

Limb Salvage and Treatment of Posttraumatic Lymphedema in a Mangled Lower Extremity

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Summary: Post traumatic lymphedema (PTL) is a known complication of extremity trauma that is detrimental to limb form and function, healing, and quality of life. In cases of complex lower extremity trauma with vascular and extensive soft tissue injury, the risk of PTL is increased. However, many trauma patients are lost to follow-up, making the risk and potential management of these patients' lymphedema difficult to characterize. The purpose of this report is to describe the successful surgical management of PTL secondary to significant lower extremity trauma requiring complex limb salvage reconstruction. A 43-year-old woman involved in a motorcycle accident presented with a Gustilo IIIB right tibial fracture and single-vessel leg. She underwent successful limb salvage with serial debridement, bony fixation, creation of an arteriovenous loop with a contralateral saphenous vein graft, and a chimeric latissimus dorsi-serratus anterior muscle flap. At the 5-month follow-up, she presented with significant right lower extremity lymphedema. She underwent lymphovenous bypass surgery guided by preoperative indocyanine green lymphography, which resulted in a 62% improvement in functional outcome measures, eliminated her prior need for compression garments and inability to wear regular shoes, and sustained improvement at two years follow-up. This case illustrates a near circumferential traumatic defect reconstructed with a muscle flap and successful delayed lymphatic reconstruction with lymphovenous bypass in the same patient. (*Plast Reconstr Surg Glob Open* 2024; 12:e6209; doi: [10.1097/GOX.0000000000006209](https://doi.org/10.1097/GOX.0000000000006209); Published online 1 October 2024.)

Post traumatic lymphedema (PTL) is a known complication of traumatic extremity injury that can result in poor wound healing and functional impairment, and 20%–55% of patients who undergo surgical treatment for traumatic injury have persistent postoperative edema.^{1–3} Microsurgical techniques for PTL include vascularized lymph node transfer (VLNT), lymphovenous bypass (LVB), or prophylactic LIFT (lymph interpositional flap transfer) and SCIP-LV (superficial circumflex iliac artery perforator lymphatic vessels) flaps.^{4–7} Cases of successfully treated PTL after limb salvage are limited, but one study showed LVB after flap coverage of limited soft tissue injury resulted in 55.93% reduction in excess volume.⁸ However, restoration of lymphatic channels via

delayed LVB is rarely reported in complex limb salvage patients.

Microsurgical advancements have improved 5-year amputation free rates to 83% even in single-vessel extremities; thus, effective treatment for PTL after complex limb salvage should be explored.^{9,10} We present a case of lymphatic reconstruction in a 43-year-old woman with right lower extremity lymphedema after complex reconstruction of a single-vessel limb. This case adds to the sparse literature on lymphatic outcomes of near circumferential defects reconstructed with muscle flaps and shows that PTL can be treated with delayed LVB in limb salvage patients.

CASE REPORT

A 43-year-old otherwise healthy woman presented to the emergency department after a motorcycle accident with a mangled right lower extremity. Evaluation demonstrated a Gustilo class IIIB tibial fracture, loss of the anterior tibial and

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Fig. 1. Right lower leg with Gustilo class IIIB tibial fracture following debridement with exposed bone and hardware.

peroneal artery angiosomes, compromised venous drainage, and single-vessel patency of the posterior tibial artery on angiogram. Debridement revealed more than 5 cm exposed tibia/tibial rod and a circumferential soft tissue deficit (Fig. 1). An arteriovenous (AV) loop was created outside the zone of injury using a contralateral saphenous vein graft to the ipsilateral superficial femoral artery and vein. After AV loop creation, immediate free flap coverage using a chimeric latissimus dorsi-serratus anterior muscle flap was performed, as the wound was too large for standard skin flaps. The postoperative course was unremarkable, and care followed institutional standards. The patient was discharged 2 months after the initial injury.

The patient presented 5 months after flap reconstruction with ISL stage II extremity lymphedema that impaired activities of daily living and prevented her from fitting into standard sized shoes. After a 4-month failed trial of comprehensive decongestive therapy (CDT) and 20-30 mm Hg knee high-compression stockings, ICG lymphography was performed and demonstrated no linear patterns in the proximal leg and dermal backflow in the zone of trauma, confirming a diagnosis of PTL. (See figure, Supplemental Digital Content 1, which displays ICG lymphography showing normal lymphatic channels with linearity and dermal backflow in area of trauma. <http://links.lww.com/PRSGO/D536>.) LVB was planned over VLNT, as patent lymphatic channels were present, and candidate lymphatic channels for bypass were identified. (See figure, Supplemental Digital Content 2, which displays the preoperative markings for lymphovenous bypass with planned bypass sites. <http://links.lww.com/PRSGO/D537>.) End-to-end lymphatic bypass was performed, and intraoperative ICG confirmed patency.

The patient reported symptom improvement 2 weeks postoperatively and resumed CDT at 1 month postoperatively. At 6 months, the patient met rehabilitation goals of ambulating without intermittent limb elevation, had a 62% functional improvement via LLIS (Lymphedema Life Impact Scale) score (11.76%–4.41% impairment), and a LEFS (Lower Extremity Functional Scale) improvement from 15 (<80% impairment) to 26 (<60% impairment). There was also a 27% improvement of difference in limb circumference with maximum reduction of 32.42% at 30 cm proximal to



Fig. 2. Clinical improvement 2 weeks postoperatively.

the ankle, and a final limb volume less than 50 mL from the contralateral limb (4.05% to 2.73% excess volume). At 2-year follow-up, the patient reported complete functional restoration, including standing for long periods and walking without compression garments, did not require further CDT, and was able to wear standard sized shoes (Figs. 2–4).

DISCUSSION

This report demonstrates the development of PTL after complex limb salvage of a near circumferential defect with free muscle flap and subsequent resolution after delayed LVB in the same patient. A chimeric muscle flap was chosen due to the defect size, and other prophylactic lymphatic reconstructive flaps such as the SCIP-LV or the LIFT may not be feasible in the case of total extremity anatomy



Fig. 3. Clinical improvement 6 months postoperatively.

reconstruction due to increased operating time, inability to detect functional lymphatic channels, abnormally shaped defects, and lack of patent recipient site vessels. In this case, a reconstructive choice that maximized flap malleability and coverage was prioritized.

There is no conclusive evidence on the optimal timing of lymphatic reconstruction in limb salvage patients. Immediate reconstruction can reduce the number of operations and prevent symptom development, whereas delayed reconstruction can reduce donor site morbidity. In some cases, it is not feasible to perform lymphatic procedures at the time of reconstruction due to the lack of functional veins and soft tissue coverage, and the short-term priority is limb salvage. When considering LVB versus VLNT, functional lymphatic channels are ideally treated with LVB whereas VLNT is reserved for cases without linear functional channels. Risks associated with VLNT include donor site lymphedema and contour deformity, whereas LVB has standard surgical risks. One benefit of delayed reconstruction is the ability to determine the patency of lymph channels after the acute injury phase has subsided, allowing LVB to be performed over a VLNT.



Fig. 4. Clinical improvement and final 2-year follow-up, with no recurrence.

Reconstructive options which include superficial lymphatic channels are fasciocutaneous and myocutaneous flaps. Some muscular flaps are well situated for concurrent VLNT, such as a subscapular based free flap with thoracic axillary nodes. Free muscle flaps without VLNT may have a higher incidence of lymphedema development, but this has never been conclusively demonstrated. Lymphatic anatomy should be considered in any limb salvage reconstruction plan, whether in preserving or reconstructing lymphatics acutely or as part of the long-term treatment plan. This case demonstrates the use of a versatile high volume free muscle flap and that any subsequent development of PTL can be treated with a lymphatic reconstructive option with low morbidity.

Limitations of this report include lack of postoperative ICG, lack of generalizability to typical injury patterns, and limited calculations due to muscle wasting. Future directions include comparative studies on quantitative outcomes of delayed versus immediate lymphatic reconstruction and on the incidence of PTL after different flap types.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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