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Case Report

# Successful reconstruction of a post-traumatic defect of 16 cm of the distal femur by modified Capanna's technique (vascularised free fibula combined with allograft) – A case report and technical note

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ABSTRACT

Reconstruction of large defects following trauma in the distal femur are a surgical challenge. These cases usually require multiple procedures and are associated with poor functional outcomes. We managed a post-traumatic distal femur defect of 16 cm using the modified Capanna's technique – combination of a vascularised free fibula and an allograft – and achieved a successful union at 6 months and also a good functional outcome with knee flexion of 100°. The patient received a vascularised free fibula which was pegged into an allograft which was sculptured to bridge the defect. The construct was fixed with a locking compression plate on the lateral side. With the allograft providing structural stability and the vascularised free fibula enhancing biology, our technique which involves the expertise of an orthopaedic surgeon and a plastic surgeon is a useful single stage procedure to manage large post-traumatic bone defects.

## Introduction

Reconstruction of large post-traumatic bone defects of the distal femur are a major challenge as they are associated with increased chances of poorer outcomes. Procedures like distraction osteogenesis, Masquelet's induced membrane technique, only allografts and vascularised fibula have been described but each have their own share of complications and are not universally acceptable [1–3]. Innovating on the Capanna's technique [4], we used a vascularised fibula pegged into an allograft [Fig. 1] to reconstruct a 16 cm defect in a 23 year old male following trauma. Bony union was achieved at 6 months and in this case report we describe our surgical technique and we feel it would guide surgeons who encounter such cases to consider the modified Capanna's technique to address large bone defects of the distal femur following trauma.

## Case report and technical note

A 23 year old male presented with an open type IIIB distal femur fracture with bone loss in the distal femur following a high velocity road traffic accident. He was hypotensive on arrival with a blood pressure of 90/60 mm Hg. After fluid resuscitation, he was taken up for damage control surgery. Thorough debridement of the wound and articular reconstruction of the joint was done which

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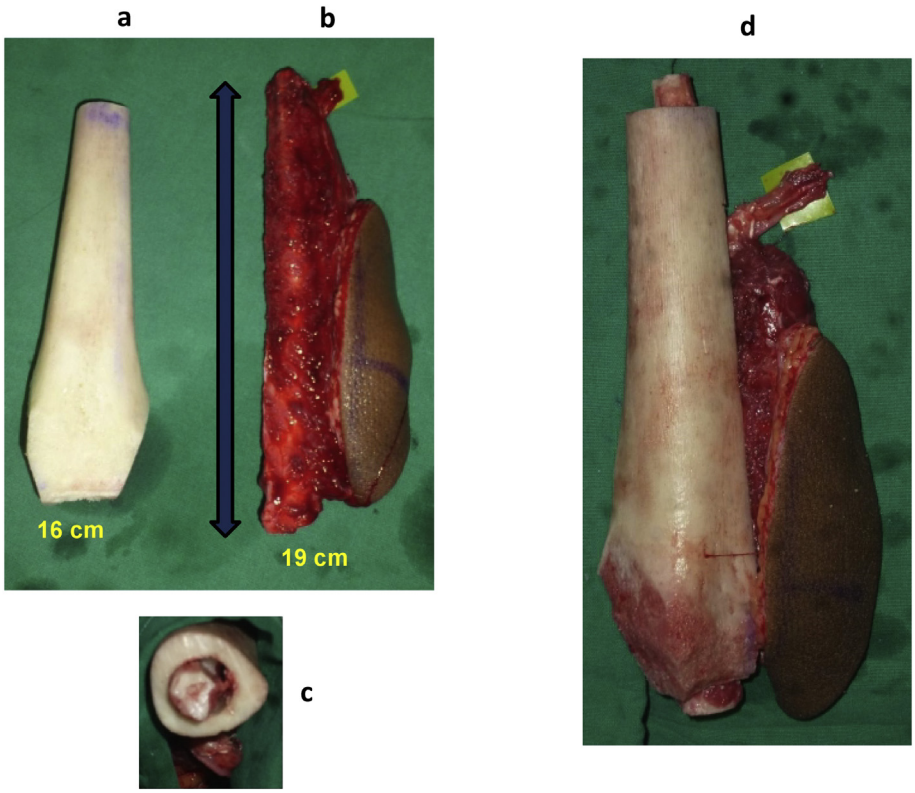


**Fig. 1.** Preparation of the construct. The sculptured allograft construct (a) and the harvested vascularised fibula with the skin pedicle (b). The fibula harvested is slightly longer than the allograft as it would help in pegging of the construct into the parent bone. The fibula is inserted into the trough and the construct is made (c, d).

was followed by a joint spanning external fixator application. Primary closure of the wound was possible without tension. The gap in the femur measured 16 cm and it was maintained with the external fixator [Fig. 2a]. Infection was ruled out by clinical examination and blood investigations. We planned for a definitive single stage reconstruction after 14 days. We planned to augment a vascularised free fibula into an allograft to bridge the defect. We modified the Capanna technique described to manage large defects of the femur following tumour resection. Our modification included a trough in the allograft to aid in pegging the pedicle [Fig. 1a, b and c] and also a skin island with the vascularised fibula which helped us to monitor flap viability [Fig. 1d].

*Technical note*

Through a longitudinal incision on the medial side of the thigh, dissection was carried out between the vastus medialis and the sartorius to isolate the femoral artery as it entered the adductor canal. The proximal and distal ends of the femur were debrided to good bleeding edges. A tibial allograft of 19 cm from the bone bank was taken and sculptured according to the size needed to augment the defect. A trough was created in the allograft as it would help in bringing the pedicle through it. The free vascularised fibula with a skin island was then harvested in the contralateral leg with the length being 3 cm more than the allograft. The construct was created by carefully pegging the vascularised fibula into the tibial allograft without damaging the pedicle in such a way that there was about 1 cm of bone seen on either side which would help in pegging the fibula into the parent bone. A lateral locking compression plate fixation with adequate screws was then done [Fig. 2c]. The fibula was then revascularised and we used the muscular branch to vastus medialis for arterial anastomosis as the pedicle was lower. Veins were anastomosed to the corresponding venae comitantes. The skin island was incorporated along the suture line and the closure was completed. We used the skin island to monitor flap viability.

Post-operative period was uneventful. Above knee slab was given for 2 weeks following which non-weight bearing walking was initiated. Knee bending was started with CPM (Continuous passive motion) assistance after 1 month from surgery. Progressive weight bearing was initiated from 6 weeks following surgery and full weight bearing was done at 3 months. Complete bony union was seen at 6 months follow up [Fig. 2d] and the patient had a knee flexion of 100° [Fig. 2e] with a LEFS (Lower extremity functional score) of 68.

## Discussion

Salvage of complex lower injuries with large bone loss is a major surgical challenge. Such injuries involving the distal femur are

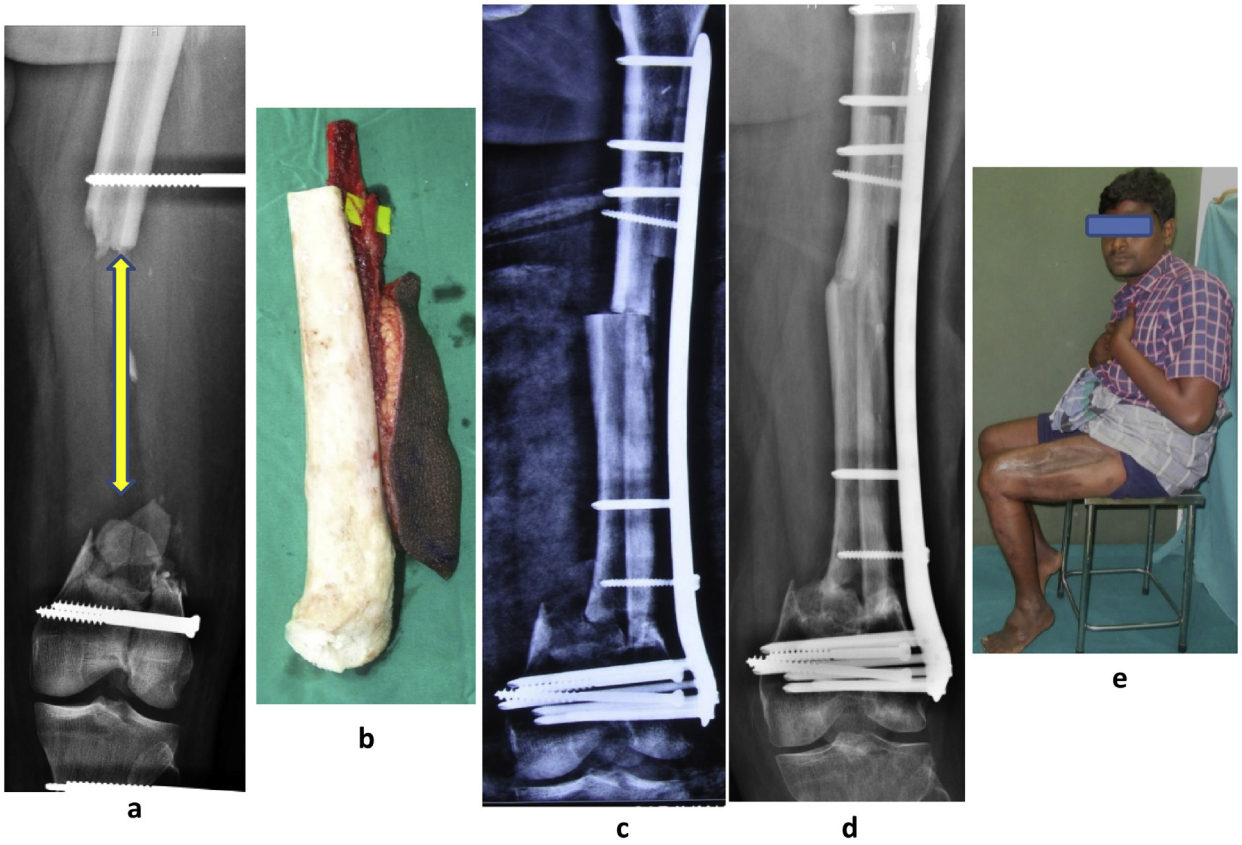


**Fig. 2.** Patient with 16 cm post traumatic bone loss in the distal femur (a). Prepared construct of the vascularised fibula pegged into the allograft strut (b). Radiograph following fixation (c). Radiograph showing complete union at 6 months (d) and clinical picture of patient with knee flexion of 100° (e).

often associated with poor outcomes, decreased knee movement and usually require multiple procedures [1,4–6]. A single stage procedure with a good functional outcome always has higher patient acceptability [6].

Various options used to reconstruct such defects include distraction osteogenesis, masquelet technique, only vascularised bone grafts and only allografts [6–8]. Distraction osteogenesis is frequently associated with complications like mal-alignment, pin tract infections and malunion and the treatment duration can be very long as a long defect needs to be bridged. Moreover, in such defects near the articular joint, the knee joint also has to be spanned which leads to higher chances of knee stiffness [1]. Masquelet technique has shown good results while managing defects of the tibia but there have been no reports in the management of distal femoral defects especially of this size [2]. Using only vascularised fibula in the distal femur would result in decreased mechanical stability due to the mismatch between the slender donor bone and the distal femur leading to increased chances of fracture [3]. Only allograft supplementation in such large defects has shown to be associated with many complications like infection and failure to incorporate. Comparing with all these options, modified Capanna's technique overcomes most of the complications by providing structural stability in the form of the allograft and the vascularised fibula enhancing biology. The most significant advantage is it being a single stage procedure and having a short time to union compared to the time taken by most techniques to achieve union in such large bone defects.

We recommend the inlay technique – placing the fibula into the medullary cavity of the allograft - while preparing the construct, as studies have shown it to provide better vascularisation and better incorporation of the allograft. The modification of using a skin island to monitor flap viability is routinely followed in most flap surgeries in our unit, as any discolouration in the flap would prompt the surgeon to have a relook at the anastomosis and the blood supply to the flap [Fig. 1d].

Our technique is a combined approach involving an orthopaedic surgeon who helped in the sculpturing of the allograft and in fixation of the construct and a plastic surgeon who helped in harvesting the fibula and performing the anastomosis. This technique requires a lot of experience, pre-operative planning and also availability of allografts of sufficient size. Our institution being a Level 1 trauma centre with a bone bank facility helped us procure gamma irradiated grafts harvested from complex lower limbs limb injuries which were amputated. Early mobilization from 1 month helped us achieve a flexion of 100° which would have been a challenge with other techniques.

## Conclusion

Our case report shows that modified Capanna's technique is a useful single stage procedure to reconstruct and achieve good functional outcomes in large post-traumatic distal femur bone defects. In the absence of infection and if expertise and allografts are available, this could be the treatment of choice in managing such complex injuries.

## Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

## Level of evidence

Level IV – Case report

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