Proximal ulna fractures can be difficult to manage because of the elbow’s complex anatomy. Advances in understanding elbow anatomy and biomechanics, however, have led to new insights. Careful preoperative evaluation is critical because failure to restore normal anatomy of the proximal ulna could have a detrimental effect on postoperative elbow function. Management options include anatomic plates, intramedullary devices, and strong tension band materials. Determining the most appropriate option for an individual fracture is based on analysis of radiographs and CT scans, including three-dimensional reconstruction. Coronoid fractures, olecranon fractures, and associated elbow instability influence the indications for any given fixation device. Appreciating the subtleties of proximal ulna anatomy and biomechanics can lead to improved clinical outcomes. Recent concepts affecting fracture management include proximal ulna dorsal angulation, the importance of the anteromedial facet of the coronoid, and intermediate fragments of the olecranon.

Elbow fractures and dislocations present a particular challenge due to the elbow’s complex anatomy and the presence of local neurovascular structures. Also, the modest soft-tissue envelope requires careful intraoperative manipulation and postoperative attention. Malreduced proximal ulna fractures may result in complications such as contracture, instability, posttraumatic arthrosis, and functional deficits. Many fractures require surgical stabilization to allow early motion and to limit complications such as stiffness, elbow instability, and posttraumatic arthritis. Elbow stability is provided by osseous congruity and the surrounding soft tissues. The coronoid process is a primary stabilizer and acts as a buttress to prevent posterior axial ulna translations. The medial collateral ligament, particularly the anterior bundle, is a primary constraint to valgus stress at the elbow joint, and the lateral ulnar collateral ligament acts to prevent rotatory translation. The radial head is defined as a secondary stabilizer against valgus and posterolateral rotational forces. The olecranon and the coronoid compose the greater sigmoid notch, which articulates with the trochlea. The lesser sigmoid notch, on the lateral aspect of the proximal ulna, articulates with the radial head to form the proximal radioulnar joint.
joint. The articular surface of the greater sigmoid notch is covered with hyaline cartilage, except for a transverse “bare area” that divides the olecranon from the coronoid process.10

Proximal ulna morphology is highly variable, especially relative to its volar and varus angulation. A physiologic sagittal plane bowing has been described as the proximal ulna dorsal angulation (PUDA).11,12 A PUDA is present in 96% of the population, with a strong correlation between right and left elbows for each individual (r = 0.86).11 The average PUDA is approximately 6° and is located nearly 5 cm distal to the tip of the olecranon. An interaction between the PUDA and overall elbow range of motion (ROM) has been observed, with greater dorsal angles associated with a decrease in terminal elbow extension.12 Puchwein et al13 described a mean varus angulation of the proximal ulna; the angle formed by the axis of the olecranon and the axis of the ulnar mid-shaft is 14° ± 4°. These authors also found a mean anterior angulation of 6° ± 3°. To guide surgical management, contralateral radiographs of the uninjured elbow may be useful to determine the normal proximal ulna anatomy, which is unique for each individual.11,14,15

The olecranon prevents anterior displacement of the ulna relative to the distal humerus.16,17 The triceps tendon inserts on the posterior surface of the olecranon with a more direct muscular insertion deep to the superficial tendon.18 The net vector of the major muscle forces at the elbow, primarily the triceps, biceps, and brachialis, is directed dorsally (Figure 1). The intact coronoid resists posterior translation and varus stress.19 The coronoid process is divided into a tip, body, anteromedial and anterolateral facets, and the sublime tubercle.3 The anterior band of the medial collateral ligament inserts on the sublime tubercle. The brachialis muscle and the anterior capsule attach to the coronoid distal to the tip, leaving a small amount of bone and generous cartilaginous cap visible from within the joint.20

The lateral ulnar collateral ligament also attaches to the proximal ulna. It inserts on the crista supinatoris on the lateral proximal ulna at the point where the supinator crest blends with the radial notch.

**Mechanisms of Injury**

Proximal ulna fractures most commonly occur from a low-velocity, direct or indirect trauma to the elbow. Overall prevalence is 21% of all proximal forearm fractures.21 A coronoid tip fracture occurs following a progressive valgus stress that forces the coronoid under the trochlea, im-
An isolated coronoid tip fracture seen on an otherwise normal radiograph is suggestive of a dislocation or subluxation injury that spontaneously reduced. The terrible triad injury results from a valgus with additional posterolateral force. The triad refers to the combination of a coronoid fracture, radial head fracture, and dislocation of the elbow, resulting in collateral ligament injury. Alternatively, an anteromedial coronoid facet fracture results from a varus and posteromedial rotational force on the elbow. The nature of the injury depends on the direction of rotation; a supination force progresses to a terrible triad, whereas a pronation force results in a varus, posteromedial type of injury.

Direct trauma to the olecranon typically causes comminuted fractures, whereas indirect avulsion injuries from the contraction of the triceps muscle result in transverse or oblique fracture patterns. Comminuted olecranon fractures can generate intermediate fragments from the articular surface, which are often difficult to detect. Recognition of the intermediate fragment, however, is essential to restore the congruity of the ulnohumeral joint and to avoid impingement by iatrogenic narrowing of the greater sigmoid notch.

Diagnostic Evaluation

A complete history and physical examination are fundamental for any patient presenting with upper extremity trauma. Patients with a proximal ulna fracture present with local pain, swelling, and frequently a palpable gap or visible deformation of the elbow. ROM is often decreased. Olecranon fractures are often associated with an extension lag. Careful neurovascular evaluation may detect associated injuries. Increased suspicion of soft-tissue and/or neurovascular injury is warranted in the presence of high-energy trauma or fracture-dislocation injuries. Inspection of the skin and soft tissues can provide clues to the status of deeper structures. The condition of the soft-tissue envelope is an important consideration with regard to the timing of surgery. Although compartment syndromes are rarely seen with these types of injuries, a combined proximal ulna and more distal forearm fracture can be associated with excessive swelling.

AP and lateral radiographs of the elbow are usually sufficient to characterize simple, noncomminuted fracture patterns. It is important to evaluate any ulnohumeral or radiocapitellar incongruity and to identify all possible fragments. Radial head alignment is measured with the radiocapitellar ratio (RCR) on a lateral view (Figure 2). The RCR measurement is the minimal distance between the axis of the radial head and the center of the capitellum divided by the diameter of the capitellum. The RCR is a valid measurement to assess radial head translation about the capitellum. Malalignment is an RCR value outside the normal range of $-5\%$ to $13\%$.

The PUDA and the RCR are closely related. In an unpublished biomechanical study, we found that a $5^\circ$ malreduction at the PUDA already leads to radial head subluxation at the radiocapitellar joint. Thus, in complex fracture patterns, a contralateral elbow radiograph can be important to assess the patient’s native PUDA because a straight locking plate may alter the normal anat-
omy and thus preclude successful radiocapitellar joint reduction.

CT should be ordered when comminution, intermediate fragments, or anteromedial coronoid facet fractures are suspected. The threshold for obtaining CT is very low. We believe that CT scans with three-dimensional reconstruction offer greater understanding of fracture patterns and fragment displacement for preoperative and surgical planning.

**Classification Systems**

Many classifications have been proposed to describe proximal ulna fractures. Accurate fracture classification can greatly influence management recommendations and ultimate prognosis.

**Olecranon Fractures**

Morrey described the Mayo classification for olecranon fractures based on elbow stability, fracture displacement, and degree of commination. Type I is a nondisplaced or minimally displaced fracture. Type II is displaced but with preserved elbow stability. Type III involves a greater surface area of the olecranon and is associated with elbow joint instability. Each type is further subclassified into subtypes A and B, which are described, respectively, as noncomminuted and comminuted fracture patterns.

The Schatzker classification divides olecranon fractures into six types (Figure 3). Intermediate fragments are accounted for in a few classification schemes, including Mayo type II and III fractures, as well as in Schatzker type B and D fractures.

**Coronoid Fractures**

Two classification systems describe coronoid process fractures. In 1989, Regan and Morrey described three types of coronoid fracture patterns, identified on lateral radiographs. Type I implied an “avulsion” of the tip of the coronoid process; type II involved ≤50% of the process; and type III, >50% of the coronoid. The type III fracture pattern was additionally classified into type A, representing an absence of elbow dislocation, and type B, representing the presence of elbow dislocation.

O’Driscoll et al later proposed a second, more descriptive classification, based on the anatomic location of the coronoid fracture, determined by CT. This anatomic classification system refers to three main portions of the coronoid—the tip, the anteromedial facet, and the base. Fractures of the tip of the coronoid are described as two subtypes: ≤2 mm and >2 mm fragments. Anteromedial facet fractures are divided into three subtypes: a subtype 1 fracture involves the anteromedial rim; subtype 2 involves the anteromedial rim and the coronoid tip; and a subtype 3 fracture is a subtype 2 pattern with a fracture of the sublime tubercle. Coronoid base fractures are divided into two sub classifications: subtype 1, comprising the coronoid body at its base, and subtype 2, described as a
Monteggia Fractures

Monteggia-type injuries were initially described in 1814 as fractures of the proximal ulna associated with a radial head dislocation. Monteggia-type injuries lead to a disruption of the proximal radioulnar joint (PRUJ), which enables the radial head to dislocate from the capitellum as well as from the ulna. In 1967, Bado developed a Monteggia fracture classification based on the direction of radial head dislocation. Type I is an anterior dislocation of the radial head associated with an anterior angulation of the proximal ulna fracture. Type II is a posterior dislocation of the radial head with a posterior angulation of the proximal ulna fracture. Type III is a lateral or anterolateral radial head dislocation associated with a proximal ulna fracture. Type IV is an anterior dislocation of the radial head with fractures of the proximal ulna and radius.

Jupiter et al modified Bado's Monteggia fracture classification by subdividing type II injuries and further describing the pattern of proximal ulna fractures. Type IIA are fractures at the greater sigmoid notch; type IIB represents fractures distal to the coronoid and at the proximal metaphysis; type IIC are diaphyseal fractures; and type IID are comminuted proximal ulna fractures.

Management

As described in the AO principles of fracture management, the main goals of fracture fixation are anatomic reduction, stable fracture fixation, soft-tissue preservation, and early articular motion to prevent associated morbidities.

Nonsurgical

Nonsurgical management of coronoid fractures should be offered for isolated tip fractures ≤2 mm or small transolecranon basal coronoid fracture (Figure 4).

There is a paucity of literature emphasizing the importance of identifying the presence of olecranon and coronoid fracture combinations. O’Driscoll et al briefly describe this fracture pattern combination in its type 3–subtype 2 subclassification. The treatment of this type of complex elbow injury relies on meticulously planning the surgical intervention to optimize final outcomes (Figure 5).
fractures <15% in height associated with a stable elbow. A limited period of immobilization is followed by early ROM. Isolated coronoid fractures are often associated with ligament injuries; thus, congruent reduction of the elbow should be assessed regularly in the early recovery period to detect intervening instability.

Olecranon fractures are rarely treated conservatively, but nonsurgical management may be appropriate when the patient is inoperable or in low-demand patients with nondisplaced fractures with an intact extensor mechanism. Close monitoring is important in these patients to assure proper bone healing and maintenance of anatomic reduction. The elbow is immobilized in the maximal amount of flexion that prevents fracture gapping, which typically occurs between 45° and 90°. Any upper extremity weight bearing and active elbow extension must be prevented until complete bone union is documented. In a compliant patient, auto-assisted active ROM exercises in a standing position may be started at 2 weeks postoperatively, four times per day. However, use of a long arm removable splint is indicated until radiologic bone union.

**Surgical**

In adults, most olecranon and Monteggia fracture-dislocations are treated with anatomic reduction and fixation. The global surgical approach for proximal ulna fractures is presented in Figures 6 and 7.

**Olecranon Fractures**

Isolated, simple noncomminuted transverse olecranon fractures are typically managed with tension band wiring (TBW) through a posterior approach. TBW creates a dynamic compressive force across the fracture. TBW is contraindicated, however, in comminuted fractures and some oblique fractures. Olecranon fractures distal to the bare area involving the base of the coronoid are also poor candidates for TBW. Two smooth Kirschner wires (1.6 mm or 2 mm) inserted from the proximal olecranon traverse the fracture line and engage the anterior ulna cortex. After engaging the second cortex, the wires are slightly backed out to prevent injury to surrounding soft tissues. A figure-of-8 is formed with one or two 18-gauge wires, passing deep to the triceps tendon and through a predrilled, 2-mm transverse hole on the dorsal aspect of the proximal ulna, at least 2 cm distal to the fracture line. The pins are bent over the tension band and impacted to bury the ends in the triceps tendon. Alternatively, an intramedullary screw can be used for longitudinal fixation.
Wilson et al recently challenged this treatment method and suggested that precontoured plates provide greater compressive force at the fracture site for transverse olecranon fractures. In addition, in comparing TBW to plate fixation, there is a greater risk of secondary displacement, and removal of instrumentation is more often necessary with TBW.

In comminuted or oblique olecranon fractures, a tension band can overcompress the greater sigmoid notch, thereby narrowing the articular surface. More importantly, a tension band does not provide sufficient stability in complex fracture patterns. In these specific cases, anatomic reduction and rigid fixation with interfragmentary screws and plate fixation is mandatory. Plate fixation is performed through a straight posterior approach. In the setting of complex elbow fractures, the authors place the patient in a lateral decubitus or prone position. The triceps insertion must be protected, and plate devices can be positioned superficial to the tendon.

Alternatively, a small longitudinal incision can be made in the tendon to bury wires or a plate. Suture fixation with a Krackow or similar tendon-grasping stitch may be used to reinforce the triceps insertion in cases of small and comminuted proximal fragments. Comminuted articular fragments should be anatomically reduced whenever possible to minimize articular incongruence, narrowing of the greater sigmoid notch, and—possibly—the risk of progressive early arthrosis.

We strongly advocate fixation and grafting for complex comminuted fractures. A thorough washout of the joint is necessary before fixation to remove any fracture debris from the articulation. A “home run screw” for intermediate olecranon fragments has been shown to stabilize and optimize the anatomically reduced articular surface (Figure 8). Visualization of the joint is necessary with articular comminution. A lateral approach to the joint can be used as an alternative to a straight posterior ap-

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**Algorithm of the management of coronoid fractures based on the O’Driscoll classification.**

- LCL = lateral collateral ligament, ORIF = open reduction and internal fixation, PUDA = proximal ulna dorsal angulation, ST = subtype

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**Figure 7**

- O’Driscoll coronoid fracture
  - Type I (Tip)
    - Stable elbow + <50% coronoid
    - Early range of motion, close observation
  - Unstable elbow + >2 mm tip
    - Coronoid fixation and LCL repair
  - LCL repair ORIF
  - Plate must be contoured for PUDA
  - ORIF
    - ST 1: Reduce coronoid in flexion
    - ST 2: Reduce olecranon in extension

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**Figure 8**

- Lateral radiograph (A) and sagittal CT scan (B) demonstrating intermediate fragment in an olecranon fracture. C, Lateral radiograph demonstrating postoperative fixation. The intermediate fragment is visible in the sagittal CT scan (panel B) but was difficult to visualize radiographically (panel A).
proach. The collateral ligaments must be protected to preserve joint stability. The proximal fragment can be reflected during identification and fixation of the smaller, impacted or displaced intra-articular fragments. Fragments are reduced and fixed, building from the distal to proximal direction using interfragmentary screws as much as possible.

On rare occasions, anatomic fixation of an olecranon fracture may not be possible. Severely comminuted fractures (ie, Schatzker type D) and open fractures associated with bone loss can preclude use of the usual fixation techniques. The proximal bone fragment attached to the triceps should be preserved as much as possible. In some instances, the distal and proximal bone can be sculpted with a rongeur to create a congruent contact surface. The fragments are then fixed with a plate and screws. Some bone loss can be accepted in the bare area. Bone graft can be used to bring the proximal ulna out to length at the posterior cortex. A gap in the nonarticulating bare area will fill with fibrous tissue as long as the posterior cortex is rigidly fixed. To secure the repair, tendon-grasping sutures are placed as dorsally as possible to maximize triceps strength; however, even in the optimal position, 24% of strength is lost. It is important to note that all of these biomechanical studies assume that the elbow is otherwise stable. For obvious reasons, olecranon excision should be reserved only for cases of nonreconstructable fractures.

**Coronoid Fractures**

Fractures of the coronoid can be approached and fixed through a posterior, medial, or lateral surgical approach. A posterior skin incision with a lateral skin flap is preferred when the lateral collateral ligament is already ruptured and surgical treatment of the radial head is planned. The coronoid process can be approached anterior to the radial head or when the radial head is resected but before replacing it with a prosthesis. During surgery, the forearm should be pronated to protect the posterior interosseous nerve. Large coronoid tip fragments are reduced and fixed with compression screws or threaded pins, which can be placed anterograde or retrograde under fluoroscopic or arthroscopic visualization. For comminuted fractures or smaller fragments not large enough for screw placement, suture fixation through the anterior capsule adjacent to the coronoid fragments encompassing the bone can provide some stability. The suture is passed through bone tunnels created from the dorsal ulnar cortex into the fracture bed. Two tunnels are created, and the sutures are tied over the bone bridge. Tunnels directed from the more medial or lateral aspect of the dorsal cortex prevent soft-tissue irritation from suture material. The ulnar nerve must be protected if more medial tunnels are used.

Anteromedial facet fractures of the coronoid are addressed through a medial approach to the joint, but the skin incision can be either medial or posterior. Initially, the ulnar nerve is identified in the cubital tunnel and can be released in situ for posterior retraction to avoid postoperative neuropathies. The flexor-pronator muscle group is detached from the medial epicondyle using an L-shaped distal-to-proximal incision, preserving the medial collateral ligament attachment. An opening of the joint capsule permits excellent visibility for anatomic fixation with screws and, when possible, a buttress plate (Figure 9). Alternatively, a flexor-pronator split, anterior to the ulnar nerve, can be used.

The coronoid is critical to elbow stability, and even small fractures can have a significant impact on elbow biomechanics. Rigid fixation techniques should be employed for larger fragments to provide stability and maximize the opportunity for bone healing.

**Combined Fractures**

Combined coronoid and olecranon fractures pose a challenge for proximal ulna fracture management. The patient is positioned in a lateral decubitus or prone position, and the procedure is performed through a posterior incision. The proximal fragment of the olecranon is reflected with the attached triceps to expose the coronoid fragments. A useful strategy employs fixation of the fragments from distal to proximal. The coronoid fragment is reduced with the elbow in flexion. Anatomic reduction can be confirmed by elevating some soft tissue from the medial and lateral aspects of the olecranon. The collateral ligaments must be preserved or reinserted at the end of the procedure to maintain stability. The sublime tubercle is often fractured and can be lifted to provide access to

Management of Fractures of the Proximal Ulna
the other coronoid fragments. The ulnar nerve must be protected during any medial fracture exposure. Intra-articular fragments are stabilized with small screws or threaded wires. Finally, the olecranon is reduced and a posterior plate is applied to the posterior ulna and olecranon (Figure 5). If malalignment at the radiocapitellar joint is suspected, a contralateral radiologic measurement of the PUDA should be done to reproduce the native proximal ulna angulation.

**Table 1**

**Pearls and Pitfalls in the Management of Proximal Ulna Fracture**

**Pearls**
- Preoperative planning
- Stable fixation of all fragments
- Simple fractures: tension band or plate
- Complex fractures: plate and screws
- Coronoid process can be approached from medial, posterior, or lateral
- Radial head can be approached from lateral or posterior
- Fix intermediate fragments first, fix coronoid fragments distal to proximal
- Intraoperative fluoroscopy
- Test the elbow through a full range of motion for stability, range, and congruence

**Pitfalls**
- Failure to identify and fix all fragments leads to loss of reduction or instability
- Nonanatomic reduction of the proximal ulna leads to radial head subluxation, bony impingement, and decreased motion
- Poorly placed hardware or screws and pins lead to ulnar nerve problems, decreased motion, or articular degeneration

**Postoperative Management**

Postoperative rehabilitation for olecranon fractures depends on the soft-tissue status and fixation stability. For cooperative patients presenting in whom solid fixation was achieved, early active ROM exercises may be started typically after 1 week of immobilization for wound healing and control of swelling. Passive ROM, strengthening exercises, and weight bearing are permitted after confirmed radiologic bone union. In cases of compromised soft tissues and thin skin, a dynamic splint blocked in extension may be used until the wound has healed. Flexion can progressively be allowed at a controlled rate (eg, increments of 15° per week), depending on the quality of the soft tissue. ROM exercises may be delayed and the elbow may be immobilized for 2 weeks or more if strong fixation was not possible.

**Pearls and Pitfalls**

Preoperative planning is critical when approaching proximal ulna fractures (Table 1). Stable anatomic fixation of all fragments is necessary to restore normal articular anatomy of the elbow. Simple fractures can be fixed with a tension band or plate and screws; more complex fractures require plate-and-screw fixation. The coronoid process can be approached from a medial, posterior (through the olecranon fracture site), or lateral approach. Intermediate fragments
need to be fixed first in order to create larger fragments that are subsequently reduced to more proximal fragments as well as to facilitate an anatomic articular reduction.

Nonanatomic reconstruction of the proximal ulna can cause radiocapitellar malalignment or dislocation. Narrowing the greater sigmoid notch by fixing the proximal fragment in flexion limits motion. Poorly positioned instrumentation can limit motion or cause ulnar nerve symptoms. Incorrectly placed screws or pins can affect motion or damage articular cartilage. Intraoperative fluoroscopy is helpful to evaluate the final reduction of the fracture and the position of instrumentation. Stability of the fixation, impingement of hardware, and articular incongruity should be evaluated by taking the elbow through a full ROM. Elbow movement should be smooth, without scraping, grating, or clicking.

### Outcome

Clinical results after olecranon fracture fixation are available for small series reported in the literature (Table 2). On average, patients lost 30° of ulnohumeral ROM after plate and combined plate-and-screw fixation, although there was improvement in ROM after late instrumentation removal.45-47,49,50 Device removal was required for 18% to 62% of the cases and is the most frequent complication after olecranon fixation. Functional outcome expressed by the Mayo Elbow Performance Score is good to excellent in the great majority of patients.45-47,49 Disabilities of the Arm, Shoulder, and Hand (DASH) and QuickDASH scores are reported as being between 9 and 17 for olecranon fractures managed with plate fixation.45-47,49 Posttraumatic arthritis occurs in 21% to 48% of patients in long-term follow-up studies.49,50 Anderson et al48 summarized the orthopaedic literature and illustrated the higher rate of device removal following olecranon fractures for TBW (11% to 82%) compared with plating systems (zero to 20%).

Approximately 58% of the anteromedial facet of the coronoid protrudes from the proximal ulna shaft, which makes the anteromedial facet of the coronoid susceptible to injury.31 Doornberg and Ring52 demonstrated the importance of secure fixation of anteromedial facet fractures of the coronoid; limited treatment may compromise elbow stability, leading to varus subluxation, early arthrosis, and poor to fair results in the Broberg-Morrey score.

### Summary

Proximal ulna fractures challenge even the most experienced surgeon. Recognition and restoration of each patient’s unique proximal ulna anatomy is essential for adequate anatomic restoration. Thorough evaluation of the injured extremity and interpretation of radiologic images are essential for adequate diagnosis, preoperative planning, and optimization of treatment outcomes. Clinical outcome studies reveal high rates of postoperative complications, including symptomatic instrumentation and posttraumatic arthritis. A methodical approach to surgical decision making maximizes the opportunity for successful reconstruction of elbow anatomy and biomechanics. Further research and innovation in terms of surgical technique and devices will be useful to help improve outcomes in these complex fractures.

### References

References printed in **bold type** are those published within the past 5 years.

3. Athwal GS, Ramsey ML, Steinmann SP, Moriatis Wolf J: Fractures and

### Table 2

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients</th>
<th>Average Follow-up (Range)</th>
<th>Fixation</th>
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<tbody>
<tr>
<td>Anderson et al48</td>
<td>32</td>
<td>2.2 yr (0.7–5.1)</td>
<td>Mayo congruent elbow plate system</td>
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<tr>
<td>Buijze and Kloen47</td>
<td>19</td>
<td>22 mo (12–48)</td>
<td>Contoured LCP and intramedullary screw fixation</td>
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<td>Erturer et al45</td>
<td>18</td>
<td>22.6 mo (7–42)</td>
<td>Locking-plate osteosynthesis</td>
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<td>15</td>
<td>16 mo (8–29)</td>
<td>3.5-mm LCP olecranon plate</td>
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DASH = Disabilities of the Arm, Shoulder, and Hand; LCP = locking compression plate; MEPS = Mayo Elbow Performance Score; OA = osteoarthritis; ROM = range of motion
Table 2 (continued)

Outcomes Following Plating of Olecranon Fracture

<table>
<thead>
<tr>
<th>Mean ROM (Pronation-supination [degrees])</th>
<th>Mean MEPS Score</th>
<th>Mean DASH Score</th>
<th>Average Broberg-Morrey Score</th>
<th>OA (%)</th>
<th>Hardware Removal (No.)</th>
<th>Nonunion (No.)</th>
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</tbody>
</table>

DASH = Disabilities of the Arm, Shoulder, and Hand; LCP = locking compression plate; MEPS = Mayo Elbow Performance Score; OA = osteoarthritis; ROM = range of motion


29. Regan W, Morrey B: Fractures of the


