화상을 동반한 당뇨병 환자에게 Razor Blade를 이용한 부분층피부조각 이식술의 효용성

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Fragmented Split-Thickness Skin Graft Using a Razor Blade in Burn Induced Diabetic Foot

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Diabetic patients have an increased risk of burn injuries on foot. Because of their diabetic neuropathy, they could contact with hot water or warming device without being aware of it. Split-thickness skin graft (STSG) is successful in treatment of various wound types; however, donor site wounds are sometimes problematic, and complications such as pain and impaired healing often occur. Although, donor site wounds in healthy young individuals can rapidly heal without complications, the wound-healing capacity of elderly patients or those with a comorbidity has been reported to be low. The dermatome is the most commonly used tool because it can harvest a large skin graft in one attempt. However, it is difficult to harvest tissues if the area is not flat. Furthermore, because the harvested skin is usually rectangular, additional skin usually remains after skin grafting. Therefore, use of razor blade and fragmented STSG on a large defect area is advantageous for harvesting a graft with a desired size, shape, and thickness. From January 2018 to July 2018, fragmented STSG was used in 9 patients who suffered from burn induced open wound on foot with diabetic neuropathy. With this approach, healing process was relatively rapid. The mean age of patients was 70 (57 ~ 86 years) and all of 9 patients had diabetes mellitus type 2. In all patients, the skin graft on the defect site healed well and did not result in complications such as hematoma or seroma. (*J Korean Burn Soc* 2020;23:20-24)

Key Words: Diabetic foot, Burns, Skin transplantation, Lower extremity, Wound healing

INTRODUCTION

Diabetic patients have an increased risk of burn injuries on foot. Because of their diabetic neuropathy, they could contact with hot water or warming device without being aware of it^{1,2)}. A split-thickness skin graft (STSG) is commonly used for reconstructing a lower extremity skin defect induced by trauma or burns^{3,4)}. Although the STSG

successfully treats various wound types, a donor site wound is sometimes problematic, and complications such as pain, impaired healing, infection, itching, hypopigmentation, and hyperpigmentation often occur⁵⁾.

Donor site wounds in healthy, young individuals can rapidly heal without problems; however, the wound-healing capacity of elderly patients or those with a comorbidity has been reported to be reduced⁶⁾. Various approaches to facilitating the healing of a donor site wound have been introduced in several studies^{4,7-9)}, including an approach involving re-grafting extra skin after grafting onto the donor site wound, which may induce rapid re-epithelialization and decrease the likelihood of hypertrophic scarring⁶⁾.

The authors believe that although the aforementioned approach has produced favorable outcomes by re-grafting, starting out with making multiple small donor site

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wounds and harvesting fragmented skin rather than making one large wound induce less post-operative pain and faster wound healing. An electrical dermatome, air dermatome, scalpel, razor blade, Weck knife, or other tools may be used to harvest the STSG^{10,11)}. The dermatome is the most commonly used because it can harvest a large skin graft in one attempt. However, it is difficult to harvest tissues if the area around the donor site interferes with the dermatome or is not flat; in addition, it is difficult to harvest small grafts. Because the shape of the harvested skin is usually rectangular, extra skin usually remains after skin grafting. Additionally, the set-up and clean-up before and after surgery are time-consuming, and the using dermatome is expensive.

The authors report the patients with a comorbidity and various skin defects of the lower extremity who underwent treatment with a fragmented skin graft harvested with a sterilized razor blade. There was no large wound at the donor site, and healing at the defect sites and donor sites was favorable.

CASE REPORT

A 64-year-old woman with previous diabetes mellitus type 2 presented to Yeungnam University Medical Center with a chief complaint of a 2-degree contact burn on her left foot dorsum sized $4 \times 2 \text{ cm}^2$ (Fig. 1). After a donor site (include the thigh, area around the lower limb defect, skin surface of a fasciocutaneous flap, sole of the foot,

Fig. 1. Preoperative skin defect. A $4 \times 2 \text{ cm}^2$ open wound on the dorsum of the left foot.

and scalp) of the same size as the skin defect was marked, a mix of 1% lidocaine with 1:100,000 epinephrine was injected in the subdermal layer. A razor blade was cut into two pieces, and the halved blade was fixated using a Mosquito forceps (or needle holder). The blade was bent into a curved shape so that it would have adequate contact with the skin (Fig. 2). Skin grafts approximately $1 \times 1 \text{ cm}^2$ were harvested by moving the blade back and forth (Fig. 3). The size and thickness of the skin grafts were controlled by adjusting the degree of curvature of the blade and the downward pressure on the donor site. The

Fig. 2. Razor blade method. After the razor blade was cut into two pieces, the halved blade was fixated with a mosquito holder and curved so that it would have adequate contact with the skin.

Fig. 3. Immediate postoperative donor site wound. After a site the same size as the defect ($4 \times 2 \text{ cm}^2$) was marked, approximately 50% of the skin graft was harvested.

harvested skin grafts were carefully unfolded and placed over the defect site with an adequate space of approximately 3~4 mm (Fig. 4). Fixation is possible using compression without a fixation suture. The entire wound area including the skin graft is compressed with wet gauze, so discharges or fluid remaining in the wound can be removed. The use of fibrin glues with spray mode provides better fixation. For our patient, a compressive dressing was applied using foam or transparent film at both the recipient and donor sites and the wound dressing was changed every other day.

From January 2018 to July 2018, fragmented STSG were performed on 9 patients (Table 1). The mean age of patients was 70 years (range, 57~86 years) and the mean defect size was 14.0 cm² (range, 6~20 cm²). All of 9 pa-

Fig. 4. Immediate postoperative recipient site wound. After the fragmented STSGs were placed at an interval of 3~4 mm, the wound was compressed with wet gauze and fixated without suturing.

tients had diabetes mellitus type 2. In all patients, the skin graft on the defect site healed well and did not result in problems such as hematoma or seroma. 4 days after the operation, the surgical site was opened for the first time and dressing was performed every 2 days thereafter. On day 4 after surgery, the gap between the grafted skin narrowed as epithelialization progressed (Fig. 5). On mean day 8.9 after surgery (range, 8~10 days), healing was complete, and an acceptable scar remained (Fig. 6, 7).

DISCUSSION

A razor blade is easy to use and does not require additional equipment. Although it is difficult to control the depth of the donor skin, it costs less than a dermatome, and does not require set-up and clean-up time. Because of these advantages, the use of a razor blade has been re-

Fig. 5. A recipient site on day 4 after surgery. The gap between the grafted skin narrowed as epithelialization progressed.

Table 1. Patient Data

No.	Age (yr)	Sex	Wound location	Wound size (cm ²)	The time to complete re-epithelialization on recipient site (day)	The time to complete re-epithelialization on donor site (day)
1	57	M	Rt. lateral malleolar area	4×1.5	4	8
2	58	F	Lt. calf	4×4	6	8
3	61	M	Rt. knee	4×3	6	8
4	62	M	Lt. foot	8×3	4	10
5	64	F	Lt. foot dorsum	4×2	6	10
6	73	F	Lt. calf	4×3	6	10
7	82	F	Rt. foot dorsum	5×3	8	8
8	84	M	Lt. pretibial area	3×3, 4×1	8	8
9	86	F	Lt. foot dorsum	5×4	8	10

Fig. 6. Complete healing on day 6 after surgery (recipient site).

ported for skin grafting for small facial wounds^{12,13}). The authors extended the use of a razor blade to lower extremity skin grafting and used a fragmented STSG on a larger defect area. This approach is advantageous for harvesting a graft with a desired size, shape, and thickness, and it involves adjusting the tilting angle, downward pressure, and degree of curvature of the razor blade such that there is no need for trimming or defatting¹⁴). Additionally, this procedure was able to be conducted under local anesthesia for patients who had poor general condition and comorbidities.

For a skin graft to successfully take, hematoma, seroma, and infection should not occur. With larger skin grafts, the rate of successful graft-taking may be decreased because hematoma and seroma are not easy to drain. To counter this difficulty, fenestration may be performed with a slit incision, or mesh skin grafting may be performed. Because the fragmented skin grafts used for the patient in this study were small (approximately 1×1 cm²), they were fixated well, without the need for a slit incision or mesh, and graft failure due to a hematoma or seroma did not occur. Even without the use of a large skin graft, the gaps between small fragmented skin grafts were confirmed to be decreased as epithelialization proceeded to the surrounding area. Although there is no need for suture fixation, fibrin glue may be used to ensure fixation.

The healing mechanism of a donor site wound involves activation, migration, and proliferation of keratinocytes.

Fig. 7. Complete healing on day 10 after surgery (donor site).

Keratinocytes generate healing as they move along the wound surface from the basal layer of the epidermis and adnexal structures, which are in the same dermal layer as the sebaceous glands and hair follicles^{15,16}).

With the approach taken by the authors, healing occurred relatively quickly. The donor site wound had a cluster of several individual wounds approximately 1 cm², and a 3- to 4-mm gap was exposed in the recipient site wound. A fragmented STSG induces spontaneous re-epithelialization and decreases the likelihood of hypertrophic scarring during healing of the recipient site because an individual STSG has independent re-epithelialization potential. Wound healing in our patient was rapid because re-epithelialization in the recipient and donor site wounds was influenced by the stem cells in the adnexal structure that originated from a healthy skin margin, and because the areas of the dermis layer exposed in the fragmented STSG were small.

In the present study, a razor blade was used to reconstruct a relatively large skin defect in the lower extremities using a fragmented STSG. The defect site and donor site wounds healed well. There was less pain during wound dressing and no complications such as impaired healing, hematoma, seroma, and graft loss. We further used this method for a total of 9 patients, and all patients healed well without complications. Possible donor sites include the thigh, area around the lower limb defect, skin surface of a fasciocutaneous flap, sole of the

foot, and scalp. The donor site can be determined based on the state of the defect site and the patient's medical condition¹⁷⁾.

Altogether, using a fragmented STSG harvested with a razor blade can be an easy, simple, and safe surgical method for resurfacing the skin of the lower extremity.

DECLARATIONS

No potential conflict of interest relevant to this article was reported. The study was performed in accordance with the principles of the Declaration of Helsinki. Written informed consents were obtained. The patient provided written informed consent for the publication and the use of his images.

CONFLICTS OF INTEREST

The authors have no financial interests in any of the products, devices, or drugs mentioned in this article.

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