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ORIGINAL ARTICLE
Reconstructive

Harvesting Split-thickness Skin from the Scalp Using a Scalpel

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Background: Split-thickness skin grafts (STSGs) from the scalp may be an attractive option for patients who do not want scars on their limbs or trunk. However, not all institutions have the equipment typically used to perform STSGs.
Methods: Between January 2015 and June 2017, STSGs were harvested with a No. 15 blade under local anesthesia from the scalps of 4 patients and grafted on small skin defects from facial trauma, a tattoo, and scarring, and on a large defect from burns. Epithelialization of the donor sites and graft take, secondary contraction, and color and texture match of the recipient sites were observed. Thickness of the harvested skin was confirmed by histopathologic examination.
Results: Mean patient age was 39.8 years; 2 patients were male. Epithelialization of the donor sites took a mean of 8.75 days. No hypertrophic scarring or alopecia was observed. Good graft take and relatively good color and texture match of the recipient site were achieved. Mild secondary contraction was noted in 2 cases. Histopathologic examination showed no damage to the hair follicles. The thickness of the harvested skin varied from 0.3 to 0.7 mm.
Conclusions: Using the scalpel technique, surgeons can perform STSGs with only several blades, minimizing surgical costs. The hair follicles remain intact because the thickness of the graft skin is <1 mm. Epithelialization of the donor site is quick, and there is no visible wound on the limb or trunk. It is especially useful to cover small defects. *(Plast Reconstr Surg Glob Open 2019;7:e2206; doi: 10.1097/GOX.0000000000002206; Published online 3 May 2019.)*

INTRODUCTION

Surgeons and dermatologists occasionally perform free skin grafts to cover a raw surface caused by burn, trauma, scarring, excision of a skin tumor, or tissue loss due to skin necrosis. Selection of the donor site and thickness of the skin graft are determined by characteristics of the recipient site (ie, location, extent of damage, risk of secondary contraction, and color and texture match) as well as postoperative care requirements at the donor site. Compared with full-thickness skin grafts (FTSGs), advantages of split-thickness skin grafts (STSGs) include good graft take, low risk of infection, and the ability to harvest and graft a large portion of skin. In addition, STSGs can be taken from the scalp, which is helpful in patients for whom use of the limbs or trunk for harvesting of skin is contraindicated. In STSGs, generally, instruments such as hand-operated or electric dermatomes are used to harvest the skin. However, some surgeons have no access to such equipment.

This article introduces the method of harvesting STSGs from the hair-bearing scalp using only a No. 15 blade. This technique allows physicians to perform skin grafts without creating an additional scar from harvest on the limbs or trunk.

METHODS

Patients

Between January 2015 and June 2017, 4 STSGs were performed in Hills Aesthetic and Cosmetic Clinic, which specializes in cosmetic and plastic surgery. The cases involved trauma in the nasal apex from a dog bite, burn scars on the dorsum of the right hand, a tattoo on the

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Received for publication October 17, 2018; accepted January 15, 2019.

DOI: 10.1097/GOX.0000000000002206

Disclosure: *The author has no financial interest in any of the products, devices, or drugs mentioned in this article.*

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dorsum of the right fifth digit, and a scar on the left anterior forearm from self-harm. None of the patients wanted an additional scar from harvest, so taking a graft from the hair bearing scalp skin was suggested. All patients agreed and provided informed consent for the procedure.

Freehand Scalpel Technique

The clinic does not own a special instrument such as a dermatome to perform STSGs. Therefore, STSGs are performed using only a No. 15 blade, which is 0.38 mm thick. One blade can harvest approximately 3 × 3 cm before becoming dull. If the harvest area is larger than 3 × 3 cm, several blade tips need to be prepared.

Skin can be harvested from any hair-bearing scalp location, but using the skin above the galea aponeurotica of the temporoparietal region is preferable because it is rigid and easiest to maneuver with a No. 15 scalpel. In contrast, the skin above the temporal muscle should be avoided because it is loose and unstable.

First mark the location of harvest and shave this area along with a 1 cm perimeter. Then inject the donor site with 0.1 mL of Xylocaine (Aspen Japan K.K., Tokyo, Japan) with 1% epinephrine and use a bosmin gauze (1:100,000) (Daiichi Sankyo Co., Ltd., Tokyo, Japan) for hemostasis of the site during harvest. Using the scalpel, gently make an incision (ie, until there is slight bleeding) around the harvest area. This incision is <1 mm deep. Then, start harvesting by inserting the blade inward, almost horizontally to the scalp skin. Maintain this angle throughout the harvest. One push of the tip of the blade is about 5 mm. After 1 push, lift the blade up until the tip can be seen through the harvested skin; then release and go on to the next push. Repeat this "push and up" motion in a rhythmic manner.

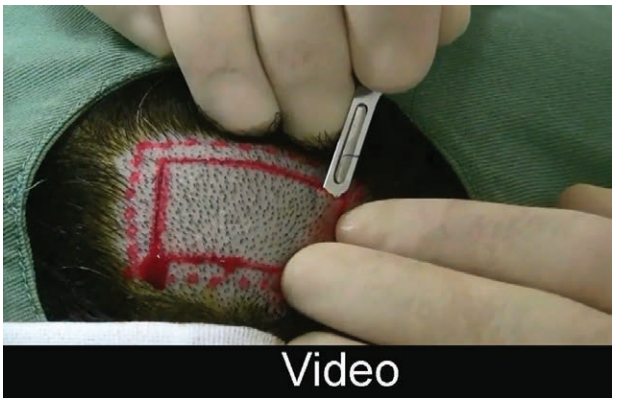
If the tip of the blade is angled upward too steeply, the harvested skin may be perforated while pushing. If it is angled downward too steeply, the push is too deep and can damage the hair follicles. Therefore, this procedure should be performed slowly and carefully.

During harvest, occasionally flip the harvested skin, gently rub it with saline gauze to remove hair, and check how far along the harvest is. Once this technique is mastered, a 3 × 3-cm harvest can be completed in <5 minutes (see **video, Supplemental Digital Content 1**, which demonstrates the harvesting process. This video is available in the "Related Videos" section of the Full-Text article on PRSGlobalOpen.com or available at ***http://links.lww.com/PRSGO/B40***).

Assessment of Donor Site

In all 4 patients, the period between harvest and complete epithelialization of the donor site was assessed. In general, if harvested skin is thin, it takes about 7 days to epithelialize; if thick, it takes about 10 days. In addition, the residual STSG was fixed in 20% formalin and underwent histopathologic examination using hematoxylin and eosin staining. This examination was conducted in accordance with the Declaration of Helsinki.

After harvest, hemostasis of the donor site was checked, and the wound was covered with a hydrocolloid dressing



Video Graphic 1. See video, Supplemental Digital Content 1, which shows the skin harvesting process of a 29-year-old female patient (case 4). Approximately 2.49 × 3.51 cm was designed on the hair-bearing scalp. Under local anesthesia, split-thickness skin was harvested using the No. 15 blade. This video is available in the "Related Videos" section of the full-text article on PRSGlobalOpen.com or available at ***http://links.lww.com/PRSGO/B40***.

(Karayahesive; ALCARE Co., Ltd., Tokyo, Japan). The donor site was then managed by the patient, who was instructed in the proper aftercare. In general, the hydrocolloid dressing was changed 2 days postoperatively, and from 3 days after surgery the patient was allowed to gently wash his or her hair while avoiding scratching the scalp with the nails. The patient was instructed to cover the wound with the dressing until complete epithelialization of the donor site was achieved. In addition, for >6 months after the operation, the donor site was observed for hypertrophic scarring, alopecia, and color. All patients were advised to use sun protection factor 20 to sun protection factor 30 PA++ protection grade of UVA (from grade +, effective, to grade ++++, extremely effective) sunscreen on the recipient sites for at least 6 months after surgery.

Assessment of Recipient Site

For > 6 months after the procedure, the recipient site was observed for graft take, presence of secondary contraction, and color and texture match. Secondary contraction in particular was checked by tracing and scanning the graft skin immediately after the procedure and at 6 months (or more) after the operation and outlining the data on Adobe Illustrator CS6. A plug-in computer software "Hakariya" (Comnet Co., Ltd., Kobe, Japan), which can be used for automatically calculating square measure, circumference and length, and settings of scales on Adobe Illustrator CS6 was downloaded. The square measures of the graft skin were calculated according to the set scale, thus contraction rate was confirmed (Fig. 1). Contraction percentages were defined as follows: <5% : "no contraction," 5%–30% : "mild contraction," and >30% : "contraction."

Regarding color and texture match of the recipient site, results were defined as follows: good: mild pigmentation/both patient and physician are satisfied; fair: mild pigmentation/either patient or physician is dissatisfied; and poor: severe pigmentation.

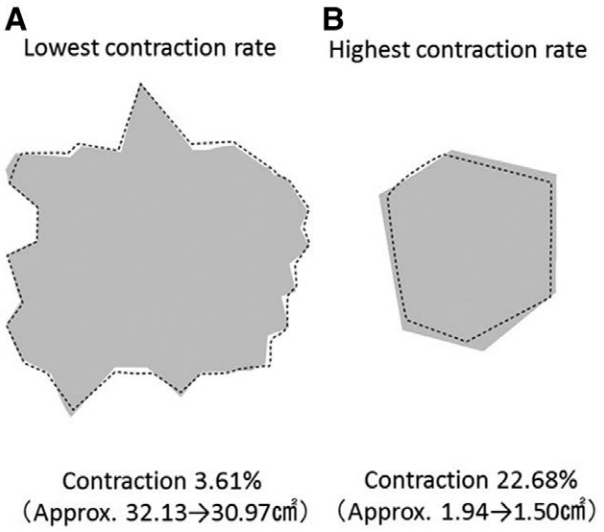


Fig. 1. The figure shows the images from a plug-in computer software "Hakariya" on Adobe Illustrator CS6. The gray portion demonstrates the square measure of the graft skin immediately after the procedure, and the dotted line shows the shape of the graft skin at 6 months (or more) after the operation. All square measures were automatically calculated by this software, and thus the contraction rate was confirmed. Case 2 resulted in the lowest contraction rate of 3.61% at 10 months after the operation (A), and case 1 had the highest contraction rate of 22.68% at 6 months after the operation (B).

RESULTS

Donor Site

The mean patient age was 39.8 years; 2 patients were men, and 2 were women. Epithelialization of the donor site was complete in an average of 8.75 days (range, 7–11 days). Over the 6 months following the procedure, none of the patients showed scarring or alopecia, and all the donor sites had good color (Table 1). Histopathologic analysis of the residual skin showed that the thickness varied from 0.3 to 0.7 mm and confirmed there was no damage to the hair follicles (Fig. 2). The preoperative harvest design of the donor site (Fig. 2A) and the appearance of the donor site at 11 days after surgery (Fig. 2B) and at 10 months after surgery (Fig. 2C) of case 2 are presented to demonstrate the process.

Recipient Site

Graft take was good in all 4 cases. Cases with small defects include trauma and tattoo. Burn scars from 1 case involved a large defect (Figs. 3–5). The average rate of secondary contraction was 10.66%: 22.68% for the nasal tip after a dog bite injury (highest contraction rate), 3.61% for the burn scar on the dorsum of the right hand (lowest contraction rate), 4.76% for removal of the tattoo from the dorsum of the right fifth digit, and 11.60% for the scars on the left anterior forearm from self-harm. Two grafts showed mild secondary contraction (Table 1). Color and texture match was relatively good in all cases. There was no pigmentation due to strict adherence to the sunscreen guidelines. Both patient and physician were satisfied with all outcomes.

DISCUSSION

Reason for Selecting STSG Using the Scalp as the Donor Site

Primary wound closure can be difficult in tissue loss and scars caused by trauma, excision of skin tumors, and tattoos. In such cases, STSGs, FTSGs, or reconstruction surgery using a local flap or a free flap is performed. When the recipient site is in the facial area, an FTSG from the preauricular region or a local flap is esthetically preferable because the color and texture match is good.[1] When the recipient site is in a joint, an FTSG or local flap is used to prevent secondary postoperative contraction.

However, the primary wounds of the 4 patients presented here involved tissue losses in the facial area, dorsal hand, digit, and upper limb, making closure difficult. In addition, the patients did not want another scar from harvest, and they desired a short rehabilitation period. This limited the choice of reconstruction method. Thus, an STSG was selected, prioritizing immediate wound closure over esthetic concerns. Unlike full-thickness skin, split-thickness skin contains skin appendages, and the migration of epithelial cells accelerates wound healing.[2–4] The optimal donor site was considered to be an area where a thick STSG, which is close to full-thickness skin and contains numerous sweat glands and sebaceous

TABLE 1. Patient Demographics, Other Characteristics, and Results

					Donor Site	Recipient Site
Case	Age/Sex	Recipient Site and Type of Scar	Operative Time (min)*	Size of STSG (cm)†	Epithelialization Period (d)‡	Contraction Rate§ Secondary Contraction¶
1	47 y/M	Nasal tip trauma from dog bite injury	51	2×1.5	7	1.94 cm²→1.50 cm² (1.50–1.94)/1.94×100 = 22.68%. Mild secondary contraction
2	31 y/F	Multiple burn scars on the dorsum of right hand	137	7.49×7.29	11	32.13 cm²→30.97 cm² (30.97–32.13)/32.13×100 = 3.61%. No contraction
3	52 y/M	Tattoo on the dorsum of right fifth digit	48	1.5×1.5	7	1.68 cm²→1.60 cm² (1.60–1.68)/1.68×100 = 4.76%. No contraction
4	29 y/F	Multiple linear scars from self-harm on left anterior forearm	75	2.49×3.51	10	8.88 cm²→7.85 cm² (7.85–8.88)/8.88×100 = 11.60%. Mild secondary contraction

*From performing the operation to immobilization of the graft. The operation and photographing are done solely by the surgeon.
†Size of the designed shape before harvest. After harvest, the graft skin was trimmed to the exact size for the recipient site.
‡Mean epithelialization period: 8.75 d.
§Square measure of graft skin immediately after surgery and at 6 mo (or more) after surgery were calculated and compared. Mean contraction rate is 10.66%.
¶Below 5%: no contraction, 5%–30%: mild contraction, >30%: contraction.

Fig. 2. Preoperative and postoperative appearance of donor site. A, Photograph shows the preoperative harvest design (case 2), which measures 7.49 × 7.29 cm. At 11 days after surgery, the donor site is still red, but epithelialization can be seen. No scarring or alopecia is shown (B). At 10 months after surgery, the hair has grown back, and there is no scarring or alopecia. The color of the donor site matches that of the surrounding area (C).

glands, could be harvested and where rapid epithelialization was possible. In STSGs from the scalp, epithelialization of the donor site is quick because the hair follicles remain intact.[5]

Harvest of the scalp skin was used successfully for second-stage ear projection and low hairline during microtia surgery by Nagata,[6] who calls the graft "ultradelicate split-thickness scalp skin." According to Nagata,[6] use of an ultradelicate split-thickness scalp skin is highly effective because it contains numerous natural drainage pores, has a low risk of hematoma or secondary contraction, and results in good graft take and color and texture match. In addition, epithelialization of the scalp is rapid because the follicular buds remain at the donor site, which also makes the area less noticeable once the hair grows back. In contrast, traditional microtia surgery involving the harvesting of full-thickness skin from the groin leaves a scar at the donor site.

Advantages of Freehand Scalpel Technique

Since Crawford first reported the scalp as the donor site in 1964, surgeons have traditionally used a dermatome to harvest grafts for the repair of skin defects for burns and atresia repair.[7–9] However, use of a No. 15 blade for an STSG from the preauricular region has also been reported.[10] To the best of my knowledge, there have been no reports on use of the No. 15 blade for STSGs from the scalp to cover defects in the facial area, in the trunk, and near the joints.

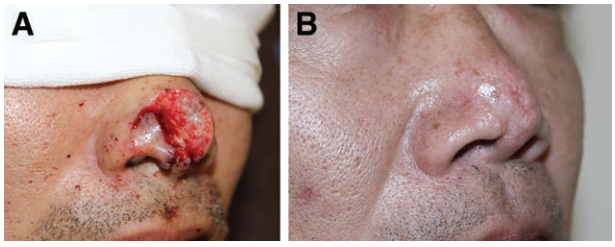


Fig. 3. Preoperative and postoperative appearance of recipient site. A, Photograph shows the nasal apex of patient 1, a 47-year-old man (case 1), after a dog bite injury and before restorative surgery. The 2 × 1.5-cm area of tissue loss in the nasal tip is shown from the right diagonal view. B, At 6 months after surgery, the photograph shows that the color and texture match is good; however, there is mild asymmetry in the nostrils. The forms of the nasal tip, nostrils, and the nasal ala are maintained.

Despite its limited use for STSGs, the freehand scalpel technique offers many advantages. Once the technique has been mastered, approximately 3 × 3 cm of split-thickness skin can be harvested in <5 minutes. In fact, STSG using a scalpel is quicker than other methods because there is no need to set up a dermatome or perform donor skin closure (as in FTSG). In addition, according to the findings from the histopathologic examination, the thickness of grafts obtained with the No. 15 blade varied from 0.3 to 0.7 mm. This is comparable to the thickness typically obtained with a dermatome (ie, 0.15–0.7 mm).[11] Furthermore, the scalpel can be adjusted to accommodate any graft shape.

Advantages of the Scalp as Donor Site

Because the scalp contains numerous skin appendages, epithelialization is quick. For the 4 cases described here, the mean epithelialization period at the donor site was 8.75 days. In addition, patients were allowed to wash their hair 3–4 days after the procedure, so they were able to quickly return to their normal lives. Another important advantage of using the scalp as donor site is avoidance of a second raw surface or scar on the limb or trunk. For these reasons, STSGs from the scalp are obtained using the No. 15 scalpel whenever immediate wound closure is a priority and it meets the patient's needs.

Disadvantages of the Freehand Scalpel Technique

The scalp can be a controversial choice for a donor site, as some female patients do not want to shave their heads. In addition, the technique requires some time to

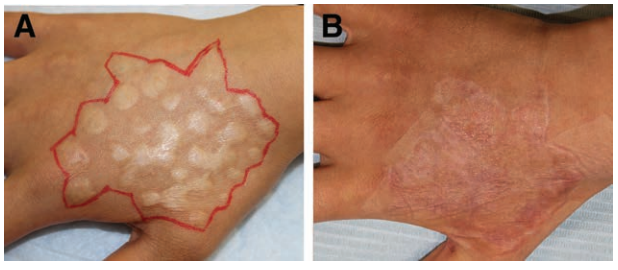


Fig. 4. Photographs show the hands of a 31-year-old woman (case 2). Preoperatively, multiple burn scars are evident on the dorsum of the right hand. No contraction was found in the dorsum or digits (A). At 10 months after surgery, the color and texture match is good (B).

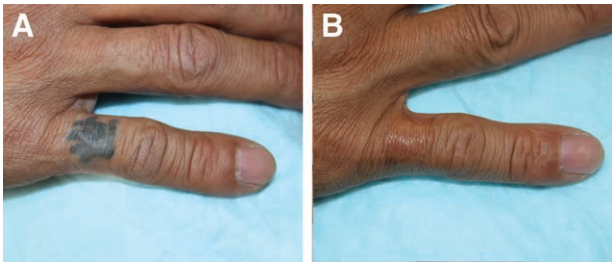


Fig. 5. Photographs show the right fifth digit of a 52-year-old man (case 3). Preoperatively, there is a green-black tattoo measuring 1.5×1.5 cm on the dorsum of the right fifth digit, between the metacarpophalangeal joint and proximal interphalangeal joint (A). Extension and flexion of the digit 6 months after surgery shows no motor dysfunction in the fifth digit. The color and texture match is good (B).

master. If the angle or depth of the cut is incorrect, there is a risk of perforating the split-thickness skin or damaging the hair follicles. In these 4 cases, it was possible to harvest the skin from the scalp in a short amount of time (albeit slightly longer than with the use of a dermatome), even in case 2 with a large portion of skin for harvest. This is because of the mastery of skill and being used to the procedure. However, if the surgeon has a dermatome in his or her facility, it is safer and more efficient to use the dermatome for harvesting a large portion of skin. Furthermore, until epithelialization of the donor site is complete, the area must be kept clean. Failure to do so will delay the epithelialization process.

Efficacy of STSG from the Scalp

This report describes a technique for STSG using a No. 15 blade and documents its effectiveness. Some may argue that an FTSG or a local flap would have been a better choice for these patients. The trauma patient, in particular, may have achieved better esthetic results with a local flap or FTSG from the preauricular area. However, considering the condition of the recipient site and his satisfaction after the operation, it is concluded that an STSG was a reasonable choice.

Use of the scalp as a donor site for STSG is especially beneficial because it precludes scar on the limb or trunk. Nagata's[6] use of scalp skin for STSG in microtia surgery was especially effective. All 4 cases presented in this article had good results as well. Three of the 4 grafts were near a joint, so a splint was fixed to immobilize them and prevent motor deficiencies (there were none). All 4 grafts had good color and texture match, though slight difference in color was noted in all cases. Four cases are certainly not enough to make a definitive conclusion about the efficacy of the method, especially for covering large defects. However, for small defects, STSG from the hair-bearing scalp using a No. 15 blade is a credible option for skin grafts.

CONCLUSIONS

Using the No. 15 scalpel technique, physicians can perform a skin graft from the scalp regardless of accessibility to a dermatome, which broadens the options for wound closure.

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