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Vascularized medial femoral condyle bone graft for the management of an acute talar neck fracture: A case report

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Abstract:

Background

Management of talar neck fractures can be challenging due to the high rate of non- or malunion, avascular necrosis and post-traumatic arthritis, which has been attributed to the disruption of the bone's tenuous blood supply during fracture displacement. Osseous medial femoral condyle (MFC) flaps are increasingly being used in the reconstruction of small bony defects due to recalcitrant non-union and avascular necrosis in the upper and lower limbs. We report a rare case of an MFC flap used in the reconstruction of an acute talar neck fracture.

Case Presentation

A 38-year-old male presented with multiple injuries following a motor vehicle accident, including an open comminuted talar neck and lateral process fracture, with dislocation of the subtalar and talocrural joints (Hawkins III). Initial exploration and debridement demonstrated a significant defect in the dorsal portion of the talar neck. Temporary stabilisation was achieved with Kirschner wires and the defect was packed with bone cement. Two weeks later, a MFC flap was harvested from the ipsilateral knee and tailored to fit the talar defect. Fixation was achieved with cannulated compression screws. At six weeks post-operative, all wounds had healed, a radiograph demonstrated a positive Hawkins sign and computed tomography showed incorporation of the flap. The patient had no donor site morbidity, and commenced weight bearing at 3 months postoperatively.

Conclusion

This is the first report demonstrating the viability of MFC flap reconstruction for the management of bony defects in acute talar neck fractures.

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Vascularized medial femoral condyle bone graft for the management of an acute talar neck fracture: A case report

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Declarations of interest: None

Abstract

Background

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This is the first report demonstrating the viability of MFC flap reconstruction for the management of bony defects in acute talar neck fractures.

Introduction

The acute surgical management of talar neck fractures can be challenging for the treating orthopaedic surgeon. The talus plays a central role in force transmission from the tibia to foot, and accurate and timely restoration is required to maintain function. Talar neck fractures often result from high-energy trauma and are associated with significant morbidity[1]. Additionally, various anatomical factors predispose the talus to sequelae following neck fractures – it receives a tenuous retrograde blood supply, which is often disrupted due to fracture or displacement, and is largely covered by cartilage, which precludes the formation of a stable collar of callus to encourage union[2,3]. Common complications following talar neck fractures include post-traumatic arthritis (68%), avascular necrosis (33%) and mal- or non-union (22%), with one in five patients requiring secondary salvage surgery (such as hindfoot arthrodesis), irrespective of the timing of fixation and achievement of reduction[4,5].

Osseous free flaps have been increasingly utilized by reconstructive surgeons in the management of upper and lower limb defects, as well as in the head and neck[6]. Osseous flaps are indicated for the reconstruction of defects larger than 4 cm in length, sites with poor local vasculature, or in the setting of recalcitrant non-union[7]. Due to the robust and immediate blood supply, these flaps are thought to be associated with lower infection risks and improved rates of union[8]. Common donor sites include the fibula, medial femoral condyle (MFC), radius and iliac crest – each confers particular advantages for defects of varying size[7, 9]. Flaps from the medial femoral condylar region are popular in the reconstruction of small defects, as they provides a reliably long vascular pedicle; can be raised to contain cortical, cancellous, chondral or fascio-cutaneous components; and may be fashioned in a chimeric fashion as required[6].

This report details the novel use of the MFC flap in the management of an acute talar neck fracture.

Case report

A 38-year-old-male presented to the emergency department of a quaternary level hospital in Sydney, Australia, following a motor vehicle accident with multiple injuries, including an open ankle fracture-dislocation. There was a 5 cm laceration over the posterior heel probing to bone, without gross contamination. Imaging of the ankle confirmed a comminuted talar neck and lateral process fracture, with dislocation of subtalar and talocrural joints and medial extrusion (Figures 1 & 2).

Surgical technique

The patient was initially taken to theatre for debridement, reduction and temporary fixation, and primary closure. Intraoperatively, minimal contamination was found in the large curvilinear posterior heel wound, which communicated with a comminuted medial malleolar fracture with periosteal stripping. After irrigation and primary closure of this wound, a separate anteromedial incision was performed. The tibialis posterior tendon was tented, but not incarcerated on the extruded talar body, and a significant defect in the dorsal portion of the talar neck was noted. Following derotation and reduction of the talus using tibial and calcaneal pins, stabilisation was achieved using three 2.0-mm Kirschner wires (refer figure 3). The talar neck defect was packed with bone cement, and the ankle temporarily immobilized in a backslab whilst awaiting definitive fixation (Figure 3).

The definitive reconstruction and fixation was performed 14 days later, which allowed for reduction in swelling, a period of antibiotics and management of comorbid injuries [including

a left temporal lobe contusion and burst fractures of the lumbar spine requiring decompression and fusion].

An ipsilateral medial femoral condyle osseous flap was utilised to reconstitute the talar neck defect. A 3 cm by 2 cm osseous flap was carefully raised on a pedicle from the descending genicular artery (Figure 4). The talus was approached through the previous anteromedial incision and the flap was shaped to the talar neck defect (Figure 5). Fixation of the talus was performed in a sequential manner, with initial stabilization of the lateral talar column followed by the medial column. Fixation was achieved using 3.0 mm and 5.0 mm fully threaded cannulated compression screws, and the medial malleolus was fixed with 3.5 mm cortical screws (Figure 6). Microvascular anastomoses was performed from the descending geniculate pedicle to the anterior tibial artery and vein. Due to the significant soft tissue stripping around the talus and the requirement for stability so as to not compromise the flap, the talocrural Kirshner wires were maintained until 6 weeks post operatively and removed at this juncture without incident.

Six weeks following definitive fixation, all wounds from both donor and recipient sites had healed without any overlying skin compromise or signs of infection. Plain radiographs demonstrated a positive Hawkins sign and computed tomography showed incorporation of the flap into the fracture defect (Figure 7). The patient had no donor site pain and commenced weight bearing at 3 months postoperative.

Discussion

Management of talar neck fracture-dislocations remain challenging due to the complexity of the injuries and significant risk of post-traumatic complications. Those with a fracture void present a unique conundrum. Mcmurtie et al. reported an excellent union rate using non-vascularized tibial autografts to fill talar neck defects – however, 92% of this cohort subsequently revealed avascular necrosis, with 83% developing ankle and subtalar post-traumatic arthritis and the majority of patients reporting unfavourable outcome measures[10]. The high risk of avascular necrosis must be anticipated during operative planning, with particular consideration given to the peculiar blood supply of the talus and limited surface area for perforating vessels[11]. The talus receives its main blood supply via an anastamotic ring, with the body primarily receiving its blood supply from the posterior tibial artery through a branch to the tarsal canal. The neck and head receive anastomotic contributions in the subtalar joint from the perforating peroneal artery, as well as the anterior tibial artery[12-13]. For this reason, disruption of this tenuous network of vessels via fracture-dislocations of the talar neck, or fractures with a significant bone defect have high rates of non-union and osteonecrosis.

Osseous flaps are increasingly being used for the management of recalcitrant non-union in long bones of the upper limb[14] where non-vascularized bone grafting may not be as effective. Their use is advantageous in cases where bone healing may be compromised by chronic infection, malignancy or radiotherapy[15]. The ability to biologically accelerate bone healing by introducing osteocytes, osteoblasts and osteoinductive growth factors (TGF-B, BMP, PDGF)[16] into hostile wound beds make osseous flaps an appealing option for the reconstruction of talar neck fractures with significant defects.

The MFC offers a reliable yet flexible flap for the reconstruction of small defects, making it popular in the management of non-union and avascular necrosis[17]. Its robust vascular pedicle is

formed by the descending or superomedial geniculate arteries, and it can be raised with the cortex intact so to preserve the osteogenic activity below the periosteum[14]. Favourable outcomes have been noted in all studies assessing the use of MFC flaps for talar reconstruction, either for avascular necrosis[18,19] or talar neck fracture non-union following failed open reduction[19, 20].

Clinical and radiological evidence of donor site morbidity for bone and soft tissue flaps from the MFC region is minimal. Several studies have reported preserved knee stability, normal gait and unimpaired range of motion[21, 22]. The most common complications include self-limiting pain, paraesthesia or hypoaesthesia related to the saphenous nerve[6]. Donor site haematomas or seromas requiring drainage [22,23] have also been reported. Rarely, iatrogenic femoral shaft fractures can occur as a result of MFC harvest, with a biomechanical study demonstrating flap harvest of greater than 7 cm in length confers a higher risk of fracture[23]. There have only been four published cases of these fractures, all of which have required surgical fixation of the femur [25-28]. Hamada et al. suggest that MFC harvests should be below 3 cm by 3 cm to minimize the risk of iatrogenic fracture[25]. There was only one reported case of femoral osteonecrosis, which was in an at-risk patient with osteoporosis and a high BMI, and the authors were unable to determine whether this was secondary to vascular insufficiency or subchondral fracture[29].

To our knowledge, this is the first report on the use of MFC flaps in acute talar neck fracture. It highlights the potential for expanding indications for the MFC flap into the reconstruction of defects in acute talar neck fractures, with the aim of minimizing the risk of avascular necrosis.

Figures:

Figure 1 Preoperative X-ray demonstrating fracture dislocation with talar extrusion

Figure 2 Preoperative CT scan showing dislocation of the talocrural joint, a comminuted talar neck and lateral process fracture, and extrusion

Figure 3 Temporary fixation with Kirschner wires and filling of talar neck defect with palacos cement

Figure 4 Excision of the medial femoral condyle flap in a 3 x 2 cm bone block, with dissection of the descending geniculate artery

Figure 5 Talar neck defect into which the bone block was inserted

Figure 6 Post-operative imaging following definitive fixation with MFC flap to the talus with 3.0 mm and 5.0 mm cannulated compression screws and medial malleolar fixation with 3.5 mm screws

Figure 7 CT at 8 weeks showing incorporation of the MFC flap into the talar neck defect

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