Case Report

Giant Cell Tumor of Distal Radius After Open Reduction Internal Fixation for Distal Radius Fracture

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Abstract

Case: A 77-year-old woman presented with volar wrist pain 1.5 years after undergoing distal radius volar locked plating for fracture. Radiographs and CT were notable only for plate prominence, and she was admitted for removal of hardware. Intraoperatively, a large cavitary bone lesion was found. Histopathology demonstrated a giant cell tumor of the bone. Definitive management consisted of wide en bloc resection and osteoarticular allograft reconstruction, which achieved local control and an acceptable clinical result.

Conclusion: Although not previously described, a giant cell tumor of the bone may develop after fracture. Metal artifact in an area of previous internal fixation can make recognition challenging, but dual-energy CT can be used to decrease this artifact. Local control can be achieved with wide excision and reconstruction.

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JAAOS Glob Res Rev 2017;1:e043

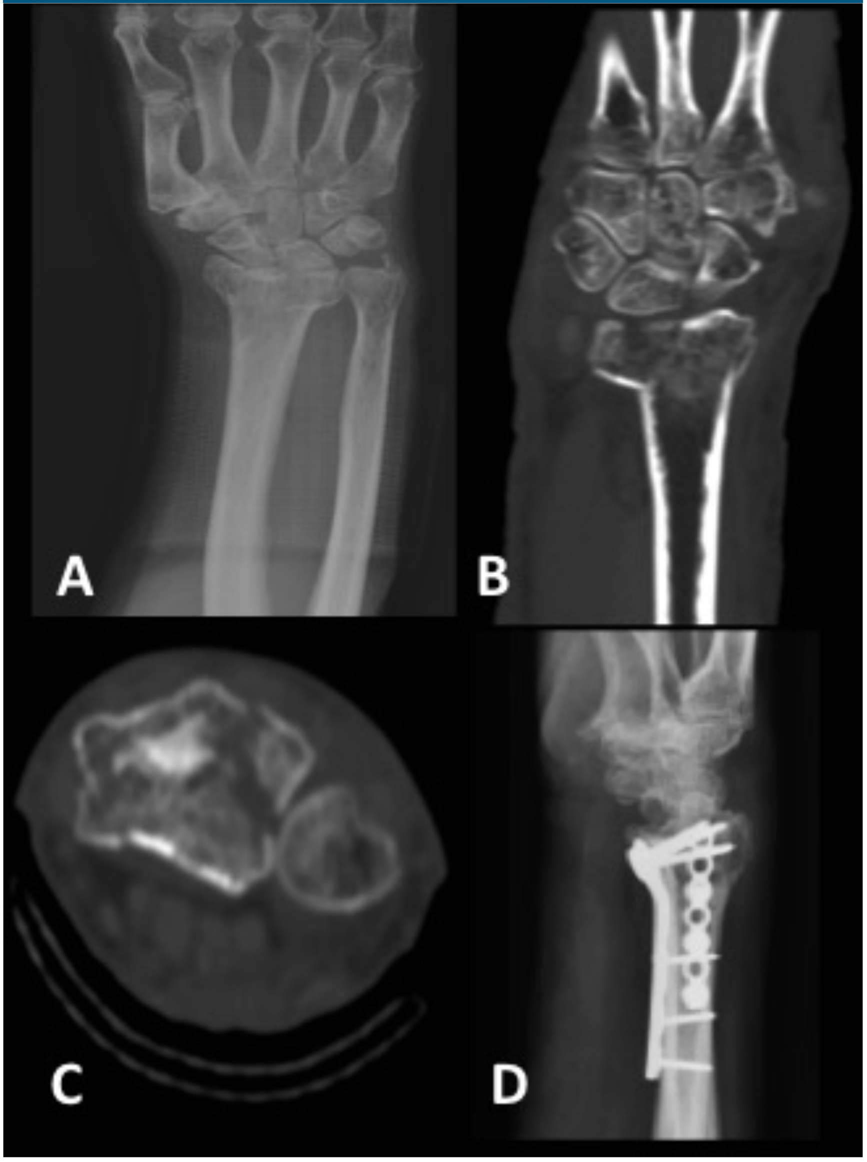
DOI: 10.5435/JAAOSGlobal-D-17-00043

Distal radius fractures (DRFs) are among the most common injuries treated by orthopaedic surgeons. Volar locked plating is a common approach for the management of operative fractures. In the absence of malunion, patients with nonspecific pain after a healed DRF managed with internal fixation are inspected for hardware irritation; device removal is indicated if there is concern for tendon irritation or attrition.[1]

Giant cell tumors (GCTs) of the distal radius are low-grade malignant lesions that are locally aggressive and can metastasize to the lung and bone.[2] The distal radius is the third most common location for a GCT. They are most commonly seen in patients in the third and fourth decades of life at the metaphyseal-epiphyseal junction. At diagnosis, approximately 12% of patients with a GCT present with pathologic fractures.[3] Surgical resection may be needed with periarticular tumors because of extensive cortical destruction and soft-tissue extension or substantial alteration of local bony architecture.[4]

We present a unique case of a GCT of the distal radius diagnosed 1.5 years after open reduction and internal fixation (ORIF) of a DRF treated by volar plating in a 77-year-old woman. At the time of fracture management, there was no radiographic or clinical evidence of

Figure 1



Preoperative images of the distal radius fracture in May 2014, demonstrating a dorsally angulated intra-articular distal radius fracture in unacceptable alignment. (**A**) AP radiograph. Coronal (**B**) and axial (**C**) CT reconstructions compared with (**D**) a lateral, immediate postoperative radiographic view of the distal radius after open reduction and internal fixation, demonstrating a prominent Soong grade 2 plate.

disease, suggesting that the tumor may have developed in the patient's eighth decade after ORIF of a DRF. Definitive management consisted of wide en bloc resection and osteoarticular allograft reconstruction of the distal radius, with local control and good clinical outcomes.

Case Report

The patient was a 77-year-old woman who sustained a right DRF in a fall. Plain radiographs and CT demonstrated a displaced, intra-articular DRF in the setting of diffuse osteopenia, but there was no evidence of pathologic lesion seen by two independent musculoskeletal radiologists (Figure 1, A–C). She was treated with ORIF of the distal radius through a standard volar approach using both volar and radial column plating (Figure 1, D). At the time of fixation, the orthopaedic traumatologist commented that the bone was "notably osteopenic" but otherwise unremarkable, with no gross evidence of pathologic lesion.

The patient's postoperative course was uncomplicated. One year later, after reporting initially good pain and functional improvements, the patient developed pain along the radial and palmar sides of the wrist without new injury. Physical examination revealed minimal swelling, notable only for tenderness along the flexor tendons and first extensor compartment. Radiographic imaging revealed excellent anatomic alignment, with the volar plate lying palmar to the watershed line (Figure 2, A). Further evaluation was obtained via CT, which used dual-energy imaging to minimize metal artifact. Both musculoskeletal radiologists interpreted the CT findings as marked osteopenia without evidence of nonunion or pathologic lesion (Figure 2, B and C). In directed retrospect, given the intraoperative

Dr. Hameed or an immediate family member serves as a paid consultant to Novartis. Dr. Fufa or an immediate family member is a member of a speakers' bureau or has made paid presentations on behalf of, and has received research or institutional support from, Medartis. None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Marshall, Dr. Bartolotta, Dr. Garcia, Dr. Lorich, and Dr. Athanasian.

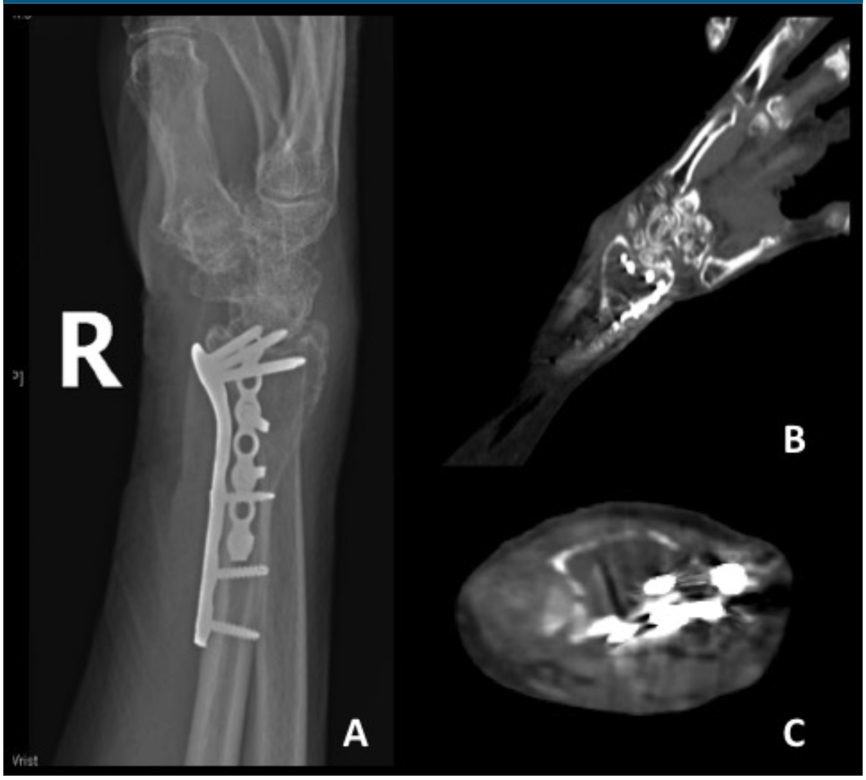
findings, the radiologists could find only a subtle suggestion of endosteal scalloping at the dorsal aspect of the fracture, which would favor the underlying lesion over osteopenia.

One and a half years after ORIF of the distal radius, following failure of conservative management, the patient was indicated for removal of the plate for presumed tendon irritation. During surgery, once the plate was removed, an expansile lesion occupying the entire volar metaphysis of the distal radius was appreciated. The lesion was curetted and sent to the pathology laboratory for frozen section assessment, which demonstrated a fibrohistiocytic-appearing lesion with multinucleated giant cells. Methyl methacrylate cement was used to fill the cortical defect and medullary cavity while awaiting the final pathologic diagnosis (Figure 3).

Microscopic examination of the tumor on permanent sections demonstrated proliferation of evenly distributed multinucleated giant cells, with intervening round to polygonal mononuclear stromal cells displaying relatively uniform vesicular nuclei and scant cytoplasm. Patchy areas with spindle cell morphology and a storiform pattern of cell arrangement were also seen. The final pathologic diagnosis was a GCT of the bone.

The patient then underwent staging with total body bone scan and chest CT to rule out metastasis. The tumor was classified as Campanacci grade 3 radiographically, with fuzzy borders and a soft-tissue mass that did not follow normal contour of the bone. There was insufficient cortex to allow an intralesional procedure. Wide excision with allograft distal radius reconstruction was offered, given the lack of carpal involvement and the desire to avoid donor site morbidity. Two months after curettage, the patient underwent en bloc excision of the distal radius and a cuff of uninvolved nonreactive soft tissue.

Figure 2



Fourteen-month postoperative views of the open reduction and internal fixation of the distal radius fracture when the patient presented with lateral wrist pain and the decision was made to proceed with removal of the plate. (**A**) Lateral radiograph True coronal (**B**) and true axial (**C**) CT reconstructions.

Reconstruction was performed with osteoarticular allograft.

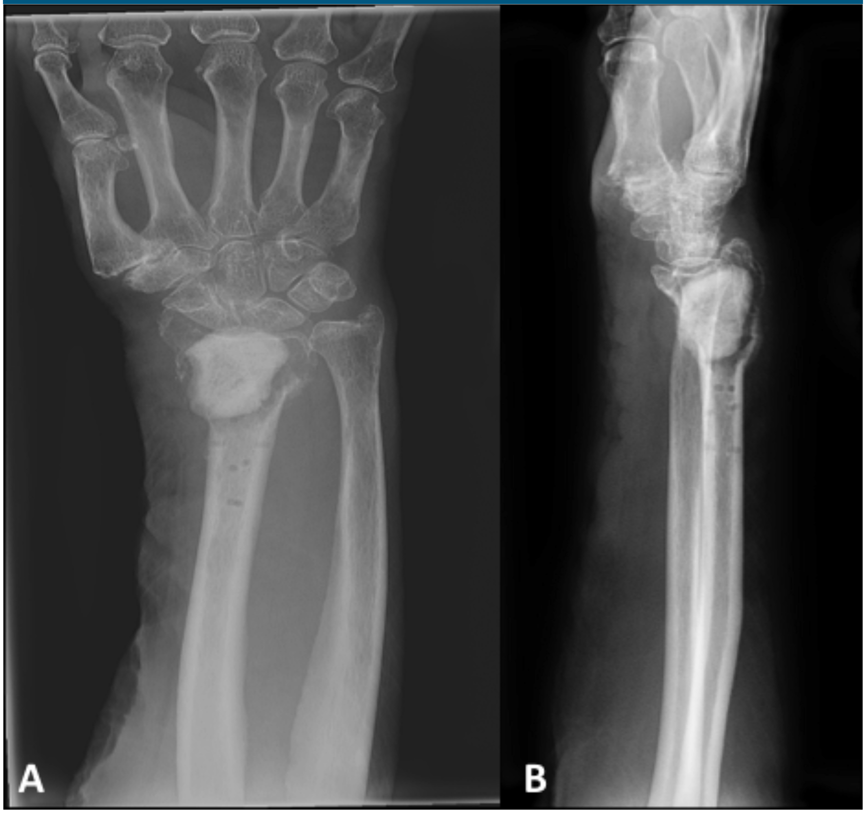
Two years after reconstruction, radiographs demonstrated acceptable osseous alignment without evidence of tumor recurrence (Figure 4). The patient had regained partial wrist motion with full digit motion. Grip strength measured 14 kg compared with 20 kg on the contralateral side, with a revised Musculoskeletal Tumor Society (MSTS) outcome system score of 27, with the patient reporting occasional pain and recreational restriction of function.[5]

Discussion

GCT is a rapidly growing destructive bone tumor caused by an abnormality of the receptor activator of the nuclear factor-κB ligand (RANKL) pathway. Approximately 10% of skeletal GCTs arise in the distal radius and are characterized by the presence of osteoclast-like multinucleated giant cells and mononuclear cells.[6] We present an uncommon case of a GCT of the distal radius in a 77-year-old woman who presented after ORIF for a DRF.

Early diagnosis of a GCT can be a challenge. Physicians should consider a GCT in female patients in their second to fourth decades of life who present with nonspecific wrist pain without associated trauma. Approximately 12% of patients who present with a pathologic fracture of the area are affected with a GCT.[3]

Figure 3



Postoperative AP (**A**) and lateral (**B**) radiographic views of the distal radius after removal of the plate and placement of temporary methyl methacrylate cement in the lesion in November 2015.

In this case, plain radiographs and CT imaging failed to detect the giant tumor lesion at the time of a DRF. The follow-up CT was performed using the dual-energy technique to decrease artifacts related to the metallic fixation hardware. Standard single-energy CT with filtered back projection suffers from photon starvation and beam hardening related to metallic hardware. Although simply increasing the peak kilovoltage of the CT acquisition can help to overcome these effects from metal, a single high-energy CT would also produce various reconstruction errors, beam hardening artifact, and overall increased patient dose. Instead, dual-energy CT allows for the creation of high-energy reconstructions without increased dose to the patient and reconstruction errors.[7]

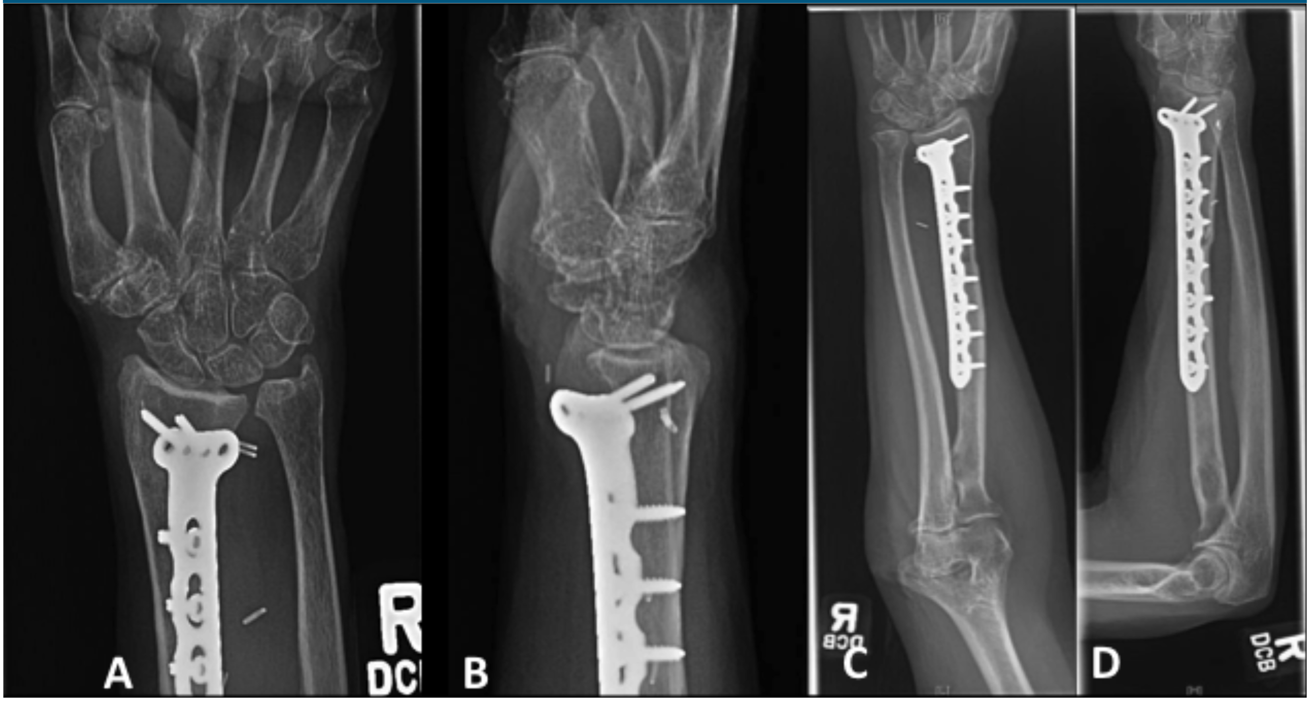
However, this second CT also failed to detect pathologic lesion, likely because of underlying osteopenia and the associated decreased sensitivity of CT for detecting marrow-replacing tumor compared to MRI. Both musculoskeletal radiologists agreed that there was no evidence of a GCT on the initial CT (even in the directed retrospect). These imaging findings and the time interval from fracture to diagnosis lead us to conclude that the GCT likely developed after ORIF of the distal radius. This case highlights the limitations of CT for detection of a GCT in the setting of osteopenia, despite metal artifact reduction techniques.

The two most common surgical treatments for a GCT of the distal radius are intralesional curettage with adjuvants or en bloc resection of the lesion with reconstruction. Intralesional curettage is often performed in patients with Campanacci grade 1 and 2 lesions.[2,4] After curettage, cementation with polymethyl methacrylate is used for reconstruction; newer cements may incorporate cytotoxic agents, which may reduce the risk of recurrence.[2,5,8] En bloc resection is often favored in Campanacci grade 3 lesions where there is cortical perforation in multiple planes in the affected bone.[3,4,8] Surgical reconstruction is commonly performed with osteoarticular allografts or arthrodesis with intercalary bone grafts.[7]

Patients treated with osteoarticular reconstruction are at a higher risk of complications, including nonunion, loss of range of motion (ROM), and weaker grip strength, compared with those treated by surgical reconstruction with osteoarticular allograft.[8] Advantages of the use of allograft include shorter surgical time, no donor site morbidity, and more accurate size matching compared to vascularized fibula arthrodesis. Risks of osteoarticular allografts include joint instability and articular degeneration.[9] Our case demonstrates successful en bloc resection with allograft reconstruction performed in an elderly patient with partial preservation of wrist ROM.

We are unaware of any previous description of a GCT arising after ORIF in the distal radius. This case emphasizes the importance of scrutiny of postoperative imaging in the setting of unexplained worsening symptoms, particularly in patients in a more typical demographic for a GCT. Furthermore, it emphasizes the importance for surgeons to submit specimens for pathology evaluation, especially when there is a high clinical suspicion of pathologic fracture. Wide en bloc resection and osteoarticular allograft reconstruction was

Figure 4



Two-year follow-up postoperative radiographic views of the distal radius after en bloc resection and osteoarticular allograft reconstruction. AP (**A**) and lateral (**B**) views of the wrist and AP (**C**) and lateral (**D**) views of the forearm.

effective in achieving local control, avoiding donor site morbidity and maximizing ROM and function.

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