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# Bilateral Lower Limb Salvage after Fourth-degree Burns: Subscapular Axis Free and Chimeric Flaps Effectiveness in Complex Reconstruction

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**Summary:** Microsurgery is usually required for reconstruction of complex lower limb defects, preserving otherwise unsalvageable injuries. Fourth-degree burns are severe traumatic injuries. A case of bilateral lower limb salvage through a resourceful use of subscapular axis free and chimeric flaps for acute burn reconstruction of extensive lower leg injuries is reported. A 48-year-old man sustained a 40% surface area flame burn, circumferential and full-thickness at the lower limbs. Debridement of fourth-degree burns of the anterior lower legs resulted in bone exposure of the left and right tibias, right medial malleolus, and Achilles tendon. A latissimus dorsi (LD) flap plus a chimeric subscapular axis free flap with 3 components (LD, serratus anterior (SA), and parascapular) were designed for reconstruction. LD insetting for left tibia coverage with anastomoses to anterior tibial vessels was performed. Right side flap insetting provided tibia coverage with LD; medial malleolus with SA; and Achilles tendon with parascapular flap. An anatomical variation required anastomoses to proximal (chimeric LD + SA) and distal (parascapular) ends of posterior tibial vessels because of an independent origin of the pedicles. At 10-months follow-up after intensive rehabilitation, the patient showed proper functional outcomes at daily-life and work activities with autonomous walking using a single crutch. This case highlights the importance of microsurgery and chimeric flaps for limb salvage in extreme situations. The authors review and discuss the surgical options, emphasizing specific considerations of microsurgical reconstruction in burn patients. *(Plast Reconstr Surg Glob Open 2020;8:e2911; doi: 10.1097/GOX.0000000000002911; Published online 25 June 2020.)*

## INTRODUCTION

Microsurgery is usually required for complex lower limb defect reconstruction, allowing salvage in extreme situations.[1–3] Indications include significant soft-tissue or bone defects with vital structure exposure, resulting from trauma, burn injuries, irradiated wounds, osteomyelitis, or tumor excisions.[1–5] The ultimate goal of lower limb reconstruction is to achieve durable soft-tissue coverage over stable skeleton and preserve sensory and motor function.[4] Fourth-degree burns (full-thickness with deep tissue exposure) are severe traumatic injuries demanding either amputation or complex reconstruction.[6] Free flap transfer represents a small proportion in acute burn reconstruction (1.5–1.8%); however, its application is increasing and proving decisive in well-selected cases for limb salvage, delivering better functional and esthetic outcomes.[6–8] Chimeric flaps—comprising separate components with distinct vascular supplies attached to a common pedicle—provide a large and versatile solution with low donor-site morbidity.[1,3] The subscapular system offers a huge variability of free flaps.[1,3] The authors report a case of bilateral lower limb salvage using free and chimeric flaps from the subscapular axis after extensive burn injuries, highlighting the importance of microsurgery, discussing the surgical options, and emphasizing specific microsurgical considerations in burn patients.

## CASE REPORT

A 48-year-old man sustained a 40% surface area flame burn, circumferential and full-thickness at both lower limbs. In the burn unit, debridement of fourth-degree burns of anterior lower legs resulted in bilateral bone exposure of the left ($21 \times 5\,cm^2$) and right ($23 \times 6\,cm^2$) tibias, right medial malleolus ($3 \times 3\,cm^2$), and Achilles tendon ($10 \times 4\,cm^2$)

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**Fig. 1.** Bilateral extensive soft-tissue defects of the lower leg, with bone exposure of the left and right tibias, right medial malleolus, and Achilles tendon.

(Fig. 1). Lower extremity angiography showed patency of main vascular axes. Free flap reconstruction was initiated after hemodynamic stabilization, septic control, and complete debridement were achieved. A free latissimus dorsi (LD) muscle flap (ipsilateral, 27 × 15 $cm^2$) was harvested for left tibia coverage with end-to-end anastomoses to anterior tibial vessels (post-burn day 36). For right side reconstruction (3 days after), a larger flap was necessary to match the defect dimensions, and a chimeric subscapular axis free flap (including 3 components) was designed: LD, serratus anterior (SA), and parascapular flaps (Figure 2). The chimeric flap harvesting started with the parascapular flap (17 × 7 $cm^2$) and dissection of the circumflex scapular artery's (CSA) descending branch; followed by the LD (30 × 17 $cm^2$) and SA muscle flaps (sixth to eighth rib muscle slips; 5 × 8 $cm^2$). During dissection, an anatomical variation was found. The subscapular artery was absent, with the thoracodorsal artery and CSA arising separately from the axillary artery. Therefore, the chimeric LD + SA flap pedicle was dissected independently from the parascapular pedicle, and end-to-end anastomoses were performed to proximal and distal ends of the posterior tibial vessels, respectively. The flaps were inset with LD and SA resurfacing the right tibia and medial malleolus and parascapular covering the Achilles tendon. Bilateral insetting is shown in Figure 3. Dorsal donor-site was closed primarily. A free rectus abdominis was additionally harvested following infection and debridement of right LD's partial necrosis. Muscle flaps were skin grafted. An early burn unit inpatient rehabilitation program was set, both for donor and recipient flap sites. At 10-month follow-up visit after intensive rehabilitation, the patient showed proper functional outcomes (Fig. 4), without shoulder function impairment and presenting autonomous walking, with a single crutch to balance a right-ankle dorsiflexion deficit, and independence at daily-life and work activities.

## DISCUSSION

Lower limb salvage is currently possible in extreme cases due to microsurgery. Traditionally, free muscle flaps (LD, rectus abdominis, gracilis) were considered superior in resistance to infection and dead-space obliteration.[1,2,4] Recently, fasciocutaneous flaps (scapular, parascapular, anterolateral thigh, and radial forearm) were considered reliable and associated with better functional and esthetic outcomes.[1,2,4,8]

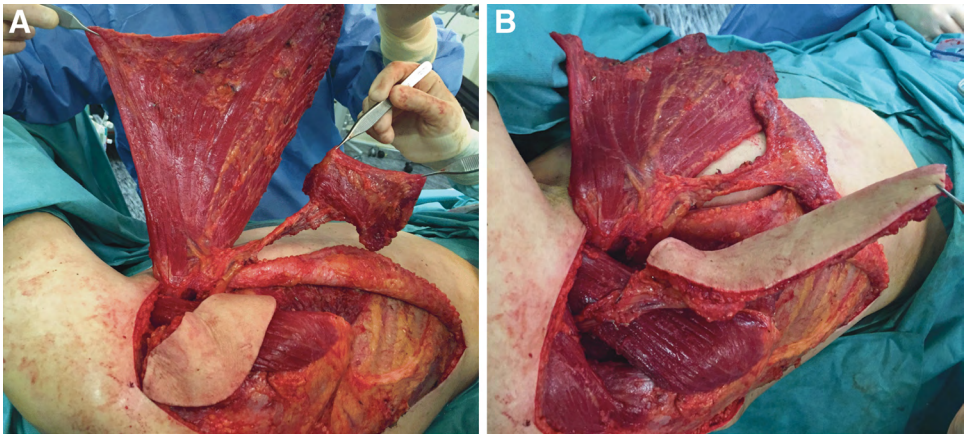


**Fig. 2.** Chimeric subscapular axis flap harvesting. A, LD and SA muscle flaps with vascular pedicles arising from the thoracodorsal artery (TdA). B, Parascapular flap based on the descending branch of the CSA; independent origin of TdA and CSA directly from the axillary artery.

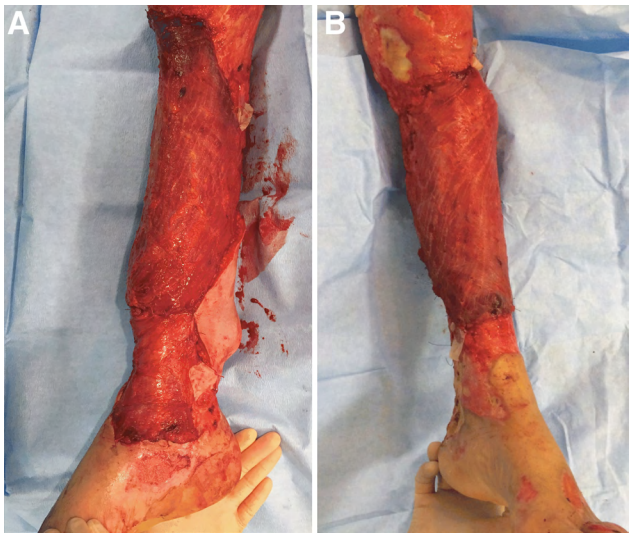


**Fig. 3.** Postoperative views. A, Right leg reconstruction, with a chimeric LD and SA muscle flap resurfacing the tibia and medial malleolus and parascapular flap covering the Achilles tendon. B, LD muscle free flap covering the left tibia.

**Fig. 4.** Lower limb salvage accomplished: the patient is able to stand and achieve autonomous walking after intensive rehabilitation (10 months follow-up). Good healing result of bilateral burn injuries.

Chimeric flaps with different functional (muscular–cutaneous–bone) units can be harvested based on a single vascular pedicle and donor area, requiring only one recipient anastomosis site.[1,3] The flexibility of design and customized insetting with spatial independence of each component has revolutionized the ability to reconstruct extensive/complex defects and optimize limb salvage outcomes.[3,5]

This case represented a reconstructive challenge, in which bilateral leg salvage after severe burn injuries was achieved with multiple free flaps, avoiding bilateral amputations above the knee. Moreover, a subscapular axis chimeric flap (LD + SA muscles) and parascapular flap were imperative for reconstruction of extensive multifocal right leg defects. Subscapular artery system flaps are versatile and reliable workhorses for lower extremity reconstruction, offering a variety of separate components (muscle, skin, fascia, and scapular bone) joining a common pedicle.[1,3,5,9] The chimeric LD/SA/scapular/parascapular combined flap is considered the largest coverage option for complex 3-dimensional lower extremity defects.[1,9] The LD large dimensions for tibia resurfacing, the SA slips for malleolus coverage, and parascapular gliding surface for tendinous coverage suited perfectly the defect features in our patient. Only the serratus slips from the fifth to eighth ribs should be harvested to avoid a winged scapula.[9,10] If harvested correctly, subscapular axis chimeric flaps have lower donor-site impact, provide reliable large coverage, and avoid additional lower extremity morbidity, which are benefits comparing with gracilis (smaller dimensions), rectus abdominis (abdominal morbidity), or anterolateral thigh plus vastus lateralis (esthetic and functional donor-site morbidity).[1,4]

Chimeric flaps have some drawbacks: long learning curve; unexpected anatomical variations; long operative time; higher risk of complications, partial/total flap loss and wound dehiscence; flap compression in extensive/circumferential defects; long recovery time and rehabilitation.[1,3] Subscapular artery anomalies with CSA and thoracodorsal artery arising independently from the axillary artery were reported in cadaver (3–5%) and imaging (9.7%) studies.[10,11]

Particularities of burn patient's reconstruction are relevant. Free flaps are the best option in extensive burns with vital structures exposure where local/regional flaps are injured. Early free flap coverage is not always possible in large burn patients because preceding physiologic stability, extensive debridement, and septic control are mandatory.[7,8] Timing of free flap primary burn reconstruction thus comprises immediate (<5 days), early (5–21 days), intermediate (21 days–6 weeks), and late primary (>6 weeks), while secondary burn reconstruction includes mature scars reconstruction (>6 months).[7,8] Free flap transfer faces several challenges in burn patients, including limited donor-site availability, higher risk of flap failure (associated with infection and venous thromboembolism), and injury of recipient vessels.[6–8] Arteriovenous loops—allowing anastomosis to proximal suitable vessels—are an innovative solution when local vessels are of inadequate caliber, poor quality, or within the zone of injury.[6,12] Early intensive burn unit rehabilitation for both dorsal donor-site and lower limbs is critical for restoration of physical, psychological, and functional outcomes, facilitating hospital discharge and a successful long-term recovery.[13,14]

This case report highlights and reviews key literature supporting the major role of free and chimeric flaps in

extensive and complex 3-dimensional lower limb reconstruction. Despite the higher risks associated with the defect complexity, chimeric flaps inherent drawbacks, and specificities of burn patient's reconstruction, a good overall functional outcome was achieved.

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*The authors agree to be accountable for all aspects of the work, accuracy, and integrity of the content.*

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