proposed that this method decreases morbidity of the donor site, and minimizes problems of prolonged healing times, discomfort, fluid loss, and undesirable cosmetic results. The Ablaza method was modified by Goverman et al. who introduced a back-grafting method in which the skin graft donor site was treated using an additional 1:4 mesh skin graft harvested from the initial graft donor site.[15] An additional thin STSG is another option to treat skin graft donor sites.[5] Those researchers suggested that this method could shorten the reepithelialization time, reduce pain, and prevent hyperplastic scar formation. However, this method needs an additional large skin graft donor area. Moreover, some patients do not like the shape of the final result of the meshed skin graft because it tends to result in an unusual net-like appearance.

Table 2
Outcome of Vancouver scar scale

	Total (n = 26)	Skin re-grafting (n = 15)	No skin re-grafting (n = 11)	p value
Vascularity (0–3)	0.9	0.36 (SD 0.34)	1.64 (SD 0.61)	< 0.01*
Pigmentation (0–2)	1.14	0.52 (SD 0.31)	1.98 (SD 0.44)	< 0.01*
Pliability (0–5)	0.91	0.48 (SD 0.26)	1.49 (SD 0.51)	< 0.01*
Height (0–3)	0.55	0.23 (SD 0.20)	0.98 (SD 0.39)	< 0.01*

* $p < 0.01$.

Sgonc et al. conducted a mini-review and concluded that cutaneous wound healing in healthy elderly people is delayed, but scar maturation is improved compared to young individuals.[25] Impaired wound healing leading to chronic wounds is primarily associated with comorbidities, which are more prevalent in old age. Nevertheless, age (< 60 years) is an independent risk factor for less-frequent closure of chronic wounds. Various factors associated with aging or predominantly concerning elderly people additionally affect wound healing, e.g., decline of sex steroid hormones, malnutrition, immobilization, psychological stress, medications, and comorbidities such as diabetes, peripheral arterial disease, and chronic venous insufficiency. With the above statement and our positive result, we cannot overemphasize the importance of regrafting of over-harvested skin at donor sites in elderly patients.

4.2. Scar assessment

As we mentioned above, there are a few publications which indicate that the regrafting of autologous skin can improve scarring at donor sites. In our series, all variables of the VSS in the regrafting group were significantly lower than those in the non-grafting group. This revealed that the procedure of regrafting can produce less scarring at wound sites. The reason is that regrafting accelerates wound healing, which is the most significant finding in our comparative study. The regrafted skin acts as a dibbling of seeds, which can provide factors for epithelialization. As far as we know, scarring only occurs on the raw surface, and not in regrafted skin. Regrafted skin also acts as an island that breaks apart scar contraction. In addition, the regrafted skin is thicker and softer than newly grown epithelium. All of the above reasons elaborate better scar conditions in the regraft group.

Not only this method can provide re-epithelialization though the impact of keratinocyte proliferation and subsequent wound closure. Autologous skin cell suspensions (ASCS), epidermal cells delivered in a solution via spray or droplet form to a wound, can also reduce time to re-epithelialization in adult split-thickness skin graft donor site.[26] Hu and colleges[27] also reported the use of autologous skin cell suspension with hydrocolloid dressings accelerated epithelialization and improved healing quality of the donor site compared with hydrocolloid dressings alone. These studies emphasize the importance on rapid and effective healing of secondary wounds, such as skin graft donor sites, is an important consideration in any reconstructive procedure. Compared with ASCS, our method is an easier and more economical method to provide re-epithelialization. But the most concern is our method needs more skin remanent than ASCS.

In our study, we showed an equivalent control group for patients who had regrafting and showed the benefits of this maneuver versus use of local dressings only. The advantage of utilization of over-harvested skin demonstrated reduced healing times and ameliorated scarring at donor sites. This study confirms that regrafted skin is a useful and safe procedure compatible with various types of dressings. Limitations of this study include a lack of sufficient case numbers, and a lack of diversity of donor sites for skin harvesting and histological research. Further work should be directed at elucidating experimental evaluations of molecular factors underlying the reduction in scar formation.

5. Conclusions

Compared to polyurethane dressing only, immediate regrafting of over-harvested skin at donor sites in STSG is a reliable method to provide faster healing times and reduced scar formation in the elderly.

Conflicts of interest and sources of funding

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