

# Wrist Arthrodesis with Vascularized Fibular Graft after Failed Allograft Replacement for Giant-Cell Tumor Resection

Stefano Bastoni<sup>1</sup>, Elena Lucattelli<sup>2,\*</sup>, Luca Delcroix<sup>2</sup>, Fabio Sciancalepore<sup>1</sup>, Primo Andrea Daolio<sup>1</sup>, Marco Innocenti<sup>2</sup>

<sup>1</sup>C.O.O., Azienda Socio Sanitaria Territoriale Gaetano Pini, Milan, Italy

<sup>2</sup>Plastic and Reconstructive Microsurgery, Careggi University Hospital, Florence, Italy

**Abstract:** Giant-cell tumor (GCT) is locally aggressive bone neoplasm, with an unpredictable pattern of biological aggressiveness. The optimal treatment had to achieve a negligible local recurrence rate while maximizing musculoskeletal function. Numerous options for reconstruction are available, but in the literature there is a lack of salvage surgery data. We present a case of a 67-year-old woman who underwent complete wrist arthrodesis with vascularized fibular graft as salvage procedure for allograft necrosis, after excision of a distal radius GCT. The patient did not complain of any impairment in daily use, and the functional score was 22 points (73%) at latest follow-up of 14 months. Despite joint salvage remains the most favorable treatment with regard to functional outcome for aggressive tumors of the distal radius, vascularized fibular grafts is a valuable alternative especially in salvage procedures, where the use of another allograft could lead to higher complications rate.

**Keywords:** Vascularized fibular graft, Wrist arthrodesis, Giant-Cell Tumor, Fibula free flap.

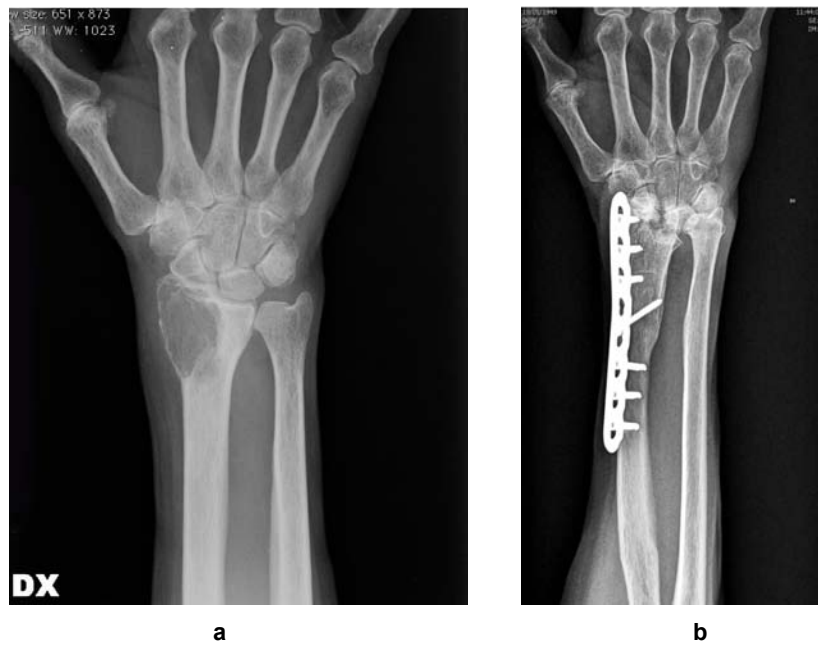
## INTRODUCTION

Giant-cell tumor (GCT) is locally aggressive bone neoplasm, with an unpredictable pattern of biological aggressiveness, pulmonary metastasis in about 2% and pathological fractures in 5-10% of patients [1]. They typically occur in patients aged 20 to 45 years, and the distal end of the radius is the third most common site affected after the distal femur and the proximal tibia. The optimal treatment had to achieve a negligible local recurrence rate while maximizing musculoskeletal function, but wide excision often leads to considerable functional loss. Once the tumor has been resected, numerous options for reconstruction are available. By definition, arthroplasty is performed to obtain wrist mobility. After radio-carpal arthrodesis, midcarpal motion is preserved, and after total wrist arthrodesis, no mobility is left [2]. The bone used to bridge the gap may be allograft [3], non-vascularized [4] or vascularized autograft [5]. None of these types of graft have been shown to be superior to others. However, after failure of a first reconstructive attempt with allograft, the best solution is to use vascularized autologous tissues. In literature, not much importance has been given to rescue procedures after allograft failure, and there is a lack of salvage surgery data. We present a case of complete wrist arthrodesis with vascularized fibular graft as salvage procedure after allograft necrosis in a patient who had already undergone removal of a GCT of the distal radius.

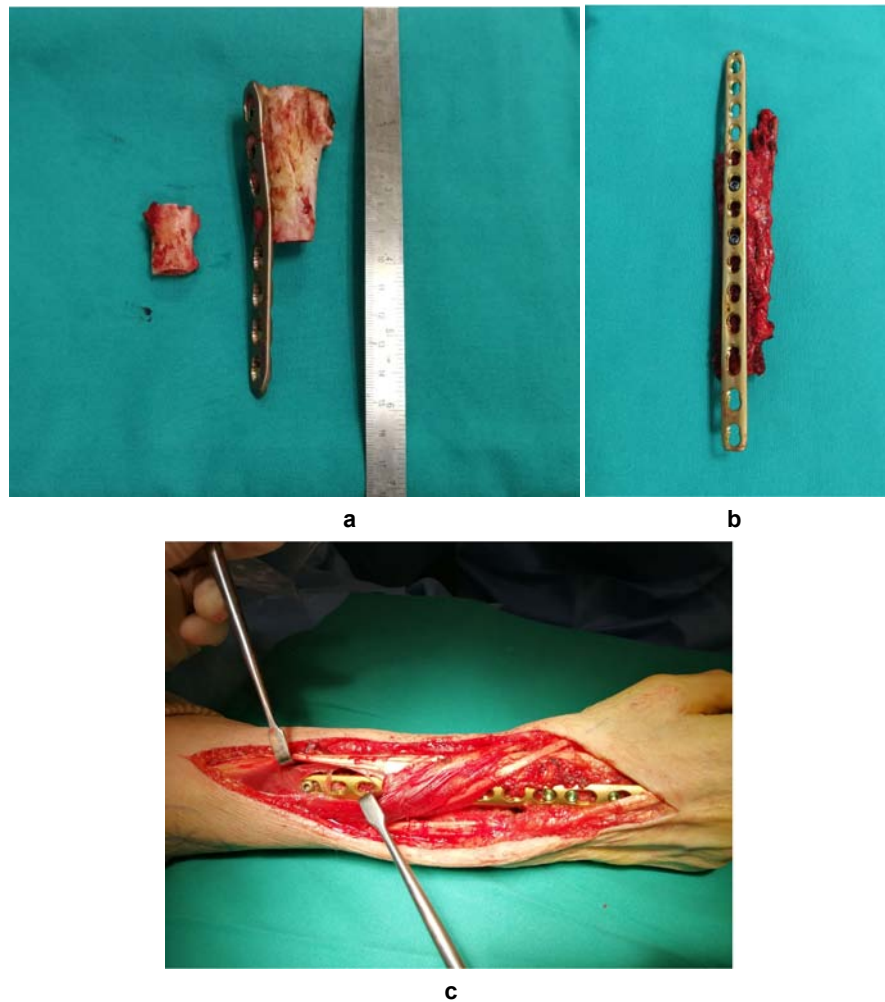
## REPORT OF THE CASE

A 67-year-old woman noticed pain and swelling in her right wrist. Radiographs of the wrist revealed an extensive lytic lesion in the distal radius (Figure 1a), and histological examination confirmed the diagnosis of a typical GCT. She underwent initial treatment with *en bloc* resection of the tumor and allograft replacement. Temporary K-wires were removed after one month. Eighteen months postoperatively, the patient presented painful swelling of the wrist. Physical examination revealed volar carpal subluxation and X-Rays showed clear signs of allograft necrosis and articular surface resorption (Figure 1b). After 4 months the patient underwent surgical debridement of the necrotic allograft and plate removal (Figure 2a). The defect was reconstructed with a wrist arthrodesis performed with a 12-cm-long free vascularized fibula graft (Figure 2b). Under fluoroscopic control, the wrist joint was totally stabilized by a reconstruction plate (Figure 2c). The radial stump was fixed to the proximal carpal row and the third metacarpal bone in order to obtain a complete wrist arthrodesis. The peroneal artery and vein were anastomosed in end-to-end fashion to the radial artery and the cephalic vein. The donor site was closed primarily. Enoxaparin was administered pre and post-operatively to prevent microvascular thrombosis. Fair postoperative soft-tissue swelling was resolved maintaining sloping position of the arm. Surgical sites healed uneventfully. The long arm cast was removed after 4 weeks and a splint wrist brace was used for an additional 30 days. Radiographs taken 3 months postoperatively revealed union at both junctions (Figure 3a, 3b), and there were no signs of tumor recurrence

\*Address correspondence to this author at the AOU Careggi Largo Piero Palagi 1, 50139 Firenze (FI), Italy; E-mail: elena.lucattelli@gmail.com



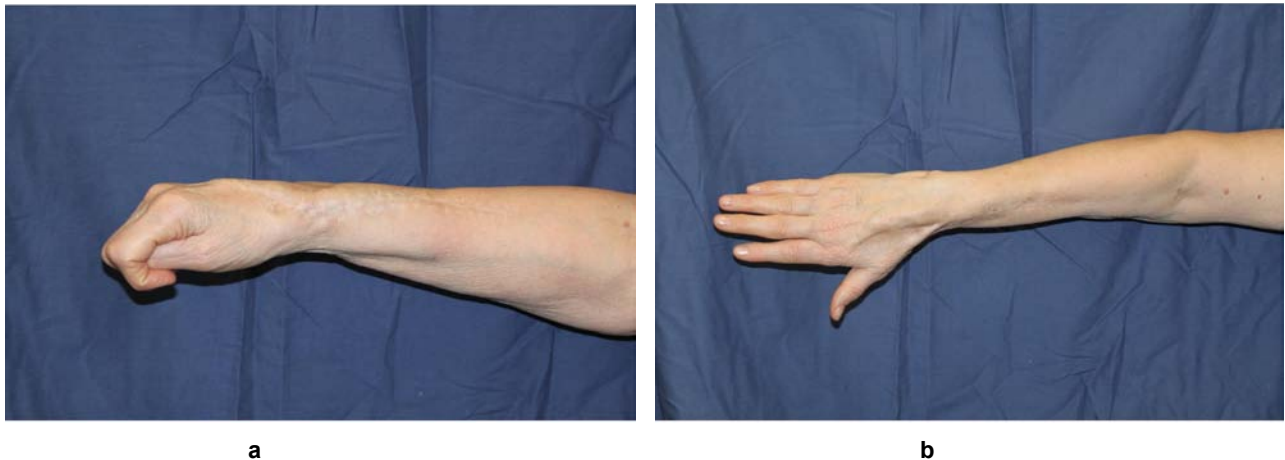
**Figure 1:** a. Radiographs of the wrist in a 67-year-old woman revealed an extensive lytic lesion in the distal radius. b. Eighteen months postoperatively X-Rays showed clear signs of allograft necrosis and articular surface resorption.



**Figure 2:** a. After 4 months the patient underwent surgical debridement of the necrotic allograft and plate removal. b. The defect was reconstructed with a wrist arthrodesis performed with a 12-cm-long free vascularized fibula graft. c. Under fluoroscopic control, the wrist joint was totally stabilized by a reconstruction plate.



**Figure 3:** a. Postero-anterior (a) and latero-lateral (b) radiographs taken 3 months postoperatively revealed union at both junctions. b. Postero-anterior (a) and latero-lateral (b) radiographs taken 3 months postoperatively revealed union at both junctions.



**Figure 4:** a. At final follow-up, the patient did not complain of any impairment in daily use (a) and aesthetic result was acceptable (b). b. At final follow-up, the patient did not complain of any impairment in daily use (a) and aesthetic result was acceptable (b).

36 months after the first operation. The patient did not complain of any impairment in daily use and aesthetic result was acceptable (Figure 4a, 4b). The functional score was 22 points (73%) at final follow-up.

**DISCUSSION**

Reconstruction of large defects after resection of the distal radius to treat giant-cell tumors remains

challenging, particularly in the decision-making phase of the optimal extent of the resection as well as what type of reconstruction will provide the best functional outcome for the patient with the least complications. Few options, including resection arthroplasty, the use of non-vascularized or vascularized autogenous fibular graft and allograft replacement, custom prosthetic replacement and ulnar translocation have been used for reconstruction of this bone defects. Distal radius allografts have been used after excision of skeletal tumors [3]. However, non-vascularized allografts or autografts have not yielded satisfactory results in reconstruction of defects longer than 10 cm [4]. Complications of this technique include nonunions, resorption, and fracture of the graft.

Joint reconstruction after resection of aggressive tumors remains a popular alternative in order to reduce the local recurrence rate while maintain wrist motion and ideally improving function compared to arthrodesis. The use of free vascularized proximal fibula graft is attractive because of its similarity in shape to the distal radius [2]. However, some major postoperative complications were reported including progressive degenerative changes, bony collapse secondary to poor vascularity of the fibular head, and volar subluxation resulting from incongruity between the fibular head and the proximal carpal row. Moreover, peroneal nerve damage frequently occurs as donor-site complication [6].

Recent literature has shown that there is no difference in long-term functional outcome between reconstruction and fusion group [2]. Translocations of ulna, wrist arthrodesis using segmental iliac crest graft and complex procedure of segmental double barrel ulnar graft arthrodesis with Sauve-Kapandji procedure also produce equally long-term outcome [7-9]. Some authors recommended a partial wrist arthrodesis using a vascularized fibular graft to avoid unpredictable complications [6]. Some wrist motion remains when the midcarpal joint is preserved after performing fibulo-scapho-lunate fusion. However, this procedure should be considered for young patients with high activity in daily living if the carpal bone can be preserved. Complete arthrodesis produces a painless and stable wrist, though absence of motion, with minimal disability [10]. Moreover, the grip strength after wrist fusion is usually stronger compared to reconstruction [2]. A stable and painless wrist is attributed to better tendon excursion and muscle strength for the grip, and allows earlier rehabilitation. Complications, including fractures and non-unions, are rare, but most are relatively minor

and easily managed with a single surgical procedure. This technique is particularly indicated in patients with less functional demand, and especially in salvage procedures, as in the reported case. At latest follow-up of 14 months, our patient had good function with a painless and stable wrist, and she returned to useful employment.

Overall, joint salvage remains the most favorable treatment with regard to functional outcome for aggressive tumors of the distal radius, but some of this patients may have weaker grip strength and develop symptoms related to early arthritis. Wrist arthrodesis with vascularized fibular graft is a valuable alternative especially in salvage procedures, where the use of another allograft could lead to higher complication rate. To the best of our knowledge, this is the first reported case of salvage surgery with this technique for allograft necrosis in distal radius reconstruction after TGC excision.

## REFERENCES

- [1] Jaminet P, Rahmanian-Schwarz A, Pfau M, *et al.* Fibulo-scapho-lunate arthrodesis after resection of the distal radius for giant-cell tumor of the bone. *Microsurgery* 2012; 32: 458-62.  
<https://doi.org/10.1002/micr.21971>
- [2] Choo CY, Mat-Saad AM, Wan-Azman WS, *et al.* Functional Outcome after Treatment of Aggressive Tumours in the Distal Radius: Comparison between Reconstruction using Proximal Fibular Graft and Wrist Fusion. *Malays Orthop J* 2018; 12: 19-23.  
<https://doi.org/10.5704/MOJ.1811.004>
- [3] Kocher MS, Gebhardt MC, Mankin HJ. Reconstruction of the distal aspect of the radius with use of an osteoarticular allograft after excision of a skeletal tumor. *J Bone Joint Surg Am* 1998; 80: 407-19.  
<https://doi.org/10.2106/00004623-199803000-00014>
- [4] Clarkson PW, Sandford K, Phillips AE, *et al.* Functional results following vascularized versus nonvascularized bone grafts for wrist arthrodesis following excision of giant cell tumors. *J Hand Surg Am* 2013; 38: 935-940.e1.  
<https://doi.org/10.1016/j.jhssa.2012.12.026>
- [5] Flouzat-Lachaniette C-H, Babinet A, Kahwaji A, *et al.* Limited arthrodesis of the wrist for treatment of giant cell tumor of the distal radius. *J Hand Surg Am* 2013; 38: 1505-12.  
<https://doi.org/10.1016/j.jhssa.2013.04.026>
- [6] Minami A, Kato H, Iwasaki N. Vascularized fibular graft after excision of giant-cell tumor of the distal radius: wrist arthroplasty versus partial wrist arthrodesis. *Plast Reconstr Surg* 2002; 110: 112-7.  
<https://doi.org/10.1097/00006534-200207000-00020>
- [7] Zhang W, Zhong J, Li D, *et al.* Functional outcome of en bloc resection of a giant cell tumour of the distal radius and arthrodesis of the wrist and distal ulna using an ipsilateral double barrel segmental ulna bone graft combined with a modified Sauve-Kapandji procedure. *J Hand Surg Eur Vol* 2017; 42: 377-81.  
<https://doi.org/10.1177/1753193416664291>
- [8] Wang T, Chan CM, Yu F, *et al.* Does Wrist Arthrodesis With Structural Iliac Crest Bone Graft After Wide Resection of Distal Radius Giant Cell Tumor Result in Satisfactory

- Function and Local Control? Clin Orthop Relat Res 2017; 475: 767-75.  
<https://doi.org/10.1007/s11999-015-4678-y>
- [9] Bhan S, Biyani A. Ulnar translocation after excision of giant cell tumour of distal radius. J Hand Surg Br 1990; 15: 496-500.  
[https://doi.org/10.1016/0266-7681\(90\)90102-A](https://doi.org/10.1016/0266-7681(90)90102-A)
- [10] Puloski SKT, Griffin A, Ferguson PC, *et al.* Functional outcomes after treatment of aggressive tumors in the distal radius. Clin Orthop Relat Res 2007; 459: 154-60.  
<https://doi.org/10.1097/BLO.0b013e318059b91f>

---

Received on 01-12-2019

Accepted on 12-12-2019

Published on 30-12-2019

DOI: <https://doi.org/10.31907/2414-2093.2019.05.05>

© 2019 Bastoni *et al.*; Licensee Green Publishers.

This is an open access article licensed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non-commercial use, distribution and reproduction in any medium, provided the work is properly cited.