Original Research Article

Functional outcome of Giant cell tumor of distal end radius treated with excision and fibular bone grafting

Abstract

Introduction: Giant Cell Tumors (GCT) comprise about 4-5% of all primary bone tumors and about 20% of benign bone lesions. GCT commonly affects the ends of long bones. The lower end of the radius is the third common site to be affected. The distal radius plays a significant role in the radio-carpal articulation and hence in the function of the hand. Various treatment modalities are advocated in the literature. We have done wide excision and proximal fibula bone graft with temporary wrist arthrodesis by 2 different procedures.

Materials and methods: A prospective study including 6 cases of giant cell tumor of distal end of radius was conducted in KIMS, Karad from 2015 and 2018. All patients were evaluated preoperatively with plain radiograph and MRI of involved wrist. All the 6 patients were operated with wide excision, autogenous non-vascularised fibular graft and temporary wrist arthrodesis. Follow up included clinical and radiographic assessment and functional assessment using the Disabilities of the Arm, Shoulder and Hand (DASH) score.

Results: The mean follow-up period was 24 months (20–27) months. All patients achieved radiological union after a mean of 16weeks (14–20) weeks. The mean active range of movement in the operated wrists was 45º dorsiflexion, 15º palmar flexion, 10º radial deviation, 14º ulnar deviation.

Conclusion: Wide excision and proximal fibula bone graft with temporary wrist arthrodesis has been found to be an effective method of treatment for Campanacci grade 2 Giant cell tumor of distal end radius.

Keywords: Giant cell tumor, Distal radius, Fibular bone graft.

Introduction:

Giant cell tumor (GCT) is a benign, locally aggressive neoplasm of bone which is composed of sheets of neoplastic, ovoid, mononuclear cells interspersed with uniformly distributed large osteoclast-like giant cells[(1)]. GCTs comprise about 4-5% of primary bone tumors and about 20% of benign bone lesions. The age of incidence was found to be at peak between 20 to 45 years [(1)]. 70% of the cases of GCT are in between 20-45 years. This tumor is found to be rare in <10 years age group. The common sites to be affected are distal femur, proximal tibia, distal radius and proximal humerus. In the axial skeleton sacrum is the most common site [(1)]. The lower end of the radius is the third common site to be affected [(2)]. The distal radius plays a significant role in the radio-carpal articulation and hence in the function of the hand. It's a challenging factor in the reconstruction of the defect caused by excision of the distal radius tumors. The complexity of the treatment of GCT's of lower end radius is because of 2 factors one is the anatomy and the other achieving an acceptable functional outcome with clearance of the disease. Various treatment modalities like extended curettage[(3)], with or without reconstruction using autogenic/allogenic bone grafts or polymethyl-methacrylate[(4,5)], resection and reconstruction with vascularized or nonvascularized proximal fibula[(6)], resection with partial wrist arthrodesis using a strut bone graft[(7)], resection and complete wrist arthrodesis using an intervening strut bone graft[(8,9)] are advocated in literature.

Fig 1: Clinical picture of GCT of Distal end Radius

Materials and methods:

A prospective study including six cases of giant cell tumor of distal end of radius was conducted in KIMS, Karad between 2015 and 2018.All patients were evaluated preoperatively with plain radiograph and MRI of involved wrist and with plain radiograph of chest. Serum calcium, phosphorus and alkaline phosphatase were also determined to rule out hyperparathyroidism.

Patients were classified according to Campanacci's radiological grading method consisting of three grades. Grade I tumors had a well-defined border of a thin rim of mature bone and bony cortex was intact. Grade II lesions had relatively well-defined margins but there was no radio-opaque cortical rim. Grade III was designated to the lesions with fuzzy borders, suggesting a rapid, and possibly a permeative, growth of the tumor.

Six patients were treated for Campanacci Grade II & III giant cell tumor of the distal radius of which 4 patients had grade II and 2 patients had grade III tumour. All the six patients were operated with wide excision, autogenous non-vascularised fibular graft and temporary wrist arthrodesis. Follow up included clinical and radiographic assessment and functional assessment using the Disabilities of the Arm, Shoulder and Hand (DASH).

Fig 2: Pre-operative X-ray and MRI showing GCT of distal end radius (case-1)

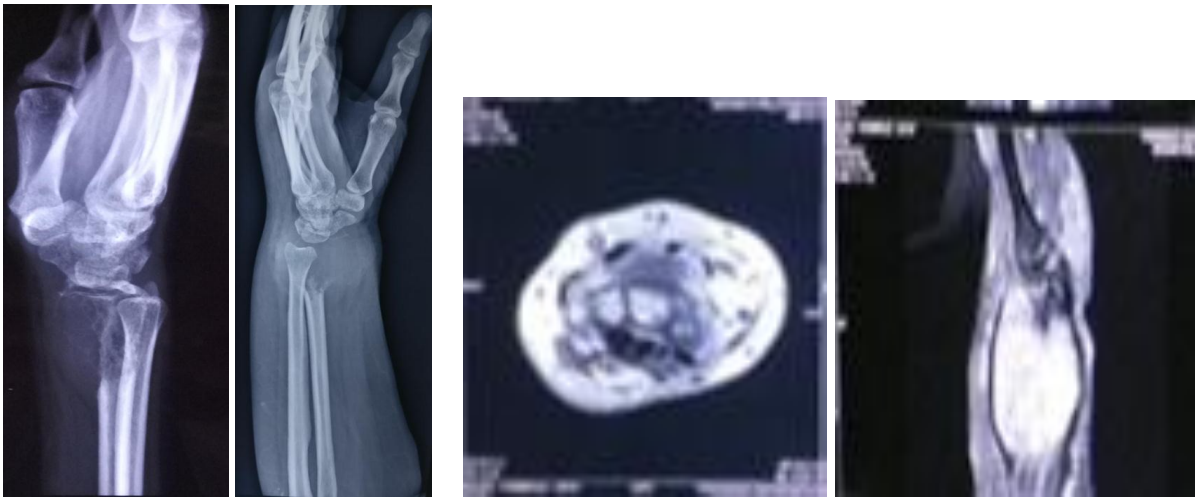

Fig 3: Pre-operative X-ray and MRI showing GCT of distal end radius (case-2)

Operative procedure

Patients once diagnosed with giant cell tumor of distal end of radius, all the routine pre-operative investigations were carried out and patients were posted for surgery.

Patients were given supraclavicular block or general anesthesia as per the choice of anesthetist. Tourniquet was applied but Esmarch was not used for limb exsanguination. Dorsal approach was used in all cases for exploration and excision of the tumor. Excised tumor sample (fig.4) was collected and sent for histopathology. Bone graft was harvested from the proximal end of fibula from the contralateral side. The surface and contour of contralateral fibula is found to match with the distal end of radius in a better way as compared to the ipsilateral one. Hence, contralateral proximal fibula was the bone graft of choice for reconstruction of distal end radius (fig 5). While harvesting the graft, a part of lateral collateral ligament and biceps femoris tendon was kept intact at the fibular head (fig 6). Once graft was harvested, size was measured, matched with the excised part of radius and appropriate sized graft was placed at the distal end radius. The remaining part of lateral collateral ligament and biceps femoris tendon over the graft was sutured with the wrist joint capsule. This helped in retaining the joint stability with a *capsule-like* attachment to the graft. The graft was fixed to the radius by plating. Three patients (group-1) underwent temporary wrist arthrodesis with a single long reconstruction plate extending from radius upto 3rd metacarpal and radio-ulnar stability was maintained using a 4.0 mm cannulated

cancellous screw at the distal radio-ulnar joint (fig 6) and 3 patients (group-2) graft was fixed using 3.5 DCP and wrist arthrodesis was achieved using radio-carpal and radio-ulnar K-wires. (fig 7)

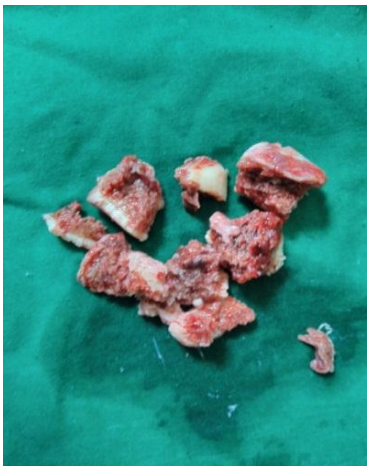

Fig 4: Excised tumor sample

Fig 5: Proximal fibula used as graft

Fig. 6: Post Operative Xray (Case 1)

Fig. 7: Post Operative Xray (Case 2)

Post-operative protocol

Post operatively, limb was immobilized with above the elbow cast in functional position (15-20 degree dorsiflexion) for 6 weeks. After 6 weeks, it was converted to below the elbow slab. After 4 months, when adequate union was visible, wrist was mobilized by removing the part of the plate causing wrist arthrodesis along with the radio-ulnar cannulated cancellous screw (fig 8) in

group 1 patients, and by removing k wires causing wrist arthrodesis (fig. 9) in group 2 patients and patient was started with active physiotherapy for wrist mobilization.

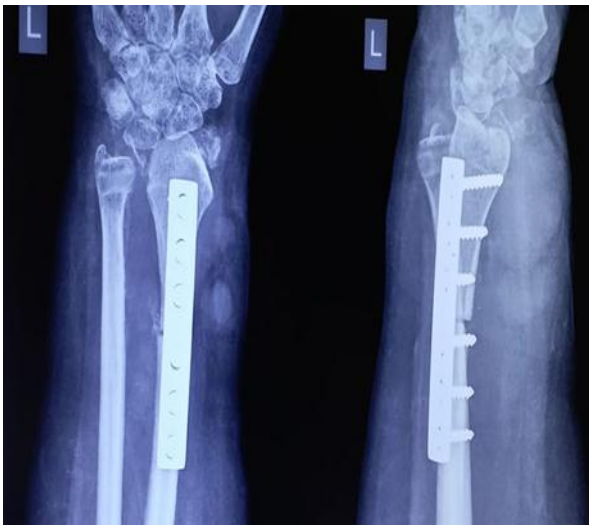

Fig 8: Xray after mobilization of wrist (Case 1) Fig 9: Xray after mobilization of wrist (Case 2)

OBSERVATION AND RESULTS-

The mean follow-up period was 24 months (20–27 months). All patients achieved radiological union after a mean of 16weeks (14–20 weeks). The mean active range of movement in the operated wrists was 45º dorsiflexion, 15º palmar flexion, 10º radial deviations, 14º ulnar deviations. Mean DASH score was 66. Compared with the contralateral wrists, the operated wrists regained 60% of the function, with satisfactory grip strength, with normal finger and thumb movements and hand sensation. Patients in group 1 who underwent wrist arthrodesis with a single long reconstruction the mean active range of movement in the operated wrists was 50º dorsiflexion, 14.6º palmar flexion, 9.3º radial deviations, 14.6º ulnar deviations. Mean DASH score was 61.6 .Patients in group 2 who underwent wrist arthrodesis with a dynamic compression plate the mean active range of movement in the operated wrists was 40º dorsiflexion, 15.5º palmar flexion, 11º radial deviations, 13.3º ulnar deviations. Mean DASH score was 71.6.

One patient had soft tissue recurrence (fig 11) after 1 year for which she was reposted and excision was done .One patient had superficial infection, which was resolved with intravenous antibiotics and dressings.

Fig. 10: Post operative Range of Movements (Case 1)

Fig 11: Post operative Range of movements with recurrence (clinical picture and Xray)

Fig 12: Post operative Range of movements after revision surgery.

Table 1: Overall outcomes by Range of movements and DASH Scores

Patient no	Dorsiflexion	Palmar flexion	Radial deviation	Ulnar deviation	DASH score
1	50	13	10	18	60
2	50	14	10	12	60
3	51	17	8	14	65
4	37	15	10	10	60
5	43	16	11	16	75
6	40	15	12	14	80
Mean	**45**	**15**	**10**	**14**	**66**

Table 2: Outcomes of group 1 patients by Range of movements and DASH Scores

Patient no	Dorsiflexion	Palmar flexion	Radial deviation	Ulnar deviation	DASH score
1	50	13	10	18	60
2	50	14	10	12	60
3	51	17	8	14	65
mean	**50**	**14.6**	**9.3**	**14.6**	**61.6**

Table 3: Outcomes of group 2 patients by Range of movements and DASH Scores

Patient no	Dorsiflexion	Palmar flexion	Radial deviation	Ulnar deviation	DASH score
1	37	15	10	10	60
2	43	16	11	16	75
3	40	15	12	14	80
mean	**40**	**15.5**	**11**	**13.3**	**71.6**

Discussion:

Giant cell tumor of bone may present with pain and swelling over the joint with effusion. This tumour is locally aggressive and has a high incidence of recurrence. It can also metastasize to the lung in rare cases. The goal of treatment in this type of patient is not only to completely resect the tumor but also have to maintain the function of the upper limb. A variety of treatment have been advocated for giant-cell tumor of bone depending upon its grade, including curettage, curettage and bone grafting, cryotherapy of the cavity after curettage, application of phenol after curettage, insertion of polymethyl-methacrylate cement in the cavity after curettage and resection followed by allograft, autograft or prosthetic reconstruction[(3-6)]. Historically, simple curettage of giant-cell tumor is associated with a 40 to 50% rate of local recurrence [(10)]. Adjuvant treatment of bone bed with liquid nitrogen or phenol after removal of the tumor has been advocated to

decrease the risk of local recurrence. Liquid nitrogen results in effective osteonecrosis to a depth of 1 to 2 centimeters. However, the extent of the osteonecrosis induced by liquid nitrogen is difficult to control, thus it may weaken the bone and lead to a fracture. Phenol has been advocated as a safer agent than liquid nitrogen for adjuvant therapy [(10)]. Phenol causes protein coagulation, damages DNA, and causes necrosis but preventing leakage of Phenol in the extensive cortical disruption while at the same time allowing adequate saturation of the bone with the chemical is difficult and the leakage can potentially be harmful [(10)]. Phenol is toxic to the nervous system, the heart, kidney, and the liver. It is readily absorbed through skin, mucosa and open wounds.The technique of intralesional curettage followed by packing of the defect with methylmethacrylate has become popular [(10)]. The free radicals and the thermal effects of the polymerization reaction can cause necrosis as much as 2 or 3 mms in the cancellous bone [(10)]. After the resection of a lesion that is not amenable to curettage, techniques of athroplasty have been employed in an attempt to preserve motion at the wrist joint. A lower rate of recurrence has been noted after resection of the distal part of the radius compared with curettage, especially when the tumor has broken the cortex or when there has been rapid enlargement of the lesion or a local recurrence [(10)]. After resection, the defect has been reconstructed as an arthroplasty or an arthrodesis involving use of either vascularised or non vascularised bone grafts from the tibia, the proximal part of the fibula, the iliac crest, or the distal part of ulna. Other procedures that have been used to fill the defect have included use of an osteoarticular allograft, custom made prosthesis and transposition of the carpus onto the distal part of the ulna to create a one bone forearm.

Although there are advantages to the use of vascularised bone grafts, non vascularised bone graft were successfully employed in the few series. The advantages of vascularised graft may be less important in the distal radius, due to its relatively short length of resection and graft. However, this procedure often requires temporary arthrodesis which is necessary for soft tissue reconstruction with which the wrist joint is stabilized.

Resection with wrist reconstruction using autogenous fibular grafting enables the patient to achieve some function at the wrist as compared to fusion. Most patients can return to useful employment despite their functional limitations. Hence, in our study, we used wide excision and autogenous fibular graft as the treatment of choice.

All the patients responded well to our treatment in the beginning. Two patients at the end of 6 months had a considerably good function of the wrist joint.Patient can do most of their activities of daily living without much disability. There are no signs of recurrence of the tumor till date in 5 patients. However, one patient in our study responded well in the beginning upto 6 months, after which, patient again started developing swelling over the wrist. But, on radiograph, it was found that the swelling was not related to the bone and was arising from the soft tissue (fig 11). This patient was reposted for surgery and soft tissue recurrence was excised. None of the patients in our study had any major intra-operative or post-operative complications like superficial or deep infection at the operative site or the donor bone graft site. Also, there were no complications associated with graft harvesting like common peroneal nerve injury or knee instability. In a study done by Panchwagh Y et al [(2)] reported that Campanacci grades are found to be associated with rate of recurrence. In our study, second patient had grade 3 lesion, hence it was more susceptible for recurrence. However, wide resection with fibular grafting carries the risk of complications related to the graft such as non-union, graft fracture, residual subluxation of the carpus, degenerative osteoarthrosis, limited wrist movement and pain. There can also be donor site complications such as chronic leg pain, lateral ligament laxity and foot drop.

Conclusion

Wide excision and proximal fibula bone graft with temporary wrist arthrodesis has been found to be an effective method of treatment for Campanacci grade 2 Giant cell tumor of distal end radius. After a recovery period, patients may achieve a considerably good function of the wrist joint with relatively less complications.

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