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손날 부위에서의 전층 피부이식을 이용한 수부 피복

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Hand Resurfacing with Full Thickness Skin Graft from the Palm Ulnar Border

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Purpose: Split-or full-thickness skin grafts are used to reconstruct palmar skin and soft tissue defects after trauma or to release burn scar contracture on the hand. Glabrous skin defects should be substituted with similar skin to preserve function and aesthetics. The authors report their experiences with a technique that uses a full-thickness graft taken from glabrous skin on the ulnar edge of the palm for the reconstruction of soft tissue defects of the hand.

Methods: During a three-year period from 2007 to 2010, 22 patients with burn scar contracture and 12 patients with post-traumatic skin defects on their hands were treated with full-thickness skin graft operations. The palmar skin and soft tissue defects after release of burn scar contracture or debridement of post-traumatic wounds were reconstructed with full-thickness skin grafts harvested from the ulnar border of their palms. All donor-site wounds were primarily closed.

Results: The followup periods ranged from 3 to 25 months. Contractures of the hand were corrected without recurrence, and the grafts showed relatively good contour and color match to the adjacent fields. There were no reported complications such as significant color change or hypertrophic scarring. The grafted skin showed an average 5.9 mm static two-point discrimination obtained in fingertip reconstruction cases, indicating satisfactory reinnervation.

Conclusion: Glabrous full-thickness grafts harvested from the palmar ulnar border is a very useful way of reconstructing soft tissue defects on hands, including fingertips, for function restoration, favorable aesthetic results, and low donor-site morbidity.

Key Words: Skin transplantation, Finger injuries

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I. INTRODUCTION

A skin graft is the simplest way to reconstruct an area of glabrous skin loss. The same principle of replacing "like with like" is applied to the reconstruction of a digit skin defect. Historically, this dictum has not been applied to defects of the palmar hand, and traditionally either full-thickness or, more recently, split-thickness skin grafts have been proposed to reconstruct these glabrous skin defects. Split-thickness glabrous skin grafts result in significant donor-site morbidity, including prolonged healing, pain, hypertrophic scarring, and hyperpigmentation.[1] Donor sites for full-thickness glabrous skin are scant. The wrist, forearm, anticubital fossa, periclavicular area, and groin are typically used to harvest full-thickness skin grafts.[1,2] However, doing so always results in a scar at the donor site and a skin mismatch between the graft and recipient areas. Therefore, skin grafts from the hypothenar eminence area have been widely used for palmar skin defects of the digits, because the skin color and texture of this area are well matched to palmar skin.[3] However, grafting from the hypothenar eminence area can produce discomfort at the donor site as it comes under pressure during daily activities.

The hand ulnar border seems to have a high potential for full-thickness glabrous skin graft donor sites, as it provides glabrous skin and subcutaneous fat tissue protective padding, minimal morbidity, and satisfactory functional recovery and cosmesis. The aim of our study is to show the excellent benefits of its use as a donor site for repairing palmar skin defects of the digits.

II. MATERIALS AND METHODS

A. Patients

A retrospective chart review was performed at a single institution, and a total of 34 consecutive cases were examined for this study (Table I). Twenty-two cases were post-burn scar contracture and 12 cases were post-traumatic digit injury. Ten patients had an operation at the fingertip and 24 patients had an operation at the interphalangeal joint. There were 21 male and 13 female patients with ages ranging from 5 to 54 years (average, 39 years). Followup of the patients ranged from 3 months to 25 months (average, 13 months). The operation was performed under intravenous anesthesia, except for the younger patients.

B. Operation technique

The defect was prepared by incision or by excising the scar tissue or dirty injured tissue down to healthy tissue in the joint or tip area. A finger tourniquet can be used to secure the field of vision by controlling bleeding; meticulous hemostasis must be obtained to prepare the bed for graft take. The defect of the digit was then measured in a 1 : 1 fashion by using a latex glove as a template to achieve a three-dimensional design. In the region of the ulnar border, the graft was designed in the mid-axis border between the dorsal and palmar skin (Fig. 1). The donor site was infiltrated with tumescent fluid of 1% lidocaine and 1 : 200,000 epinephrine. The size of the graft was determined by the skin defect size. The ratio of harvested palmar and dorsal skin was determined by skin defect characteristics. Palmar skin was mainly harvested, but dorsal skin was also harvested when the defect area included the dorsal side. Wide donor site closures required some dorsal skin undermining. A proper amount of subcutaneous fat was harvested together with glabrous skin for a thick and endurable full-thickness tissue. The graft was then transferred into the defect and sutured simply with Nylon 5-0. The digits were dressed with hydrofoam, and no tie-over dressing was used. The digits were then placed in a static splint with the digits in full extension for one week. Patients were seen again after another week and at a two to three month interval after wound stitch out.

Table I. Patients Summary Table

Sex	Male	21
	Female	13
Age	5~54 years (Average 39 years)	
Follow up period	3~25 months (Average 13 months)	
Cause	Burn scar contracture	22
	Traumatic digit injury	12
Location	Finger tip	10
	Interphanlageal joint	24
Intraoperative graft size	Width	0.5~2.4 cm
	Length	0.7~3.5 cm
Static two-point discrimination	3.0~6.5 mm (Average 5.9 mm)	
Complication	Partial graft loss	2
	Total graft loss	None
	Donor site problem	None
	Recurred scar contracture	None

Total of 34 consecutive cases were examined for this study. There were 21 male and 13 female patients with ages ranging from 5 to 54 years(average, 39 years). Followup of the patients ranged from 3 months to 25 months(average, 13 months). Twenty-two cases were post-burn scar contracture and 12 cases were post-traumatic digit injury. Ten patients had an operation at the fingertip and 24 patients had an operation at the interphalangeal joint. The width of the grafts ranged from 0.5 cm to 2.4 cm, and the length ranged from 0.7 cm to 3.5 cm. There were only two partial graft losses due to hematoma. There were no total graft loss, donor-site complications, recurred scar contracture. Sensory reinnervation obtained from fingertip reconstruction cases reached an average static two-point discrimination of 5.9 mm at six months.

III. RESULTS

All glabrous full-thickness skin grafts demonstrated good take rates, resembling the surrounding glabrous skin with regard to appearance and color. The full-thickness tissue grafts provided good protective padding, and the overall contour of the grafts was aesthetically acceptable without significant contraction. The width of the grafts ranged from 0.5 cm to 2.4 cm, and the length ranged from 0.7 cm to 3.5 cm. Among the 34 patients, there were only two partial graft losses due to hematoma. The overall joint movement was good, except for three patients who had severe joint ankylosis. There were no donor-site complications. All donor sites healed to completion without significant scar, hypopigmentation, hyperpigmentation, or contour irregularities. Sensory reinnervation obtained from fingertip reconstruction cases reached an average static two-point discrimination of 5.9 mm at six months. There was no sensory loss on the fifth digit near the donor site.

Case 1

A 50-year-old woman had burn scar contracture on the left little finger. There was limited range of motion and extension at the proximal and distal interphalangeal joints. The range of motion of the joints measured 120 degrees and 100 degrees. After release of a crescent-shaped fold along the crease of the digit's flexion surface, the flaps were mobilized with a subcutaneous fat layer. Two skin defects at the joints, 1.5 × 1.5 cm and 1.5 × 1 cm, were covered with full-thickness grafts from the ipsilateral palmar ulnar border. Contracture was released completely with no conspicuous scars (Fig. 2). Post-operative range of motion of both joints measured 180 degrees.

Case 2

A 12-year-old girl presented with burn scar contracture caused by a hot pot 10 years prior on the palmar side of the left ring finger, involving the proximal interphalangeal joint area. The range of motion of the joint measured 80 degrees. The scar band was released, and 1.5 × 3 cm skin and subcutaneous tissue harvested from the palmar ulnar border area was grafted. The flexor tendons of the ring finger were partially exposed on the distal interphalangeal joint after

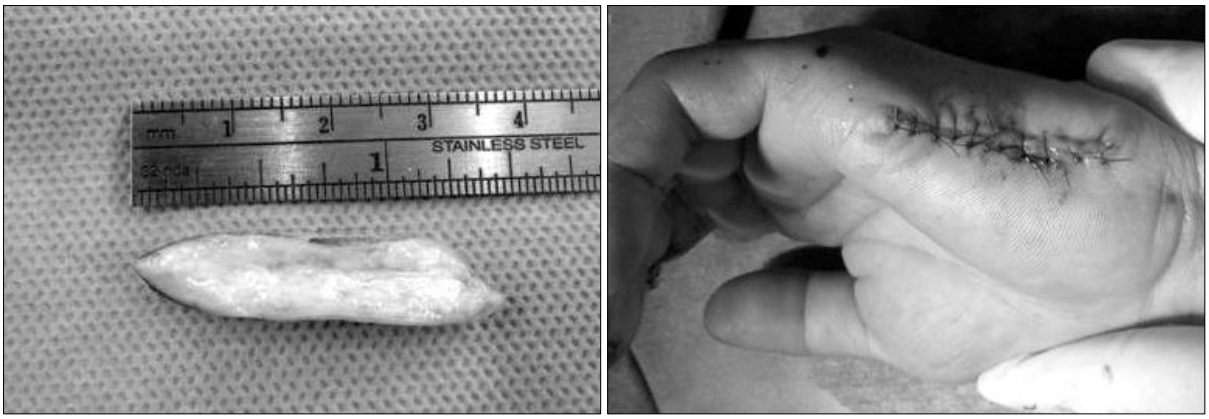

Fig. 1. (Left) Glabrous skin including superficial subcutaneous fat, harvested from the palmar ulnar border. (Right) Primarily closed donor site wound.

Fig. 2. A 50-year-old woman had a burn scar contracture at the proximal and distal interphalangeal joints of the left fifth finger. (Left) Preoperative view. Full-thickness grafts (1.5 × 1.5cm and 1.5 × 1 cm) from the ipsilateral palm ulnar edge were performed at the palmar area of each joint. (Center) Postoperative view after two months. (Right) Postoperative view after eighteen months. Contracture was released completely with no conspicuous scars.

Fig. 3. A 12-year-old girl presented with a burn scar contracture at the palmar PIP joint of the left fourth finger. (Above, Left) Preoperative view. (Above, Right) Intraoperative view. The scar band was released and 1.5 × 3cm full-thickness tissue harvested from the palm ulnar area was grafted. The released finger was fixed with a K-wire insertion. (Below, Left) Postoperative view after fourteen months. (Below, Right) Donor site scar postoperatively at fourteen months. There was no evident recurrence of the acceptable donor-site scar.

tangential excision, but the graft took completely. The released digit was fixed with a Kirschner wire insertion. After fourteen months there was no recurrence of contracture and the donor-site scar was acceptable (Fig. 3). Postoperative range of motion of the joint measured 180 degrees.

Case 3

A 41-year-old man had a crushing injury caused by car repair equipment on the palmar side of the left index fingertip. The distal phalangeal bone was exposed, but its periosteum was intact. The digit was debrided and treated with a full-thickness skin graft harvested from the palmar ulnar border (1 × 3.5 cm) for soft tissue defect coverage. The wounds were fully healed by four weeks. After twenty months, there was no graft loss and the site presented good contour and excellent skin color match. The patient was able to recognize static two-point separation of 5.5 mm on the grafted fingertip (Fig. 4).

Case 4

A 44-year-old man caught his left index fingertip in his car door. The amputated part, including the nail bed, was unacceptable for replantation. We debrided dirty wound margin and grafted full-thickness tissue, including skin and superficial subcutaneous tissue, from the palmar ulnar border (1.5 × 1.5 cm) onto the skin defect. The nail bed was harvested from the ipsilateral big toe and transferred to the defect area of the index finger. Followup after two year showed a completely taken graft wound with acceptable contour, and the patient was satisfied with the result (Fig. 5).

IV. DISCUSSION

In the reconstruction of lost tissue, the fundamental principle consists of replacing the lost tissue with similar tissue. Glabrous skin is unique because of its specialized function and appearance. It has a thicker epidermis with a well-defined stratum lucidum, as well as a thick stratum spinosum and stratum corneum. In addition, the dermis is less elastic and more compact, which allows the skin to withstand greater force, pressure, and shear. It has abundant sweat glands and dermal papillae that

Fig. 4. A 41-year-old man had a crushing injury caused by car repair equipment at the palmar side of the left index fingertip. (Above, Center) Preoperative view. The distal phalangeal bone was exposed. (Below) Twenty-month postoperative view, showing good contour and excellent skin color match.

Fig. 5. A 44-year-old man caught his left index fingertip in his car door. (Above) Preoperative view. The left second fingertip, including the nail bed, was injured. (Center) Intraoperative view. Fingertip resurfacing with full-thickness graft harvested from the palm ulnar area (1.5 × 1.5 cm). (Below) Two-year postoperative view. There was no graft loss and relatively good contour was presented, so the patient was satisfied with the result.

allow rapid healing of small, partial-thickness defects. Glabrous skin has fewer melanocytes and contains no hair. These characteristics make glabrous skin functionally and aesthetically different from the skin found on the rest of the body.[4]

Glabrous skin grafts demonstrate durability without hyperkeratosis and hyperpigmentation and have even demonstrated improved recovery of sensation when compared with hair-bearing grafts.[5] However, when taking full-thickness glabrous grafts, the donor site is always limited. Anatomically, the ideal skin donor site is the closest to the recipient area, which results in a close match of the skin between the donor and recipient sites and also limits the surgical procedure to a single field under the effect of the same tourniquet.[1,2,6]

A method of hypothenar skin graft has been introduced that has the advantage of good quality supply of glabrous skin.[3,7,8] However, scarring in the hypothenar area could be troublesome in many hand positions. It is a contact surface during daily life such as writing and computer mouse controlling; therefore, the risk of discomfort at the palm ulnar edge is less than at the hypothenar eminence. The area lies within the "low premium" area of the hand, which does not usually come under significant pressure during gripping or other daily activities. Some have reported that the ideal site for

grafting to glabrous digital skin defects is from other digits.[9] However, digits have limited skin for harvesting and require a second donor site if a larger area is harvested.

In such a case, the ulnar border of the palm is suggested for an ideal donor site of digit skin loss, providing glabrous skin and subcutaneous protective padding, minimal morbidity, and satisfactory functional recovery and cosmesis. This also reduces the required field of anesthesia. The procedure is usually performed under a local digital block and infiltration anesthesia, unless an associated injury is involved. In addition, by not having to harvest thick skin from the groin or other area that is less glabrous, patients can return more quickly to their work and normal daily life.

Harvesting a graft from the hand palmar ulnar border rather than the hypothenar area has an additional advantage in that the dorsal skin can be harvested when the digit skin defect extends to the digit dorsum over the mid-lateral line. The skin texture and quality can be controlled by regulating the ratio of harvested palmar and dorsal skin according to the shape and extent of the skin defect. Healing of the donor site is also very satisfactory. Complete wound healing occurs within a week, with a functionally and cosmetically acceptable scar. Postoperative mobilization of the digit at one week has little effect on the healing of the donor site, as that area is the least mobile with flexion and extension of the digit because it lies on the palmar ulnar border of the hand. Therefore, the donor site heals before the grafts are completely taken. The donor scar is inconspicuous and there is no sensory deficit. In three years, we have had no complaints from patients regarding the donor site.

The subcutaneous fat in the palm ulnar area is sufficient to provide protective padding for additional durability; therefore, the glabrous skin with superficial fat layer provides a satisfactory aesthetic outcome on fingertips.[10-12] In addition, maintenance of the soft tissue pad helps to restore fine sensibility and overcome postoperative disturbances such as cold intolerance.[13]

The tactile sensation of the digit has a vital impact on hand function. The average static two-point discrimination of 5.9 mm obtained from fingertip reconstruction cases was similar to those repaired with cross-finger flaps (6 mm) and replanted fingers (5.7 mm),[14] which shows good quality of skin from the palm ulnar edge area.

V. CONCLUSION

The technique of glabrous full-thickness grafting replaces the defect with like tissue and restores the functional and aesthetic properties of glabrous skin. The palmar ulnar border area is inconspicuous and provides suitable tissue size to cover digit skin defects. In addition, this technique causes no sensory deficit, and the skin texture and quality are very good. Little immobilization is required for donor site healing. Consequently, the palmar ulnar border is a reliable donor area for providing glabrous full-thickness grafts and should be included in the list of donor sites used to cover skin defects on digits.

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