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Fifteen-year follow-up of catastrophic distal humeral bone loss treated with a cement spacer: a case report

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Management of massive bone loss in the elbow poses a daunting clinical challenge. If the loss includes the articular surface, options are generally limited to arthroplasty, osteoarticular allograft, or allograft prosthetic composites and custom prostheses. Total elbow arthroplasty (TEA) is an effective surgical treatment for severe elbow arthritis and highly comminuted distal humerus fractures providing pain relief and improved function but has a high complication rate.[3] In general TEA is considered a salvage operation for elderly patients. Massive open injuries also represent a relative contraindication to TEA because of infection risk.

We present a case of massive distal humeral bone loss in a 20-year-old musician treated with an antibiotic cement spacer with 15 years of follow-up, an excellent functional outcome, and a high level of patient satisfaction.

A 20-year-old right-hand-dominant female presented as a hospital-to-hospital transfer with a left elbow injury after a rollover motor vehicle collision. Initial x-rays demonstrated a highly comminuted distal humerus fracture with considerable bone loss, a highly comminuted olecranon fracture, and a minimally displaced radial head fracture. She underwent irrigation, debridement, and external fixation (Fig. 1) at an outside facility before transfer.

Initial examination demonstrated a static elbow spanning the external fixator with a 15-cm wound laterally. The patient had 2-point discrimination intact to 4 mm in median and ulnar distributions. Her motor function was intact distally, and she had 2+ radial and ulnar pulses. Reconstructive options were considered. Elbow replacement was felt to be a poor option given her age and open injury. The initial plan was to place an antibiotic cement spacer followed by eventual allograft reconstruction.

In the initial surgery performed shortly after transfer, an antibiotic cement spacer was formed around a Rush rod (Zimmer Biomet, Warsaw, IN, USA) stabilized by intramedullary humeral implantation (Fig. 2). The canal was prepared using a Rush rod reamer/awl. By sequentially increasing the diameter, rods were trialed to evaluate for stability and length. No more than moderate resistance was desired. Films of the contralateral humerus were used to assess and reestablish length. Sutures (0 PDS) were passed through the cement while it was hardening to allow for reattachment of the common flexor and extensor origins. The ulna was highly comminuted with bone loss and was not reconstructible. Suture material was used to capture the olecranon pieces and reattach the triceps to the ulna. She was placed into a long arm splint until initial follow-up a week later, at which point the sutures were removed and she was transitioned to a hinged elbow brace. She was initially placed in a hinged elbow brace with 90-degree flexion block to protect the posterior repair. The brace was adjusted to decrease the block by 15 degrees every 1-2 weeks. She maintained elbow stability and worked with occupational therapy

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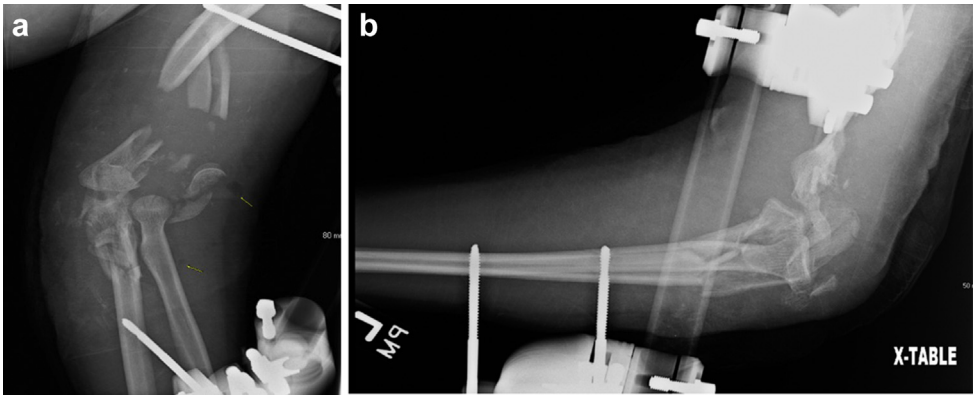

Figure 1 (**a**) Radiograph of the *left* elbow with external fixator in place. (**b**) Lateral radiograph showing external fixation.

Figure 2 (**a**) Anteroposterior radiograph of the Rush rod with initial antibiotic-impregnated cement spacer. (**b**) Lateral radiograph of the initial spacer.

to increase her strength as motion improved. Range of motion remained moderately restricted.

She completed a course of antibiotics and had no evidence of clinical or serologic infection. After considering all reconstructive options, we implanted a smaller antibiotic spacer to decrease soft-tissue tension and hopefully improve motion (Fig. 3). Motion improved further after surgery and has remained consistent with the values measured at 15-year follow-up.

At five months postoperatively, the patient reported doing well and was able to continue her musical training on piano. At the family's request, we facilitated multiple opinions. Ultimately, she opted to avoid additional surgery and followed up every two years for examination and radiographs. Images of the patient's range of motion in supination, pronation, flexion, and extension were taken at a 15-year follow-up appointment (Fig. 4). Radiographs were also obtained at 15-year follow-up visit (Fig. 5). The radiographs demonstrated increased bone enveloping the spacer and changes in the position of the ulna relative to the spacer. The patient reports excellent range of motion and no difficulties in activities of daily living. Her current range of motion measures 140/124 extension/flexion and 40/27 pronation/supination. She avoids heavy lifting. She has gone on to a successful career as a performer and composer with piano as her primary instrument. Patient consent was obtained for this case report to be published.

Discussion

There are several options for humeral reconstruction in the presence of massive bone loss. The use of total elbow, large osteoarticular allograft, or allograft prosthetic composite reconstructions has been shown to have a high complication rate and is recommended for use in salvage situations.[6] There has also been a successful report of the use of a pedicled scapular flap to recreate the distal humerus after surgical debridement of chronic osteomyelitis causing extensive bone loss. Although in this case the patient regained functional range of motion, this is a technically challenging surgery and relies on the artery patency for graft survival.[8]

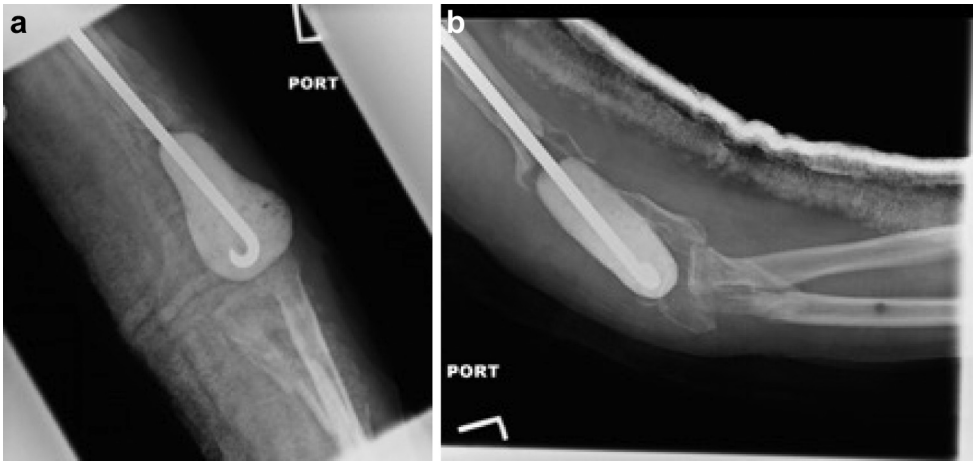

Figure 3 (**a**) Anteroposterior radiograph of the revised spacer. (**b**) Lateral radiographs of the revised spacer.

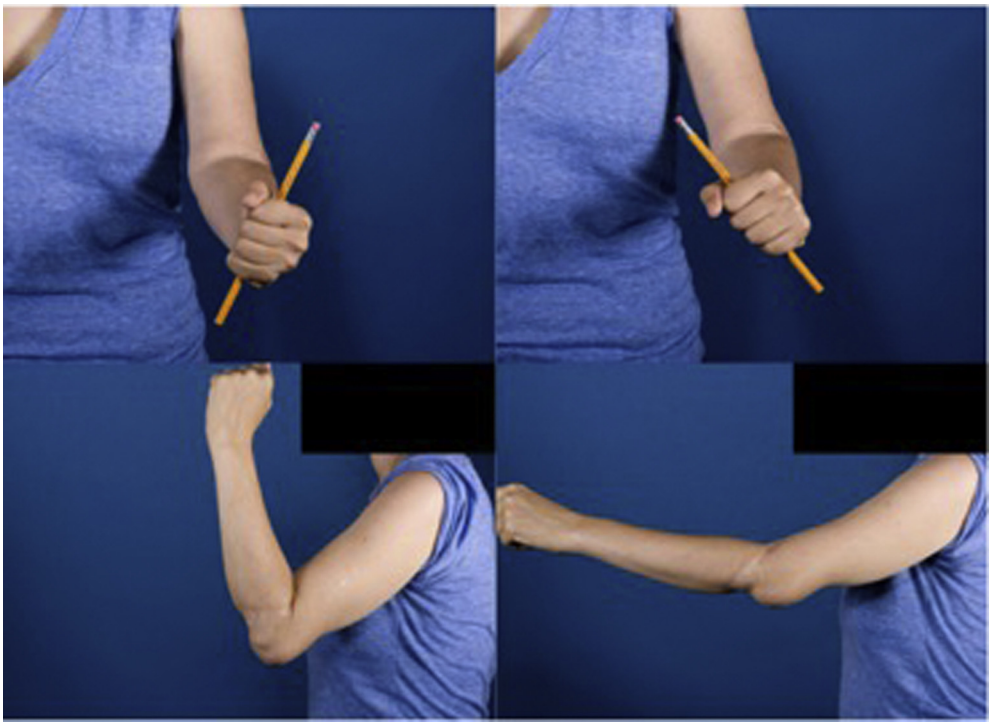

Figure 4 Fifteen-year follow-up of supination (*top left*), pronation (*top right*), flexion (*bottom left*), and extension (*bottom right*).

Cement spacers are commonly used as the first stage in a two-stage procedure to allow maintenance of a soft-tissue envelope, enhance biologic incorporation, and provide some degree of function while awaiting a second stage. Articulating cement spacers have been used in the hip and knee for two-stage revisions to maintain soft-tissue balancing in preparation for definitive implantation. Various techniques of articulating cement spacers used in the elbow for the first stage of a two-stage revision for a prosthetic elbow infection have been described. In one report, cement-coated Steinmann pins and a k-wire were used to create a hinge to allow maintenance of the soft-tissue envelope and motion while awaiting the second stage of surgery.[11] A novel technique of creating a hinged antibiotic spacer using Ilizarov rods was also described. The patient went on to have a definitive prosthesis placed in the second stage and was pain free with a range of motion of 10-110 degrees.[7] There has also been a report of using a hinge mechanism cement spacer created with K-wire and 18-gauge wire in a patient for an infected TEA with bone loss. Although there were limitations in motion, the patient was satisfied with his function and outcome and declined further surgery.[5]

Although uncommon, there are reports on the use of a cement spacer as definitive management in the hand, shoulder, and ankle for infection eradication.[1,2,4] There is a report of a cement spacer used in the shoulder as a first stage for a planned two-stage revision for a prosthetic shoulder infection; however, the patient was extremely satisfied with her results and, at five years of follow-up, continued to refuse the second stage of surgery.[10] Another report of a cement spacer used in the shoulder had four years of follow-up, and the patient had comparable range of motion and better outcome scores than patients undergoing two-stage revision.[4] The definitive use of an articulating cement spacer in a knee with seven years of follow-up did reveal progressive bone loss on radiographs; however, the patient continued to be functional and happy and refused conversion to a knee arthroplasty.[9]

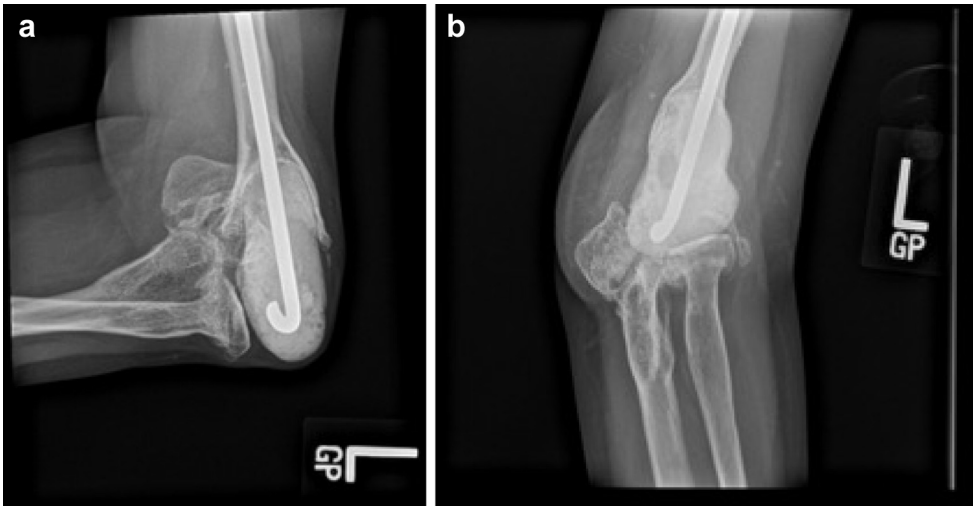

Figure 5 (**a**) Lateral radiograph at 15-year follow-up. (**b**) Anteroposterior radiograph at 15-year follow-up.

Conclusion

This case report presents a cement spacer with intramedullary stabilization and suture fixation as management for catastrophic bone loss with excellent long-term functional outcome. Although there is presumably less stress placed on the upper extremity than on the lower extremity, there is still concern for the possibility of bone loss around the cement spacer and need for future revision. There are no long-term case reports of definitive cement spacers used in the elbow, so durability is unknown. This remains a unique case, so a larger study is not currently possible. The patient is both functional and satisfied but will continue to be followed up with periodic examination and radiographs. At the very least, the spacer has provided a safe functional option while preserving the possibility of subsequent allograft or arthroplasty surgery if necessary.

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