

Wide excision and ulno-carpal arthrodesis for primary aggressive and recurrent giant cell tumours

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Abstract Twenty-five patients underwent wide resection of the distal radial giant cell tumours (GCTs) followed by ulno-carpal arthrodesis. There were 15 male and ten female patients, with an average age of 21.5 years. Tumours included ten primary aggressive and 15 recurrent GCTs.

Mean follow up was 2.4 years. Pain, swelling and reduced range of movement (ROM) were noted. Average time to fusion was 7.6 months. Five patients had persistent pain in the proximal forearm. Grip strength was 65% compared to the uninvolved side. Two patients had superficial wound infection, two underwent additional bone grafting and three implant removals due to hardware prominence were carried out. There was no evidence of carpal instability or arthritis on clinical or radiological examination at the time of final follow up. Fusion of the carpus to the ulna is a simple method of producing a painless stable wrist, though at the expense of mobility. The procedure allows wide resection with a lower rate of recurrence. Pain in the proximal forearm seems to persist for 3 to 4 months only to improve at subsequent follow up. The procedure provides a valid option for the management of primary aggressive and recurrent GCTs of distal radius.

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Résumé 25 patients ont bénéficié d'une large résection pour tumeurs à cellules géantes agressives de l'extrémité distale du radius. A ce traitement a été associé une arthrodèse cubito carpienne. Il s'agissait de 15 sujets de sexe masculin et de 10 sujets de sexe féminin. 10 tumeurs étaient primitives et 15 étaient des récives. L'âge moyen des patients était de 21.5 ans, le suivi moyen de 2.4 ans. Les douleurs et la mobilité du poignet ont été évaluées. Le temps moyen pour la fusion osseuse a été de 7.6 mois. 5 patients présentaient des douleurs résiduelles au niveau de l'extrémité distale de l'avant bras, la force de serrage était de 65% en comparaison au côté sain. Deux patients ont présenté une infection superficielle, deux ont nécessité une greffe secondaire et trois une ablation de matériel nécessaire du fait de la gêne qu'il entraînait. Le suivi n'a pas mis en évidence d'instabilité du carpe ou d'arthrose. Seuls 4 patients ont dû changer de travail. L'arthrodèse du cubitus au carpe est une technique

simple, peu douloureuse et permettant d'obtenir un poignet stable. Cette technique permet de larges résections avec un taux faible de récurrence de la tumeur. La douleur semble persister au niveau de l'avant bras pendant 3 ou 4 mois puis paraît s'améliorer par la suite. Cette technique nous semble tout à fait valable pour le traitement des tumeurs primitives à cellules géantes agressives ainsi que pour les récurrences de tumeurs à cellules géantes de l'extrémité distale du radius.

Introduction

Up to 10% of giant cell tumours (GCTs) of bone occur in the distal radius, making this the most frequently reported tumour of the distal radius [4, 6, 11, 16]. Treatment goals include excision of the lesion, the restoration of function and the prevention of recurrence. Several different surgical options exist, which include curettage and bone grafting, chemical treatment, cementing, wide local excision and reconstruction in the form of arthrodesis or arthroplasty with vascularised or non-vascularised fibula grafting, distal ulnar translocation and osteoarticular allografts. The complexity of reconstruction increases with all of these procedures and requires microvascular expertise and the services of bone banking. Recurrence continues to be a major problem in spite of recent developments for a group of primarily aggressive GCTs. The authors aim to report a simple technique of fusing the wrist to ulna in a functional position which allows wide resection in the case of a primary aggressive or recurrent distal radial GCT.

Materials and methods

The authors' institute is a 650-bed regional comprehensive cancer care centre providing in-patient treatment to approximately 18,000 cancer-related patients per year. The subjects of the study presented to the Department of Orthopaedic Oncology from various parts of the Gujarat state, as well as the neighbouring states of Rajasthan and Madhya Pradesh. From 1995 to 2003, 25 patients, 15 male and ten female at a mean age of 21.5 years, underwent operative management using the technique of ulno-carpal arthrodesis for distal radius GCTs.

Information regarding patient demographics, dominant side, involved side, primary or secondary referral, previous treatment, stage of the tumour, strength and occupation requirement, presenting complaints and delay in the presentation from the time of symptom onset or recurrence was collected by reviewing health records and imaging modalities. Plain radiographs were assessed for the effects of the tumour on the bone, recurrence of the tumour, local reaction of the bone to the tumour and the presence and

character of tumour matrix formation. Magnetic resonance (MR) scans were used to delineate the integrity of the wrist ligaments, the presence of cortical destruction and soft tissue extension of the tumour. Computed tomography (CT) scans of the chest were carried out if necessary to detect a distant spread of the primary aggressive tumours. Histological diagnosis was confirmed either by an initial biopsy or surgical specimen.

Surgical technique involved en block excision of the tumour with the creation of a single-bone forearm or centralisation of the ulna on the wrist. Following resection of the tumour with optimal margins, the ulna is detached from the carpus by dividing the ulnar collateral ligament and resecting the triangular fibrocartilage complex. The articular surface of the distal ulna and proximal row carpal bones were decorticated, exposing the underlying cancellous bone. A mortise was created in the central portion of the carpus to accept the distal ulna, which was aligned with the third metacarpal. The hand and carpus were positioned in neutral flexion and extension and neutral to slight pronation. A dorsal compression plate or an intra-medullary Steinmann pin with supplemental K wires were used to provide fixation. A plaster cast was applied post-fixation for 6–10 weeks to protect the reconstruction. Outcome assessment included grip strength, elbow function, time to radiological fusion and return to occupation.

Results

All of the cases had unilateral involvement. Eighteen patients had the dominant side involved. Fifteen patients were manual labourers. Fifteen patients who presented with recurrent GCT had failure of the previous procedure. Eight of these patients were referred for recurrence after primary curettage and bone grafting (CBG) carried out elsewhere; four patients had CBG carried out at the authors' institute only and an example of this is shown in Fig. 1. Two patients had previous fibular arthrodesis. One patient had CBG followed by fibular arthrodesis. These three patients had recurrence in the fibula graft, an example of which is shown in Fig. 2. Ten patients presented with voluminous tumours, having a cortical break or intra-articular extension and the involvement of nearly the entire epiphysis-metaphyseal region rendering CBG impossible (Enneking stage III). The average time from the onset of symptoms to presentation at the institute was 14.2 weeks and 8.9 weeks for the patients presenting primarily and those presenting after recurrence due to failure of the primary procedure, respectively. Table 1 summarises the demographic data as well as the presenting types.

All patients underwent wide excision of the distal radius (or fibula) and ulno-carpal arthrodesis. The average operating



Fig. 1 **a** Recurrence of giant cell tumour (GCT) following curettage and bone grafting (CBG). **b** Ulno-carpal fusion at 2.5 years follow up

time was 126 min. A dorsal plate was applied in 21 patients and intra-medullary Steinman pins in three cases. One patient had K wire fixation only. Bracing was required for a period of 10 weeks on an average. Three patients had superficial infection, which settled with antibiotics. The average length of the distal radius excised was 11.4 cm (range 8–14.7 cm) with tumour-free margins of at least 2 cm.

Patients were followed up for a period of 2.4 years on average (range 2–6.5 years). Bony fusion was confirmed

both clinically and radiologically in all of the patients at an average time of 7.6 months. Two patients required an additional procedure in the form of bone grafting at 7.6 months and 8 months. Six patients complained of prominent hardware and underwent the removal of the dorsal plate. No wrist instability was noted at the final follow up.

There were no recurrences (either the involvement of ulna or soft tissue recurrences). Five patients had persistent pain in the proximal forearm, which settled in approximately at 12 months follow up. Grip strength on the operated side was 70% compared to the uninvolved side. There was no evidence of carpal instability or arthritis on clinical or radiological examination at the time of the final follow up. Four patients had a change of occupation as they moved away from heavy manual labour work.

Discussion

The management of primary aggressive and recurrent GCTs represents a challenging task as, anatomically, the region has a soft tissue envelope with neurovascular structures and a relationship with the proximal carpal row which makes excision difficult without compromising hand function. This is further compounded by the fact that recurrence is higher with distal radius GCTs compared to other locations like the distal femur and proximal tibia [13, 21]. The goals in the management are to remove the tumour as completely as possible, prevent recurrence, preserve function and achieve a stable wrist while minimising the number of procedures.

Treatment strategy has evolved over the years with different surgical options, which can be summarised under two main categories:

1. Intra-lesional curettage and/or chemical treatment, followed by packing of the cavity with bone grafts, bone graft substitutes and/or polymethylmethacrylate (PMMA) [1, 24].
2. En bloc resection of the entire tumour followed by reconstruction in the form of arthroplasty or arthrodesis using: (a) a proximal or mid-shaft fibula, which could be vascularised or non-vascularised, an autograft or allograft [7, 12, 15, 22, 23]; (B) an osteoarticular fresh-frozen allograft [8, 9]; (C) distal ulnar translocation to create a single-bone forearm [18]; (D) a vascularised pedicle graft of the ulna [10] and (E) a structural autograft from either ilium or proximal tibia [17].

Several modifications of the above techniques have been suggested. These include partial wrist arthrodesis [14] or the addition of the Sauve-Kapandji procedure [19] after resection and osteoarticular allografting.

It has generally been accepted that stage I and II lesions are amenable to CBG or a less aggressive type of surgical

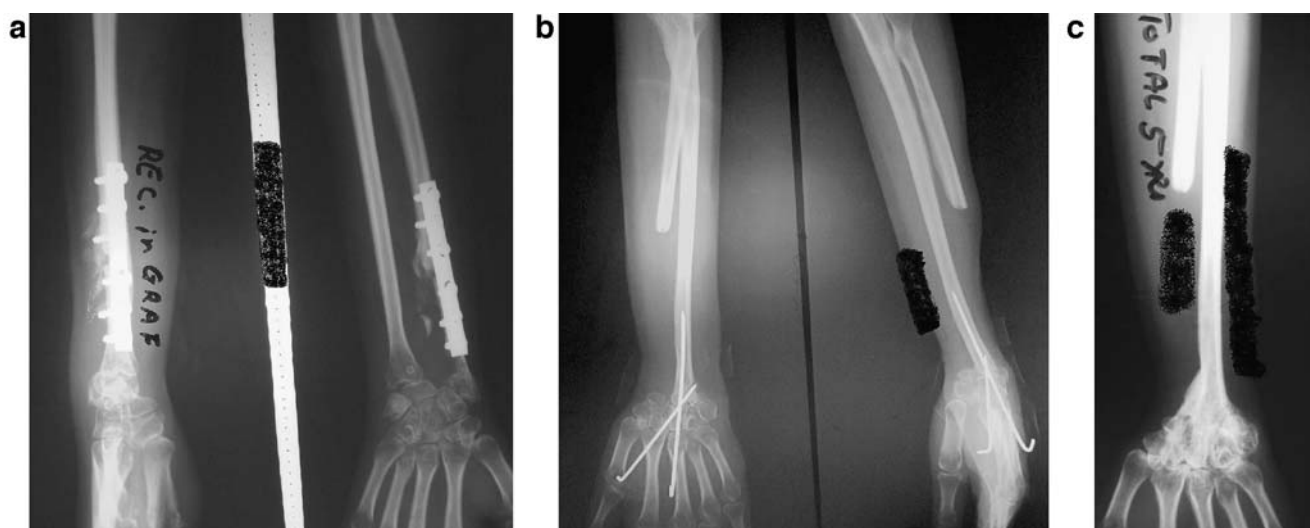


Fig. 2 **a** Recurrence of GCT in a fibula graft. **b** Excision of the graft and ulno-carpal fusion with K wires. **c** Sound and stable ulno-carpal fusion at 5 years follow up

management [1, 24]. Recurrence rates with curettage and phenol and packing with PMMA or bone grafts are 5–17% [13, 24]. The management of stage III lesions remains controversial, with increasingly complex reconstructions being undertaken, as mentioned above. None of the procedures are, however, free from complications. Curettage only is likely to have poor wrist function and a recurrence rate of up to 70%. The cortical grafts have reduced capacity to withstand the stress and are likely to undergo fatigue fracture during the first two-year interval [5, 14]. This will necessitate external orthotic support during this one- to two-year post-operative period. Other disadvantages include donor site morbidity, palmar/ulnar subluxation of the carpus or instability [4], delayed or the non-union of the fibulo-radial junction [24], distal radio-ulnar joint instability [4], post-arthroplasty degenerative changes and the requirement of an additional procedure, such as bone grafting. The cortical graft is not free from recurrence either. Three patients in our series had such a

recurrence involving a fibular graft. These procedures require a certain level of expertise (microvascular) and institutional facilities (bone banking).

The authors describe the technique of the resection of distal radial GCTs followed by ulno-carpal arthrodesis. The concept of the creation of a single-bone forearm or centralisation of the wrist and hand on the ulna was initially described for the congenital absence of radius [20] and for the loss of large segments of the radius secondary to trauma or osteomyelitis [2, 3]. However, this has not been described in context with the management of GCTs of distal radius. Fusion of the carpus to the ulna is a simple method of producing a painless stable wrist with reasonable grip strength, though at the expense of mobility. This technique allows wide local excision and, thereby, reduces the local recurrence. The procedure is relatively short and avoids the problems associated with graft procurement, graft fracture, hardware failure and need for long-term bracing. It allows considerable lengths of the

Table 1 Patient demographics according to presentation types

Characteristics	Primary presentation	Recurrent tumours after previous procedures		No. of patients
		CBG*	Fibular arthrodesis	
No. of patients	10	12	3	25
Male	7	6	2	15
Female	3	6	1	10
Average age (years)	23.5	22	24.4	23.4 years
Symptom duration (weeks)	14.2	7.3	10.5	
11.5 weeks				
Cortical break (no. of cases)	8	9	3	20
Soft tissue extension Enneking stage III (no. of cases)	7	6	3	16

*CBG=curettage and bone grafting

radii to be removed to provide adequate tumour-free margins, as it does not rely on the availability of a size-limited autograft or allograft for a later reconstruction. None of the patients had persistent pain or instability around the wrist. A reasonable range of supination and pronation can be obtained.

The procedure was selected over the other procedures by the authors as it seems to meet the high demands of our patient population, which mainly comprised of manual workers, as well as having the ability to carry out wide local excision. The procedure was undertaken only after a detailed discussion about the advantages and disadvantages of various other options. According to the authors, the advantages that prompted the patients to select this procedure over the others included the avoidance of fibular grafting, multiple operations and the possible low incidence of recurrence.

One of the pre-requisites for this procedure would be normal function of the elbow and shoulder to compensate for the loss of wrist movements. Pre-operative scans will help detect the extent of involvement of soft tissues and the carpus. The position of arthrodesis is, again, an important consideration and requires attention to detail. Pain in the proximal forearm seems to persist for 3 to 4 months on the removal of plaster; however, an improvement was noted for 80% of the patients at 1 year and subsequent follow up, as most of the patients in our series returned to their original occupation. This is probably associated with the hypersensitivity at the proximal radial stump, which is more pronounced during pronation and supination. This procedure may have a low overall functional outcome and satisfaction compared to fibular arthrodesis [16] but it does seem to work well for a carefully selected group of patients.

Though the procedure cannot be uniformly applied to all cases of recurrent or stage III tumours, it certainly adds to the armamentarium of an orthopaedic onco-surgeon. The results are from a short to intermediate follow up only and, importantly, no recurrences or deaths due to the disease have been noted. Long-term results need to be evaluated, particularly with reference to the effect of the procedure on the elbow and the rest of the carpus.

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