Complex elbow dislocations involving fractures of the proximal radius and ulna often require operative fixation. Fracture patterns such as terrible triad elbow injuries, Monteggia variants, and transolecranon fracture-dislocations with concomitant radial head fractures fall in this category of complex injuries.  

Radial head fractures with a lesser degree of displacement and comminution may be treated nonoperatively or with open reduction and internal fixation. Higher degrees of displacement and comminution are often treated with radial head arthroplasty (RHA). There are important indications for RHA. Thirteen of 14 patients with a Mason type-3 comminuted fracture with more than 3 articular fragments had an unsatisfactory result. Thus, comminution with 3 or more pieces should be definitively treated with RHA. Other indications include severe plastic deformation of the radial head, greater than 30% involvement of the articular surface with elbow instability, terrible triad injuries of the elbow, posterior Monteggia variants, and malunion of the radial head.

Olecranon fractures are often intra-articular, and require careful consideration regarding restoring the articular surface. There are numerous options described in the literature for operative treatment of olecranon fractures: tension band wiring, intramedullary screw fixation, plate fixation, and excision of fragment with triceps advancement. Managing concomitant proximal ulna and radius fractures requires adequate exposure often necessitat-
ing separate approaches that place neurovascular structures and elbow-stabilizing structures at risk.

Surgical approaches to the elbow for exposure of these injuries are well described.\textsuperscript{7,13} Fractures of the olecranon are approached from a posterior incision. When addressing proximal radius fractures, typically a separate lateral approach is needed to expose the proximal radius for operative management. The Kaplan and Kocher approaches to the lateral elbow are commonly employed for RHA; however, these surgical approaches through soft tissue intervals may further exacerbate the soft tissue damage caused by the associated trauma. The authors propose a transolecranon approach to the radial head injury for RHA in elbows with associated proximal ulna fractures that is both safe and effective.

**Case Report**

A 56-year-old woman presented to the emergency department with left elbow pain after tripping and falling on an outstretched hand. The left elbow clinically showed obvious deformity, swelling, and tenderness to palpation. Plain radiographs showed a transolecranon fracture-dislocation of the left elbow (Figure 1). From the original radiographs, it was evident that the radial neck was fractured and the radial head was 100\% displaced. A closed reduction maneuver was performed and the patient was splinted for comfort, admitted to the hospital for serial neurovascular examinations, and scheduled for surgery the following day.

The patient was placed in the right lateral decubitus position with the arm hanging freely over a fixed support under the brachium (Figure 2). A midline posterior incision was made. The medial and lateral skin flaps were developed and the ulnar nerve was identified medially and followed through the zone of injury. The ulnar nerve was mobilized enough to achieve access to the medial aspect of the ulna. Careful dissection was required to avoid iatrogenic injury to the collateral ligaments. With the ulnar nerve mobilized and protected, the proximal olecranon fragment was reflected proximally (as in an elective olecranon osteotomy for access to the distal humerus), allowing access to the fracture-dislocation of the radial head.

The elbow was then hyperflexed, delivering the coronoid process and radial shaft proximally toward the surgeon. This maneuver will subluxate the tip of the coronoid posteriorly while holding the elbow in approximately 180° of flexion. Through this maneuver, there is excellent access to the intramedullary canal of the radial shaft as well as to the tip of the coronoid (Figure 3A).

In this case, the majority of the radial head was sitting in a dislocated position and was removed. The intramedullary canal of the radius was then fully visualized. Despite the lack of comminution of the radial head, the dislocation and dissociation of the radial head was the determinant for RHA. Through this approach, a fracture of the coronoid can be repaired at the same time the radial head injury is addressed. The patient had fractured the coronoid tip, which was repaired with a transosseous suture.

Reaming of the radial canal is easier with a laterally based approach because direct access to the canal is possible rather than approaching the canal off axis. Although the radial head is to be replaced, an effort is made to roughly reconstruct the fractured radial head and neck to provide a sizing template for the prosthesis. The amount of length that needs to be replaced can be directly measured from the reconstructed fracture fragments to provide a height estimate for the implant. The width of the radial head implant can be estimated from the fractured radial head as well to provide a guide for proper sizing. Once the dimensions of the fractured fragment are known, then the canal of the radial shaft can be prepared by hand.

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**Figure 1:** Initial injury anteroposterior radiograph showing a posterior transolecranon fracture-dislocation (A). Initial injury lateral radiograph showing the location of the radial head (arrow) (B).

**Figure 2:** Intraoperative photograph from a different case of a young male with a right elbow fracture showing the lateral decubitus position used for the transolecranon approach.
reaming straight down the long axis of the radius. Once the canal diameter has been determined, the trial implant can be assembled for insertion. Sizing by using the trial implant can now be confirmed or modified based on its fit against the proximal ulnar cartilage, which is directly visible. The lateral coronoid facet and the articulating surface of the RHA should be of equal height at this point, confirming the selected height of the RHA. By taking the elbow out of hyperflexion and reduc-
ing the joint, the relationship of the radial head implant with the capitellum can be visualized and evaluated.

In this case, the canal of the proximal radius was opened using a rasp. A 7.5-mm stem was chosen. The native radial head diameter was measured by ruler to be 22 mm. A 20-mm head with +2 mm added height built into the stem was trialed and implanted (Figure 3B). After insertion of the RHA, the elbow was taken out of hyperflexion and reduced. With the elbow maintained in a reduced position, the olecranon was then reduced back to the coronoid portion of the proximal ulna. The olecranon was held with provisional intraoperative K-wires before applying the dorsal plate to repair the fracture of the proximal ulna. At this point, the elbow was taken through range of motion to assess its stability. The elbow was examined under fluoroscopy and the manipulation showed a congruent and stable elbow joint. Varus, valgus, posterolateral, and translational stability was confirmed.

The soft tissue envelopes were closed with 2-0 Vicryl suture (Ethicon, Somervillle, New Jersey). Staples were applied and intraoperative radiographs were obtained. The radiographs confirmed successful reduction and alignment (Figure 4). Compartments were assessed and were soft and compressible. A soft gauze dressing was applied to cover the surgical wound. The patient was allowed immediate postoperative active and passive range of motion exercises to begin her rehabilitation.

**Discussion**

The authors propose that in an elbow that has undergone a complex fracture-dislocation involving the olecranon and radial head necessitating a RHA, the transolecranon approach for RHA is a novel surgical technique that can spare the patient further soft tissue morbidity and allow for appropriate sizing of the radial head implant.

The transolecranon approach obviates the need to further disrupt the soft tissue envelope, as it takes advantage of the osseous injury and simply reflects the olecranon proximally. Specifically, the authors are able to avoid using either a Kaplan or Kocher interval approach to the radial neck. The fracture of the olecranon present at the time of injury can be used as access for the RHA and then the ulna fracture can be repaired with plate fixation.

The lateral approach to the radial head (Kaplan) is a standard in orthopedic surgery. The lateral ulnar collateral ligament is spared in this approach. A superficial interval is developed between the extensor digitorum communis and extensor carpi radialis longus and brevis. In this approach, the biggest complication that could occur is damage to the posterior interosseous nerve. To prevent this, the surgeon or assistant must pronate the forearm to increase the distance of the posterior interosseous nerve. The lateral ulnar collateral

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**Figure 3:** The elbow was hyperflexed (shotgun maneuver) and the intramedullary canal of the radius was visualized. The proximal ulna fragment was reflected superiorly. The coronoid process was easily seen (A). The prosthetic radial head was placed in relation to the lateral coronoid (B).

**Figure 4:** Lateral postoperative radiograph showing the radial head aligned with the capitellum.
eral ligament can be compromised in the Kocher approach to the lateral elbow. In this approach, exposure is gained through an incision between the interval of the extensor carpi ulnaris and anconeus. The authors argue that the transolecranon approach to RHA is a superior alternative when the olecranon has been fractured. This surgical technique provides a method that allows for arthroplasty and olecranon repair without putting the lateral ulnar collateral ligament and posterior interosseous nerve at risk.

Using the transolecranon approach, the authors were able to restore the height of the radial head in relation to the ulna. The direct visualization to the radial head implant and its association with the lateral coronoid facet in this approach is one of its benefits. Doornberg et al.\(^{14}\) described the proximal edge of the radial head as 0.9 mm distal to the lateral edge of the coronoid process on average on computed tomography. Athwal et al.\(^{15}\) noted that radiographic evidence of medial ulnohumeral joint gapping was evident when the joint was over stuffed more than 6 mm. The transolecranon approach decreases the risk for overstuffing the prosthesis because of the direct visualization of the radial head and lateral coronoid facet. Overstuffing the joint can cause restricted motion and bony erosion.\(^{12,15}\) The transolecranon approach allows for intraoperative ranging of the prosthesis, accurate reduction, prosthesis sizing, and stable fixation.

If medial or lateral collateral ligament injury exists, then the transolecranon approach may still be viable. If the fracture of the proximal ulna is distal to the insertions of the lateral ulnar collateral ligament and medial collateral ligament, then every effort should be made to preserve the insertions of these ligaments. In the cases where the fracture of the proximal ulna is distal to the insertion of the collateral ligaments, this approach may still have utility depending on the severity of soft tissue injury around the joint. In such cases where the fracture is slightly more distal, typically there exists more soft tissue damage either medially or laterally. In that situation, it is usually possible to retract the proximal ulna toward the side of the surgical field with less soft tissue injury, rather than reflecting the tip of the ulna proximally. After that, the proximal radius can be delivered into the surgical field for the arthroplasty. As the fracture of the ulna moves even further distally, the radial head should simply be replaced through the standard Kocher interval when arthroplasty is indicated.

Postoperative rehabilitation of patients undergoing the transolecranon approach allows them immediate range of motion. Typically, once the bone injury is repaired for the transolecranon fracture-dislocation patterns, instability is not an issue in the postoperative rehabilitation course. Although elbow stiffness is a common complication with elbow fractures, this is not unique to this approach even though the patient is allowed immediate postoperative range of motion.\(^{16}\) At 3 months postoperatively, the patient showed a stable elbow with 5° to 120° of extension/flexion and 45°/45° of pronation/supination (Figure 5). During the past 5 years, the transolecranon approach has been used at the authors’ institution for 6 RHAs for complex elbow injuries. Three transolecranon fracture-dislocations and 3 Monteggia-variant fracture-dislocations were treated. The mean age of patients was 59 years, mean follow-up was 12 months, and mean range of motion was from 18° to 117° of flexion. These patients have not had postoperative dislocations or revisions. Additionally, no evidence of malsizing of the RHA has been observed.

**Conclusion**

The transolecranon approach for RHA takes advantage of a bone injury to access the radial head injury and avoid further soft tissue disruption. Concomitant coronoid and ulna fractures can also be addressed intraoperatively. Surgical exposure was more than adequate and the reduction and fixation was excellent. Appropriate sizing of the RHA was easily achieved with direct visualization of its relationship with the lateral coronoid facet. The authors advocate the transolecranon approach as a safe and effective alternative for some elbow fracture-dislocations that may necessitate RHA.

**References**


