Original Article

Giant Cell Tumour of the Distal Radius: Wide Resection and Reconstruction by Non-vascularised Proximal Fibular Autograft

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Abstract

Introduction: Giant cell tumours of the bone are aggressive and potentially malignant lesions. Juxtaarticular giant cell tumours of the lower end radius are common and present a special problem of reconstruction after tumour excision. Out of the various reconstructive procedures described, non-vascularised fibular autograft has been widely used with satisfactory functional results. Materials and Methods: Ten patients with a mean age of 33.4 years, with either Campanacci grade II or III histologically proven giant cell tumours of lower end radius were treated with wide excision and reconstruction with ipsilateral non-vascularised proximal fibular autograft. Host graft junction was fixed with dynamic compression plate (DCP) in all cases. Wrist ligament reconstruction and fixation of the head of the fibula with carpal bones and distal end of the ulna using K-wires and primary cancellous iliac crest grafting at graft host junction was done in all cases. Results: The follow-up ranged from 30 to 60 months (mean, 46.8). At last follow-up, the average combined range of motion was 100.5° with range varying from 60° to 125°. The average union time was 7 months (range, 4 to 12). Non-union occurred in 1 case. Graft resorption occurred in another case. Localised soft tissue recurrence occurred in another case after 3 years and was treated by excision. There was no case of graft fracture, metastasis, death, local recurrence or significant donor site morbidity. A total of 3 secondary procedures were required. Conclusions: Enbloc resection of giant cell tumours of the lower end radius is a widely accepted method. Reconstruction with non-vascularised fibular graft, internal fixation with DCP with primary corticocancellous bone grafting with transfixation of the fibular head and wrist ligament reconstruction minimises the problem and gives satisfactory functional results.

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Key words: Bone tumours, Bone graft, Giant cell tumour, Wide resection

Introduction

Giant cell tumours (GCT) of the bone are aggressive and potentially malignant lesions. They are recognised for variable clinical behaviour, which is not always related to radiographic or histological appearance.[1] Giant cell tumour is an aggressive lesion with a high rate of recurrence. The problem of selecting proper treatment is complicated by the failure of its histologic appearance to indicate its biologic behaviour.[2]

Treatment of GCT of bone is basically via surgical intervention by curettage and adjuvant treatment to eliminate any remnant of the tumour, and reconstruction of the osseous defect with bone graft or methylmetacrylate. However, the treatment of Stage III GCT, that is, whether to perform an intralesional or en-bloc resection, remains controversial.[3,4]

Despite controversies, it is generally agreed that for a giant cell tumour of lower end radius, the extent of the surgical procedure and subsequent functional deficit must be weighed against the chance of recurrence.[5]

Complete excision of the tumour offers the best chance of cure but sacrifices the articular surface and presents complex reconstructive problems. This may lead to complications, repeat surgeries and a decreased quality of life. Although the method for the resection of giant cell tumours has been fairly uniform in literature, the methods of reconstruction have varied. Proximal fibular autograft (vascularised and non-vascularised) has been widely used with good results.[6]

In this prospective case series of patients with giant cell tumour of the distal radius, we questioned the effectiveness of reconstruction of the defect after wide resection using non-vascularised fibular autograft. We assessed the radiological and functional outcome at a mean follow-up of 4 years.

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Patients and Methods

Ten patients with giant cell tumour of the bone at the distal end of the radius were treated between January 2003 and January 2008 at our institution. There were 3 male and 7 female patients. Their ages ranged from 25 to 45 years (average, 33.4 years). The average follow-up was 46.8 months (range, 30 to 60 months) (Table 1). All patients underwent staging studies that included plain radiography, computed tomography (CT), magnetic resonance imaging (MRI) and chest CT.

Campanacci's staging system for giant cell tumour of the bone,[7] was used for cortical breach. Grade I tumour had a well-marginated 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 tumours were classified as Stage II and 7 tumours as Stage III.

If the clinical presentation and the imaging studies were compatible with a diagnosis of a classic benign giant cell tumour of the bone, the biopsy (frozen section) and surgery were performed during the same session. In the case of atypical clinical or radiologic presentation, either CT guided core needle or open incisional biopsy was performed and surgery was delayed until histopathologic evaluation had been completed. One case (case 1) was presented to us with local recurrence after curettage and application of bone cement. Open biopsy revealed that the lesion was still benign.

The tumour was approached through volar approach. Wide resection was done with a safety margin of 2 to 3 cm based on the tumour extent in the MRI. The defect was bridged by non-vascularised proximal fibular autograft. Graft host junction was fixed by small DCP with cancellous bone graft from the iliac crest at the junction (Fig. 1). Reconstruction of the wrist ligaments was done via repair of the remnants of the inferior radio-ulnar and radio-carpal ligaments to the graft by non-absorbable sutures passed through drill holes made in the graft. The proximal fibular graft was fixed with K-wire to the carpal bones and the distal ulna. Postoperatively, an above elbow cast immobilisation was given in all cases for 3 months. After that, a below elbow splint was applied until union. K-wires were removed at 8 weeks. Patients were followed-up at weekly intervals in the first month, fortnightly for the next 2 months and monthly thereafter. X-rays were taken at every visit after the 8 weeks and then every 6 weeks. The aim of the early follow-up is to detect local recurrence. 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 al[9] 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 100.5° (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) (Table 1).

The average union time was 7 months (range 4 to 12 months). Non-union occurred in 1 case (Case 6) and was treated by additional bone graft from the iliac crest and full union was achieved at 12 months (Fig. 2). Graft resorption occurred in another case that was managed by wrist arthrodesis using intercalary fibular graft and iliac crest bone graft (Fig. 3). Localised soft tissue recurrence was encountered in another case (Fig. 4) after 3 years and

Table 1. Patients' Characteristics

Case	Age	Sex	Grade	Follow-up (mo)	Graft union (mo)	Functional score (%)	ROM	Complication	Second procedure
Case 1	25	F	II	60	6	96	125°	None	None
Case 2	28	M	II	56	8	93	120°	None	None
Case 3	30	F	III	48		83	–	Graft resorption	Wrist arthrodesis
Case 4	34	F	III	48	8	93	110°	None	None
Case 5	42	M	II	30	4	96	90°	None	None
Case 6	35	F	III	60	12	90	60°	Non-union	Secondary grafting
Case 7	45	F	III	36	7	96	100°	None	None
Case 8	25	F	III	30	7	93	90°	None	None
Case 9	44	M	III	55	8	96	125°	Soft tissue recurrence	Excision and implant removal
Case 10	26	F	III	45	10	96	85°	None	None

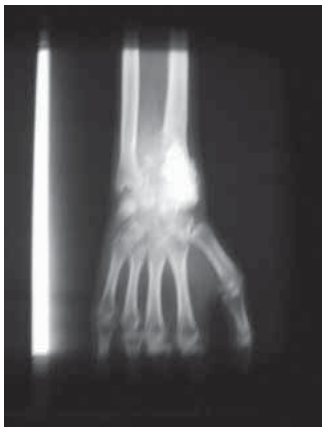

Fig. 1a.

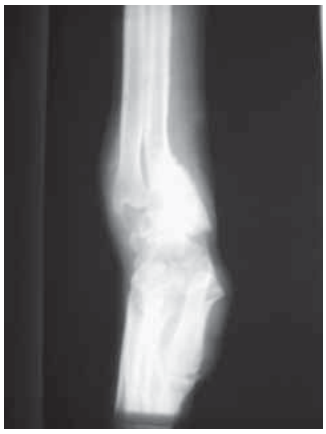

Fig. 1b.

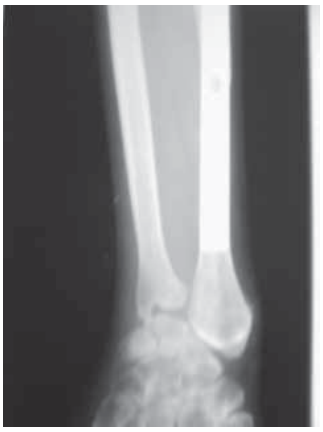

Fig. 1c.

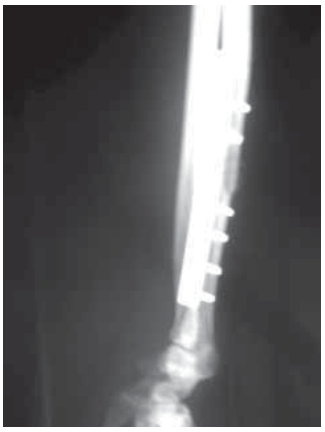

Fig. 1d.

Fig. 1. (a) and (b) Plain X-rays at presentation showing recurrence after curettage and bone cement. (c and d) Follow-up X-rays showing full union of the graft at 6 months.

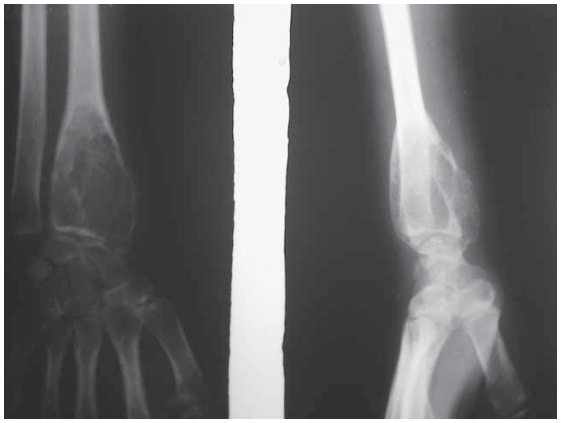

Fig. 2a.

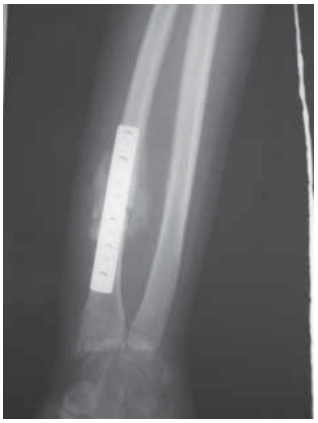

Fig. 2b.

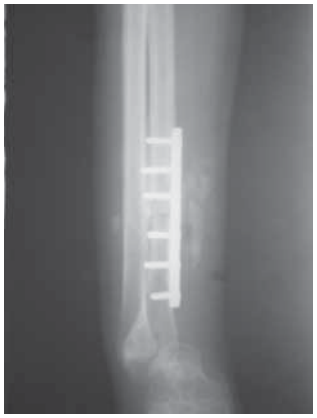

Fig. 2c.

Figure 2. (a) Plain X-ray showing typical giant cell tumour of the distal radius (Case 6). (b and c) Follow-up X-ray after secondary bone graft application.

was managed by a local excision of the nodule with the removal of the plate as the graft was fully united. This patient was followed for another 2 years and achieved good functional results with no complications. A total of 3 secondary procedures were required. There was no case of graft fracture, metastasis, death, local recurrence or significant donor site morbidity.

Discussion

Giant cell tumour is an aggressive lesion with a high rate of recurrence.[10] The problem of selecting proper treatment is complicated by the failure of its histologic appearance to indicate its biologic behaviour.[10] Despite controversies, it is generally agreed that for a giant cell tumour of the lower end radius, the extent of the surgical procedure and subsequent functional deficit must be weighed against the chance of recurrence.[11] There are reports that giant cell tumours in the lower end of the radius are more aggressive and metastasise more often to the lungs.[1]

Thorough curettage through a sufficiently large window followed by good filling up of a cavity with cancellous bone grafts seems to be justified only in histologically typical tumours that are well contained within an intact cortex. For histologically aggressive tumours, the only reliable technique appears to be en-bloc resection with conservation of extremity. The main reasons for poor 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]

En-bloc resection is strongly recommended, especially in high grade tumours and those which have recurred, have pathological fracture, have enlarged rapidly or are frankly malignant.[2] Reconstruction is necessary 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

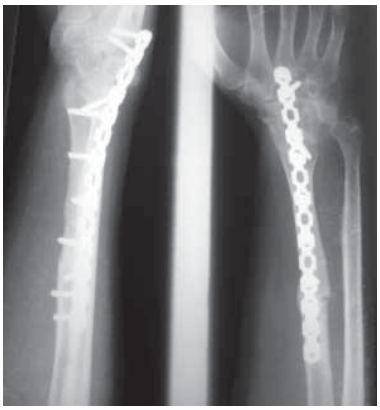

Fig. 3. Wrist arthrodesis in case 3 with graft resorption.

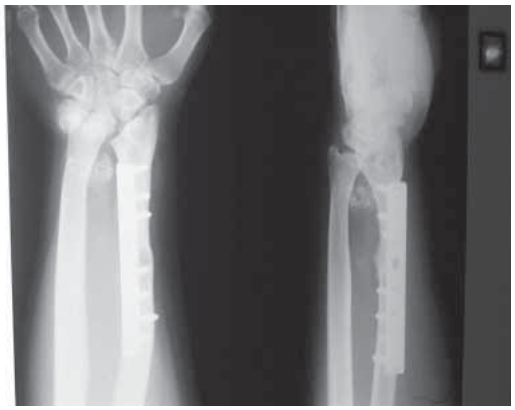

Fig. 4a.

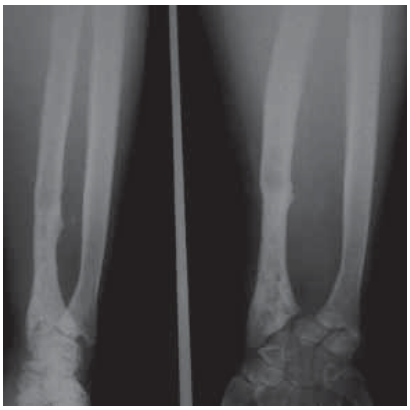

Fig. 4b.

Fig. 4. (a) Follow-up X-ray after 3 years showing localised soft tissue recurrence with peripheral calcification. (b) X-ray after excision of the nodule and removal of the plate.

allograft, vascularised or non-vascularised fibular graft and prosthesis.[6, 13-17]

Reconstruction with corticocancellous iliac or centralisation of ulna sacrifices the wrist and forearm motion. Nearly half of these grafts suffer stress fracture.[5] 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 healing and functions of the wrist joint.[17] Vascularised fibular autograft 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.[13]

Non-vascularised fibular autograft was first used in 1945 for congenital absence of radius.[18] Later, fibular transplants were used by various authors for tumours of the lower end radius.[6,14] This reconstruction technique has yielded good functional results for giant cell tumour of the lower 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, non-union, 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 reported that some patients in whom arthroplasty of the distal radius had been fashioned with vascularised fibular graft required arthrodesis due to persistant pain.[20] We had 1 case that required wrist arthrodesis after the graft had been resorbed.

In this case series, we treated 10 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 100.5°. This has been shown in literature to vary from 40° to 77° and 70° to 185°, respectively.[6,21]

We noted 1 case of soft tissue recurrence. Recurrence was reported to be nil by Chiang[21] (n = 8), 5 by Murray[20] and 1 by Lackman.[11]

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. 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.

Financial support: No financial support was received for this study.

Ethical approval: The board of the Orthopaedic Department at Ain Shams University has approved this study from the scientific and ethical point of view. This study meets the ethical standards and complies with the national as well as the local standards set within the department.

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