



GIANT CELL TUMOR OF DISTAL RADIUS- EXCISION AND RECONSTRUCTION WITH NONVASCULARISED PROXIMAL FIBULAR AUTOGRAFT A CASE SERIES

VINOTH KUMAR N

Department of Orthopaedic Surgery, MADRAS MEDICAL COLLEGE AND GOVERNMENT GENERAL HOSPITAL

Abstract : Giant cell tumor is a benign aggressive bone tumor of obscure origin presenting in between second and fourth decade of life, accounts for 4-5percent of primary bone tumors and about 20 percent of benign bone tumors. Worldwide significantly higher incidence rates are observed in Asia, where it constitutes about 20percent of all primary bone tumors in China. It is slightly more common in females, has predilection for the epiphyseal metaphyseal region of long bones. After distal femur and proximal tibia, distal radius is the most common site of occurrence for GCT. This site has further distinction of having more aggressive behaviour of GCT with higher chances of recurrences and malignant transformation. Treatment options for GCT at this site include intraleisional curettage with bone grafting or cementing, sandwich technique, adjuvant treatment with Bisphosphonate Irrigation therapy, en bloc excision and reconstruction with non vascular or vascularised fibular autograft, osteoarticular allograft, ulnar translocation, endo prosthesis, custom mega prosthesis. Although amputation would seem likely to be curative, it is seldom warranted in a tumour that rarely metastasizes. 4 patients with mean age of 21years, with either Campanacci grade I, II or III histopathologically proven giant cell tumors of distal end radius were treated with wide excision with 2-3cm margin clearance and transverse osteotomy of proximal radius and reconstruction with ipsilateral nonvascularised proximal fibular autograft. Host graft junction was stabilised with Asian DCP in all cases. Wrist ligament reconstruction and fixation of the head of the fibula with carpal bones and distal ulna using K-wires and primary cancellous iliac crest grafting at graft host junction was done in all cases. The follow-up ranged from 14 to 20months. At last follow-up, the average combined range of motion was 100.5degrees with range varying from 60 to 125degrees. The average union time was 7.5months (range 4 to 12months). There was no case of graft fracture, metastasis, death or significant donor site morbidity. Conclusion, Enbloc resection of giant cell tumor of the distal end radius is widely accepted method. Reconstruction with nonvascularised fibular graft, internal fixation with Asian DCP

with primary corticocancellous bone grafting with transfixation of fibular head minimises the problem and gives satisfactory functional outcome.

Keyword : giant cell tumor, Osteoclastoma, non vascular proximal fibular graft, giant cell tumor distal radius, giant cell tumor excision reconstruction, campanacci grading

INTRODUCTION

Giant cell tumor is a benign aggressive bone tumor of obscure origin presenting in second and fourth decade of life, accounts for 4-5% of primary bone tumors and about 20% of benign bone tumors. In worldwide significantly higher incidence rates are observed in Asia, where it constitutes about 20% of all primary bone tumors in China²¹. It is slightly more common in females, has a predilection for the epiphyseal/metaphyseal region of long bones. After distal femur and proximal tibia, distal radius is the most common site of occurrence for GCT¹. This site has a further distinction of having more aggressive behaviour of GCT with higher chances of recurrences and malignant transformation. Treatment options for GCT at this site include intraleisional curettage¹ with bone grafting or cementing, sandwich technique²³ and adjuvant treatment with Bisphosphonate Irrigation therapy²², en bloc excision and reconstruction with non vascular²⁴ or vascularised fibular autograft, osteoarticular allograft, ulnar translocation, or endo prosthesis, custom mega prosthesis. Although amputation would seem likely to be curative, it is seldom warranted in a tumour that rarely metastasizes. The recurrence rate for primary treatment of GCT is relatively higher for curettage or extended curettage as compared to en bloc excision, making later a more suitable and reliable option in cases showing aggressive lesions which so often is the case in distal radius². Although providing the best chance of cure from GCT, en bloc excision of distal radius presents reconstructive problems. Reconstruction of wrist after en bloc excision of distal radius is a challenging task. Most patients are young active adults demanding cosmetically acceptable and functionally adequate wrist. We have used ipsilateral non vascularised fibular autograft for reconstructing distal radius. The problems with non vascularized fibular autograft are slow incorporation of the graft, osteoporosis, nonunion and progressive absorption over time.

MATERIALS AND METHODS

Four cases of giant cell tumor of the distal radius were followed up for a mean of 12 months (range 8 to 24 months). There were 3 female and 1 male patients. Their ages ranged from 15 to 26 years (average, 21 years). The average follow-up was 14 months (range, 8 to 20 months). All patients underwent staging studies that included plain radiography, computed tomography (CT), and chest CT. 3 patients underwent primary resection and reconstruction with fibular autograft. 1 patient had recurrent GCT who initially underwent curettage and bone grafting. Campanacci's staging system for giant cell tumour of the bone⁷, It is radiological grading system was used. Grade I tumour had a well-margined border of a thin rim of mature bone and the cortex was intact or slightly thinned but not deformed. Grade II tumour had relatively well defined margins but no radio-opaque rim. Grade III tumours had fuzzy borders. According to this system, 3 tumors were classified as Stage II and 1 tumour as Stage III. Core needle biopsy was performed and surgery was delayed until histo pathologic evaluation had been completed. One case (case 4) presented to us with local recurrence after curettage and application of bone graft. Core needle revealed recurrence. The tumor was approached through volar approach. Wide resection was done by transverse osteotomy of radius with a safety margin of 2 to 3 cm. The defect was bridged by ipsilateral non-vascularised proximal fibular autograft. Graft host junction was fixed by Asian DCP with cancellous bone graft from the iliac crest at the junction. Reconstruction of the inferior radio-ulnar and radio-carpal ligaments to the collateral ligament of fibular head by non-absorbable sutures passed through drill holes made in the graft. Distally fibular head fixed with K-wire to the carpal bones and the distal ulna. Postoperatively, an above elbow cast immobilisation was given for 8-12 weeks. After that, a below elbow splint was applied until union. K-wires were removed at 8-12 weeks. The functional evaluation was performed using a modified system of the Musculoskeletal Tumour Society.⁸ Radiological union of the graft was assessed according to Hsu et al⁹ with graft union defined as uninterrupted external bony borders between the graft and the recipient bone in addition to obscured or absent osteotomy lines.

RESULTS:

At last follow-up, the average combined range of motion was 100° (supination, pronation, dorsiflexion, palmar flexion, ulnar deviation and radial deviation) with range varying from 60° to 125°. Using the modified system of the Musculoskeletal Tumour Society,⁸ the mean functional score was 93.2 (ranged from 83 to 96). The average union time was 8 months (range 6 to 12 months). There were no non-union, graft resorption, localised recurrence, graft fracture, metastasis, death or significant donor site morbidity.

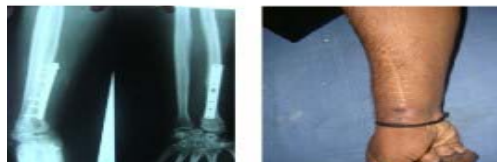
Table 1. MASTER CHART

Case	Age	Sex	Grade	Follow Up (months)	Graft union (months)	Functional score (%)	ROM (degree)	Complication	Secondary Procedure
1	24	M	III	22	8	83	90	none	none
2	19	F	II	10	6	93	110	none	none
3	26	F	II	9	4	96	110	none	none
4	15	F	II	8	12	89	90	none	none

CASE 1:

24/male, c/o pain & swelling for 3 months duration, X-ray osteolytic lesion with cortical breach, Biopsy-confirmed as GCT. Wide resection and fibular autograft, fixed with 3.5 DCP. At 2 year follow up patient had functional range of movement can do daily activities.

PRE OP

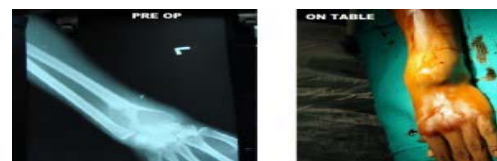


PRONATION

CASE 2 :

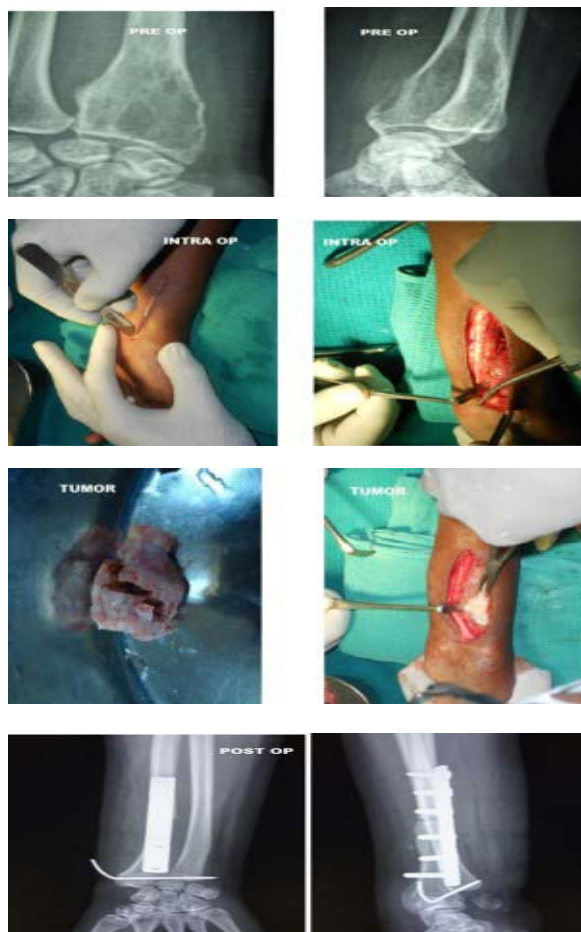
19/female, Pain and swelling for past 9 months, Biopsy-GCT, Wide resection and fibular autograft, fixed with 3.5 DCP

SUPINATION



CASE 3:

26/f, C/o pain & swelling of rt distal forearm for 6 months, H/O native treatment present, Biopsy – GCT right distal radius, P/D – Tumour resection, fibular autograft and fixed with ADCP



CASE 4:

18/ female, c/o pain and swelling for past 7 months, biopsy –GCT, 1st –curettage with bone graft and bone substitute, 2nd –recurrence with in 5 months, repeat biopsy came as grade III campanacci GCT, Proceeded with resection and reconstruction



DISCUSSION

Giant cell tumor is an aggressive neoplasm with a high rate of recurrence.¹⁰ The problem of selecting exact treatment is complicated by the failure of its histopathologic appearance to indicate its biologic behaviour.¹⁰ Despite many controversies, it is generally agreed that for a giant cell tumor of the distal end radius, the extent of the surgical procedure and subsequent functional deficit must be weighed against the chance of recurrence and its consequences.¹¹ There are several reports that giant cell tumors in the distal end of the radius are more aggressive and metastasise more often to the pulmonary system. Thorough extended curettage through a sufficiently large cortical window followed by good filling up of a cavity with cancellous bone grafts or bone cement seems to be justified only in histologically typical tumors that are well contained within an intact cortex. For histologically aggressive tumors, the only reliable technique appears to be en bloc resection with conservation of hand. The main causes for poor clinical results of curettage and bone grafting in extensive lesions were tumour recurrence and joint surface collapse. Thus the functional outcomes were worse than those of patients initially treated with wide resection and reconstructions.¹² Recently tumor excision and subchondral collapse can be prevented by doing sandwich technique, in which after extended curettage of lesion, cavity filled with cancellous bone graft and methyl methacrylate cement in a manner of layer by layer so that it will give secondary strength to prevent surface collapse. En bloc resection and reconstruction is strongly recommended, especially in high grade neoplasms and those which have recurred, have pathological fracture, have enlarged rapidly or are frankly malignant transformation.² Reconstruction is mandatory after adequate resection of the tumour to preserve the function and alignment. Many techniques have been described for reconstruction and include iliac crest graft, centralisation of ulna, distal radial allograft, vascularised or non-vascularised fibular graft and prosthesis.^{6, 13-17} endo prosthesis, osteoarticular allograft where bone bank facility available, custom mega prosthesis. Reconstruction with cortico cancellous iliac graft or centralisation of ulna sacrifices the wrist and forearm motion. Nearly half of these grafts suffer stress fracture and subsequent subluxation of joint. Although the use of radial allograft has shown encouraging results, there are many associated problems. Selection of suitable donors, the method of obtaining and preserving the graft, and the technique of allograft reconstruction deserve particular attention. The surgeon must consider the risks of infection, or graft rejection, delayed wound healing and functions of the wrist joint.¹⁷ Vascularised fibular auto graft is technically more demanding with the use of microsurgical techniques. All complications of vascularised free bone graft are possible. Skin closure of forearm also poses problems.¹⁵ The potentially increased operative time, effort, expense and associated complications must be shown to decrease the morbidity and late fracture

problems, before they can be considered superior to other.¹³ Non-vascular fibular autograft was first used in the year 1945 for congenital absence of radius.¹⁸ Later, fibular transplants were used by various authors for tumors of the distal end radius.^{6,14} This reconstruction technique has yielded good functional results for giant cell tumour of the distal end of the radius in various series, although large series with longer follow-ups are few.^{6,13} This procedure also has problems such as delayed union, nonunion, stress fractures, bone resorption, deformities, ulnar impingement, carpal degenerative changes and donor site morbidity.⁶ In a review of a large series of patients treated with a similar technique of reconstruction with osteoarticular allograft of the distal radius, allograft was revised or amputation was performed in 33% of the cases.¹⁹ Murray and Schlafly et al reported in their study that some patients in whom arthroplasty of the distal radius had been fashioned with vascularised fibular graft required arthrodesis due to persistent pain in all movements of wrist joint.²⁰ In this case series, we treated 4 patients with giant cell tumour of the distal radius by wide resection and non-vascularised fibular graft. Graft union occurred in a time comparable with the published series.^{5,6,13} This reconstruction technique has yielded good functional results (Table 1). Our combined range of motion was an average of 100°. This has been shown in literature to vary from 40° to 77° and 70° to 185°, respectively. ^{6, 21} Non-vascularised proximal fibular graft is reasonably congruous with distal radius. Its incorporation as an autograft is more rapid and predictable. Moreover, it is easily accessible without significant donor site morbidity. Literature reveals donor site morbidity in the form of objective motor weakness, subjective discomfort in the ankle and other sites in the leg, and sensory abnormalities in the lower limb (or limbs) from which the graft had been obtained, common peroneal nerve injury slightly prevalent in vascularised autograft²⁵. The wrist functions are clinically acceptable. Using this technique of reconstruction after wide resection of the giant cell tumour of the distal end of the radius is a reasonable method for managing such a problem with good functional results.

CONCLUSION

En bloc resection of giant cell tumors of the lower end of radius is a widely accepted method. Reconstruction with non-vascularized bular graft, internal fixation with Asian DCP with trans fixation of the bular head and wrist ligament reconstruction minimizes the problem and gives satisfactory functional results. Non-vascularised proximal bular graft is reasonably congruous with distal radius. Its incorporation as an autograft is more rapid and predictable. Moreover, it is easily accessible without significant donor site morbidity. The wrist functions are clinically acceptable. Using this technique of reconstruction after wide resection of the giant cell tumor of the distal end of the radius is a reasonable method for managing such a problem with good functional results.

REFERENCES

1. Szendroi M. Giant cell tumor of bone. *J Bone Joint Surg Br* 2004;86:5-12.
2. Smith RJ, Mankin HJ. Allograft replacement of distal radius for giant cell tumor. *J Hand Surg Am* 1977;2:299-309.
3. O'Donnell RJ, Springfield DS, Motwani HK, Ready JE, Gebhardt MC, Mankin HJ. Recurrence of giant cell tumors of the long bones after curettage and packing with cement. *J Bone Joint Surg Am* 1994;76:1827-33.
4. Rock MG. Curettage of giant cell tumour of bone. Factors influencing local recurrences and metastasis. *ChirOrganiMov* 1990;75:204-5.
5. Lackman RD, McDonald DJ, Beckenbaugh RD, Sim FH. Fibular reconstruction for giant cell tumour of the radius. *ClinOrthop* 1987;218:232-8.
6. Dhammi IK, Jain AK, Maheshwari AV, Singh MP. Giant cell tumors of lower end of the radius: problems and solutions. *Indian J Orthop* 2005;39:201-5.
7. Campanacci M. Giant cell tumor and chondrosarcoma: grading, treatment and results. *Cancer Res* 1976;54:257-61.

8. Enneking WF, Dunham W, Gebhardt MC, Malawar M, Pritchard DJ. A system for the functional evaluation of reconstructive procedures after surgical treatment of tumors of the musculoskeletal system. *ClinOrthop* 1993;241-6.
9. Hsu RW, Wood MB, Sim FH, Chao EY. Free vascularised fibular grafting for reconstruction after tumour resection. *J Bone Joint Surg Br* 1997;79:36-42.
10. Smith RJ, Mankin HJ. Allograft replacement of distal radius for giant cell tumor. *J Hand Surg Am* 1977;2:299-308.
11. Lackman RD, McDonald DJ, Beckenbaugh RD, Sim FH. Fibular reconstruction for Giant cell tumour of the radius. *ClinOrthop* 1987;218:232-8.
12. Su YP, Chen WM, Chen TH. Giant cell tumors of bone: an analysis of 87 cases. *IntOrthop* 2004;28:239-43.
13. Murray JA, Schlafly B. Giant cell tumors in the distal end of the radius. Treatment by resection and fibular autograft interpositional arthroplasties. *J Bone Joint Surg Am* 1986;68:687-94.
14. Parrish FF. Treatment of bone tumors by total excision and replacement with massive autologous and homologous grafts. *J Bone Joint Surg Am* 1966;48:968-90.
15. Pho RW. Malignant giant cell tumor of the distal end or the radius treated by a free vascularized fibular transplant. *J Bone Joint Surg Am* 1981;63:877-84.
16. Unni KK. General aspects and data on 11087 cases. In: Dahlin's Bone Tumors. 5th ed. Philadelphia: Lippincott-Raven Publishers, 1996:263-87.
17. Mund DF, Yao L, Fu YS, Eckardt JJ. Case report 826: physiological resorption of allograft simulating recurrent giant cell tumor. *Skeletal Radiol* 1994;23:139-41.
18. Starr DE. Congenital absence of radius; method of surgical correction. *J Bone Joint Surg* 1945;27:572.
19. Kocher MS, Gebhardt MC, Mankin HG. Reconstruction of the distal aspect of the radius with the use of osteoarticular allograft after excision of skeletal tumour. *J Bone Joint Surg* 1998;40:7419.
20. Murray JA, Schlafly B. Giant cell tumors in the distal end of the radius. Treatment by resection and fibular autograft interpositional arthroplasties. *J Bone Joint Surg Am* 1986;68:794.
21. Thomas, D. M., & Skubitz, T. (2009). Giant-cell tumour of bone. *Current Opinion in Oncology*, 21, 338-344.
22. Southern Medical University, Guangzhou, Guangdong 510515, PR China. Electronic address: Medical Hypotheses (Impact Factor: 1.15). 08/2013; DOI: 10.1016/j.mehy.2013.08.002 Source: PubMed
23. Indian J Orthop. 2007 Apr-Jun; 41(2): 151-153. doi: 10.4103/0019-5413.32048. PMID: PMC2989140, Multicentric giant cell tumor around the knee Anil Salgia, SK Biswas, Rahul Agrawal, and Vishavdeep Goyal
24. Giant Cell Tumour of the Distal Radius: Wide Resection and Reconstruction by Non-vascularised Proximal Fibular Autograft Ayman Abdelaziz Bassiony, *IMD*
25. *J Bone Joint Surg Am*. 1996 Feb;78(2):204-11. Donor-site morbidity with use of vascularized autogenous fibular grafts. Vail TP1, Urbaniak JR1 Duke University Medical Center, Durham, North Carolina 27710, USA.