Elbow Trauma

INDICATIONS AND TECHNIQUE OF OPEN REDUCTION AND INTERNAL FIXATION OF RADIAL HEAD FRACTURES

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Radial head fractures associated with elbow instability or with a mechanical block to elbow motion are best managed operatively. The decision to reduce and internally fix the fracture or to excise the radial head with or without prosthetic replacement is made once the fracture is exposed. In this article we review our indications and techniques for open reduction and internal fixation of radial head fractures.

ANATOMY

The majority of the radial head is covered with articular cartilage. However, the anterolateral quadrant of the articular margin is devoid of cartilage. The absence of strong subchondral bone in this area of the head makes it more susceptible to shear fractures. Because this portion of the head does not articulate with the lesser semilunar fossae, even in the extremes of pronation and supination, it is a convenient portal for screw or Kirschner-wire placement.1

The central depression of the radial head articulates with the dome of the capitellum; however, posttraumatic arthritis is rare in this area, even in the presence of incongruity.2,3

The head and neck of the radius form an angle of 15° with the shaft of the radius, the apex directed toward the radial tuberosity. If this angle is greater than 25°, an associated injury to the medial collateral ligament is probable.4,5

BIOMECHANICS

During forearm rotation, the proximal radius rotates around its central axis and the distal radius rotates around the ulna. The normal extremes of pronation and supination are 70° and 85°, and the normal extremes of extension and flexion are 0° and 140°. Pronation and supination of 50° and extension and flexion of 30° and 130° are essential for the performance of the activities of daily living.2

The radial head has two primary functions: 1) It acts as a restraint to valgus stresses across the elbow by providing a fulcrum for the medial collateral ligament; and 2) It functions in the transfer of stresses from the hand and wrist to the distal humerus. As forces are applied in a proximal direction axially along the shaft of the radius, the central tendinous portion of the interosseous membrane tightens. These forces are then transmitted from the radius through the interosseous membrane to the ulna and eventually to the humerus. When the radial head has been removed, proximally directed stresses result in ulnar shift of the radius as opposed to tightening of the interosseous membrane. Therefore, altering the method of stress transmission to the ulna may affect the mechanics of the distal radioulnar joint.2,6,7

MECHANISM OF INJURY

A fall forward with the elbow extended and the forearm pronated or a fall backward with the elbow extended and the forearm supinated are the most frequent causes of injury. Less frequently, a direct blow or trauma causing a dislocation of the elbow results in fracture of the radial head.5

CLINICAL EXAMINATION

Pain and swelling are present over the lateral aspect of the elbow. After neurovascular examination, the hematoma is aspirated and the elbow
is injected with a local anesthetic. The elbow is examined carefully to determine if there is a mechanical block to forearm rotation in different degrees of flexion, and if there is an associated ligamentous injury. The integrity of the medial collateral ligament is of particular concern. It is assessed with the arm externally rotated and the elbow flexed to 15°, thus relaxing the anterior capsule and removing the olecranon from the olecranon fossae. A gentle valgus stress is then applied to the elbow. The distal radioulnar joint is examined for tenderness, instability, and prominence of the distal ulna.1,8

**RADIOGRAPHIC EXAMINATION**

Standard AP and lateral views of the involved elbow usually are sufficient to diagnose and classify the radial head fracture. The radiocapitellum view may provide additional information.1,9 To obtain this projection, the forearm is placed in neutral rotation and the elbow is flexed and positioned on the cassette as for a routine lateral. The x-ray tube is angulated 45° toward the humeral head.2,7

In cases where there may be an associated injury of the distal radioulnar joint, AP and lateral views of the wrist are obtained. It is usually necessary to obtain a comparison view of the uninjured wrist to rule out radial shortening and dorsal subluxation of the distal ulna.

**CLASSIFICATION**

Fractures of the radial head are most frequently grouped according to a classification developed by Mason10:

- Type I: undisplaced.
- Type II: displaced.
- Type III: comminuted.

Johnston9 added Type IV: radial head fracture associated with elbow dislocation. In this group we include fractures associated with: elbow instability with or without a dislocation; isolated radial instability, ie, the Essex-Lopresti lesion; and a fracture of the ulnar diaphysis, ie, a Monteggia equivalent.10

**MANAGEMENT**

The goal of management is a painless, stable elbow with as close to normal motion as possible.

Mason Type I fractures (undisplaced) are managed nonoperatively. The patient is placed in a sling for 3 weeks. Gentle active range of motion (ROM) is encouraged. At 3 weeks the sling is discontinued and more aggressive physical therapy is initiated.

Mason Type II and III fractures (displaced) can be further divided into two groups: those
Figs 3-4: AP (3) and lateral (4) radiographs of the elbow following open reduction and internal fixation of the fracture through the anconeus approach. Two Herbert screws were used to fix the fragment, which was reduced anatomically. Two 2.7 mm screws were used to fix an undisplaced fracture of the radial neck, which was not evident on preoperative radiographs. Early motion was started postoperatively.

Fig 5: AP and lateral radiographs of an elbow of a 28-year-old woman. There is a posterior dislocation with an associated radial head fracture. The fracture is best seen on the lateral projection and appears to involve the anterior portion of the radial head.

Fig 6: The dislocation was reduced and the patient was taken to the operating room where the fracture was exposed. The anterior portion of the radial head was reduced and fixed to the remainder of the radial head with a 2.7 mm lag screw. Following fixation the elbow remained located throughout the full range of flexion/extension and pronation/supination. Postoperatively, the patient was placed in a sling and splint. Four days after surgery these were removed three times a day for supervised range of motion exercises.
without a mechanical block which are managed nonoperatively, and those with a mechanical block which are managed operatively (Figs 1-4).

Mason Type IV fractures (associated ligamentous instability) are managed operatively (Figs 5-12).

When operative intervention is required, the surgeon should be prepared to reduce and fix the fragments or excise the head. In most cases, this decision can be made only after the fracture is exposed.

Circumstances that indicate fixation include: a young patient; an experienced surgeon; a fracture that involves only part of the radial head (eg, a Mason Type II); and associated ligamentous injury (ie, a Mason Type IV). In cases with associated ligamentous injuries, the head must be reduced and fixed, or excised and replaced with a silastic spacer, or the ligaments must be repaired. Of these alternatives, we believe reduction and fixation of the radial head give the best results.

Contraindications for fixation are: an elderly patient; injury of the capitellum; and preexisting osteoarthritis.

**OPEN REDUCTION AND INTERNAL FIXATION**

The anconeus approach, as described by Pankovich,\textsuperscript{11} offers the widest exposure of the radial head. In this approach, the entire insertion of the anconeus is reflected proximally from the ulna by subperiosteal dissection. If the capsule and synovium are not torn, they are incised longitudinally. We do not hesitate to incise up to two thirds of the annular ligament to obtain wider exposure. In addition, the proximal or distal portion of the capsular incision can be ‘T’-ed. As the forearm is pronated and supinated the entire radial head is visualized. Associated fractures of the ulna can be reduced and stabilized through the same approach.

Fragments are reduced and fixed with 2.0 mm or 2.7 mm cortical screws, Herbert screws, or Kirschner wires. Ideally the implants are buried below the articular cartilage. It is important to
Figs 10-11: As indicated by these AP (10) and lateral (11) radiographs of the elbow, the radial head was reduced and fixed with four 2.7 mm screws.

Fig 10.

Fig 11.

Fig 12: An AP radiograph of the entire forearm. The distal radius was reduced and fixed with pins. The radioulnar joint was reduced and stabilized with a single Kirschner wire, and the ulnar styloid was reduced and held in place with a 3.5 mm fully threaded cancellous screw with a washer. Postoperatively the arm was splinted for 4 weeks.

with pronation of the forearm.

POSTOPERATIVE MANAGEMENT

Postoperatively the arm is placed in a sling. A splint is added if there is an associated ligamentous injury. The sling or splint is removed three times a day for supervised active ROM exercises. At 3 to 4 weeks the sling and splint are discontinued.

Patients with associated isolated radial instability present a unique set of problems (Figs 7-12). In these injuries the interosseous membrane and distal radial ulnar joint capsule are disrupted and pronation and supination exercises may result in displacement. Therefore, after open reduction and internal fixation of the radial head, the arm is splinted in supination, or the distal radioulnar joint is pinned. The pin is removed 4 weeks after injury. The splint is continued but is removed three times a day for active ROM. At 6 weeks the splint is discontinued.

REFERENCES