

Skeletal Union Following Long Bone Reconstruction Using Vascularised Fibula Graft

Y Imran, W Zulmi, A S Halim

ABSTRACT

Thirteen patients had skeletal reconstruction using vascularised fibula graft following resection of the diseased bone. Eleven patients had reconstruction of the lower limbs and two patients of the upper limbs. Clinical and radiographical evidence union were achieved with the average time of 32 weeks (earliest eight weeks). Six out of 11 patients (54%) in lower limb reconstruction started weight bearing at the average of 27 weeks. Bony union in this study is comparable with other studies using vascularised fibula graft.

Keywords: skeletal union, vascularised fibula graft

Singapore Med J 2003 Vol 44(6):286-287

INTRODUCTION

Skeletal defects following trauma or bone tumour resection may be successfully treated by conventional bone grafting or bone transport. However, for massive defect following en bloc resection of a localised tumour, chronic osteomyelitis or following trauma, the reconstruction of such defects remains a challenge. Since 1975, vascularised fibular graft had been advocated by Taylor and successful use of the free vascularised fibula graft for the reconstruction of a tibial defect⁽¹⁾. In Malaysia, the application of vascularised fibular graft for the management of massive bone loss is still new and not widely performed.

MATERIALS AND METHODS

This is a retrospective study of 13 patients who had long bone reconstruction using vascularised fibula graft. All 13 patients had undergone reconstruction of the limbs following massive resection of the diseased bones for musculoskeletal tumour, infected non-union and congenital pseudoarthrosis (Table I). Vascularised fibula graft was used in these patients because of the need of radical resection of the diseased bone to ensure free margin from tumour cells, infected bone or abnormal bones. The bony defects were satisfactorily bridged with fibula graft. Vascularised

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

Indication	No. of patients	Bony defect post resection (cm)
Musculoskeletal tumor	nine patients	
Phylloides tumor	one patient	27.0
Chondrosarcoma	one patient	23.0
Triton tumor	one patient	19.0
Metastatic thyroid CA	one patient	18.0
Osteosarcoma	two patients	18.0, 26.0
Giant cell tumor	two patients	14.0, 23.0
Fibromatosis	one patient	19.0
Infected non union	three patients	7.0, 16.0, 17.0
Congenital pseudoarthrosis of the tibia	one patient	6.5

fibula graft has the advantages of providing better union and strength with its ability to undergo hypertrophy. The signs of radiological and clinical union were assessed and reviewed. The patients were followed up until they achieved bony union or died of disease.

RESULTS

Patients' ages ranged from two years to 65 years old. The recipient sites involved four femurs, seven tibias, one humerus, one radius and ulna. The total resection and reconstructive procedures took an average of 17.6 hours. All patients had undergone at least one operation prior to the surgery with the maximum being seven operations prior to it except the child with the pseudoarthrosis who was treated with this technique primarily. An average skeletal defect reconstructed was 17.9 cm in length and the average fibula graft harvested was 22.2 cm in length.

In this study, four patients died but two of them succumbed after the graft united, leaving 11 patients available for analysis. The average time for union in this group is eight months. The earliest was achieved within eight weeks in a 15-year-old girl who had

Department of
Orthopaedics
School of Medical
Science USM
16150 Kubang Kerian
Kelantan Malaysia

Y Imran, MD (UKM),
MMed (Ortho), USM
Lecturer

Oncology &
Reconstructive Unit

W Zulmi, MBBS,
MS (Ortho), UKM
Associate Professor

Reconstructive
Sciences Unit
Department of
Surgery

A S Halim, MD, FCCP
Associate Professor

Correspondence to:
Dr Imran Yusof
Email: drimran@
kb.usm.my

reconstruction of the humerus following a tumour resection (Fig. 1). Six patients have started full weight bearing with an average time of 27 weeks post operatively. The earliest weight bearing is at 11 weeks in a case of pseudoarthrosis of a tibia. The largest is one year in a case of GCT of proximal tibia. However, radiological union was documented at 28 weeks post operatively.

DISCUSSION

Limb salvage surgery is an established method for management of locally aggressive tumour, early stage bone or soft tissue sarcoma. Previously, amputation was the only option for these patients. Limb salvage surgery involves radical resection of the bone tumour. The large defect can be bridged by prosthesis, metal implants or vascularised autograft.

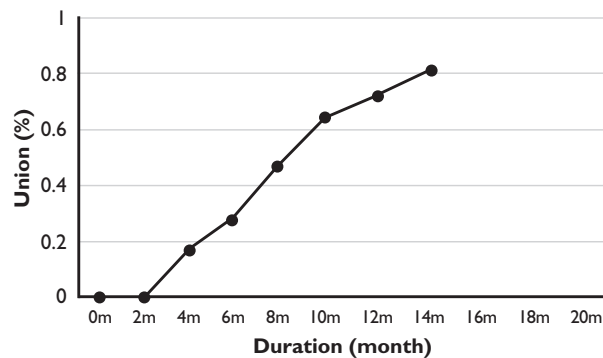
Vascularised fibula graft is the graft of choice used in our centre for skeletal reconstruction. The advantages of the graft have been described in many literatures⁽²⁻⁴⁾. The availability of a long segment of the graft, early bony union, complete incorporation and the ability of the graft undergoing hypertrophy with load, are the main reasons we have chosen this technique as biological spacer in our reconstruction.

Average height of 22.2 cm (ranges from 9.5 cm to 26.5 cm) of fibula graft was transferred. This reflects the relatively large size of the defect to be bridged. Most of the defects were due to the tumour resection. Because of availability of long segment of fibula graft, it allows the surgeons to resect the tumour to the safest margin without worrying the extent of bony defect. Our largest graft is 26.5 cm of fibula. The aggressive and radical resection is one of the most important contributing factors to reduce local recurrence as shown by most of the studies⁽⁵⁾.

Reconstruction using vascularised fibula graft alone takes as early as three months to unite⁽²⁾. In other studies, an average time of three to five months is needed for union⁽⁶⁾. Ninety percent of the patients achieved union at average of 7.6 months as reported by Hsu⁽⁷⁾.

An allograft alone takes an average of 14 months to unite, as reported by Makley⁽⁹⁾. In another report, union at allograft host junction occurs at six months⁽¹⁰⁾. Many other reports mention different times for union^(11,12). Incorporation of allograft will take many years and is never complete⁽¹¹⁾. The incidence of delayed union is about 10%^(5,11,12). Allograft union by average unites later than vascularised graft^(5,10,12). Our observation of this small series suggest that union is rapidly achieved in children or in young patients with vascularised fibula graft. There is no incidence of fracture in our patients.

Fig. 1 Graft shows percentage of patients who achieved bone union with time of follow-up.



It is believed that there are a lot of factors that influence the rate of union. Rigid internal fixation is crucial for union^(9,12). Unstable construct will not only predispose graft to fracture but also delay union. Chemotherapy will affect osteoblast function and may also delay union⁽¹³⁾.

CONCLUSION

Vascularised fibula grafts offer an effective and considerable means of reconstruction of a segmental massive bone defect following radical resection for bony pathology. This procedure can restore height and provide immediate revascularisation, thus improving the outcomes as compared to other surgical procedures. Skeletal union achieved is comparable with union in normal fracture healing.

REFERENCES

1. Taylor GI. The free vascularised bone graft. A clinical extension of microvascular techniques. *Plast Reconstr Surg* May 1975; 55(5):533-44.
2. Shaffer JW, Field GA, Goldberg VM, Davy DT. Fate of vascularised and nonvascularised autografts. *Clin Orthop* 1985; 197:32-43.
3. Jupiter JB, Gerhard HJ, Guerrero J, Nunley JA, Levin LS. Treatment of segmental defects of the radius with use of the vascularised osteocutaneous fibular autogenous graft. *J Bone Joint Surg* Apr 1997; 79-A:542-50.
4. Newington DP, Sykes PJ. The versatility of the free fibula flap in the management of traumatic long bone defects. *Injury* 1991; 22(4):275-81.
5. Mankin HJ, Doppelt S, Tomford W. Clinical experience with allograft implantation. The first 10 years. *Clin Orthop* 1983; 174:69-86.
6. Weiland AJ, Moore JR, Daniel K. Vascularised bone autografts. Experience with 41 cases. *Clin Orthop* 1983; 174:87-95.
7. Hsu RWW, Wood MB, Sim FH, Chao EYS. Free vascularised fibular grafting for reconstruction after tumor resection. *J Bone Joint Surg* Jan 1997; 79-B:36-42.
8. Wood MB. Free vascularised bone transfers for nonunions, segmental gaps and following tumor resection. *Orthopedics* Jun 1986; 9(6):810-6.
9. Makley JT. The use of allografts to reconstruct intercalary defects of long bones. *Clin Orthop* 1985; 197:58-75.
10. Gitelis S, Heligman D, Quill G, Piasecki P. The use of large allografts for tumor reconstruction and salvage of the failed total hip arthroplasty. *Clin Orthop* 1988; 231:62-70.
11. Mnayneh W, Malinin TI, Makley JT, Dick HM. Massive osteoarticular allografts in the reconstruction of extremities following resection of tumours not requiring chemotherapy and radiation. *Clin Orthop* 1985; 197:76-87.
12. Griend RAV. The effect of internal fixation on the healing of large allografts. *J Bone Joint Surg* May 1994; 76-A:657-63.
13. Friedlaender GE, Tross RB, Doganis AC, Kirkwood JM, Barron R. Effects of chemotherapeutic agents on bone. *J Bone Joint Surg* 1984; 66-A:602-7.