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Vascularised fibular grafts as a salvage procedure in failed intercalary reconstructions after bone tumour resection of the femur

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ABSTRACT

Vascularised fibular grafts (VFGs) are widely used for primary reconstruction of long bones after bone tumour resections. The biological properties of VFGs are such that they can be a useful option even in failed intercalary reconstructions. The purpose of the current study was to investigate the results and the morbidity of VFGs as a salvage procedure in failed previous reconstructions after intercalary bone tumour resection of the femur. Our series included 12 patients, treated from April 1989 to March 2005, with an average age of 23 years (range 10–43 years) at presentation. The initial diagnosis was osteosarcoma in 10 cases and Ewing's sarcoma in two cases. All patients received chemotherapy and none received radiation therapy. Seven patients received VFG as biologic augmentation in intercalary allograft non-union and in the other five patients, a combination of allograft and VFG was used to replace a cement spacer with hardware failure (four patients) and a failed intercalary prosthesis (one patient). Three patients died during follow-up, in all cases because of metastatic disease. At an average follow-up of 147 months (range 11–260 months), the remaining nine patients were continuously disease-free. Complete healing of the osteotomy of both allograft and VFG was observed in 10 patients at final follow-up. Two major complications were observed that required surgical revision, eventually healing in one case and leading to a poor functional outcome in one case. Significant hypertrophy of the VFG was detected in seven of nine evaluable patients. At final follow-up the mean Musculoskeletal Tumour Society (MSTS)'93 functional score of the nine evaluable patients was 90% (range 66–100%). These results indicate that VFG is a valid salvage procedure in failed intercalary reconstructions of the femur after bone resection.

Introduction

The femur is the most common site of occurrence of primary bone tumours. Several reconstructive options have been described for intercalary resections, including bone transportation, massive allografts, autografts and intercalary spacers and prostheses [1–7]. Biologic reconstructions with massive allografts have been widely used during the last three decades and a consistent number of complications has been described, including non-union and fractures, which frequently required surgical revision [2–4,8]. Synthetic reconstructions with cement spacers or intercalary prostheses provide immediate stability, which enables early weight-bearing and functional recovery, but they were seen to be at risk of long-term failure because of hardware breakage or aseptic loosening [7]. Vascularised fibular graft (VFG) has been used alone or in combination with a massive allograft for reconstruction of intercalary defects of long bones [9–19]. The first case of VFG in limb salvage procedures after trauma was reported by Taylor et al. in 1975, while Weiland et al. in 1977 described the first reconstruction of long bones with vascularised fibula after tumour resection [20,21]. Currently, the fibula is the most commonly used vascularised bone graft in limb salvage procedures, particularly for long bone defects. The biologic properties of the VFG can induce an early fusion of the osteotomies and the progressive hypertrophy of the viable bone can lead to a long-lasting reconstruction. The combination of the VFG with a massive allograft associates the mechanical strength of the allograft with the biologic potential of the fibula, thereby decreasing the risk of mechanical complications (non-union and fractures) and increasing the rate of internal repair of the allograft [22].

Besides the application as a primary reconstruction, the VFG has been used as a salvage procedure in failed intercalary allograft

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reconstructions and in pathological fractures in irradiated bone [23,24].

The purpose of the current study was to review retrospectively our series of patients treated with VFG as a salvage procedure in failed intercalary reconstructions after primary bone tumour resection of the femur.

Materials and methods

Twelve patients were treated from April 1989 to March 2005 with a vascularised free fibular transfer after failure of previous intercalary reconstructions for bone tumour resections. Patient characteristics are summarised in Table 1. There were six males and six females with an average age of 23 years (range 10–43 years). The oncological diagnosis was a malignant bone tumour in all cases (10 osteosarcoma, two Ewing's sarcoma). All patients received pre- and post-operative chemotherapy around the first surgical procedure. None of the patients received radiation therapy. At histologic examination of the resection specimen, surgical margins were wide in all cases.

The initial reconstruction after resection of femoral diaphyseal bone tumour was an intercalary allograft in six cases (fixed with intramedullary nail in four cases and plate in two cases) (Figs. 1 and 2), a cement spacer in five cases (fixed with plate in three cases and intramedullary nail in two cases) (Fig. 3) and an intercalary prosthesis in one case. Failure of the first reconstruction occurred because of allograft non-union with or without hardware breakage in seven cases, hardware failure of cement spacers in four cases and stem aseptic loosening in one case of intercalary prosthesis.

All surgical revisions were performed by a lateral approach. An accessory medial approach was used in 11 cases to facilitate microsurgical anastomosis of the vascular pedicle; in one case a single lateral approach was sufficient. The anastomosis was always obtained with an artery and a vein and it was performed on a collateral branch of the superficial femoral artery in five cases, on a collateral branch of the profunda femoral artery in six cases and on a geniculate artery in one case.

The average length of the fibular graft was 18 cm (range 12–24 cm). The VFG was harvested from the contralateral limb by the microsurgical team using separate instruments, taking care to avoid contamination between the two different surgical fields. The harvested fibula was at least 2 cm longer than the length of the femoral defect to allow a minimum overlapping of 1 cm for each osteotomy.

In the seven cases of allograft non-union, the allograft was preserved and VFG was placed medially, overlapping the osteotomy lines and fixed with screws. In the remaining five cases, the previous reconstruction was removed (cement spacer in four cases and intercalary prosthesis in one case) and the VFG was placed medially and parallel to a massive allograft and fixed with lag-screws to the host bone, overlapping both allograft–host bone osteotomies. A plate fixation of the allograft was performed in seven cases, and the intramedullary nail of the previous reconstruction was retained in five cases.

Full weight-bearing without a brace was allowed an average of 14.6 months (range 8–19 months) after surgery; in three cases between 6 months and 1 year and in nine cases between 1 and 2 years.

Three patients died during follow-up, in all cases because of metastatic disease. The remaining nine patients underwent clinical and radiographic examination at follow-up. The functional result was evaluated by an orthopaedic surgeon, who assessed pain, function, emotional acceptance, support, walking ability and gait using the modified 30-point scoring system of the Musculoskeletal Tumour Society (MSTS'93) for the lower limb [25]. Union,

Table 1
Data of 12 patients.

Patient no.	Age	Gender	Diagnosis	Length of VFG (CM)	Primary reconstruction	Fixation	Follow up (months)	Complication	Treatment of complications	Outcome of complication treatment	Oncologic relapse	Oncological outcome	MSTS
1	27	F	OS	19	Cement spacer	Plate	60				CDF		29
2	25	F	OS	24	Intercalary prosthesis	Plate	11				CDF		30
3	17	F	ES	14	Allograft	Nail	53				MET	DOD	nv
4	11	F	OS	13	Allograft	Plate	34				MET	DOD	nv
5	24	F	OS	24	Allograft	Nail	235				CDF		24
6	43	M	OS	18	Allograft	Plate	224				CDF		30
7	10	M	OS	12	Cement spacer	Plate	160	Knee stiffness	Closed arthrolysis under anaesthesia		CDF		25
8	18	M	OS	13	Cement spacer	Plate	260	Fracture + infection	Two stage revision, allograft removal (27 months)	Healing of VGF Poor functional result	CDF		20
9	21	M	OS	17.5	Allograft	Nail	273				CDF		30
10	17	F	ES	22	Cement spacer	Plate	120				CDF		27
11	20	M	OS	19	Allograft	Nail	89	Fracture + telescopage + hardware failure	Plate fixation + autogenous graft (34 months)	Healing with shortening	MET	DOD	nv
12	43	M	OS	17	Allograft	Nail	246				CDF		30

OS: osteosarcoma; ES: Ewing's sarcoma; MET: metastases; CDF: continuously disease free; DOD: dead of disease.