Skin paddle as an indicator of the viability of vascularised fibular graft

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ABSTRACT

Introduction: Immediate recognition of anastomotic failure is important to ensure the viability of the vasularised fibular graft. The problems associated with post-operative bone scanning and angiography for immediate detection of anastomotic failure have been described.

Methods: We report the effectiveness of using a skin paddle as an indicator of the vascularised fibular graft viability in 13 cases which had undergone various types of long bone reconstruction using fasciocutaneous free vascularised fibular graft.

Results: Early detection of anastomotic failure in 100 percent of the patients (4 out of 4) with 92 percent (12 out of 13 patients) success rate shows the effectiveness of this method.

Conclusion: The skin paddle offers the best method of post-operative monitoring of fibular graft viability.

Keywords: graft viability, skin paddle, vascularised fibular graft

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INTRODUCTION

Vascularised fibular graft is the graft of choice used in many centres for long bone reconstruction. The advantages of the graft has been extensively described, and are well known to most reconstructive surgeons[1-3]. Weiland et al highlighted problems related to the immediate post-operative circulation monitoring of the fibular graft. Techniques that are unable to detect early circulatory failure are useless, since failure to detect this at the early stage makes revision of the anastomosis unhelpful[4]. Bone scans using technetium-99m, employed in the immediate post-operative period (24-72 hours), is helpful. Angiography is not helpful for the monitoring because of large numbers of vessels that obscure the nutrient vessels supplying the graft[5].

In 1983, Yoshimura et al published a new method for monitoring the circulation of the grafted fibula. He used a skin island taken together with bone to act as a marker to monitor the circulation. This proved to be very reliable[6]. A skin flap was also considered more valuable than bone scintiscan in assessing bone vascularity.

The aim of this study is to assess the effectiveness of this method for post-operative monitoring of the fibula graft viability. Immediate detection is mandatory to prevent failure in vascular revision. The viability of the fibular graft is important for the patient to benefit from the advantages of vascularised fibular graft, and the skin paddle viability itself is important for the coverage of bones, neurovascular bundles and the implant composites. This method is not only new to most orthopaedic surgeons but difficult to perform. Therefore, evaluation of this method is important for the routine use of this method for post-operative monitoring of vascularised fibular graft.

METHODS

This is a retrospective study of 13 patients who had undergone long bone reconstruction using vascularised fibular graft. All of them had undergone vascularised fibular grafting, harvested together with a skin paddle (osteofasciocutaneous composite flap). Post-operatively, the viability of the fibular graft were monitored based on the viability of the skin paddle. Evidence of the skin colour, temperature, turgor and circulation was assessed. Any skin changes were immediately informed to the surgeon for immediate reevaluation and reassessment. Vascular revision or reanastomosis were done immediately if indicated. The viability of the fibula graft were confirmed either by angiogram or bone scintiscan, which were done later during follow up.

RESULTS

Thirteen patients were included in this study. Indications for skeletal reconstructions using vascularised fibular grafts were: tumour (9), infected non-union (3) and congenital pseudoarthrosis (1) (Table I). Four patients developed anastomotic complications requiring revision of the anastomosis. The perfusion failure was detected

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Table I. The indications for skeletal reconstruction using vascularised fibular graft.

Indication	No. of patients	Size of bony defect post-resection (in cm)
Musculoskeletal tumour	9	
• Phylloides tumour	1	27.0
• Chondrosarcoma	1	23.0
• Triton tumour	1	19.0
• Metastatic thyroid carcinoma	1	18.0
• Osteosarcoma	2	18.0, 26.0
• Giant cell tumour	2	14.0, 23.0
• Fibromatosis	1	19.0
Infected non-union	3	7.0, 16.0, 17.0
Congenital pseudoarthrosis of the tibia	1	6.5

Table II. The distribution of patients with early detection of anastomosis failure and overall reliability of the skin paddle as a post-operative monitoring method.

Total anastomosis failure (venous thrombosis)	4 patients
Patients with early detection of anastomosis failure	4 of 4 patients (100%)
Successful revision/reanastomosis	3 of 4 patients (75%)
Total no. of viable fibular grafts	12 of 13 patients (92%)

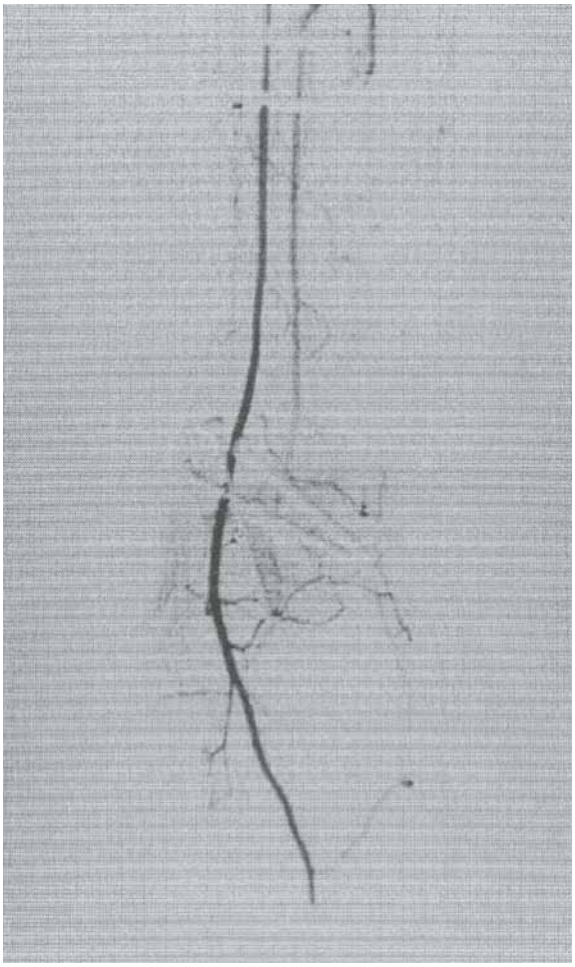

Fig. 1 Angiogram of the distal tibia taken two months post-operatively shows the patency of the anastomosis.

early in all the four patients, based on the skin paddle changes. This enabled the surgeon to explore the vascular anastomosis and the revision could be done within 4-6 hours, ensuring the viability of the fibular graft and the skin paddle. Three of the four patients successfully underwent revision surgery. One flap was lost despite multiple attempts, due to infection of the surrounding tissue. Venous thrombosis was found to be the main cause of circulation failure in all the patients that warranted emergency exploration and revision (Table II).

DISCUSSION

All our patients had composite osteocutaneous fibular grafts. Generally, it took a longer time to harvest compared to fibular graft without the skin component. Extra care is needed to avoid injury to the perforator vessels. Although it is more difficult and takes a longer time to be harvested, it is highly advantageous. In transferring the fibula together with the skin paddle, the skin acts as a useful indicator of the perfusion of the fibula graft. The skin paddle also serves as an important biological cover for the graft and prosthetic composite. This allows coverage of the surgical wound without excessive tension, thus improving wound healing.

The skin pedicle has other advantages. In many situations, part of the muscle and overlying skin need to be removed, either to ensure free tumour margin or because of the technical difficulty to separate the soft tissue from the diseased bone, leaving the underlying or endoprosthesis exposed. The skin paddle provides natural cover for the underlying bone and endoprosthesis with good soft tissue contour. It is not bulky and further debulking procedure is avoidable. Soft tissue cover is also done in a one-stage procedure and this reduces patient morbidity.

This study clearly shows the advantages of the osteocutaneous fibular graft. It allows early detection of anastomosis failure within hours after the surgery. As shown in the study, all four patients with anastomosis failure were detected early, hence enabling the anastomosis to be revised timely. This method is not only effective in early detection of anastomosis failure, but also proved to be very reliable. In all other patients who did not require revision, indirect evidence of the patency of the anastomosis were confirmed by angiography or bone scintiscans (Figs. 1 & 2).

The approach of transferring the fibula as an osteocutaneous flap enables the post-operative monitoring of the fibular vascularity in an easy and direct manner. The monitoring is based on skin colour changes, temperature and together with handheld

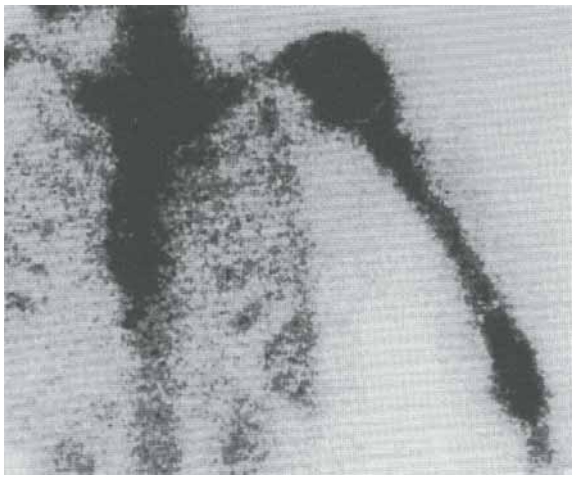

Fig. 2 Bone scintiscan of the left humerus shows the viability of the vascularised fibular graft following reconstruction.

doppler ultrasonographical examination of the pedicle. Most of the monitoring were done by the nursing staff in the ward. Basically, most medical staff members are capable of monitoring the flap, with minimal training and instruction. Laser Doppler ultrasonography can also be used for monitoring the skin paddle. This method is more accurate and allows continuous monitoring of the graft vascularity.

This method is capable of replacing other means of post-operative monitoring such as angiography or bone scintiscans, which are more expensive, time consuming and more complicated to perform. Without the skin paddle, post-operative monitoring is difficult and frequent assessment is nearly impossible. Monitoring by using bone scintiscan is expensive and is sometimes not practical. Early detection of anastomosis failure is difficult thus early revision of failure is impossible leading to overall failure of the procedure.

Bone scintiscans are useful in the long term assessment of the graft. Greenberg et al assessed the reliability of bone scintigraphy in correlation with radiological and clinical evidence of bone healing in 15 patients who underwent microvascular transfer of fibula. From this study, it appears that positive bone scan correlated with survival of the graft but not necessarily skeletal union[7]. Bone scintiscans also can be used to assess graft hypertrophy. De Boer et al showed that positive bone scintiscans are suggestive of endosteal hypertrophy . Negative or equivocal bone scintiscans suggest the periosteal type of hypertrophy[8].

In conclusion, surgery involving massive bone and soft tissue resection, particularly in tumour surgery, reconstruction of the bony defect and soft tissue cover, is very difficult and challenging. Using vascularised fibular grafts, resection of the diseased bone can be done adequately because the vascularised fibular graft offers viable graft and an “unlimited” length for reconstruction. Osteocutaneous graft allows adequate natural cover for the bone, soft tissue and endoprosthesis. Skin paddle harvested and transferred together with vascularised fibular graft offers the best method of post-operative monitoring of the viability of the fibula. Vascular anastomosis failure can be detected early, therefore exploration and revision can be done early, leading to a higher successful rate of the surgery. It is accurate and monitoring can be done with minimal training.

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