



## Case Report

# Tumors of the Proximal and Distal Radius with Free Fibular Graft Reconstruction

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## Introduction

Primary or metastatic tumors of the distal radius are uncommon. Giant cell tumors (GCT) are the most common primary tumors of the distal radius. GCT are benign tumors with uncertain malignant potential and locally aggressive. They account for 10-12% of all bone tumors and have a low metastatic rate. The differential diagnosis includes osteosarcoma, chondrosarcoma, undifferentiated pleomorphic sarcoma, and metastatic tumors, which are extremely rare [1].

Tumors of the distal radius pose a challenge due to the anatomical features, tumor size, histological type, and possible mechanical dysfunctions of the hand or elbow joint. Many techniques have been used in reconstructive wrist surgery, such as total wrist arthrodesis, partial wrist arthrodesis, osteoarticular allografts, non-vascularized or vascularized autologous fibular grafts, and prosthetic arthrodesis or arthroplasty. Vascularized fibular auto grafts seem to be the best option with better outcomes and lower complication rates [1].

Moreover, tumors of the proximal radius affect its functions since it is a stabilizer for resisting valgus, rotatory, and axial stress of the elbow and the radial head forms part of the proximal radioulnar joint that is important for forearm rotation. Therefore, an injury to the proximal radius causes dysfunction in flexion, extension, pronation and supination movements, and even elbow

stiffness [2]. We aim to describe two cases of tumors of the radius and their treatment with free vascularized fibular grafting.

**Keywords:** Proximal radius; Distal radius; Metastasis; Giant cell tumor; Free fibular graft; Reconstruction

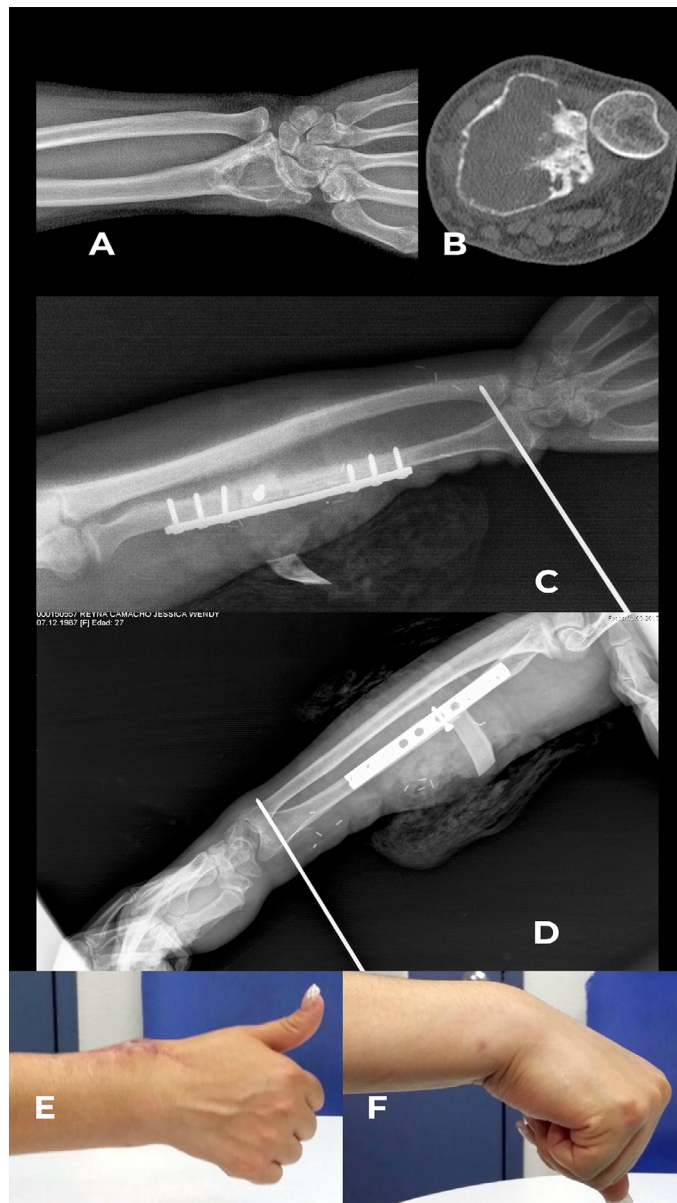
## Case 1

A 27-year-old female patient without relevant medical history noted the onset of disease in April 2013 after falling from standing height and injuring her right wrist. In February 2014, a wrist radiograph was ordered due to chronic pain; it showed an expansive lesion on the right side of the distal radius. An orthopedic doctor obtained a biopsy that revealed a Campanacci II GTC. She was treated with curettage one month later. In January 2015 she came to our hospital for the first time, she exhibited swelling at the surgical site of 2 months of evolution and severe pain when leaning against her hand or moving her wrist. In February 2015, a histopathological examination confirmed the diagnosis, and control radiographs were taken as part of the preoperative assessment (Figure 1A). We concluded there was disease progression with cortical breach caused by a Campanacci III GTC. A CT scan showed an expansive lesion with cortical breach and involvement of soft tissues, highly suspicious for recurrence (Figure 1B).

In March 2015, we performed a wide resection of the distal radius and reconstruction with a micro vascularized free fibular

graft and used a 3.5-mm dynamic compression plate and Kirschner wire to achieve fixation (Figure 1C & D). After reducing the newly formed carpal joint, the fibular diaphysis was reduced to the remaining proximal radius. The tension in the soft tissue and fibula-ulna joint was determined and adjustments were made in graft length as deemed necessary. A wire was then passed from the fibula to the ulna to stabilize the ulnar joint of the fibula.

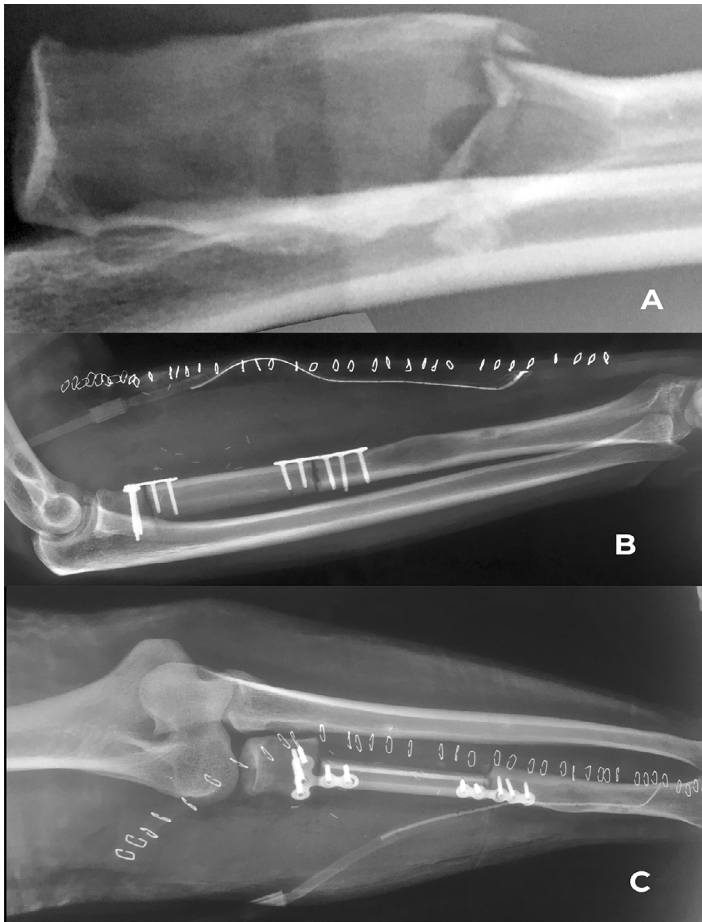
The patient's evolution was favorable with good hand mobility and no nerve injury. She was discharged on postoperative day 6. She is currently disease-free with no dysfunction (Figure 1E & F).



**Figure 1:** (A) Preoperative AP radiographs of right forearm with expanding lytic lesion in distal radial metaphysis and cortical breach and thinning. (B) CAT scan showing an expanding lytic lesion with cortical breach in right distal radius and involvement of soft tissues. (C & D) Postoperative AP radiographs showing interfragmentary compression screw + 3.5-mm dynamic compression plate with 6 screws and Kirschner wire to achieve fixation of the vascularized fibular graft to the distal ulna. (E & F) Range of motion after removing Kirschner wire at postoperative control examination.

## Case 2

A 38-year-old male patient with a pathologic fracture. AP and lateral forearm radiographs showed a bone tumor compatible with undifferentiated sarcoma. We obtained a biopsy and tried to find distant lesions. The pathologic examination indicated GCT. We performed a wide resection of the proximal third of the radius and reconstruction with miniplates (Figure 2). The postoperative diagnosis was undifferentiated sarcoma. The patient decided to continue his treatment at another hospital.



**Figure 2:** (A) Lateral radiograph of the right arm show a pathologic fracture of the radius. (B & C) AP and lateral radiographs show final reconstruction with fibula free flap.

## Discussion

Giant cell tumors are the most common tumors of the distal radius. They mostly occur in patients in their 30s and 40s and are more prevalent in women. Due to high recurrence rates after curettage and risks for lung metastasis, en bloc resection is the gold standard treatment for these tumors, when feasible [1].

It becomes a challenge when these tumors arise in a site as important as the wrist joint. They should be operated on at hospitals where an adequate resection and reconstruction can be performed based on the latest medical advances. Treatments that limit joint function in patients of productive age should be avoided so they can lead a life as normal as possible.

Campanacci's radiological grading method consists of three grades [3]. Grade I includes lesions of well-defined borders of a thin rim of mature bone and intact bony cortex. Grade II lesions have relatively well-defined margins, but there is no radiopaque cortical rim. Grade III describes lesions with fuzzy borders, suggesting a rapid, and possibly a permeative, growth. This classification also provides the type of treatment for each grade. For grades, I and II conservative management through curettage and even the application of intralesional methylmethacrylate can be considered. For grade III en bloc resection is the standard treatment, but in cases with proven malignancy amputation is acceptable [4, 5].

Choosing the right reconstruction technique is crucial. Ipsilateral fibular reconstruction of the large defect created after resection of the distal radius offers advantages over other procedures. It has low donor site morbidity with predictable and satisfactory functional results and minor complications. Forearm supination and pronation movements, which are essential in terms of functional ability, stay relatively well preserved [6]. Controversies remain regarding non-vascularized vs. vascularized fibular grafts. It seems there are no differences in the time to union since it is simply determined by the rigid fibular fixation. Moreover, the entry site of the nutrient artery to the fibula, which is the peroneal artery, varies among people; thus, it is necessary to remove a larger portion of the fibula than required. This was true in our case. We had to extend the resection of the radius to promote vascularization of the fibula to complete the anastomosis [7].

We believe that vascularized bones offer more benefits than non-vascularized ones. Vascularized bones have greater possibilities of resisting infections due to the natural hemostatic mechanisms. Additionally, good blood circulation allows for administering antibiotics and reduces the risk of resorption. In fact, vascularized bones carry this risk, especially in the epiphysis where vascular supply is derived from the anterior tibial artery. Ideally, a second anastomosis should be performed in this site, particularly during childhood to ensure adequate vascular supply to the growth plate and promote bone formation [8, 9]. An epiphyseal-diaphyseal graft vascularized only by the anterior tibial artery is feasible when preoperative angiography has ruled out anatomic abnormality. In our case, we did not perform an angiograph, but it is advisable to include it to gain experience whenever the circumstances warrant it.

We used miniplates to reduce the risk of vascularity, especially in the remaining proximal radius [10]. Moreover, radioulnar joint preservation provides many functional advantages and reduces limitations. The findings are not conclusive due to the rare occurrence of the disease and short follow-up times; more research on the success of the functional results is needed. Other donor sites have been studied such as the iliac crest, which seems promising [2].

## Conclusion

Giant cell tumors are the most common tumors of the distal radius. Treatment depends on the grade, and surgery should be performed in a hospital offering the best treatment and reconstruction, which is currently a microvascularized free fibular graft. Reconstruction is closer to the normal anatomy of the resected site, and patients recover almost completely. Treating tumors of the proximal radius is challenging from a functional point of view since it is an uncommon location. However, if the proximal radioulnar joint is preserved, better functional outcomes are achieved.

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