

# Superthin Thoracodorsal Artery Perforator Flap for the Reconstruction of Palmar Burn Contracture

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**Summary:** Treating burn scar contractures is challenging. Although free flap transfer is an effective tool for hand reconstruction, free flaps are often bulky, causing functional disturbance and poor cosmetic appearance. Secondary debulking operations are required, resulting in a prolonged total treatment period and delayed return to daily life and work for the patient. Therefore, 1-stage reconstruction using a thin and pliable flap is ideal. In this report, we present the superthin TDAP flap as an option for the reconstruction of postburn palmar contracture. During TDAP flap elevation, the thoracodorsal artery perforator was identified and traced distally until its penetration into the dermis. Subsequently, the subdermal tissue was removed and a uniformly superthin TDAP flap was elevated. Postoperatively, early functional recovery was achieved with excellent palmar contour and texture. No revision surgery was required and no recurrence of contractures occurred during the 6-month follow-up. This procedure is useful in elevating a superthin TDAP flap and is a feasible option for the reconstruction of working surfaces, such as the palm. (*Plast Reconstr Surg Glob Open* 2020;8:e2695; doi: 10.1097/GOX.0000000000002695; Published online 11 March 2020.)

## INTRODUCTION

Burn contractures decrease the range of motion and often cause severe functional impairment. Surgical treatment is indicated in such cases and various reconstructive techniques have been reported.<sup>1</sup> Free flap transfer is an effective tool that can provide adequate pliable tissue to cover the defect created after the contracture release. However, free flaps can sometimes be relatively bulky, requiring secondary debulking operations; this prolongs the total treatment period.<sup>2</sup> In contractures of working surfaces such as the palm, fingers, and sole, transfer of bulky flaps also causes delayed rehabilitation and return

to daily life. Thus, reconstruction in a single step using a thin flap is ideal for such regions.<sup>3,4</sup>

The concept of thin flaps was initially established by Colson et al<sup>5</sup> in 1967 and subsequently developed by Thomas<sup>6</sup> in 1980. Kimura et al<sup>7</sup> described microdissection of the vascular pedicle under microscope guidance in 2002, and this technique has been applied for thin flap elevation.<sup>8-10</sup>

This report describes a case of severe postburn palmar contracture successfully treated with a superthin thoracodorsal artery perforator (TDAP) flap that was elevated using the microdissection technique.

## CASE REPORT

A 54-year-old man was referred to Kanto Central Hospital for the treatment of postburn contracture of his right palm (Fig. 1). He sustained severe burns when he became intoxicated and entered the restricted area of a sauna. Debridement of necrotic tissue and split thickness skin grafting procedures were performed thrice at the University Hospital. However, his right palm was treated conservatively and re-epithelialized, resulting in severe contracture formation. We planned contracture release and free TDAP flap reconstruction. The operation was performed 18 months after the burn injury.

Preoperatively, color Doppler ultrasonography (US) was performed to confirm the presence of a dominant

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The study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from the study participant, including consent to participate and to publish the findings.

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perforator. Under general anesthesia, the patient was placed in a supine position. We initially incised the scar tissue and released the right palm contracture, which exposed the palmar digital nerve. Then, a TDAP flap measuring  $12 \times 4.5$  cm was designed and elevated based on the most dominant perforator. Under a microscope, the vascular pedicle was traced distally until its penetration into the dermis. The diameter of the perforator was 0.4 mm. With careful attention to the vascular pedicle, subdermal tissue was removed using curved scissors to make a thinner flap (Fig. 2). After confirming adequate blood perfusion throughout the flap by dermal bleeding and indocyanine green imaging, the flap was isolated (Fig. 3). The flap was inserted on the defect and scar tissue was excised. The ulnar digital artery and the dorsal vein of the little finger were anastomosed to the artery and venous pedicle of the flap, respectively, both in an end-to-end fashion.

Postoperatively, the flap survived entirely without complications. The range of motion improved significantly, and the patient resumed work as an electric mechanic without discomfort (see figure, Supplemental Digital Content 1, which demonstrates the improvement of range of motion, <http://links.lww.com/PRSGO/B318>). The contour and texture were excellent, and no revision surgery was required. No recurrence of contractures was noted during the 6-month follow-up (Fig. 4).

### DISCUSSION

Burn victims often suffer from severe postburn contractures, and surgical release is required to improve underlying joint function. This often causes defects and free flap reconstruction is versatile with the ability to supply well-vascularized pliable tissue and sufficient skin envelope after radical scar tissue excision and complete release of contracting bands.<sup>1</sup>

For the coverage of weight-bearing areas such as the sole and palm, thick, stable, and tough glabrous skin is preferable. In hand reconstruction, a TDAP flap can provide durable skin that can withstand pressure and friction during holding and grasping.<sup>3,4</sup> The flap can be harvested from a hairless area which adapts well to the palmar skin and matches its color and texture.<sup>1</sup>



**Fig. 2.** A thoracodorsal artery perforator flap was elevated from the left lateral thoracic region and the perforator was traced distally until it penetrated the deep dermal layer. Then, the adipose tissue of the flap was removed.



**Fig. 3.** After confirming adequate blood perfusion throughout the flap by dermal bleeding and indocyanine green imaging, the flap was isolated. The thickness of the flap after defatting was 3 mm.



**Fig. 1.** Preoperative photograph of the right hand. The little finger and ring finger could not be fully extended because of severe palmar postburn contracture.



**Fig. 4.** Photograph taken 5 months after the operation. The range of motion improved significantly. The contour and texture were excellent, and no revision surgery was required.

However, for the reconstruction of working surfaces such as the palm, a bulky flap can cause functional disturbance and poor cosmetic appearance.<sup>3,4</sup> Rehabilitation of hand function is delayed and activities of daily living are difficult. Revision surgeries, sometimes multiple, are required until the flap is fully debulked, resulting in a prolonged total treatment period and delayed return to daily life and work. Therefore, 1-stage reconstruction using a thin and pliable flap is ideal for the palmar contractures.<sup>2</sup>

The surgical technique for thin TDAP flap elevation has been described previously.<sup>10</sup> Kim and Kim<sup>3</sup> reported TDAP flaps which were 5–7 mm thick elevated excluding the deep adipose layer in 2003. Kim et al.<sup>11</sup> described TDAP flap elevation at the superficial fascia plane and subsequent defatting of superficial subcutaneous fat except near the peripheral perforator region in 2016. However, the subcutaneous fat surrounding the perforator was not removed in previous reports, avoiding damage to the vascular pedicles.

In our case, after the perforator was identified, the pedicle was traced distally under microscope until it penetrated the deep dermis. Then, preserving only the vascular pedicle, subcutaneous tissue was removed, and a uniformly thin TDAP flap was harvested (see **Video 1** [online], which demonstrates the dissection and thinning technique). The flap thickness after defatting was 3 mm, and the skin thickness of that area was also 3 mm according to the preoperative US examination (see **figure, Supplemental Digital Content 2**, which demonstrates US image of the perforator region, <http://links.lww.com/PRSGO/B319>). Postoperatively, the viability of the flap was monitored using the refill test and the pinprick test.

This TDAP flap elevation technique enables safe and radical defatting.<sup>9</sup> After the vascular pedicle is traced and retained until the deep dermal layer, subcutaneous tissue can be excised without concern for the risk of pedicle damage. Therefore, the adipose tissue surrounding the perforator can be removed and a uniformly superthin flap with a thickness similar to that of a full-thickness skin graft can be elevated.<sup>2,8</sup>

Because palmar and plantar skin have similar features, including pigmentation, texture, and durability, the flaps from the sole are possible alternatives in palmar reconstruction procedures.<sup>12</sup> However, in our case, that area was within the zone of burn injury. Moreover, because skin grafts had been harvested from the thigh, groin, and abdomen during the acute phase surgery, other thin flaps, such as anterolateral thigh, superficial circumflex iliac artery perforator, and superficial inferior epigastric

artery perforator flaps, were unavailable.<sup>10</sup> Therefore, we elevated a TDAP flap from the spared left lateral thoracic region.

The TDAP flap elevated using this technique is a uniformly superthin pliable flap with durable skin. It can provide elastic motion, contribute to 1-stage reconstruction without revision surgeries, and enable early rehabilitation and functional recovery. This procedure can be utilized as a viable alternative in the reconstruction of working surfaces such as the palm.

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