Abstract: We report a case series of four patients with giant cell tumour of the distal end of the radius managed by wide resection and reconstruction using fibular autograft and its oncological and functional outcome from January 2009 and July 2011. There were 4 cases of GCT involving distal radius managed by wide resection and autogenous fibular bone grafting with a mean age of 21 years. All patients were Campanacci Grade III. The mean follow up was 16.25 months with a maximum follow up of 26 months. The functional and oncological outcomes of the patients were analysed. The functional outcome of the patients were evaluated using the Musculoskeletal tumour society scoring the mean of which was 22 (range 18 to 26). Three patients showed clinical and radiological union. Average palmar flexion of the wrist was 67 degrees (range 55 to 85) and dorsiflexion was 50 degrees (range 20 to 70). The mean supination achieved in our study was 31 degrees (range 0-50) and the mean pronation was 75 degrees (range 60-90). None of our patients had a recurrence at the surgical site or distant metastasis at the time of latest follow-up. Stiffness was reported in all the patients in our study which was seen in most other studies. The results we have are comparable to other studies done with larger sample size. Reconstruction of the distal radius with avascular autogenous fibular graft after resection for a Grade III Campanacci Giant cell tumor of the distal radius provides adequate functional restoration of the wrist with excellent oncological outcome.

Keyword: giant cell tumour, distal radius, giant cell tumour, fibular grafting

Introduction:
Giant cell tumours account for 5% of all primary bone tumours [1-3]. The most common location of these benign tumours is around the
knee joint. Less than one percent of these tumours are malignant[2]. It is locally aggressive and its clinical behaviour is difficult to predict based on its microscopic appearance alone. The ideal form of treatment for lesions which arise near major joints remains controversial. We report a case series of four patients with giant cell tumour of the distal end of the radius managed by wide resection and reconstruction using fibular autograft and its oncological and functional outcome at our institute.

Patients and Methods:
Between January 2009 and July 2011, we treated 4 patients with an histologically proven GCT involving distal radius, by wide resection and autogenous fibular bone grafting. These included the cases treated primarily as well as the cases with a recurrence after undergoing surgery outside. They have been followed up for a mean period of 16.25 months (range, 8 to 26 months). The mean age at the time of the patients we operated was 21 years (17-24 yrs) with three females (75%) and one male (25%). The side affected was right forearm in three and left in one patient. Campanacci grading was used in our study. Campanacci type III patients alone were included in our study. Grade I and II Campanacci were excluded. Plain radiographs of the forearm with wrist and a chest xray was taken in all patients. CT chest was taken and thoracic physician opinion was taken to rule out secondaries. CT scan of the lesion was done in cases where cortical integrity was suspected to be present as it influences the surgical management. Open incisional biopsy was done in all cases to confirm our diagnosis before definitive surgery was performed. Three patients underwent primary wide resection and fibular grafting. One patient had been referred from elsewhere with recurrence after a primary simple curettage and bone grafting. He underwent wide resection and fibular grafting.

Preoperative radiograph
Operative technique:
After exposure of the distal radius using volar Henry’s approach in 3 patients and dorsal approach in one patient (due to inappropriate biopsy scar), the level of resection which is 2.5 centimeters proximal to the tumour margin. The tumour is removed by sharp extraperiosteal dissection. Using separate instruments, an appropriate length (the length of the resected radius) of ipsilateral proximal fibula is taken and kept aside. The apex of the fibular head replaces the radial styloid. The articular cartilage on the anteromedial aspect of its head articulates with the scaphoid. The fibula graft is fixed to the radius with an Asian dynamic compression plate and 3.5 mm cortical screws. The carpus is stabilized by one or two Kirschner wires on the distal end of the fibular transplant. In our study, tendon and soft tissue involvement was not seen. The tendons were stretched and thinned out. The tumour was removed in toto and skin closure was possible in all our cases without difficulty.
Post operative management:
The upper extremity is splinted from above the elbow to the proximal palmar crease. Elbow is immobilised at 90 degrees, forearm in neutral rotation, wrist in 20 degrees dorsiflexion. At 6 weeks, the splint and wires are removed, and gentle active exercises are begun. The patients were reviewed clinically and radiographically every month for the first three months, once every three months for one year and bi-annually thereafter for any signs of local recurrence and impending complication viz. gap nonunion/graft failure. The associated recurrence rates, disease-free intervals and the related complications were studied.

Results:
The functional scoring of the outcome was done using the Musculo Skeletal Tumor Society system. The functional score is expressed in percentage of the actual points scored out of the total 30. A total of 4 distal radius giant cell tumours were treated between January 2009 and July 2011. Three patients showed clinical and radiological union. One of the patients did not show osteointegration at the time of follow-up 8 months after surgery. One patient had received a simple curettage and bone grafting elsewhere who, after revision surgery and reconstruction with fibular grafting, had good union at the end of 5 months after surgery. The average MSTS scoring was 22 (range 18-26). Average palmar flexion of the wrist was 67 degrees (range 55 to 85) and dorsiflexion was 50 degrees (range 20 to 70). The mean supination achieved in our study was 31 degrees (range 0-50) and the mean pronation that could be performed was 75 degrees (range 60-90). Radial deviation was restricted in one patient and ulnar deviation was restricted in all the patients. The movements at the wrist joint was restricted but enough to carry out the activities of daily living.

Intraoperative clinical photograph - dorsal approach
We did CT chest in subsequent visits once a year in two patients who had a followup of more than one year to rule out metastasis and took x-rays of the operated site to rule out local recurrence at every visit. None of our patients had a recurrence at the surgical site or distant metastasis at the time of latest follow-up at a mean period of 16.25 months (range 8 to 26 months). One of the patient had a superficial infection that was managed successfully with antibiotics. This patient reported the worst functional result on follow-up. Stiffness of the wrist was seen in all the patients. All patients had a pain-free wrist which did not necessitate arthrodesis of the wrist. None of the cases had a donor site morbidity. One patient had a non-union at the graft site at the time of latest follow-up and she had good functional outcome of the wrist. Although mild tenderness was elicited on deep pressure over the graft-radius interface she refused resurgery even after explaining the consequences. 3 patients out of the 4 returned to their previous occupation. One patient who had a non-union at latest followup.
was a housewife and was advised not to carry heavy weights. This study has a short term follow-up and these patients need to be closely monitored for local recurrence and secondaries for a longer period of time as this is a slow growing tumour which may recur after longer periods.

Discussion:

There are various anatomical constraints in treating a distal radius giant cell tumour. It is closely associated with the radio-carpal and the radio-ulnar joints. Soft tissue cover is very less. Important vessels, nerves and tendons need to be preserved so as to regain optimum hand function. All these factors need to be taken into consideration while treating distal radius GCT so as to strike the right balance between complete disease clearance and retaining good hand function. At the same time, the recurrence and the complication rates need to be kept low. Excision with adequate margins is the single most important factor to prevent recurrence[3-5]. A Campanacci Grade 1 or some cases of grade 2 GCT of the distal radius is usually treated by curettage and reconstruction with either polymethyl methacrylate (PMMA) or bone grafts. The recurrence is easier to be noticed with a cement reconstruct and it also gives immediate structural stability. The exothermic reaction that occurs while the cement cures is also supposed to increase the tumoricidal effect[5]. However, there are recent reports throwing light on the cartilaginous degeneration arising thereof. Cheng et al .[6] treated Grade III lesions with curettage when the tumor did not invade the wrist, destroy more than 50% of the cortex or break through the cortex with an extraosseous mass in more than one plane. Khan et al[3] have shown that curettage alone is adequate treatment for the majority of patients with GCTs of the distal radius; but some form of stabilization may be required in the presence of extensive bone destruction. They had adopted curettage for all patients in their study regardless of the grade of tumour. 3 out of the 5 Grade III tumours had local recurrence in their study.

Postoperative radiograph

Harness and Mankin[7] have put forth data which supports the concept that marginal resection and complete distal radial allograft implantation should be used for patients with tumors that have destroyed much of the bone and have extensive soft tissue components (Campanacci Grade 3). They state that curettage and PMMA insertion should be reserved for patients where the structural alteration of the bone is minimal (Campanacci Grade 1). There are a lot of studies advocating proximal fibular replacement as the reconstructive option after distal radius excision. It has been found to have good functional result in the other series in the literature[8-18]. Our study further replicates the results achieved by these studies showing that this method of reconstruction is a useful option in treating distal radius giant cell tumours of campanacci grade II and more.
Stiffness was reported in all the patients in our study which was seen in most other studies. However, in our study the number of cases with proximal fibular replacement was only four. We had one case of gap nonunion of the graft. The results we have are comparable to other studies done with larger sample size. However, these patients should be followed up for a longer duration to find other sequela of this procedure.

**Conclusion:**
Reconstruction of the distal radius with avascular autogenous fibular graft after resection for a Grade III Campanacci Giant cell tumor of the distal radius provides adequate functional restoration of the wrist with excellent oncological outcome. This paper is to stimulate practising Orthopaedic surgeons to the availability of fibula as a graft source in distal radius GCT Campanacci III and to stress the importance of reconstruction of distal radius to achieve good functional results of the wrist and the hand.
CT scan of the lesion and MRI of one of our cases.

References:
7. Sheth DS, Healey JH, Sobel M, Lane JM, Marcove RC. Giant cell tumor of the distal radius.
