The Application of Posttransfer Free Flap Expansion for Management of Severe Foot Crush Injury with Extensive Soft Tissue Loss: A Case Report

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Summary: Reconstruction of posttraumatic soft tissue defects has been revolutionized after the application of microvascular free flaps. However, standard flaps are limited in size and may not completely cover the defect. Expanding transferred flaps enables advancement, rotation, and tension-free closure of defects. The literature review revealed a higher complication rate in the expansion of free flaps implanted in the extremities. A 7-year-old Palestinian girl presented with right foot crush injury and open multiple metatarsal and tarsal bone fractures with significant soft tissue loss. She underwent free latissimus dorsi flap transfer and overlying skin graft island application followed months later by expander implantation within the flap. This flap was serially expanded once a week for 4 months, until its dimension was declared to be large enough to cover the foot defect. We successfully transferred a free flap to a foot with extensive tissue loss. The overlying skin island contracted and minimized the defect size. The flap was serially expanded until completely covered the defect. No features of vascular compromise or other complications occurred; the flap remained viable with good aesthetic outcome. Posttransfer free flap expansion in lower limb defects can be utilized with meticulous care and follow-up for reconstruction of large defects.

INTRODUCTION
Reconstruction of soft tissue defects was improved after application of microvascular free flap transfer. However, standard flaps are limited in size and cannot cover large defects, causing extensive scarring and contractures, and leading to cosmetic and functional problems. Expanding transferred flaps enables advancement, rotation, and tension-free closure of defects. It was first described by Neumann in 1957 and now widely used in trauma, burns, or giant navi treatment. The merit of tissue expansion is an improved aesthetic outcome by utilizing autogenous tissue of matching color, texture and thickness, and minimal donor site morbidity. Various reports discussed two possible approaches for tissue expansion as an adjunct to free flap transfer, either pretransfer flap expansion which is conventionally performed and widely discussed in the literature or posttransfer expansion when urgent surgical intervention is required. Although fewer reports were published about posttransfer expansion, it is considered safe in selected cases.

Tissue bulking is the main drawback of flap transfer; this necessitates subsequent debulking to match the surrounding structure contour. However, expansion offers flap tissue enlargement and debulking at the same time. Documented histologic changes include thinning of epidermal and dermal layers, thinning and compaction of the expanded muscle.

When compared to the trunk, head and neck, expansions inset in the extremities carry a higher complication rate. Other risk factors include patient’s age, gender, smoking, and serial expansion. Complications include infection, expander exposure, implant deflation, flap necrosis, hematoma, nerve injury, and wound dehiscence.

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Here, we present our experience at the Bethlehem Arab Society for Rehabilitation and Specialized Surgery Hospital with right foot crush injury and extensive soft tissue loss. Posttransfer free flap expansion was performed successfully and tissue defect was completely reconstructed.

CASE REPORT

A 7-year-old Palestinian girl experienced a severe right foot crush injury after a motor vehicle passed over her foot. She had open fractures involving multiple metatarsal and tarsal bones with significant dorsal foot soft tissue and skin loss. Primary closure was impossible, so she underwent transfer of the latissimus dorsi flap and overlying split-thickness skin island application. The donor site was closed with primary closure.

Three months later, a 450 cm³ rectangular tissue expander was inserted. Gradual inflation was initiated after 2 months with 10–15 cc saline once a week for 4 months. The additional gain enabled whole defect coverage and replacement of the scar. Follow-up in the outpatient clinic revealed marked functional improvement with the acceptable aesthetic outcome. (See video [online], which displays our patient walking, with a normal gait and normal movements of her foot.)

DISCUSSION

Latissimus dorsi flap is considered a workhorse for reconstructive surgeons and has been used for soft tissue defect coverage. Tissue expander became a valuable reconstructive tool for maximizing flap dimensions to cover large defects with extensive soft tissue loss or whenever there is a shortage of donor tissue.

We presented a case of devastating foot injury. Initially, the patient underwent latissimus dorsi flap transfer. A skin island was applied over the transferred flap. This formed contractures that pulled the defect edges to each other and decreased the defect size. The expander was then placed beneath the flap skin in a manner allowed distribution of the expansion force to all flap dimensions, which in turn facilitated flap debulking.

Expander implantation time should be performed once wound healing is confirmed to avoid flap vascular compromise. Different lag times between flap transfer and expander implantation were reported in the literature. We followed our patient for 3 months after flap transfer, then we implanted the expander. Two months later, inflation was started and until the end of the serial inflations, no vascular compromise occurred.

The most common and serious complication is infection. However, no complications were seen during the follow-up. To further match the foot dorsum contour, our patient underwent one debulking operation. At her last clinic visit, she is able to walk on her foot, and right foot dorsal surface tissue almost matches in terms of color, texture, and contour.

Fig. 1. Patient’s right foot injury showing large defect with skin and soft tissue loss.

Fig. 2. Latissimus dorsi flap after was transferred to the right foot.

Fig. 3. Right foot with transferred flap at the end of the serial expansion, covering the whole defect.
CONCLUSION

Based on our experience, posttransfer flap expansion can be utilized to reconstruct large lower limb defect in selected patients after meticulous planning and precise surgical intervention.

SUMMARY

Tissue transfer permits covering tissue defects, but in cases with larger defects adjunctive tissue expansion of a transplanted flap will be necessary. Here, we presented a case with successful posttransfer free flap expansion in the right foot that generated tissue similar in color and texture to native surrounding tissues and assisted flap debulking without evidence of complications. This indicates that with careful preparation, treatment, and strict follow-up, such operations can be performed to lower limb injury successfully.

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