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Case Presentation
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Reverse Osteomyocutaneous Medial Tibia Flap for Complex Midfoot Reconstruction: Case Report

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Abstract

Introduction: Defects originated from oncologic bone resections can compromise function, especially in weight bearing areas such as the foot, ultimately impairing gait and movement. Reconstruction of a metatarsal bone resection can be performed with bone grafts or flaps, either pedicled or free vascularized. We present a salvage reconstruction with an original reverse osteomyocutaneous medial tibia flap (ROMT), after a failed fibula graft for a first metatarsal chondrosarcoma resection. This is the first report of the use of this flap.

Case Report: Thirty-five year old male patient, who underwent reconstruction with an ipsilateral fibula bone graft, after tumor resection of the first right metatarsal bone by the oncology orthopedics team. On follow up, he presented bone graft necrosis, infection and wound dehiscence. Debridement of the graft and wound bed left a complex defect comprising bone and soft tissue on the medial aspect of the foot. We designed the ROMT based on the posterior tibial vessels and safenous vein for the reconstruction. The safenous vein was included to improve venous drainage of the reverse flap. The flap included a 15 cm × 4 cm wedge of cortical and cancellous bone from the proximal medial aspect of the tibia, and the overlying muscle, subcutaneous and skin. Donor site was primarily closed. The patient walked in partial weight bearing with crutches for 2 months. On follow up 10 months the patient presents normal gait, with complete reossification of the donor site.

Conclusion: In the case presented, the ROMT was a safe alternative for complex reconstruction of the foot and presented low donor site morbidity with satisfactory functional recovery. This original flap may be an option for pedicled reconstructions of the foot and distal part of the lower extremity, or even as a free flap for complex reconstructions in other segments of the body.

Keywords: Chondrosarcoma; Reverse osteomyocutaneous medial tibia flap; Vascularized tibia flap; Foot reconstruction; Pedicled flap; Reverse pedicled flap

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Introduction

Malignant neoplasms of the foot are rare and, among the sarcomas, less than 3% are in this region. Chondrosarcoma is one of the major types of bone sarcoma, together with osteosarcoma and Ewing's sarcoma, and requires surgical treatment with wide excision, resulting in complex defects that can compromise function, mobility and quality of life [1,2].

Reconstruction of a first metatarsal bone defect is most commonly performed with the use of the fibula, either as a graft or as a vascularized pedicled flap. Other alternatives include the iliac crest, radius, rib and scapula [1,3].

We designed an original reverse osteomyocutaneous medial tibia flap (ROMT) for a case of a failed fibula graft after a first metatarsal chondrosarcoma resection. It is a composite reverse pedicled flap based on the posterior tibial vessels and safenous vein. This is the first report of the use of this flap.

Case Presentation

Thirty-five-year old male patient had the diagnosis of first right metatarsal osteochondroma, through biopsy, after an occasional radiograph from foot trauma at the age of 23. The patient initially opted for no treatment.

After 12 years, he was referred to the oncology orthopedic team due to volume increase and

Figure 1: Radiographic images of the foot. A: Chondrosarcoma of the first metatarsal bone. B: After fibular bone graft reconstruction. C: After ROMT reconstruction.

Figure 2: Composite right foot defect. A: Necrotic fibula graft with wound dehiscence and skin necrosis. B: Wound bed after removal of the dead bone graft and debridement.

recurrent pain episodes. A new biopsy showed degeneration to chondrosarcoma and surgical resection was planned. The orthopedic team used a free fibula bone graft to reconstruct the bony defect, which was covered by the thin soft tissue from the midfoot. In this procedure, the first metatarsal and proximal portion of the proximal phalanx of the hallux were removed in a single block, and a non-vascularized 15 cm bone graft of the ipsilateral fibula was used for reconstruction, which was fixed with plates and screws (Figure 1).

On follow up, the fibula bone graft got necrosed and infected, with wound dehiscence, skin necrosis, and exposure of the bone graft and plates (Figure 2A).

Plastic surgery was asked for evaluation and we decided for complete removal of the dead bone graft and debridement of the wound bed, resulting in a complex defect in the medial aspect of the midfoot (Figure 2B). The defect comprised the first right metatarsal bone, soft tissue, skin and a flailing hallux, with functional impairment and gait compromise. We sought for a new osteomyocutaneous flap for bony and soft tissue reconstruction of the midfoot that would stabilize the hallux, cover the defect, and allow gait rehabilitation. We then designed the ROMT based on the posterior tibial vessels and the saphenous vein. A 15 cm × 5 cm skin island was designed in the proximal antero-medial aspect of the leg. The flap also included a 15 cm × 4 cm wedge of cortical and cancellous bone from the proximal medial aspect of the tibia, and the overlying soleus muscle, subcutaneous and skin. The skin island was designed based on the pinch test and the donor site was primarily closed. The proximal end

Video 1:

Figure 3: Intraoperative view. A: design of the 15 cm × 5 cm skin island flap with the posterior tibial pedicle and saphenous vein. B: Elevation of the ROMT flap with the bone and soft tissue components. C: Inset of the flap in the foot.

of the tibia bone harvested started 6 cm from the knee joint edge, and extended 15 cm down the diaphysis. The width was 4 cm and the bone flap was raised with the use of a reciprocating electric saw. A portion of the soleus muscle was included as a bridge between the bone and the vascular pedicle.

The posterior tibial vessels were dissected distally until rotation of the flap was safe and the pedicle could be loosely positioned in the subcutaneous of the leg.

The ROMT was then rotated to the recipient site in the medial midfoot (Video 1).

The bone component was trimmed to fit the defect and anchored with nylon sutures to the fibrotic surrounding tissue. The soft tissue and skin were closed with separate nylon sutures. An exposed subcutaneous distal part of the flap was skin grafted (Figure 3).

The flap survived entirely and there were no complications. The patient was prescribed to walk in partial weight bearing with crutches for 2 months.

On follow up 10 months, the patient presents normal gait and

Video 2:

Figure 4: Close view of the flap in the foot at post op 10 months.

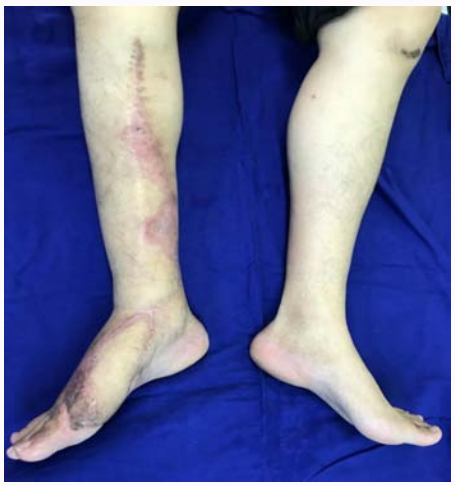

Figure 5: Frontal view of both legs and feet, showing the donor site and ROMT flap in the medial portion of the right foot at post op 10 months.

wears usual footwear. He denies discomfort or pain, but presents a still present discrete walking difficulty that is being improved with physical therapy (Video 2). The wound shows acceptable aesthetic outcome (Figures 4 and 5). Radiographic images show the pre and post op status of the leg and foot, with integration of the bone component of the flap and complete reossification of the donor site (Figures 1 and 6).

Discussion

Chondrosarcoma is a malignant neoplasm where the majority of the neoplastic tissue is composed of well differentiated cartilage.

Figure 6: Radiographic images of the right leg. A: After removal of the fibular graft. B: Immediate post op after ROMT reconstruction. C: Complete reossification of the donor site on post of 10 months.

It may be primary or secondary to a previous bone injury. It predominantly affects adult males, usually after the third decade of life. The most common site of involvement is the pelvis, femur and proximal humerus, being rarely described in the foot [2,4].

Clinical presentation is insidious and the initial presentation usually is a palpable mass or deformity in addition to local pain [2,4]. Some patients may present with pathological fractures due to minimal trauma [4].

The treatment of chondrosarcoma is wide surgical margin resection, leading to large and complex defects, involving bones and soft tissue, which can be a challenge for the reconstructive surgeon, especially when it affects the foot. As in this case, the first metatarsus plays an important structure in sustaining body weight in the orthostatic position and while walking [1,3].

Initially, non-vascularized bone grafts were used, but survival and integration of the bone graft depends on the size of the graft and the recipient soft tissue conditions. Grafts larger than 4 cm usually present little integration rates [1]. In this case report, a 15 cm fibula bone graft was used, with consequent bone necrosis, skin infection and wound dehiscence.

The introduction of vascularized bone grafts offered more reliable reconstructive options. Since the first description by Taylor et al. in 1975, vascularized bone graft of the fibula has become the standard method for the reconstruction of large bone defects after trauma or tumor resection [1,3]. Yoshimura et al. described the osteomyocutaneous fibula flap for simultaneous reconstruction of bone and soft tissue, which is currently widely used for mandible and long bone composite defects, and is also used for complex foot reconstructions [1].

Other than the fibula, the iliac crest, rib, scapula and radius have been used for metatarsal reconstruction. The fibula has advantages in metatarsal reconstruction due to their similar shape and diameter, easy access and low donor site morbidity [1,3,5,6]. The main disadvantage reported in literature for the reverse pedicled fibular flap is venous congestion. To diminish this complication, it is recommended a tension-free flap inset and prevention of torsion or compression of the pedicle [5].

In this of the fibula, we developed a reverse osteomyocutaneous medial tibia flap for the composite reconstruction of the first metatarsus and medial foot soft tissue defect. We chose to raise the flap in the same limb because the patient already could not walk from the foot defect on that side, and could use the time for rehabilitation. The skin island was planned based on the pinch test for primary closure of the donor site, and was vascularized by perforators arising from the posterior tibial vessels. The bone component represented 25% of the circumference of the tibia, without compromise of the structure and strength of the remaining tibia.

The saphenous vein was included as a secondary venous pedicle, along with the posterior tibial vessels, to improve venous drainage for the reverse flow flap. The flap didn't show any congestion in the post-operative period. The medial tibia bone component was sutured to the fibrotic tissue of the recipient site. We opted for no rigid plate fixation to the bone to develop a proximal and distal pseudoarthrosis that would function as neo joints, and allow better movement of the foot for an improved gait pattern.

We report the advantages of this new flap as the use of the same limb for donor site, which is already recovering from the initial surgery. The use of a portion of vascularized cortical and cancellous tibial bone, which is resistant to the straining forces of weigh bearing and ambulation. Inclusion of an extra drainage system through the saphenous vein. Reduction of surgical time and complexity through a pedicled reconstruction avoiding the need for microsurgical anastomosis in a possible unfavorable recipient setting. Complete reossification of the donor tibia, with minimal compromise of the tibia bone strength over time.

The disadvantages were discrete residual edema of the foot and donor leg that completely resolved in 2 months; in addition to the extra volume of the soft tissue, that will require secondary thinning later. To harvest the ROMT, the posterior tibial vascular pedicle is ligated, and vascularization of the leg and foot needs to be guaranteed by the other lower extremity vessels, which limits its use in poorly vascularized limbs.

We are now analyzing the possibility of expanding the use of the ROMT for lower third of the leg reconstructions and as a free flap.

Conclusion

The newly described ROMT is a reliable flap that has a reproducible harvesting technique. The inclusion of the saphenous vein improves venous drainage to prevent congestion. The composite tissues make it suitable for complex reconstruction of bone and soft tissue. It presents low donor site morbidity with primary closure of the skin defect and complete reossification of the tibia. In this case report, it was a good option for midfoot complex reconstruction, with adequate functional and aesthetic outcome.

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