Journal of Plastic, Reconstructive & Aesthetic Surgery (2016) 69, 856–863

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Extracorporeally frozen tumour-bearing bone combined with free vascularised fibula for the intercalary reconstruction of femoral defect after resection of bony sarcoma

Jing Li [a,*], Fujun Zhang [a,1], Ming Yang [a,1], Shiping Liu [b], Xin Wang [b], Qianzi Yang [c], Zhigang Wu [a], Chuanlei Ji [a]

[a] *The Orthopaedic Department, Xi Jing Hospital Affiliated to the Fourth Military Medical University, Xi'an, People's Republic of China*
[b] *The Orthopaedic Department, Yan'an People Hospital Affiliated to the Yan'an University, Yan'an, People's Republic of China*
[c] *The Orthopaedic Department, Wuwei Cancer Hospital Affiliated to the Lanzhou University, Wuwei, People's Republic of China*

Received 6 July 2015; accepted 28 February 2016

KEYWORDS
Sarcoma;
Femur;
Frozen autograft;
Reconstruction;
Fibula flap

Summary *Background:* With the improved survival for patients with bone sarcomas, there is a trend to reconstruct intercalary femur defects using biologic techniques. This study examined whether the results of a frozen femur autograft with vascularised fibula are comparable to other reconstructive options in terms of the functional outcomes and the complications.
Materials and methods: Between 2008 and 2012, eight patients with bony sarcoma of the femur were subjected to reconstruction with a recycled frozen autograft combined with a vascularised fibula flap inside. The oncologic and functional results were analysed retrospectively.
Results: The mean follow-up was 48.7 months (37–71). The oncologic results were continuously disease free in five patients; there was no evidence of disease in one, one patient was alive with disease and another died of the disease. The average length of defect was 13.6 cm (9–21). Bone union was achieved in all cases. The mean time to bone union was 7.9 months (5–19) and to full weight bearing was 7.8 months (6–11). There was no infection or construct fracture in this series. Two complications were observed. One tumour recurrence in soft tissue was treated with reresection. One tibia fracture was successfully managed with cast immobilisation. The average Musculoskeletal Tumor Society functional score was 95% (27–30). The construct was intact in all patients.

* Corresponding author. Orthopaedic Department, Xijing Hospital, Xi'an, 710032, People's Republic of China. Tel./fax: +86 029 84771064.
E-mail address: ljfmmu@sina.com (J. Li).
[1] Co-first author: Fujun Zhang and Ming Yang contributed equally to the article.

http://dx.doi.org/10.1016/j.bjps.2016.02.018

Conclusions: Vascularised fibular flap combined with frozen autografts is a dependable and durable option for the reconstruction of large bony defects after femoral sarcoma resection. It had the merits of reliable bone union and low complications, which compare well with other biological reconstructions.

Evidence Rating Scale for Therapeutic Studies Level IV, therapeutic study.

Introduction

Limb-sparing surgery for the treatment of bone sarcomas in femur is a reliable alternative to amputation in the majority of patients as improvement has been achieved in chemotherapy and surgical techniques.[1,2] Surgeons have multiple options for reconstruction of femoral defects following tumour resection, including intercalary endoprosthesis,[3] massive allograft,[4] vascularised fibula[5] and recycling of tumour-bearing bone.[6–8] In view of the long-term viability of spared limbs, the limited durability of prostheses is a major problem.[9] Allografts have been widely used, although complications such as nonunion, fracture and infection are observed.[10] Recycling of the resected tumour-bearing bone is popular in some countries. The techniques of recycling of the resected segment including pasteurisation, autoclaving, irradiation and freezing may also have some complications similar to allografts, such as infection, fracture and nonunion, all of which are related to its avascular status.[6–8,11]

The ideal method of segmental reconstruction should be a permanent solution for the defect, resistant to infection and biologically capable of resisting bone resorption. In 1993, Capanna et al. reported a technique that combine a vascularised fibula with a massive allograft to reconstruct segmental defects of the long bone after tumour resection.[12] Combining the advantages of the different components results in a structurally competent reconstruction with reliable osteogenic capabilities with the potential to diminish risks of nonunion, fracture and infection. Mottard et al. reported utilising irradiated tumour-bearing bone in combination with a fibular graft to repair a tibia defect after excision of a malignant tumour.[13] Both Masataka Noguchi and Ozaki described a technique of implantation of pasteurised recycled bone with the vascularised fibula after excision of osteosarcoma in the selected cases.[14–16] These combined techniques are widely accepted for their durability and lower complication rate.

Capanna's techniques, reported previously, encouraged the use of a frozen autograft in selected patients with femoral sarcomas, in conjunction with a vascularised fibular graft inside the bone. It combines the structural strength of the frozen autograft and the advantages of fibula's intrinsic blood supply to encourage union. The purpose of this study was to determine the outcome of patients who underwent this procedure and compare it with the other available options.

Materials and methods

Between February 2008 and March 2012, 51 patients with a primary sarcoma of the femur were registered at our institute. Intercalary tumour resection was performed in 29 patients. We performed femoral reconstruction following intercalary resection using recycled frozen autograft with inlay free vascularised fibula flap if the following criteria were met simultaneously: (1) there was no evidence of progression of the tumour during neoadjuvant chemotherapy, (2) safe surgical margins should be obtained, (3) patients understood the alternative options including prosthesis or other biological reconstructions and (4) patients were aware of the advantages and disadvantages of this procedure. The contraindications for this procedure were as follows: (1) there was poor chemotherapeutic response or tumour progression while on chemotherapy, (2) severe osteolytic changes presented over half of the lesion, (3) there was pathologic fracture or impending fracture of femur and (4) there was bone metastasis prior to surgery. We obtained the informed consent and a letter of acceptance from all patients prior to surgery.

There were five women and three men with an average age of 15.8 years (range 10–26). The mean follow-up was 48.7 months (range 37–71). There were four cases of classic osteosarcomas and one case each of parosteal osteosarcoma, periosteal osteosarcoma, Ewing's sarcoma and chondrosarcoma. There were six cases of stage IIB cancer and one case of stage IB according to Enneking's criteria. Six patients underwent neoadjuvant and adjuvant chemotherapies using methotrexate, doxorubicin and cisplatinum. Post-operative radiotherapy was performed in one patient with Ewing's sarcoma. All data were obtained from medical records and radiographs.

Surgery

The surgery began with resection of the tumour, including biopsy scars, with safe bone and soft tissue margins. The resected length of femur was frozen in the following manner. The surgical specimen was removed from the surgical field and, using a completely different set of instruments, its soft tissue, gross tumour and the intramedullary macroscopic portion of the tumour were removed, taking care not to disturb the structure of the segment. A longitudinal slot with a width of 1–2 cm in the specimen was made for the subsequent fibula flap inlay