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CASE REPORT

E.P.C.M.S.

Treatment of a Giant Cell Tumor of the Distal Ulna with a Fully Constrained Prosthesis

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ABSTRACT
Giant cell tumors (GCT) of bone are aggressive, expansile tumors most commonly found in the epiphyseal region of long tubular bones, including the ulna. Treatment options for GCT's of the distal ulna include curettage with or without bone graft, and distal ulna resection with or without ulna head prosthesis. Reconstructive procedures of the distal radioulnar joint (DRUJ) after resection include creation of a single bone forearm, ulna prosthetic head replacement, and arthrodesis of the DRUJ with creation of a pseudoarthrosis in the distal ulna to mention a few. We present a case report of a 21 year old male with a GCT of the distal ulna treated with an en bloc resection of the distal ulna, with immediate reconstruction of the DRUJ with a fully constrained Scheker Prosthesis.

INTRODUCTION
Giant cell tumors of bone, also known as an osteoclastoma, usually involve the epiphyseal area of long bones, particularly the knee (1). Approximately 5% of primary bone tumors are giant cell tumors (GCT) (1, 2). Most GCT are solitary, but multicentric or multifocal tumors may occur (3, 4). The dital radius is the most commonly affected bone in the wrist, whereas GCT's of the distal ulna are relatively uncommon (5). Giant cell tumors rarely become malignant; however, if in the wrist, approximately 12% of GCT's convert into malignant tumors (1). If malignant, GCT's may metastasize to distant areas such as the lungs, brain, ribs, lymph nodes, soft tissues, viscera, spine, long bones, and pelvis. The overall incidence of metastasis is estimated to be < 2% (4). In this case, a distal radioulnar joint (DRUJ) prosthesis was used to reconstruct the distal ulna and maintain DRUJ function and forearm axis rotation following excision of a large section of the distal ulna infiltrated with tumor. To our knowledge, this is the first known case of a bone tumor treated with a fully constrained DRUJ prosthesis.

CASE REPORT
A 21 year-old right-handed male sustained an injury to the left wrist while "rough-housing" with a friend. He sought medical attention in the emergency department on the day of his injury because of worsening left wrist pain. He was referred to the orthopedic clinic for evaluation and treatment after being splinted in the emergency department. Patient's history revealed a construction worker with a ten month history of an enlarging, painful mass in the left wrist. The pain prevented the patient from maintaining regular work in construction. On physical examination, a large, ulnar-sided mass on the left wrist was noted (Figs. 1A and 1B). Grip strength was markedly diminished compared to his contralateral side. Active and passive range of motion was slightly diminished compared to the contralateral side secondary to pain. Plain film radiographs revealed a radiolucent, expansile lesion in the left distal ulna (Figs. 2A and 2B). A magnetic resonance image (MRI) demonstrated an expansile, soap-bubble lesion of the distal ulna which measured 4 cm in diameter with localized destructive epiphyseal-metaphyseal lesion without involvement of the distal articular surface or radioulnar joint. No skip lesions were noted. A CT scan of the thorax and abdomen was normal without evidence of metastasis. Serologic studies revealed mild increases in hemoglobin, hematocrit, serum protein, alanine aminotransferase, and alkaline phosphatase and a mild decrease in potassium and blood urea nitrogen. All other parameters of the CBC and metabolic panel were normal.

INTRAOPERATIVE TREATMENT
The patient underwent a wide en-bloc resection of a giant cell tumor of the distal ulna, with immediate reconstruction of the DRUJ with a Scheker prosthesis (Figs. 3A and 3B). The tumor was sent for routine gross (Fig. 4), histological (Fig. 5), and pathological examinations. The specimen measured was a 7.5 x 5.5 x 4.5 cm giant cell tumor.

POSTOPERATIVE COURSE
Two weeks following surgery, forearm supination measured 5 degrees and pronation measured 40 degrees on the left side. The patient began hand therapy at that time. At two months postoperatively, the patient was able to rotate his forearm with a decreased amount of pain, made great improvements in range of motion and improved grip strength. The patient's active range of motion is shown in Figure 6 A-F. Measurements of the patient's active range of motion, grip strength, and pinch grip strength at thirteen months post-operatively are shown in Tables 1, 2, and 3 respectively. Plain film radiographs were obtained at each follow up visit. On careful inspection of the patient's recent radiographs, there are signs of loosening of the ulnar component, perhaps due to a cantilever mechanism observed with some hip prosthesis (fixation stable on the proximal end and windshield wiper motion on the distal end) (Fig. 7A and 7B). This however may be related to the large segment of bone that was required for excision of the tumor proximal to the plasma spray region of the prosthesis, which did not allow for bony ingrowth. The radial component, on the other hand, was very stable without any radiographic signs of loosening. Despite these radiographic findings, the patient returned to work as a security officer and is totally asymptomatic.

DISCUSSION
Patients with GCT's usually present from 20 through 40 years of age. The tumors are more common in Asians than Caucasians.

Continued on page 10

Unlike most bone tumors, GCT's are more common in females than males. Patients often present with pain, swelling, and limited range of motion. Giant cell tumors may also present with a pathological fracture due to thinning of the cortex (2).

On gross examination, GCT's are generally solitary, well circumscribed, and appear hemorrhagic. Necrotic areas are occasionally encountered. Giant cell tumors are also called osteoclastomas because, microscopically, they contain a large number of osteoclast-like giant cells. The histological background consists of anaplastic mononuclear stromal cells (7, 8).

Radiographically, GCT's appear as a lytic and expansile lesions in the epiphyseal-metaphyseal region of long bone. The lesion is usually surrounded by a thin rim of cortex. The matrix appears multiloculated with a classic soap-bubble appearance (7, 8).

Various treatment options have been proposed for GCT's of the distal ulna. All procedures alter the function and biomechanics of the forearm axis and the DRUJ. Methods of treating GCT's of the distal radius and ulna include: curettage, and en bloc excision with or without reconstruction using bone grafts, arthrodesis, and/or soft tissue stabilization of the distal ulna. Vascularized bone grafting has also been successful. A high recurrence rate of GCT's is associated when curettage is the only form of treatment performed (7, 8). Haskell et al reported a recurrence rate of 25-35% after performing curettage, while Rock et al reported the rate to range between 10 and 47%. Most recurrences typically appear within two to five years (8).

En bloc resection of the distal ulna without reconstruction is the preferred method of treatment reported by some authors (1, 5). According to Cooney et al, replacement of the distal ulna after resection is usually not necessary to maintain function. However, other authors disagree because stabilization of the distal ulna following large resection can be a significant clinical problem with associated pain and weakness. Several reconstructive procedures have been recommended to stabilize the DRUJ and forearm-axis and help address the large segmental bone loss. These procedures include tethering procedures using various tendons or muscle (e.g. extensor carpi ulnaris and pronator quadratus), creation of a single bone forearm, and arthrodesis of the DRUJ with creation of a pseudarthrosis (6, 9-15). Some of the problems associated with the traditional reconstructive procedures include persistent ulnar-sided wrist pain due to tendonitis, impingement of the ulna against the radius, ulnocarpal instability, limited forearm rotation, unsightly bobbing of the proximal stump of the ulna, and attritional rupture of the extensor tendons. A rare complication is ulnar translation of the carpus (6, 9, 16, 17). An oncological prosthesis per se is currently not available to reconstruct the distal ulna following resection of a tumor. The Scheker DRUJ prosthesis is an option when the distal ulna is removed. Moreover, when all of the soft tissue support is removed from the distal ulna (i.e., triangular fibrocartilage complex (TFCC) and the interosseous membrane), a constrained device should be used to substitute for this deficiency and to address the gross instability of the remaining ulna caused by a large segmental resection.

In this case, we used a fully constrained DRUJ prosthesis (Scheker Prosthesis) to reconstruct the distal ulna after excision of the giant cell tumor. This is a relatively new prosthesis and it is, to our knowledge, the first time it has been used after excision of a large benign tumor of the distal ulna.

There have been some concerns that have been expressed regarding the use of this prosthesis, which are similar concerns with all prosthesis about the wrist. How long will the prosthesis hold up? How much loosening, if any, will occur? Will the patient obtain and maintain full forearm rotation? How much activity can the patient perform? These questions are all valid concerns, but currently the reconstructive options for the DRUJ all have their own intrinsic clinical problems, particularly in a young individual. So the search continues to find a reconstructive procedure for the DRUJ that is consistent and acceptable for both the patient and physician. This new (constrained) prosthesis is where we have evolved to today in the search for a satisfactory reconstructive procedure.

CONCLUSION

This case demonstrates that a fully constrained Scheker prosthesis can be used successfully to reconstruct and stabilize the distal radioulnar joint following the resection of a large tumor, which in this case was a giant cell tumor of the distal ulna. Moreover, the fully constrained prosthesis provided the patient the ability to return back to reasonable function following resection of a large distal segment of the ulna. Long-term studies are certainly required to determine the usefulness of this prosthesis.

ACKNOWLEDGEMENTS

None

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Continued on page 11

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Table 1: Range of Motion of Right and Left Wrist

Range of Motion	Right	Left
Palmar Flexion	75	70
Dorsiflexion	65	65
Ulnar Deviation	45	45
Radial Deviation	25	24
Supination	72	70
Pronation	90	80

Measurements were calculated in degrees using a goniometer 13 months post-operatively.

Table 2: Bilateral Hand Grip Strength Measurements

Position	Right	Left
V	81	88
IV	104	94
III	115	99
II	124	104
I	91	69

Grip strength measured using JAMAR Dynamometer using all five settings at 13 months post-operatively. Measurements are the average of 3 trials and are in pounds per square inch. Values are rounded to the next whole number.

Table 3: Bilateral Pinch Grip Strength Measurements

Pinch Grip Position	Right	Left
Key	28	28
Chuck	26	21
Pincer	18	13

Pinch grip strength measurements at 13 months post-operatively. Measurements are the average of 3 trials and are in pounds per square inch. Values are rounded to the next whole number.

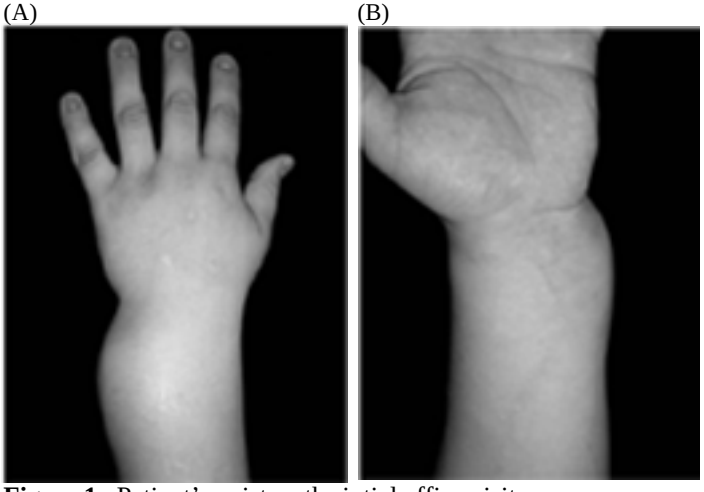

Figure 1: Patient's wrist on the intial office visit:
A: PA view
B: AP view

Figure 2: X-ray of the patient's wrist demonstrating the giant cell tumor of the distal ulna.
A: PA view
B: Lateral view

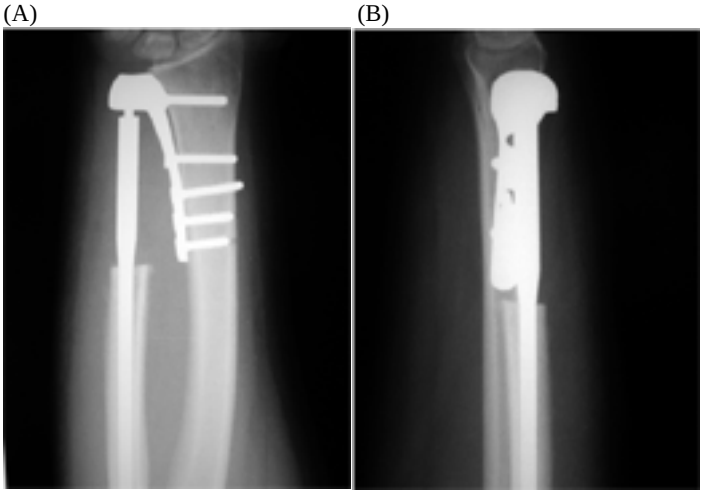

Figure 3: X-ray of the patient's wrist showing the Scheker prosthesis in place immediately post-operatively.
A: PA view
B: Lateral view

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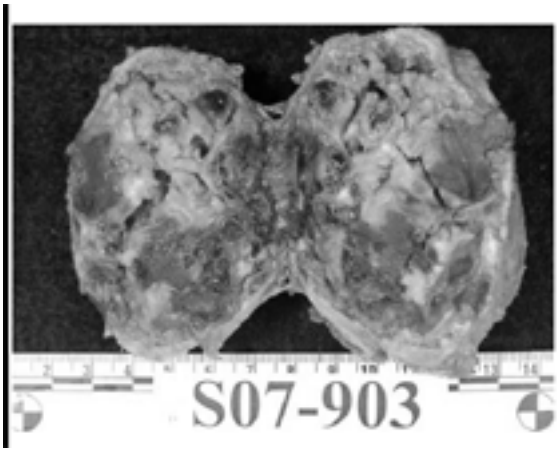


Figure 4: Giant cell tumor of bone demonstrating focal hemorrhage.

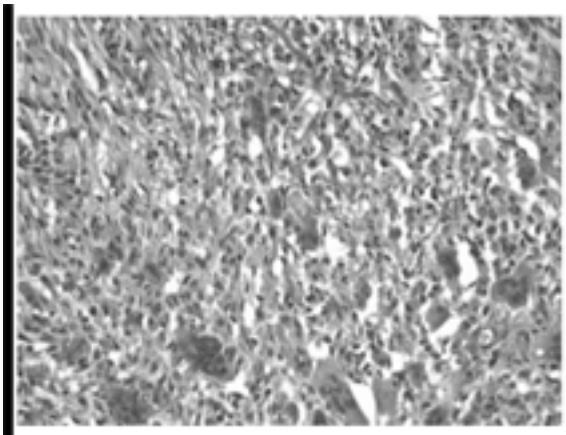


Figure 5: Low power microscope field showing characteristic mononuclear cells and scattered giant cells.

(A) (B)

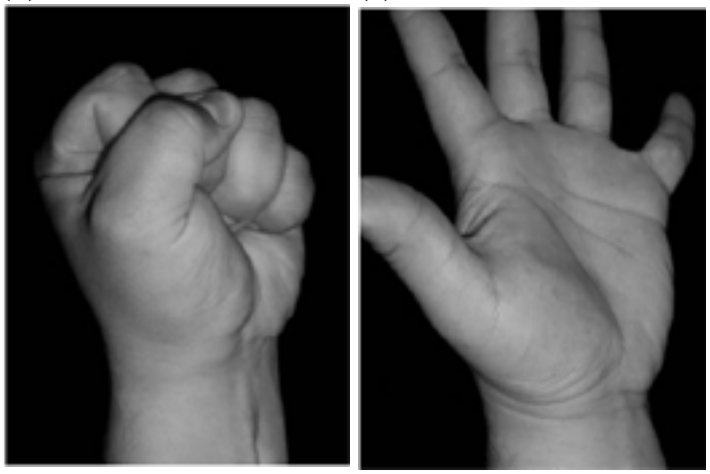
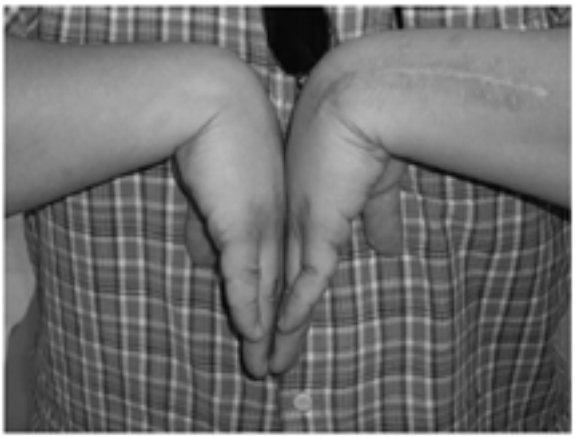


Figure 6: Active range of motion thirteen months post-operatively.
A: Fist
B: Open hand
C: Palmar flexion with dorsal aspects of both hands together
D: Wrist Extention with palms of both hands together
E: Forearm supination
F: Forearm pronation

(C)



(D)

(E)

(F)

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(A) (B)

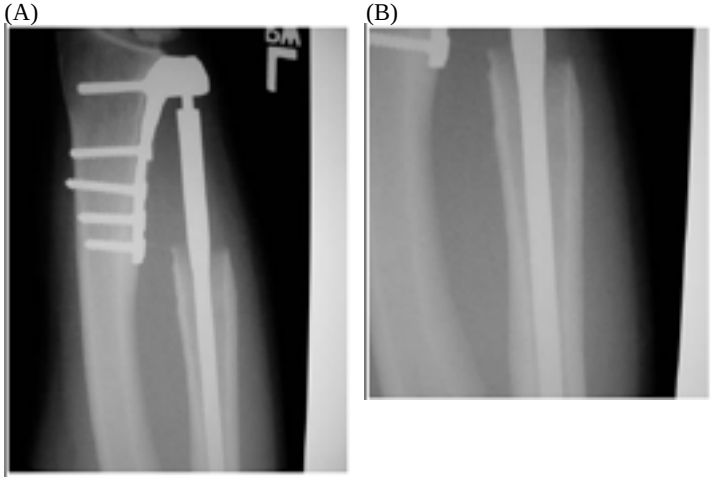

Figure 7: X-ray of the patient's left wrist with the Scheker prosthesis inplace thirteen months post operatively, showing signs of some loosening of the ulnar component.
A: AP view
B: AP view

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