British Journal of Plastic Surgery (1993), 46, 466–469

BRITISH JOURNAL OF PLASTIC SURGERY

The morbidity of the free vascularised fibula flap

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SUMMARY. **Twenty patients who had undergone free vascularised fibula flap transfers were reviewed to determine the incidence of peri and postoperative complications. The mean follow-up was 3.2 years (0.2–10); 18 grafts were successful, but required 10 re-operations for complications including 5 haematoma evacuations and 3 bone grafts and plates for delayed or non-union. The two unsuccessful fibula grafts required 11 re-operations, the majority for infections and non-union. Technical details of the operative procedure are reviewed for their part in the complications.**

The free vascularised fibula flap[1,2] has become established in the one-stage reconstruction of bony defects resulting from trauma, tumour resection and congenital pseudarthrosis. For some patients it is the only alternative to amputation of a limb, especially in those where the defect is a "hostile bed" compromised by radiation damage, infection or scarring. The advantages of the free vascularised fibula flap are its single vascular pedicle, the length, shape and versatility of the bone involved and the option of a skin paddle.

The morbidity of the donor site has been well documented.[3,4] Patients walk with an altered gait, with a reduced walking distance and weakness of the long flexor tendons. Other reported changes are an altered sensory awareness and cold intolerance with oedema of the leg.

Early complications of the free vascularised fibula flap following harvest and inset can involve potential risks of vascular compromise to the flap and to the donor and recipient limb. The incidence of infection ranges from 33% superficial infection[5] to 14% deep infection.[6] Later complications such as non-union have at best been reported as 10–20%, being improved in children and worse in pseudarthrosis[7] and osteomyelitis.[8] Stress fractures occurred in 25% of the series reported by deBoer.[9]

The iliac crest vascularised on the deep circumflex iliac artery provides an alternative for bony defects less than 12 cm but its cartilaginous nature limits its use in children.[10] Until recently there had been no alternatives to the fibula flap for long bone reconstruction over 12 cm, however, with the introduction of bone lengthening and bone transport techniques[11,12] it is necessary to establish the morbidity of the free fibula flap for future comparison with alternative techniques.

Materials and methods

All patients who had a free vascularised fibula flap at our unit between 1981 and 1991 were included in the study. The details of the morbidity were obtained retrospectively from the patients' notes and by reviewing those patients still under follow-up. All of the patients had been operated on by one consultant (PLT).

Results

A total of twenty free vascularised fibula flaps were performed in twenty patients over the ten year study period (Tables 1 and 2). There was a mean age of 27.8 years, with a range of 8 to 61 years; fifteen were males and five were females. Follow-up was a mean 3.2 years with a range of 0.2–10 years. The mean length of the bony flap was 16 cm with a range from 6 to 22 cm.

In eleven of the twenty patients the flaps were used for reconstruction following trauma. Bone tumour resection accounted for seven patients and the remaining two patients had osteomyelitis and avascular necrosis. The bone tumours were 2 chondrosarcomas, 2 giant cell tumours, 1 osteosarcoma, 1 aneurysmal bone cyst and 1 fibrous dysplasia. Twelve flaps were for lower limb reconstruction, six for upper limb and there were two for pelvic reconstructions following bony tumour resection. Seventeen flaps were of the single strut type, two with skin paddles and three were double barrelled.[13]

Eighteen of the twenty free vascularised fibula flaps were successful. Of these 18, complications requiring conservative management occurred in four lower limb reconstructions where there was a leg length discrepancy of more than 2 cm. Superficial wound infection, defined as clinical evidence of infection with a positive culture swab, occurred in 3 patients. All were treated with appropriate antibiotics with complete resolution. Pin site infection occurred in 2 patients who had compound fractures; these were treated with careful attention to regular cleansing and dressings which resulted in complete resolution. A deep venous thrombosis occurred in the contralateral leg to the donor site in one patient, who required warfarin anticoagulation for three months.

In the successful flaps, complications needing early surgery occurred in 5 patients, who all required evacuation of haematomas at the flap recipient site within 48 hours of the original surgery.

Table 1 Successful free vascularised fibula flaps

Case	*Age/Sex*	*Diagnosis*	*Procedure*	*Complications*	*Re-operations*
1	25/M	Distal femoral fracture	Double barrelled	Haematoma	Evacuated
2	18/F	Chondrosarcoma femur	Strut	Stress fracture	None
3	38/M	Compound radius and ulnar fracture	Strut to central forearm Osseocutaneous	Haematoma	Evacuated
4	9/M	Avascular necrosis of femoral head	Strut to femoral neck	Delayed union	Pinned
5	18/M	Femoral fracture	Strut	Delayed union Wound necrosis	Bone graft and plate
6	22/M	Fibrous dysplasia femur	Strut	Haematoma	Evacuated
7	21/M	Compound femoral fracture	Strut	Pin site infection	
8	63/M	Chondrosarcoma ileum	Strut to complete pelvic ring. Delayed fibula transfer	Pelvic haematoma	Evacuated
9	38/M	Compound fracture humerus	Strut	Delayed union Super. wound inf.	Bone graft and plate
10	20/M	Aneurysmal bone cyst radius	Strut	None	
11	26/M	Femoral fracture	Strut	Super. wound inf.	
12	23/M	Osteosarcoma ileum	Double barrelled	None	Died metastases
13	47/M	Compound radius and ulnar fracture	Strut to radius	Non-union Stiff wrist D.V.T.	Bone graft and plate. MUA
14	19/M	Compound femoral fracture	Double barrelled	Haematoma Pin site infection	Evacuated
15	37/F	Compound humoral fracture	Strut	Super. wound inf.	
16	11/F	Fractured tibia and fibula	Strut to tibia	Wound edge necrosis	Debridement
17	54/M	Osteomyelitis femur with pathological fracture	Strut	None	
18	8/F	Osteosarcoma tibia	Strut	None	

Table 2 Unsuccessful free fibula flaps

Case	*Age/Sex*	*Diagnosis*	*Procedure*	*Complications*	*Re-operations*
1	18/M	Compound fracture femur Vascular reconstruction	Osseocutaneous flap	Venous anastomosis failed	Revise anastomosis Abscess drained and Debridement (×2) Turn-up plasty
2	43/F	Giant cell tumour radius Radiotherapy	Central forearm strut	SSG loss, muscle necrosis. Graft resorption Non-union	Groin flap (×2) Debridement (×3) MUA (×2)

Table 3 Method of primary fixation of the fibula flap

	Number of Patients
External fixator	11
Screws only	5
Plate/Screws	3
Plate/Rod	1

The method of primary fixation of the fibula flaps ranged from external fixators to screws, plates and rods (Table 3). Delayed or non-union occurred in 4 of 36 bony junctions (12.5%). Three of these required secondary non vascularised bone grafting and plating. The other was a young boy who had a septic arthritis that resulted in avascular necrosis of the femoral head. A vascularised fibula peg was inserted along the neck of the femur to encourage re-vascularisation.[14,15] The proximal bony junction from peg to femoral head was delayed in uniting and was pinned. Lastly, one patient who had a forearm reconstruction required a manipulation under anaesthetic of the wrist joint to improve the range of movement.

The two fibula flaps that failed required a total of 11 re-operations. In the first patient referral was made at 3 months after a motor cycle accident, when the 18-year-old man sustained a compound femoral fracture with bone loss and a femoral artery and vein transection. The original surgery involved vascular repair with dacron prostheses and reinsertion of the cleaned bony fragment. In the subsequent weeks the bony fragment became infected and required excision; he was referred for reconstruction of the bony gap. A free vascularised fibula flap was used with a skin paddle. The anastomosis was made to the inferior epigastric vessels because of the vascular repair. Postoperatively the venous anastomosis failed and required revision, but the skin paddle was lost and he later developed osteomyelitis requiring debridement and drainage of abscesses and a subsequent above knee amputation lengthened with a "turn-up plasty".[16,17]

In the second failed fibula flap a 43-year-old woman was referred one week following radiotherapy and excision of a giant cell tumour of the distal radius, the bony defect being maintained with an external fixator. The local tissues were in poor condition, and a free fibula flap was planned for the bony defect. She

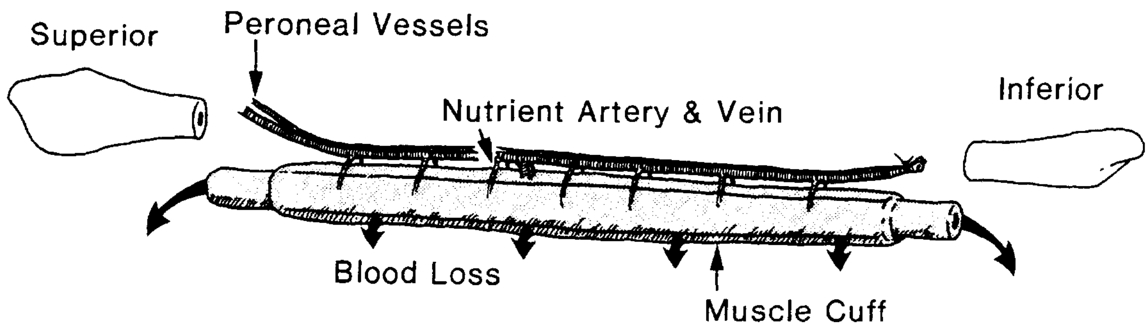

Fig. 1

Figure 1—Diagram of the single strut free fibula flap with the peroneal vessels as the pedicle. Blood loss occurs from the two open medullary ends and the muscle cuff.

developed early deep infection with loss of the overlying skin and exposure of the fixation plate, with eventual resorption of the fibula.

Discussion

In a series of 20 free fibula flaps the peri and postoperative morbidity of the procedure has been described. No objective details of donor site morbidity are recorded, as these have been well documented elsewhere.[3,4] In our series the underlying diagnosis ranged from bony defects due to trauma, tumour resections, osteomyelitis and avascular necrosis; there were no mandibular reconstructions performed with this method. There were no deaths related to the reconstruction, although one patient died of metastatic osteosarcoma ten months postoperatively.

Eighteen of the free fibula flaps survived (90%). Complications that occurred whilst in hospital for the original operation which required conservative treatment included two cases of superficial wound infection. The microbiological growth was a coliform in one and the other was a Pseudomonas species; both responded to appropriate antibiotics.

Early complications requiring operative treatment were due to haematomas forming around the recipient site. All five required draining, but there was no uniform cause, since these ranged from a single arterial bleeding point to a general venous ooze. Haematomas occurred in two of the three double barrelled fibulas, but no cases of donor site haematoma causing a compartment syndrome were seen.[18] None of the patients had been actively anticoagulated.

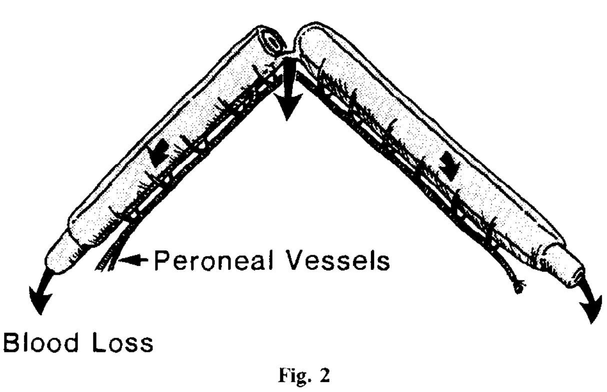

Fig. 2

Figure 2—Diagram of the double barrelled free fibula flap. The opportunity for blood loss is increased compared to the single strut due to the four open medullary ends and divided muscle cuffs.

The fibula flap survives on a single arterial input but there are many potential channels for venous output. Besides the venous anastomosis there is oozing from the muscle cuff and loss from the open medullary ends of the fibula (Fig. 1). This last site may be especially important in the double barrelled fibulas, where there is an increased surface area for blood loss, and could explain the high incidence of haematomas seen in this group (Fig. 2). These extra venous channels may reduce the usefulness of performing two venous anastomoses, where flow in each will be reduced to half. Under some circumstances a free fibula flap dowelled into the femur may establish sufficient venous circulation through the medullary cavity such that any formal venous anastomosis becomes unnecessary. A similar situation exists in vascularised nerve grafts, where they can survive with only an arterial connection and venous return is presumed to be by leakage from the flap.[19,20] This situation would not exist where the fibula is screwed to the side of another bone, for example, the radius.

Late complications requiring conservative treatment included four patients who had lower limb reconstructions and had leg length discrepancies of more than 2 cm; these were dealt with by a shoe raise.

Delayed or non-union occurred in 4 of 36 bony junctions; all were at the proximal site where there would be expected to be a greater leverage effect of the distal limb on the junction. The chance of non-union was unaffected by the polarity of the free fibula (orthograde or retrograde). Of those bony junctions that united, bony union was quickest in the upper limb (mean 9.4 months) and took longer in the lower limb (mean 12.3 months).

A range of fixation devices were used (Table 3), their indication depending upon specific local circumstances. Non-union was not related specifically to the type of fixation device used, although where fixation was difficult because of local circumstances (*e.g.* a fibula peg to the femoral head remnant (Table 1, case 9)) there was a higher incidence of non-union. Where possible the fibula was dowelled into the recipient ends of the bone to provide a secure fitting. The shape of the bone often limits the size and use of plate fixation, while an intramedullary rod is not advisable in view of the vascular importance of endosteal blood supply, thus screws and dowelling of the fibula are often the best compromise. Most lower limb reconstructions had protected weight bearing for a year post-operatively, this being adjusted according to clinical and radiological examination.

The two unsuccessful flaps have been described in detail. Both were late referrals for reconstruction and it was likely that the recipient beds were infected and in one case compromised by radiotherapy. In these patients the free vascularised fibula flap was the last chance at limb salvage, but the postoperative courses were marked by early infection with graft loss.

In conclusion, there was a 90% success rate for 20 free vascularised fibula flaps; the two main complications in the successful flaps were early haematoma formation and later delayed and non-union. In the 2 cases of failed free fibula flaps there was a high morbidity; factors contributing to this morbidity included delayed referral, radiotherapy and infection.

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Paper received 20 October 1992.
Accepted 25 March 1993, after revision.