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Fibular epiphyseal transfer: the peroneal vessels revisited

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Section: General reconstruction

Introduction

We report the case of a seven-year-old boy with a Ewing's sarcoma of the humerus diaphysis extending into the epiphysis proximally. He underwent chemotherapy followed by 12 cm resection of the proximal humerus with preservation of rotator cuff. Reconstruction was performed using a 15 cm vascularized fibula epiphyseal transfer. This was raised using a postero-lateral approach based on the peroneal artery and its venae commitans. The common peroneal nerve was protected proximally and all motor branches were preserved. The pedicle length was 7cm. When isolated on the peroneal artery, bleeding was seen at the level of the epiphysis and periosteum of the fibula head **(Figure 1)**.

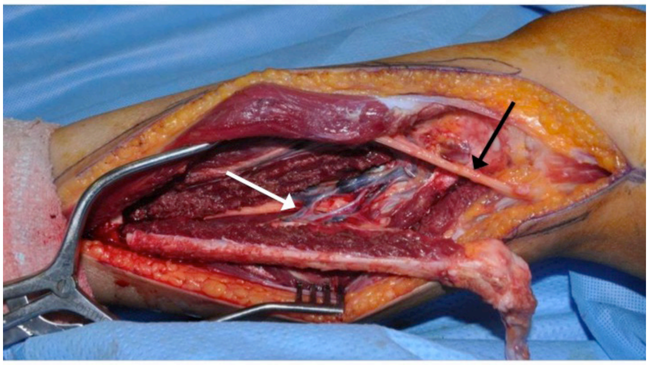


Figure 1: Intraoperative dissection showing the fibula, including epiphysis, on the peroneal pedicle (white arrow) and the common peroneal nerve unaffected by the dissection (black arrow)

Donor vessels were the profunda brachi artery and a single vena commitans. Ischemia time was 50 minutes. The distal end of the fibular flap was step-cut into the medullary cavity of the humerus and the osteosynthesis fixed with a locking plate. Proximally the epiphysis of the fibula was placed in the glenoid fossa and the shoulder capsule and rotator cuff repaired. The fibular head subsequently dislocated from the glenoid fossa, and the rotator cuff will be reconstructed at a later date.

At day five post-operation, x-rays and a bone scan were performed. The bone scan showed perfusion of the flap with increased activity at the growth plate compared to the metaphysis (**Figure 2**). A CT scan performed at 18 months postoperation (for oncological surveillance) showed the proximal fibular epiphysis had remained open, also demonstrated on plain film x-ray (**figures 3a** and **3b**).

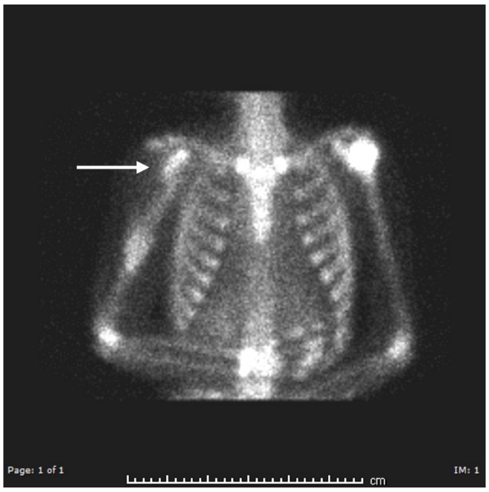
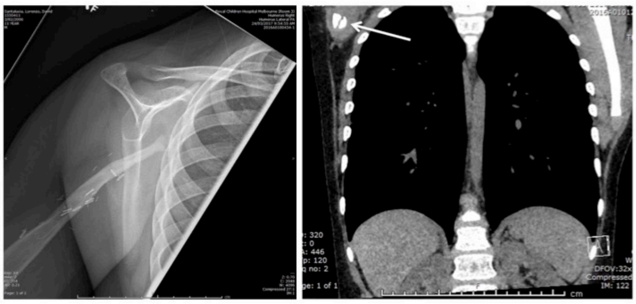


Figure 2: Technetium-99m bone scan performed five days postoperatively showing increased uptake in the growth plate area of the transferred fibula (white arrow)



a b

Figure 3a and 3b

3a: X-ray performed 18 months postoperatively showing a patent epiphyseal plate of the transferred proximal fibula

3b: CT performed 18 months postoperatively showing a patent epiphyseal plate of the transferred proximal fibula

Discussion

Three sources of epiphyseal blood supply are described here: epiphyseal, metaphyseal and periosteal vessels. In some circumstances, there is cross-anastomosis between the epiphyseal and metaphyseal circulations. These transphyseal vessels are found in large epiphyses near the periphery.[5,6]

Taylor[2] showed that the fibula epiphysis is supplied by an anastomosis of vessels: descending genicular artery, branches from the popliteal artery and branches from the anterior tibial artery. This study also showed that the peroneal artery supplied the epiphysis through periosteal vessels and the ascending branch of the nutrient artery (metaphyseal). Menezes-Leite et al[7] showed significant vascularisation of the diaphysis via anastamotic connections with the anterior tibial artery in 13 cadavers. They did not look at vascularisation of the epiphysis by the same connections in reverse, but it is reasonable to assume reverse flow is possible.

Early experiences with fibular epiphyseal transfer yielded unpredictable outcomes. Tsai et al[3] found four of eight cases they performed resulted in premature epiphyseal closure and no growth. These cases used an epiphyseal and metaphyseal artery, with two arterial anastomoses. The metaphyseal artery was a short branch from the anterior tibial artery or the posterior tibial-peroneal trunk. The nutrient artery was not harvested. Later cases using both the lateral inferior geniculate and the nutrient artery from the peroneal artery showed good results with maintenance of an open growth plate.

Pho et al[4] carried out three cases of fibular epiphyseal transfer based on the peroneal vessels (including the nutrient artery) with good results. All cases demonstrated growth, with maintenance of an open growth plate and uptake of Technetium-99m on bone scan.

Later series have cited these equivocal results to assert that the anterior tibial pedicle is the best choice to provide blood supply both to the epiphysis and diaphysis with a single pedicle. Innocenti et al[8, 9] showed favourable outcomes in six children using fibular epiphyseal transfer based on the anterior tibial artery. All achieved bony union and longitudinal growth. Half, however, developed postoperative peroneal nerve palsy, which was permanent in one case. The motor branches of the deep peroneal nerve are intimately related to the anterior tibial vessels and division of one or more of these may be necessary to harvest the flap on this pedicle, a problem not encountered using the peroneal vessels.

Yang et al[10] described transferring the fibular epiphysis using the descending lateral genicular artery. This yielded a short, small-calibre pedicle and limited diaphyseal bone. Longitudinal growth and bony integration were satisfactory with this technique.

Conclusion

The free fibula flap revolutionised the reconstruction of bony defects,[1] providing reliable diaphyseal bone with integration and healing.[2] This technique was advanced by incorporating the proximal epiphysis of the fibula, allowing the potential for growth of the transfer bone.[3,4] The choice of pedicle to supply the epiphysis has remained controversial.

Both our case and the review of the literature demonstrate that the epiphysis and diaphysis of the fibula can be safely transferred on the peroneal artery. The growth plate remains open 18 months after transfer. There is less donor site morbidity than using the anterior tibial vessels.

Disclosure

The authors have no financial or commercial conflicts of interest to disclose.

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