

Use of fresh parental fibular allograft for reconstruction of skeletal defects after limb salvage surgery

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Abstract

Objective: To share early experience with paediatric patients having undergone skeletal reconstruction after limb salvage surgery.

Methods: A retrospective audit study was conducted at Aga Khan University Hospital, Karachi, from 1994 to 2011. An audit of the institutional tumour registry was done and relevant cases of paediatric patients having undergone skeletal reconstruction after limb salvage surgery were tracked. Outcomes were objectively assessed through Musculoskeletal Tumour Society score. International Society of Limb Salvage grading was used to measure union of the graft to the host bone.

Results: Of the total 9 patients, 5(55.6%) were males and 4(44.4%) were females with an overall mean age of 11 ± 3 SD years (range: 7-14 years). Six (66.7%) cases involved lower limbs, while 2(22.2%) cases involved upper limbs. The mean follow-up was 41 ± 3 SD months (range: 14-204 months). There was no tissue reaction observed locally or systemically. No local recurrence was seen. Mean Musculoskeletal Tumor Society score was 21.2 ± 3 SD and International Society Of Limb Salvage grading was excellent in 5(55.5%) patients and good in 2(22.2%). One (11.1%) fibula fractured due to non-union at the proximal site. One (11.1%) patient died of the disease. Donor site morbidity was minimum except a big toe drop in 1(11%) case.

Conclusion: Parental fresh fibular allografts provide a good alternative for skeletal reconstruction. Donor site morbidity was minimal.

Keywords: Parental fibula, Tumour, Limb salvage. (JPMA 64: S-151 (Suppl. 2); 2014)

Introduction

A significant number of patients who undergo resection of a malignant bone tumour of the extremity are skeletally immature. As a result of current adjuvant chemotherapy regimens, anticipated survival in patients with localised disease at presentation is 60% to 70%.¹

The goals in reconstructing skeletal defects in paediatric patients are long-term function and durable fixation. Limb reconstruction with a free vascularised fibular graft, rather than with allograft or endoprosthetic reconstruction, provides a viable bone environment that minimises complications secondary to chemotherapy and immunosuppression.² Free vascularised fibular grafts are either intercalary fibular grafts supplied by the peroneal vessels or proximal fibula grafts supplied by the anterior tibial vessels. Intercalary grafts provide enhanced osteosynthetic healing in complex reconstructions. Transfer of the proximal fibula allows for biologic joint reconstruction, and the active viable physis has the advantage of preserving longitudinal growth.³ Because of the rarity of bone sarcomas,

there is relatively little experience among surgeons with specialised techniques involved in these procedures.

Going one step ahead, there are times when we need some more bone stalk for reconstruction of skeletal defects and the vascularised fibula or the child's own fibula may not be enough for it, for that we can use the fibula from one of the parents for reconstruction and it has been used as a standard of treatment.^{4,5} The current paper shares our early experience with paediatric patients having undergone skeletal reconstruction after limb salvage surgery.

Materials and Methods

A retrospective audit was conducted at Aga Khan University Hospital (AKUH), Karachi, from 1994 to 2011. An audit of the institutional tumour registry was done and relevant cases were tracked of paediatric patients whose skeletal reconstruction was done solely or in addition to autografts by parental fibula whether donated by mother or father. Patients having fibula donated by other persons were excluded. Outcomes were objectively assessed through Musculoskeletal Tumour Society (MSTS) score for upper and lower limb (Table-1 a&b). International Society of Limb Salvage (ISOLS) grading was used to measure union of the graft to the host bone. The grading system covers 8 areas: healing of proximal or distal osteotomies; contour of the

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SCORE	PAIN	FUNCTION	EMOTIONAL	HAND POSITIONING	MANUAL DEXTERITY	LIFTING ABILITY
5	No pain	No restriction	Enthused	Unlimited	Unlimited	Normal load
4	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
3	Modest/Non-disabling	Recreational restriction	Satisfied	Not above shoulder or no Prosupination	Loss of fine movements	Limited
2	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
1	Moderate/Disabling	Partial restriction	Accepts	Not above wrist	Cannot pinch	Helping only
0	Severe disabling	Total restriction	Dislikes	None	Cannot grasp	Cannot help

a: For Upper Limb.

SCORE	PAIN	FUNCTION	EMOTIONAL	SUPPORTS	WALKING	GAIT	Final Patient Score of FUNCTIONAL EVALUATION
5	No pain	No restriction	Enthused	None	Unlimited	Normal	
4	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	
3	Modest/Non-disabling	Recreational restriction	Satisfied	None	Limited	Minor cosmetic	
2	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	
1	Moderate/Disabling	Partial restriction	Accepts	One cane or crutch	Inside only	Major cosmetic	
0	Severe disabling	Total restriction	Dislikes	Two canes or crutches	Not independent	Major handicap	
Patient score							

b: For Lower Limb.

Table-1: Musculoskeletal Tumour Society (MSTS) scoring system.

graft; fixation of the graft; density of the graft; stability of the joint; diameter of the graft; and degeneration of the joint. The score is calculated by adding the value for each criterion and dividing by the maximum attainable score overall. The score is expressed as a percentage, with a maximum possible score of 100%. Greater than 85% was taken as excellent, while 7-85% was good and 50-70% was taken as satisfactory. Below 50% was poor.

Results

Of the total 9 patients, 5(55.6%) were males and 4(44.4%) were females with an overall mean age of 11±3 SD years (range: 7-14 years). Six (66.7%) cases involved lower limbs,

while 2(22.2%) cases involved upper limbs. Six (66.7%) patients had Ewing's sarcoma, 2(22.2%) had osteosarcoma and 1(11.1%) had fibrous dysplasia. One (11.1%) Ewing's sarcoma patient died (Table-2). The mean follow-up was 41±3 SD months (range: 14-204 months). Five (55.6%) patients had fibula donated by the mother, while 3(33.3%) by the father. Parental fibula was harvested in a parallel operating room and delivered to the main operating room in sterile packing.

There was no tissue reaction observed locally or systemically. No local recurrence was seen. Mean MSTS score was 21.2±3 SD and ISOLS grading was excellent in 5(55.6%) patients and good in 2(22.2%). One (11.1%) fibula fractured due to non-

Table-2: Case series.

S.No	Age	Gender	Diagnosis	Follow-up	Recurrence	Complications
1	7	M	EWINGS	2	METS	Died Of Disease
2	9	F	EWINGS	2	None	
3	7	M	EWINGS	1-1/2	None	
4	10	M	OGS	2-1/2	None	
5	8	F	EWINGS	3	None	
6	10	M	OGS	3	Local Recurrence	Hip Disarticulation
7	9	F	EWINGS	1	None	
8	11	F	FIBROUS DYSPLASIA	1-1/2	None	
9	9	F	OGS	18	None	Fractured Twice; Managed Conservatively

METS: Metastatic

OGS: Osteosarcoma.

union at the proximal site. Donor site morbidity was minimum except a big toe drop in 1(11.1%) case.

Discussion

The reconstruction of large skeletal defects in children following resection of a bone tumour presents a unique challenge to the orthopaedic surgeon. Issues in this population that are not present in the adult population include significant remaining growth potential, the desire for biological preservation of the joint surface, and the need for a long-term viable reconstruction in patients who are anticipated to survive for decades. Vascularised fibulas are used for reconstruction. Vascularised fibular grafts, as opposed to non-vascularised fibular autografts or allografts, are necessary to reconstruct bony defects >6cm or defects associated with poorly vascularised tissue. Given the small size of the articulating segment in the paediatric population, other reconstructive options (prostheses, for instance) are far less optimal because they are generally too large for this population and do not provide durable intramedullary fixation in a growing tubular bone.

Fresh parental fibula is an easily available and inexpensive option with low morbidity. Parents are always willing to donate their fibula to their children. Mother's fibula is preferred over father's as it is small in size and needs minimal trimming. This fibula can be used as an intramedullary strut or as an extramedullary reconstructive option which is stabilised by compression plates or sometimes simple screws. The incorporation of the bone in the host is followed over a period of time.

Preoperatively the parents are evaluated for any communicable diseases. Pre-op counselling is also done about post-procedure precautions and rehabilitatory course and also about any possible complications. In our series we had

encouraging results of patients being tumour-free and also achieving near-normal life with good bone uptake and healing. Reconstruction of large skeletal defects following oncologic resection in skeletally immature patients should be durable throughout growth and development and provide optimal function. Techniques in these challenging procedures have evolved so that amputation is rarely indicated. The complexity of the reconstructive procedures in children requires specialists in microvascular surgery as well as orthopaedic surgery.

Conclusion

Parental fresh fibular allografts provided a good alternative for skeletal reconstruction, and donor site morbidity was minimal. Careful preoperative planning, patient evaluation and strict postoperative rehabilitation protocols are necessary to continue the successful track record.

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