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A case report: instability after distal humerus hemiarthroplasty leading to revision with a total elbow arthroplasty

Daniel S. McNeil, MD[a], Kristen I. Barton, MD, PhD[a,b,c], Kenneth J. Faber, MD, MHPE[a,b,*]

[a]Roth|McFarlane Hand and Upper Limb Centre, London, ON, Canada
[b]Schulich School of Dentistry and Medicine, Western University, London, ON, Canada
[c]Faculty of Health Sciences, School of Physical Therapy, Western University, London, ON, Canada

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The most common operative management of distal humerus fractures is open reduction and internal fixation.[11] In some patients, the distal humerus may not be reconstructable and arthroplasty is required.[10] In older patients with lower functional demands, total elbow arthroplasty (TEA) provides a good outcome.[10] Younger or more active patients may not be compliant with the postoperative restrictions and are generally not considered suitable candidates for TEAs.[5] Distal humeral hemiarthroplasty (DHH) may not require the same postoperative restrictions and is an alternative treatment in younger patients with nonreconstructable distal humerus fractures.[5]

There is limited published research on instability following DHH. The authors of a recent review state that they are "aware of an unpublished case revised to TEA for instability in a patient with juvenile rheumatoid arthritis"; however, no further details are provided related to TEA but details ligament reconstruction.[2] A recent systematic review identified 4 cases of instability following DHH.[9] Heijink et al reported 3 patients with instability among 6 cases.[6] Two of these 3 cases used a lateral collateral ligament (LCL) release for surgical exposure, with the third using an olecranon osteotomy. None of these patients required further surgical intervention. Nestorson et al identified one case of instability in 42 cases.[12] This patient required subsequent LCL reconstruction. LCL release was not performed in any case in this series, suggesting that this may represent an unrecognized injury at the time of the index surgery. At final follow-up, this patient had a stable elbow. We are not aware of any published reports of revision of modern hemiarthroplasty components to TEA for instability following treatment of a distal humerus fracture.

There is limited literature reporting elbow instability requiring revision following DHH to TEA for fracture. We present a case of a patient who sustained a distal humerus fracture that was treated with DHH and was subsequently revised to TEA for ligamentous instability yielding a good clinical outcome.

Case report

A 75-year-old, right-hand–dominant woman sustained an isolated closed left distal humerus fracture during a slip and fall while gardening. Her past medical history was significant for dyslipidemia, gastroesophageal reflux, and osteopenia treated with risedronate. She was active and lived independently.

Physical examination revealed a closed injury, and the patient was neurovascularly intact. Radiographs demonstrated a comminuted articular fracture of the distal humerus (AO-OTA 13B3.3; Fig. 1 *A–D*).

A posterior midline incision was used. The ulnar nerve was mobilized and subsequently transposed at the end of the case. A lateral para-olecranon approach was used.[21] The LCL complex was avulsed from its humeral origin and the ulnar insertion was intact and preserved. Lateral instability was noted at this time. The triceps was split, and the medial collateral ligament was released from the

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*Corresponding author: Kenneth Faber, MD, PhD, Roth|McFarlane Hand and Upper Limb Centre, 268 Grosvenor St, London, ON N6A 4V6, Canada.
E-mail address: kjfaber@uwo.ca (K.J. Faber).

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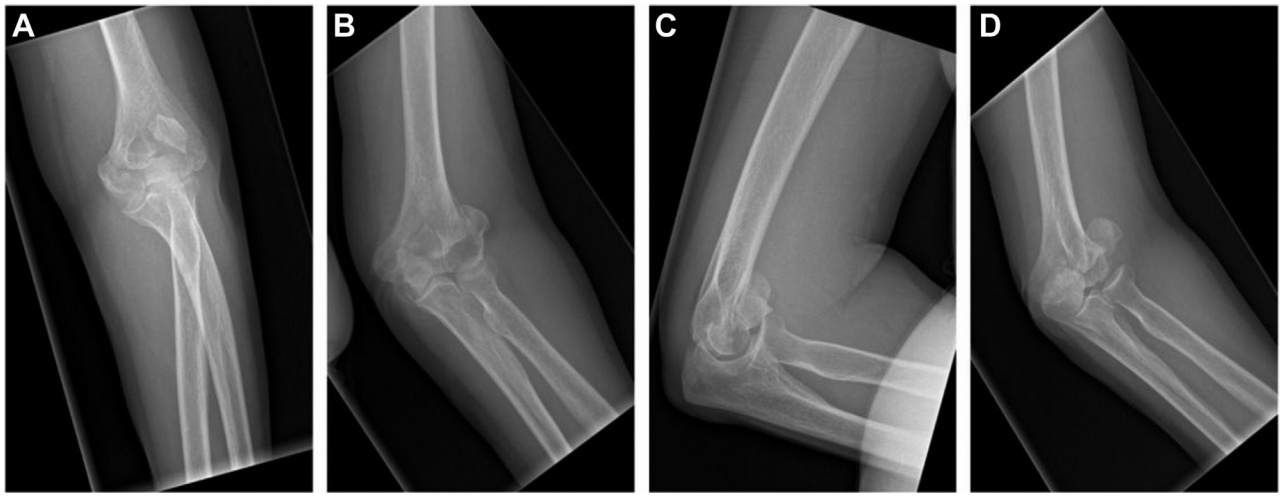

Figure 1 Initial x-rays of the left elbow injury in the following views: anteriorposterior (**A**), oblique 1 (**B**), lateral (**C**), and oblique 2 (**D**).

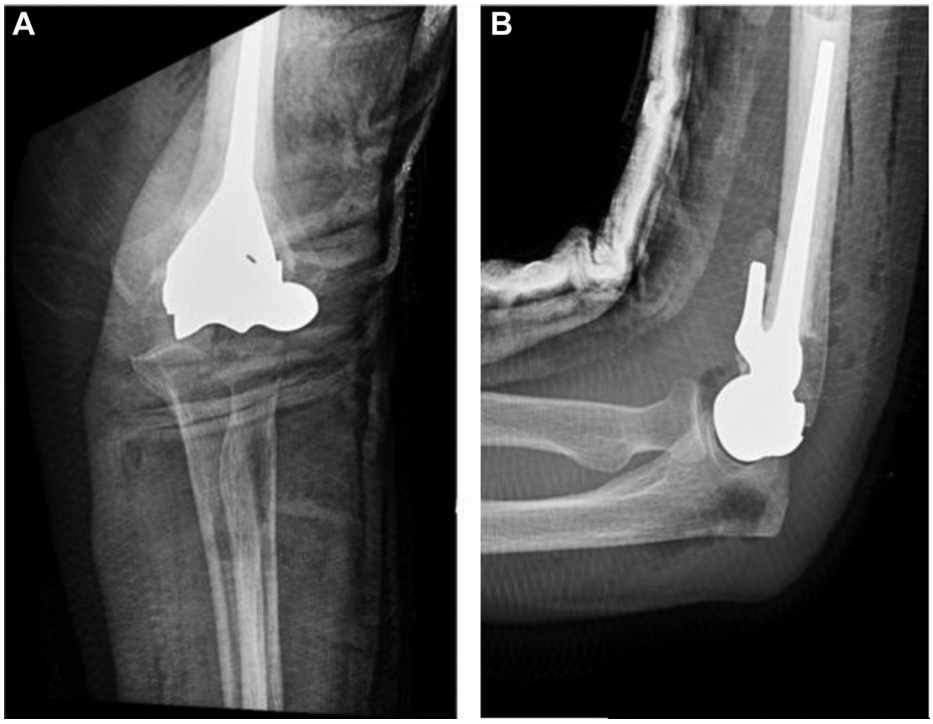

Figure 2 X-rays on postoperative day 1 following left distal humerus hemiarthroplasty in the following views: anteriorposterior (**A**) and lateral (**B**).

medial epicondyle to allow full exposure of the distal humerus. The distal humerus had extensive articular comminution that was not amenable to open reduction and internal fixation and was prepared for hemiarthroplasty.

Trial components for the Tornier Latitude system (Stryker, Kalamazoo, MI, USA) were placed and trial reduction revealed appropriate positioning, and care was taken to ensure correct rotational alignment during implant placement. Trial components were removed. Running locking sutures were placed into the medial collateral ligament and LCL complex and then passed though transosseous bone tunnels in the epicondyles. These were then passed through the central axis of the implant. The definitive implant was cemented in place and the collateral ligaments were secured. Soft tissues were closed in a standard fashion in layers. The elbow was splinted in a position of 90° flexion and neutral forearm rotation.

Radiographs performed on postoperative day 1 revealed joint incongruity with medial translation of the forearm relative to the humerus (Fig. 2 *A* and *B*). Examination with fluoroscopy revealed instability to both varus and valgus stress. A concentric reduction was obtained under fluoroscopic guidance and the elbow was immobilized. Repeat imaging on postoperative day 2 revealed medial dislocation of the ulnohumeral and radiocapitellar joints (Fig. 3 *A* and *B*). The patient then underwent revision to a linked TEA.

Intraoperative findings revealed that the sutures and knots remained intact in both collateral ligaments, but the sutures had cut through the bone of the epicondyles resulting in loss of

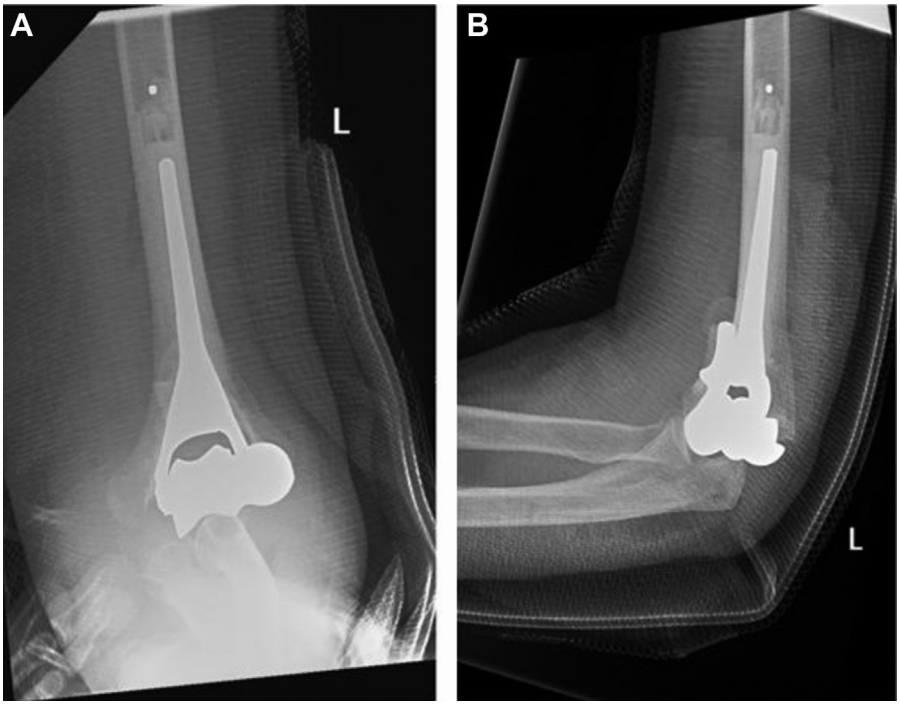

Figure 3 X-rays on postoperative day 2 following left distal humerus hemiarthroplasty in the following views: anteriorposterior (**A**) and lateral (**B**).

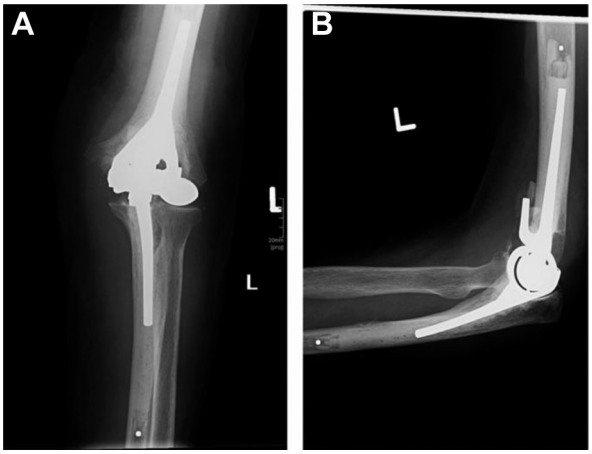

Figure 4 X-rays 2 weeks after revision to total elbow arthroplasty in the following views: anteriorposterior (**A**) and lateral (**B**).

appropriate tension and subsequent instability. The ulna was prepared and then the ulnar component was cemented in place. The anatomic distal humerus spool was exchanged for a linking spool. The ulnar cap was then placed to link the components. The wound was closed in layers and the patient was splinted at 30° for wound healing.

At the 2-week follow-up (Fig. 4 *A* and *B*), the patient reported decreased sensation to the ulnar distribution in the hand, but this had completely resolved by the 6-week visit. At 4-year follow-up, the patient was doing well and had a good clinical outcome. She reported mild sensitivity along the subcutaneous border of the ulna but was otherwise doing well. Range of motion revealed extension of 10°, flexion of 140°, supination of 70°, and pronation of 70°. Patient-reported outcome measures included Mayo Elbow Performance Score of 85, Single Assessment Numeric Evaluation of 80, Short-Form 12 physical score of 54, Short-Form 12 mental score of 47, and Patient-Rated Elbow Evaluation of 12. Radiographs were stable with no evidence of complication (Fig. 5 *A* and *B*).

Discussion

This case report details ligament instability following DHH, in which a conversion to a linked TEA was completed. Relevant issues that led to instability in this case include the following: osteopenic bone, advanced age, and a ligament repair that was not sufficiently strong to maintain joint stability. Caution should be used with DHH in elderly patients where ligament repair is required, as TEA should be preferred in this patient population. The utility of the convertible TEA implant is also an important consideration in DHH and is recommended by the authors for this patient population.

Nestorson et al reviewed 3 Swedish joint registries for distal humerus fractures treated with arthroplasty.[13] They identified 87 cases of hemiarthroplasty. Two of these 87 hemiarthroplasties underwent revision to TEA. Neither were due to instability, with aseptic loosening and infection being the indications for revision. They did identify 1 case of instability for a distal humerus fracture treated with hemiarthroplasty, but this did not require revision surgery. Furthermore, in the series of 10 patients who underwent DHH for fracture reported by Burkhart et al, there is 1 patient who is awaiting conversion to TEA for progression of arthritis at the ulnohumeral and radiocapitellar joints.[4]

Another consideration is soft tissue stability. When DHH is performed for fracture, concomitant soft tissue injuries from the trauma may decrease elbow stability. When collateral ligaments are attached to a fractured condyle or epicondyle, stability can be re-established through fixation of the fracture with plates, screws, or Kirschner wires.[15] Isolated collateral ligament injuries can be repaired with sutures and secured to bone with transosseous tunnels or suture anchors or secured to the implant itself.[15,16]

Implant positioning, particularly rotation, also plays an important role in stability. Humeral component malrotation results in abnormal joint kinematics.[8] This can result in abnormal strain on

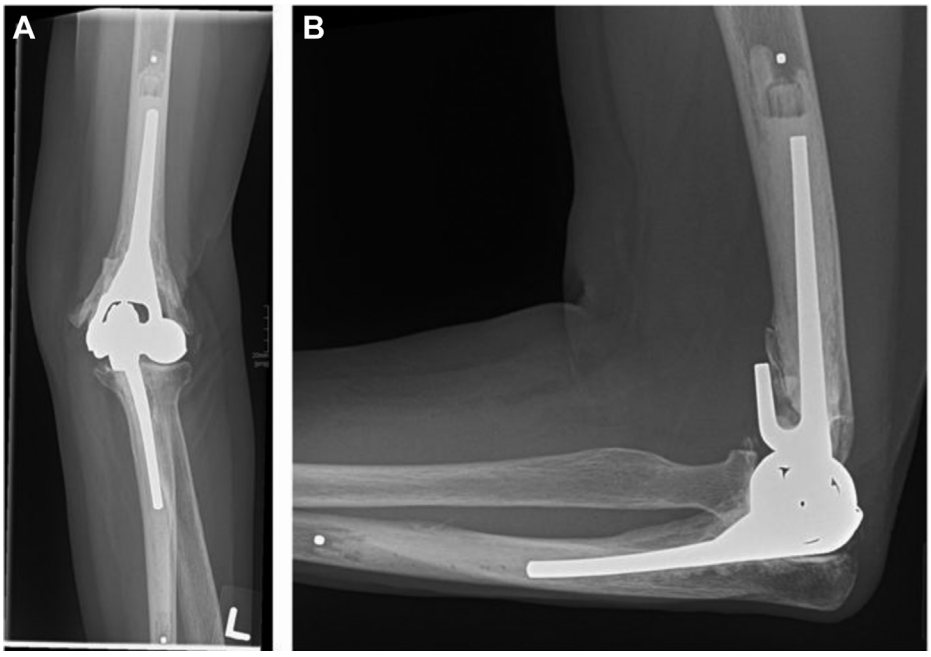

Figure 5 X-rays 4 years after the total elbow arthroplasty in the following views: anteriorposterior (**A**) and lateral (**B**).

the collateral ligaments and could result in early failure of ligament repair. In a trauma setting, traditional landmarks may not be available to guide implant rotation. The posterior humeral cortex is a reliable landmark that can be used. The humeral implant should be positioned in 14° of internal rotation relative to the posterior humeral cortex.[17]

These cases illustrate the importance of the LCL complex in elbow stability following distal humerus hemiarthroplasty. LCL incompetence also contributed to instability of the elbow in the present case report. However, several studies have reported condyle or epicondyle fractures that were stabilized without subsequent elbow instability.[1,3,12,20] This suggests that condyle or epicondyle fractures are not contraindications to elbow hemiarthroplasty. In patients with collateral ligament avulsion or intrasubstance tear, distal humerus fracture fixation or TEA may be preferred due to risk of instability. Ligament release should be avoided for distal humerus exposure and instead an olecranon osteotomy may be preferred.

An olecranon osteotomy can have associated complications. Smith and Hughes report using an olecranon osteotomy in 23 of 26 patients undergoing DHH for fracture or fracture sequelae.[20] Various techniques were used to fix the osteotomy, including tension band wire, tension band wire combined with a screw, plate fixation, and compression screw. Ten of the 23 patients underwent hardware removal, including 7 of 10 tension band wirings. However, it is unclear how many of these patients were symptomatic and this number almost certainly represents an overestimate. A previously published study of 8 patients by Smith et al states that hardware removal is routinely offered to patients once the osteotomy is healed regardless of symptomatology to “minimize the complexity of any future revision surgery”.[19] In other studies with more than 1 case of osteotomy, the rate of olecranon hardware removal ranges from 0%-37.5%.[3,6,7,12,14,18]

Conclusion

DHH is a treatment option for nonreconstructable distal humerus fracture in active patients, but an LCL complex release should be avoided due to the risk of instability. The authors recommend that there should be caution with using the DHH. In older active patients, TEA remains the preferred option to avoid this complication. Furthermore, an olecranon osteotomy should be considered as an alternative approach that may require less soft tissue releases to facilitate humerus preparation and component insertion. A system allowing conversion to a linked TEA is recommended, yields a good clinical outcome, and simplifies treatment of ligament instability following DHH.

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Patient consent: Verbal and written consent was obtained from the patient prior to the preparation of this manuscript.

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