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Original Article

Microsurgical free muscle flaps for reconstruction of post-traumatic complex tissue defects of foot

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ABSTRACT

Background: Crush injuries of the foot often result in complex tissue loss with exposed bones and tendons. These three-dimensional defects ideally require flexible well-perfused flaps to fill the space, afford resistance to infections, and to provide supple, durable weight- and pressure-bearing surfaces. Free muscle flaps with split thickness skin graft cover have been found to have several advantages in covering three-dimensional defects with exposed tendons and bones.

Methods: All patients with post-traumatic composite tissue defects of the foot exposing bones and tendons, who presented to a tertiary care center during a 40-month period, were reconstructed with free muscle flaps as the first option. Gracilis muscle flap was used for eight patients and latissimus dorsi muscle for two patients. Decision regarding the choice of muscle was based on the size of the defect. The patients were followed up for 1 year and observed for return to activity, ability to wear footwear, requirement of secondary procedures, and any other complications.

Results: Ten patients presented with composite post-traumatic tissue defects in the foot. All were male, with age ranging from 25 to 76 years. The defects ranged from 25 cm^2 to 225 cm^2. Free muscle transfer was successful in nine patients. Even though four required secondary flap contouring, all patients had normal weight-bearing ambulation and returned to their normal activities at 1-year follow-up.

Conclusion: Free muscle flaps merit consideration as primary reconstructive option for post-traumatic composite tissue defects of foot.

Introduction

Foot injuries are common. The usual modes of injury are road traffic accidents, fall of heavy objects, crushing between moving objects, and combat-related injuries like mine blasts. They often result in complex tissue loss requiring reconstruction aimed at restoring form and function. The stress and strain of weight bearing, ambulation, activities of daily living, and occupation have to be considered while planning

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reconstructive options for the foot. Adequate bulk, flexibility, and resilience for weight bearing are mandatory for tissues used for reconstruction of these defects. Three-dimensional defects in the foot resulting from composite tissue loss ideally require flexible well-perfused flaps, which fill the defect, afford resistance to infections, provide a smooth gliding surface to tendons, and afford supple, durable weight- and pressure-bearing surfaces. Microsurgical free muscle flaps with split thickness skin graft cover have been found to have several advantages in covering such defects.[1]

Decision-making regarding the type of flap to be used is often influenced by institutional practices, facilities, and expertise. Microsurgical free muscle transfer requires higher levels of skills and facilities, and intensive monitoring compared to fasciocutaneous flaps. However, with more surgeons practicing reconstructive microsurgery, the application of this technique is becoming more popular. Skin-grafted muscle flaps are the first choice for post-traumatic defects of the foot and leg at many centers.[2] Modern protocols for limb salvage surgery in combat injuries have included early flap covers to limit the number and extent of amputations.[3,4]

We report our experience of using free muscle flaps as the primary option in post-traumatic defects of the foot at a tertiary care center during a 40-month period.

Materials and methods

The study design was prospective interventional (case series). All patients who presented to a tertiary care center during a period of 40 months with post-traumatic complex tissue defects of foot were managed with microsurgical free muscle flaps as the primary option. Complex tissue defects were defined as those found to have loss of skin and subcutaneous tissues along with deeper structures, which resulted in three-dimensional tissue loss exposing tendons or bones.

Wounds were debrided primarily under tourniquet control and loupe magnification to ensure removal of all contamination and devitalized tissue with minimal blood loss. Reconstruction was done in the same sitting in four cases and after 48–72 h in six cases. Decision regarding immediate reconstruction vs deferred coverage was based on the initial contamination, assessed clinically. Deferred cases were managed with antibiotics and gauze dressings and parenteral antibiotics for 2–3 days prior to being taken up for cover, to control the infective load.

The gracilis muscle was used for defects less than 100 cm^2 and the latissimus dorsi was chosen for defects larger than 100 cm^2. All cases were operated under epidural analgesia, with the addition of general anesthesia during flap harvest for the two cases managed with latissimus dorsi.

Harvest of gracilis muscle was done through a medial longitudinal thigh incision along a line 5 cm posterior and parallel to the line joining adductor longus tendon and the midpoint of the medial joint line of knee. The muscle was isolated on the major pedicle, which was dissected between the adductor longus and magnus, up to its origin from the descending branch of the medial circumflex femoral vessels. Branches to the adductor magnus were identified and divided to facilitate this. The donor site was closed primarily in two layers over suction drain.

Harvest of the latissimus dorsi was done under general anesthesia, with the patient turned to lateral decubitus. Incision was just posterior and parallel to the anterior border of the latissimus dorsi. The thoracodorsal vessels were identified in the axilla and muscle harvest completed by dividing the vessels close to its origin from axillary vessels. Donor site was closed primarily with suction drains. Small tube drains were used under the muscle flaps at the recipient site.

Microanastomosis of the flap vessels to recipient vessels was done under 3.2× loupe magnification using interrupted sutures of 8–0 polypropylene. Anterior or posterior tibial vessels were used as recipient vessels depending on the proximity and the lie of the defect. Topical 1% lignocaine soaks were used routinely at the anastomotic site to prevent vasospasm and 3% papaverine was sprayed when spasm persisted.

All cases received 2500 IU of unfractionated heparin intravenously at clamp release. Lignocaine and papaverine were used as local agents at the anastomotic site to augment the flow as required. Split skin grafting of the flap was done at the same sitting for gracilis flap and after 48 h for latissimus dorsi flaps.

Skin grafting of LD flaps was delayed to avoid the risk of graft loss due to ooze from the relatively larger surface area. Delayed grafting was done using freshly taken graft after 48 h. All patients were started on low-dose heparin infusion at 5000 IU over 24 h for 5 days postoperatively. The patients were confined to bed during this period. Monitoring of the flap was done by direct visual observation through a small window in the dressings. First change of dressings was done at 48 h or according to the soakage.

Patients were mobilized out of the bed on a wheelchair on the sixth day, after discontinuation of heparin and removal of epidural catheter. Dressings were discontinued on 15th day and partial weight-bearing ambulation started with a light compression stocking applied to prevent flap edema. All patients were able to wear commercially available soft sandals with loose straps during the initial period of ambulation. The elderly patient who underwent complete "wrap" of the foot with LD flap was prescribed diabetic footwear for comfort and prevention of further graft loss. Patients used walkers and elbow crutches during the initial 2 weeks of ambulation. Gradually, increasing weight bearing was allowed and full weight bearing started at 6 weeks.

Follow-up was done at 3 months, 6 months, and 1 year from surgery. Requirement of secondary procedures was assessed and necessary surgery done between 6 months and 1 year. Final outcome was assessed at 1 year from surgery. The following were considered at outcome analysis: (a) gait, (b) ability to perform activities of daily living, (c) ability to wear footwear comfortably, and (d) performance of occupational tasks.

Results

Ten patients presented with post-traumatic complex tissue defects of the foot. All were male, with age range of 25–76 years. All were crush injuries resulting from road traffic