

**Evaluation of the result of distal radius giant cell tumor treated by fibular autograft replacement**

Reza Eshraghi<sup>1</sup>, Mohammad Gharehdaghi<sup>1</sup>, Ali Moradi<sup>2</sup>, Parham Seyf<sup>3</sup>, Hengameh Ebrahimi<sup>4</sup>, Nastoor Bekhradianpoor<sup>3</sup>, Amirreza fatehi<sup>3</sup>, Hassan Attarchi<sup>3</sup>, Mahssa Espandar<sup>5</sup>, Meisam Fathi Vavsari<sup>3</sup>, Nima Fatehi<sup>6</sup>, Hanieh Zandy<sup>7</sup>, Ida Kashani<sup>7</sup>

- <sup>1</sup>. Associate-professor of Orthopedic surgery, Orthopedic and trauma Research Center, Ghaem Hospital , Ahmad-Abad Street, Mashhad University of Medical Sciences, Mashhad, Iran
- <sup>2</sup>. Assistant Professor of Orthopedic Surgery, Orthopedic and trauma Research Center, Mashhad University of Medical Sciences, Ghaem Hospital, Ahmad- Abad Street, Mashhad, Iran
- <sup>3</sup>. Orthopedic Resident, Orthopedic and Trauma Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
- <sup>4</sup>. Assistant Professor of Educational Nursing, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
- <sup>5</sup>. Neurology Resident, Mashhad University of Medical Sciences, Mashhad, Iran
- <sup>6</sup>. Intern of Medical student, Mashhad University of Medical Sciences. Mashhad, Iran
- <sup>7</sup>. General Practitioner, Mashhad University of Medical Sciences, Mashhad, Iran  
[gharehdaghim@mums.ac.ir](mailto:gharehdaghim@mums.ac.ir)

**Abstract:** Although giant cell tumor is considered to be a primary benign bone tumor, its aggressive behavior makes its diagnosis and treatment, difficult and challenging. This is especially true in distal radius where giant cell tumor appears to be more aggressive and difficult to control locally. We report our clinical outcome of en-block resection and reconstruction with non-vascularized fibular autograft in 15 patients with distal radius giant cell tumor. We retrospectively reviewed 15 patients with giant cell tumor (Grade 2, 3) of distal radius who were treated with en-block resection and non-vascularized fibular autograft. Five of 15 were recurrent giant cell tumor treated initially with extended curettage, local adjuvant therapy and filling the cavity with cement or bone graft. 11 patients were women and 4 men. Mean age of patients was 29 years (range 19-48). We followed the patients for mean 7.2 years post operation (range 4 years to 11 years). Patients were evaluated post operation with clinical examination, plain radiography of distal radius and chest X-Ray and/or CT scan. We had no lung metastasis; bony recurrence occurred in one patient (6.6%). Pain, function, and range of motion and grip strength of affected limb were evaluated and mayo wrist score was assessed. 53.3% patients had excellent or good functional wrist score. 80% patients were free of pain or had only occasional pain. 80% of patients returned to work. Mean range of motion of the wrist was 77 degrees of flexion- extension and mean grip strength was 70% of the normal hand. En-block resection of distal radius giant cell tumor and reconstruction with non-vascularized fibular autograft is an acceptable method of treatment in local control of the tumor and preserving function of the limb.

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**1. Introduction**

Giant cell tumor (GCT) is a relatively common primary benign bone tumor, which is usually seen at the end of long bones under the age of 40 years [1]. It is a locally potential aggressive lesion with unique ability to produce lung metastasis. Although metaphyseal region of distal femur and proximal tibia are more commonly affected, giant cell tumor in distal radius is both common and puzzling. Intralesional extended curettage with local adjuvant therapy, is an acceptable method for the treatment of this indistinctive behavior bone tumor with reasonable rate of recurrence (up to 25%) [2-9].

The mild symptoms may present for months before becoming severe enough to be visited by the physician. Acute events especially fractures with acute and severe pain, bring the tumor to clinical attention [10].

Giant cell tumor in distal end of the radius is commonly associated with cortical invasion, pathologic fracture and extracompartmental extension, with high rate of recurrence after extended curettage of the lesion. En-block resection with some kind of reconstruction surgery ranging from arthroplasty to allograft techniques may reduce recurrence rate [2, 3]. Non-vascularized fibular autograft is a method that we present here for

reconstruction of distal part of the radius after en-block resection of the tumor.

## 2. Material and Methods

After approval by the research committee of our institute, we retrospectively reviewed 15 patients with histologically proved distal radius giant cell tumor (grade 2,3) treated with en-block resection and non-vascularized fibular autograft from 2001 to 2007 in our referral hospital. Eleven patients were women and 4 men with mean age of 29 years (range 19-48). In 12 patients (80%) the lesion was in right radius and in other 3 patients (20%) left radius was involved.

Five patients were treated before, with extended curettage, local adjuvant therapy and bone graft or bone cement as a cavity filler (bone graft in 2 patients and bone cement in 3 patients) and the tumor had been recurred in mean 18 months (ranging 3 months to 5 years) after initial surgery. No lung metastasis had been detected. Ten patients were not treated before and presented primarily to our institute. All patients had plain radiography as the first step in evaluation, [1] and MRI of the distal radius. Chest X-Rays and / or chest CT scan were included in initial evaluation. All patients histologically proved to be giant cell tumor. In one of recurrent cases, on histological examination, aneurismal bone cyst coexisted in addition to underlying GCT. Surgery consisted of en-block resection of the tumor and reconstruction with ipsilateral fibular autograft with applying a radiofibular DCP plate.

The margin of the tumor is determined precisely on plain radiography and magnetic resonance imaging. Limits of bony involvement with additional 2.5 cm margin are considered to be safe wide margin and the appropriate length of fibula required for reconstruction is determined accordingly.

Via a Henry approach to the ipsilateral proximal fibula, along the posterior margin of the fibular head and the biceps tendon, the common peroneal nerve is isolated and watched carefully. The biceps tendon and lateral collateral ligament are dissected from fibular head and are securely fixed to lateral aspect of the proximal tibia with a soft tissue staple and adequate length of fibula is dissected and ready to transplant. Incision is closed over a suction drain. The tumor is approached via a Henry volar or dorsolateral. Radius is exposed extraperiosteally and is dissected with an oscillating saw at desired length (with at least 2.5 cm intact bone margin). Any soft tissue extension of the tumor is removed as well with a reliable margin. Radial collateral ligament is preserved for future attachment to transplanted fibula.

Harvested fibula is fixed to the radius with a 3.5 DCP plate. Tip of fibula should lie for radial styloid and its articular surface articulates with scaphoid. Radiocarpal ligament is repaired and the transplanted fibula is stabilized to the wrist with two cross pins. A long arm splint in 90 degrees of elbow flexion and 20 degrees of wrist extension is applied. Splint and pins are removed 6 weeks post-operation and gentle range of motion is advised.

Patients were followed for a mean of 7.2 years post-operation (ranging 4 years to 10 years) with clinical examination, plain radiography of the wrist and chest X-Ray and/or CT scan. All patients were assessed for pain, function, range of motion and grip strength. Wrist function was evaluated using Mayo wrist score. Mayo wrist score was developed by Amadio PC et al in 1989 (11). Mayo wrist score is a clinician reported questionnaire and includes 4 items of pain intensity, functional Status, range of motion and grip strength.

## 3. Results

We could achieve solid bony union in all patients. Soft tissue recurrence occurred in two patients at a mean of one and a half year post-operation that were resected completely and at last follow up were free of tumor. In one patient bony recurrence occurred in transplanted fibula. En-block resection and reconstruction with contralateral fibular autograft was carried out and the patient remained free of tumor at last follow-up. No lung metastasis has been detected, on clinical assessment. Recurrence of tumor in carpal bones happened in one patient 2 years after surgery (Fig.1-4).

Eight patients had no pain (53.3%), 4 had mild occasional pain (26.7%), 3 suffered of moderate tolerable pain (20%) and no one had severe intolerable pain. Four patients returned to previous work with no limitation (26.7%), 8 returned to work but with restricted employment (53.3%), 3 patients were able to work but unemployed (20%) and no one was disabled because of pain.

All patients showed some limitation in range of motion of the wrist. Five patients (33%) had flexion-extension ranging 20-120 degrees, 6 patients had flexion-extension between 60-90 degrees, and in 4 patients flexion-extension was limited to 30-60 degrees. But no patient had flexion-extension less than 30 degrees. Mean flexion-extension of the wrist was 77 degrees with mean 35 degrees of flexion and 42 degrees of extension.

In 7 patients grip strength was %75-100 of the contralateral normal hand (46.7%), in 5 patients grip strength was %50-75 and in 8 patients it was %25-50 of the normal hand. No patient had % 100 grip strength of the normal hand or less than % 25 of

it. Mean grip strength of operated limb was %70 of normal hand.

According to the Mayo wrist score system, 3 patients had excellent result (20%), 5 patients had good result (%33.3), 5 patients had acceptable result

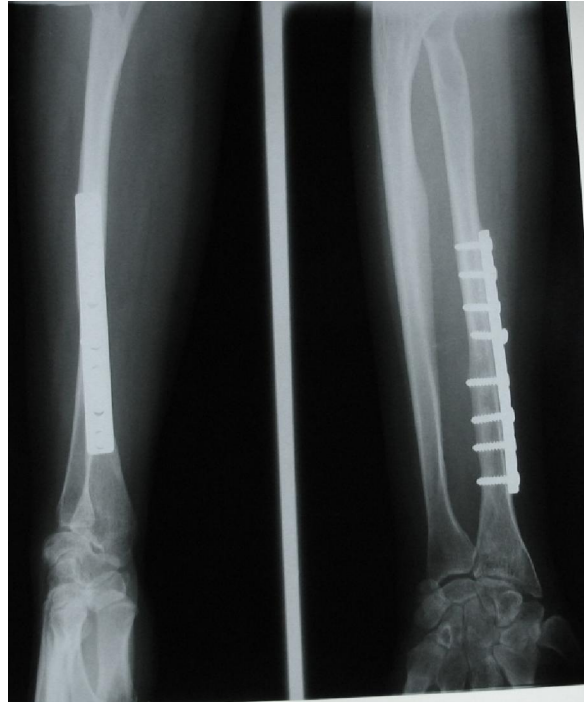
(%33.3) and 2 patients had poor result (%13.4). and mean wrist score was 64.0. According the last follow-up visit, no patient complained of any symptom in donor proximal fibula knee and there was not any lateral instability of the knees.



**Figure 1.** AP and lateral x-ray of a 38-years-old woman with giant cell tumor of distal radius



**Figure 2.** Postoperative AP and lateral x-ray of the patient who undergone wide resection of the tumor and proximal fibular autograft transplantation



**Figure 3.** AP and lateral of the above patient 48 months after primary en-block resection of distal radius giant cell tumor shows union of the fixation site, remodeling of the proximal fibula and recurrence of tumor in the carpal bones.



**Figure 4.** AP and lateral x-ray of the knee of above patient shows proximal fibula has been harvested and LCL is reattached to proximal tibia with screw

#### 4. Discussions

Giant cell tumor of the long bones is known as an aggressive highly recurrent tumor. This is more

obvious if the tumor is located at the end of radius. [12-14] it is believed that this aggressive mood also, could be a risk factor for pulmonary metastasis [15,

16]. This tendency to local recurrence may be due to remaining of tumoral cells in soft tissue, which act as the host for bone graft [13, 17]. The less likely possibility is contamination of surgical site by the instruments [18]. When treating a primary bone tumor, the first and principal goal should be complete removal of the lesion. Preserving function of the limb and planning for reconstruction procedures is not a priority and should be changed if tumor excision demands otherwise [19]. Prevention of local recurrence precedes maintaining limb function. This principle is still working when treating giant cell tumor of distal radius. Giant cell tumor is a benign aggressive bone tumor and according to Campanacci classification most of these tumors are classified as stage 2 or 3 [2, 3].

It is thought that in GCT of distal radius, cortical invasion and break through with extracompartmental extension of the tumor is common. In addition local control in distal radius is difficult [19-21]. Local recurrence after extended curettage and cementing of giant cell tumor in distal radius has been reported as high as 88% of patients [3]. Considering local control of the lesion, wide resection with some kind of reconstruction, seems to be a more valuable method of treatment. Many reconstruction procedures have been proposed after wide resection of distal radius: Osteoarticular allograft, allograft arthrodesis. Vascularized or non-vascularized fibular autograft with or without arthrodesis are more recently accepted procedures [19, 20].

Non-vascular fibular autograft preserves wrist function and maintains anatomy of the carpus. In addition, there is no risk of viral transmissions. As mentioned before most GCTs of distal radius are Campanacci stage 2 and 3. In these stages of tumor, cortical thinning, cortical expansion or breakthrough with extracompartmental extension makes complete removal of the tumor very difficult if not impossible [2, 3, 19, 20, and 21]. The surgeon never can be sure of adequate curettage and almost always leave the surgery with a sense of uncertainty. Subchondral bone near the joint, cortical thinning and expansions are regions that never one can be sure of adequate curettage. We believe that wide margin en-block excision of the tumor is a better choice than extended curettage in the treatment of giant cell tumor of distal radius, unless in rare cases of stage I Campanacci with definite sclerotic margins. After excision, there are many reconstruction choices. Osteoarticular allograft and proximal fibula autograft are more desirable for preserving function and motion of the wrist [2, 19, and 20].

Kecher et al reported low recurrence rate, good function, moderate range of motion of the wrist,

little pain and relatively high rate of revision after excision and reconstruction with osteoarticular allograft of twenty four distal radius tumors, most of them giant cell tumor (twenty of tumors). They proposed osteoarticular allograft as an acceptable option for reconstruction of distal radius benign aggressive and malignant tumors [19]. In an article in 2005, Bianchi and colleagues reported results of osteoarticular allograft after resection of distal radius in 12 patients, 9 of them giant cell tumor, and concluded that good functional outcome can be achieved with this technique and in spite of radiological signs of degenerative changes, function was acceptable. They reported 3 recurrence in these 12 patients, all of them giant cell tumor but all were free of disease at last follow-up [20].

Szabo et al in 2006 reported reasonable functional outcome after en-block excision and reconstruction with osteoarticular allograft and Sauve-kapandji procedure of 9 distal radius giant cell tumors [22]. Koul and colleagues in 2007 reported excellent and good functional results in two patients with distal radius giant cell tumor after excision of distal radius and reconstruction with free vascularized fibular autograft [23]. In 2002, Marruthainar et al reported their result of treating 13 patients with malignant and benign aggressive (giant cell tumor) tumors of distal radius with wide excision and non-vascularized fibular autograft reconstruction. They proposed this technique as an acceptable option with satisfactory functional results without compromising the prognosis [24].

In our study, we had only one bony recurrence (%6.6 of patients) which is an acceptable result, considering local control of the tumor. When patients were assessed with Mayo wrist score, % 53.3 hands excellent or good results, % 80 had no pain or only occasional pain, %80 returned to work. Although all patients had some limitation in wrist range of motion, mean range of motion was 77 degrees which is quite satisfactory. And mean grip strength was %70 of normal contralateral hand.

Although GCT is commonly considered benign, malignant cases can arise de-novo or transform from a benign lesion [25]. In this study, no lung metastasis has been detected, on clinical assessment. We didn't assess radiographic changes. We believe that as long as functional outcomes are acceptable, radiographic changes are not important and that the pain and function, make surgical intervention necessary not radiographic changes. After a period of time, proximal fibula form to distal radius and may be indistinguishable from it. This means that the bone accommodates with forces exerted at the region and shape to the original bone. In conclusion we recommend wide margin en-block

resection of distal radius giant cell tumor and reconstruction with non-vascularized fibular autograft. With this technique we can maintain acceptable function while preventing local recurrence. It has no risk of viral transmission with low complications and morbidity rate.

#### Corresponding Author:

Dr. Mohammad Gharehdaghi  
Associate-professor of Orthopedic surgery  
Orthopedic and trauma Research Center  
Ghaem Hospital, Ahmad-Abad Street  
Mashad University of Medical Sciences  
Mashad, Iran  
Tel&fax: +98.5118417453  
E-mail: [gharehdaghi@mums.ac.ir](mailto:gharehdaghi@mums.ac.ir)

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