

# LIMB SALVAGE IN BONE TUMOURS BY BONE TRANSPLANTATION

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## ABSTRACT :

Sixty-five cases of aggressive benign and low grade malignant musculoskeletal neoplasms involving the extremities treated by resection and autologous non vascularised bone grafts are analysed. The period of study is 20 years from 1978 to 1998. Skeletal reconstruction was accomplished in most cases either by fibular transplant or by resection arthrodesis. Excellent results were achieved with a low tumour recurrence rate, high limb salvage and patient survival rates and good graft incorporation. Most of the patients had satisfactory functional results. There were a few complications like infection, non-union of the graft, and fracture of the graft, which however did not compromise the function of the limb. Hence in selected patients these procedures remain a viable alternative to limb salvage by custom-made endoprosthetic replacement and are clearly superior to the functionally and psychologically deforming limb ablative procedures.

Key Words : Bone tumours — Limb salvage — Fibular graft.

The present study is a retrospective assessment of limb salvage procedures in bone tumours by resection and reconstruction by non-vascularised autologous bone grafting done at the department of orthopaedic surgery, government general hospital and Chennai medical college, over a period of two decades (1978-1998). An analysis of the results of these procedures was carried out in an attempt to study the incorporation of the graft within the host bone, with the desired stability, the functional results, local recurrence/survival rate, and donor site morbidity in these patients.

## MATERIALS AND METHODS :

During the period of 20 years, from 1978 to 1998, a total of 1300 bone tumours were managed by various modalities of treatment. Out of these, 65 suitable patients were selected for limb salvage by resection and non-vascularised autologous bone grafting. Cases which were treated by curettage and bone grafting or bone cementing were not included in this study. Out of these 65 patients, there were 34 males and 31 females. The age ranged from 17 years to 55 years, with an average age of 28 years.

Histopathologically Giant cell tumours formed the majority of lesions (61.5%) followed by chondrosarcoma (17%) and 26% were low-grade malignant lesions. Table 1 shows the histopathological nature of all the 65 cases in our series. Upper limb tumours constituted 45 (70%) cases. Lower limb tumours constituted 20 (30%) cases. Autologous fibular graft was used for bridging the skeletal defect in most of our cases. Table 2 shows the type of grafts used for skeletal reconstruction after tumour resection.

Table 3 shows the period of follow-up ranging from 1 to 20 years with mean follow-up of 6 years.

All 65 patients were reviewed and were assessed clinically, radiologically and on functional grounds, to assess the fate of the graft, any evidence of tumour recurrence and donor site morbidity. The Uyttendaele's criteria (1998) was used for functional assessment as good, fair and poor.

## RESULTS :

### Upper limb was involved in 45 cases

**Arm:** There were 8 patients in this group, the site of the tumour, the pathological diagnosis and the type of graft used are given in table 4. In all cases the patient's fibular / tibial graft was taken from the same side of the tumour. There were only 3 primary union of the graft and 5 non-unions. In primary union group one patient with chondrosarcoma of the humerus, at the junction of the upper and middle 1/3 of the humerus, had tibial cortical grafting to bridge the segmental defect following excision of the tumour. The graft consolidated well showing remarkable hypertrophy.

### Forearm and hand

There were 37 patients in this group. This site of the tumour, the pathological diagnosis and the type of bone graft used are given in table 5. In all patients, ipsilateral fibula was used to reconstruct the skeletal defect after excision of the tumour. Primary union of the fibular graft occurred in 25 patients. Most of the patients, in whom distal radius was replaced with fibular graft, returned to their prior occupation. (Lackman (1987). The motion that was preserved was functional. Most of them demonstrated some shortening of radius and some distortion of the distal radio ulnar joint radiologically. Degenerative changes of fibula carpal joint were present, but they were asymptomatic. The functional assessment for the procedures involving forearm lesions were good in 25 patients, fair in 7 patients and poor in 5 patients. (Goldenberg 1970).

**Lower Limb was involved in 20 patients**

Resection arthrodesis of the knee was carried out in 16 patients (Sim 1987). The site of the tumour, the pathological diagnosis and the type of bone graft used are given in table 6. Following resection arthrodesis of the knee, primary union occurred in 11 patients. Union after secondary procedure (Cancellous bone grafting) occurred in 4 patients, non-union 1 patient, tumour recurrence in 1 patient, deep seated infection in 2 patients and 1 patient had peroneal nerve palsy. The functional assessment for the lower limb tumour surgery was good in 11 patients, fair 5 patients and poor in 4 patients.

All the 65 patients followed-up are surviving in our series. Probably this is due to our selection of patients which comprised predominantly of benign aggressive tumours and low grade malignant tumours.

Nine patients developed minimal wound infection at the fibular graft site. It resolved completely with antibiotic treatment. The significant complication at the graft site were infection, skin necrosis, non union, fracture of the graft, shortening of the lower limb, peroneal nerve palsy, posterior interosseous nerve palsy, Sudeck's dystrophy, resorption of the graft and chronic osteomyelitis. One recurrence (GCT radius) was treated with excision of the lesion, which was in soft tissues. The other two recurrences were treated with higher amputation. Those who had non-union in the arm had a satisfactory elbow and hand function. Their arm was protected with a brace. Poor internal fixation was cited as the cause of non-union, in these cases. All the graft fractures were treated conservatively. Though there was no radiological evidence of union, the forearm and wrist were painless, with the wrist and hand function acceptable to the patients as all were in the non-dominant hand.

**DISCUSSION :**

Union of the graft eventually occurred in 45 patients (70%) out of the 65 patients followed-up. All the patients with non-union had pain and partially functioning limb. All but one of the fibular grafts, used for proximal humeral lesions went in for non-union. We suggest internal fixation of the graft with intra-medullary fixation and cancellous bone grafting around the host-graft junction or dual fibular grafting (Yadav 1990). The clinical results of non vascularised autogenous fibular replacement for distal radial lesions were good. For distal femur and proximal tibial lesions resection arthrodesis of the knee technique provided autogenous grafts from the same extremity.

Autogenous cortical bone graft is the most physiological method of reconstructing a major skeletal defect. (Dempsey 1987; Enneking 1980) Other methods of reconstructing the skeletal system should be judged by comparing them to autogenous grafting. These grafts are easily obtained, biologic, non-antigenic and have an established success rate, but they are limited by the availability of donor sites. Massive allografts of bones and joints corresponding to the parts that have been removed are, therefore, a possible solution to this difficulty;

but such of a bone bank is an extremely complex and costly undertaking and is unlikely to become widely available (Gray 1987). Neither bone allograft nor endoprosthetic replacement can be expected to function indefinitely. These experiences warrant the conclusion that in elected cases resection of bone tumour and reconstruction of the defect with bone graft is a justifiable procedure.

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*Table 1*

Histopathological diagnosis	No. of cases
Giant cell tumour	40
Chondrosarcoma	11
Parosteal osteosarcoma	5
Aneurysmal bone cyst	5
Chondromyxoid fibroma	2
Fibrosarcoma	1
Osteoma	1
<b>Total</b>	<b>65</b>

**Table 2**  
**Types of Grafts used for skeletal reconstruction**

Autologous fibular grafting	47
Resection arthrodesis of knee	16
Cortical graft from tibia	1
Rib graft	1
<b>Total</b>	<b>65</b>

Table 3  
Period of followup

	No. of patients
1-2 years	18
2-5 years	20
5-10 years	16
10-15 years	5
15-20 years	6
<b>Total</b>	<b>65</b>

Mean follow-up : 6 years

Table 4  
Upper Limb - Arm

Anatomical location of the tumour	Pathological diagnosis	No. of cases	Type of bone graft used for surgical reconstruction
Proximal humerus	Giant cell tumour	2	Fibular graft
	Chondrosarcoma	4	Fibular graft
Middle 1/3 humerus	Chondrosarcoma	1	Tibial graft
	Osteoma	1	Fibular graft

Table 5  
Forearm and Hand

Anatomical location of the tumour	Pathological diagnosis	No. of cases	Type of bone graft used for surgical reconstruction
Proximal Radius	Giant cell tumour	1	Fibular graft
Distal radius	Giant cell tumor	24	Fibular graft
	Aneurysmal bone cyst	3	Fibular graft
	Fibrosarcoma	1	Fibular graft
	Chondromyxoid Fibroma	1	Fibular graft
	Chondrosarcoma	1	Fibular graft
	Parosteal Osteosarcoma	1	Fibular graft
	Middle 1/3 Ulna	Parosteal Osteosarcoma	1
I Metacarpal	Giant cell tumour	1	Fibular graft
	Chondrosarcoma	1	Fibular graft
IV Metacarpal	Giant cell tumour	1	Fibular graft
	Aneurysmal bone cyst	1	Fibular graft

Table 6  
Lower Limb

Anatomical location of the tumour	Pathological diagnosis	No. of cases	Type of bone graft used for surgical reconstruction
Distal femur	Giant cell tumour	3	Resection arthrodesis of knee
	Parosteal osteosarcoma	1	
	Chondrosarcoma	1	
Proximal tibia	Parosteal Osteosarcoma	2	Resection arthrodesis of knee
	Aneurysmal bone cyst	1	
	Giant cell tumour	6	
Middle 1/3 tibia	Chondrosarcoma	2	
	Chondrosarcoma	1	Rib graft
Middle 1/3 femur	Chondromyxoid fibroma	1	Fibular graft
	Giant cell tumour	2	Fibular graft
Distal tibia	Giant cell tumour	2	Fibular graft

Table 7  
Complications

Sl No.	Complication	Arm	Forearm and hand	Lower limb	Total	Percentage
1.	Infection	0	3	2	5	7.7%
2.	Non-union	5	1	1	7	10.8%
3.	Local Tumour recurrence	0	3	0	3	4.6%
4.	Fracture of the graft	0	3	0	3	4.6%
5.	Nerve palsy	0	1	1	2	3.1%

### Editor's Comment :

The authors need to be congratulated for extensive series of bone tumours done. In the recurrence cases, the authors have not mentioned whether the tumours changed their nature, and how best the fixations could be improvised to have better union rates, cosmesis and good function without x-ray signs of degeneration.