Operative Techniques in
Orthopaedics

Radial Head Fractures

Christopher G. Stevens, MD, and Thomas W. Wright

Treatment of radial head fractures centers around the distinction of stable, nondisplaced or minimally displaced fractures, and those with significant displacement, which are usually part of a greater pattern of injury. Treatment of stable injuries is aimed at achieving osseous union while preventing stiffness and can usually be accomplished with nonoperative means. Operative treatment of isolated radial head fractures is indicated if significant displacement or mechanical block to motion is observed. Options for surgical treatment include open or arthroscopic techniques as well as a myriad of other options including fragment or whole-head excision, internal fixation with headless compression screws, or plate-and-screw constructs as well as prosthetic replacement. Treatment of displaced or unstable fractures centers on restoration of the radiocapitellar contact and repairing other soft tissue injuries, which are necessary to stabilize the elbow. Radial head arthroplasty should be considered in situations where 3 or more fragments of the radial head exist, with the use of various intraoperative methods to ensure restoration of the lateral elbow anatomy.
Oper Tech Orthop 23:188-197

KEYWORDS radial head fracture, radial head prosthesis, elbow arthroscopy, elbow dislocation, headless compression screw, radial head excision

Introduction, Classification, and Epidemiology

Despite recent advances in our understanding of patterns of injury, as well as improved fixation and prosthetic devices, radial head fractures still pose a difficult undertaking for the orthopaedic surgeon. In addition, controversies exist regarding the optimal treatment of such fractures.

The classification of radial head fractures was originally defined by Mason in his 1954 article where he distinguished nondisplaced fractures (type I) from displaced partial head fractures (type II) and displaced fractures involving the entire radial head (type III).[1] This classification system has been subsequently modified by Broberg and Morrey to better delineate the parameters that differentiate one particular "type" from another, then by Johnston where a type IV fracture was added to the system to account for fractures that are part of a elbow dislocation, and then by Hotchkiss to try to use the classification system to direct treatment of these fractures.[2-4]

Fractures of the radial head account for approximately 4% of all fractures.[1] The incidence of radial head fractures has been reported to be 2.5-2.9 of 10,000 inhabitants and accounts for approximately 1:3 of all elbow fractures.[5,6] A recent study on the incidence of radial head fractures over a 10-year period found that 82% of radial head fractures are Mason type I injuries, whereas Mason types II, III, and IV comprise 14%, 3%, and 1%, respectively.[7] In addition, a trend was seen in this investigation where male patients comprised 71.4% of Mason type III injuries, whereas 72.7% of type IV fractures occurred in females.[7] The propensity for radial head fractures to occur in women older than 50 years has led other authors to investigate the potential for radial head fractures to occur due to osteoporosis. Gebauer et al[8] investigated the microarchitecture of cadaveric radial heads in the elderly and found changes consistent with the diagnosis of osteoporosis. Because these fractures tend to occur earlier than other osteoporotic fractures such as the hip and vertebrae, Kaas et al[9] suggested that offering elderly patients with radial head fractures a bone mineral density measurement may allow for initiation of treatment and prevention of future osteoporotic fractrues.[10]

Department of Orthopaedics & Rehabilitation, University of Florida, Gainesville, FL.

Disclosures: Dr Stevens has no disclosures; Dr Wright is a paid consultant for Exactech and receives royalties from Exactech. The Department of Orthopaedics and Rehabilitation also receives institutional support from Exactech.

Address reprint requests to Thomas W. Wright, MD, Department of Orthopaedics & Rehabilitation, University of Florida, PO Box 112727, Gainesville, FL 32611. E-mail: wrightw@ortho.ufl.edu

1048-6666/13/$-see front matter © 2013 Elsevier Inc. All rights reserved.
doi:http://dx.doi.org/10.1053/j.oto.2013.07.007

Anatomy or Biomechanics and Radiography

The radial head articulates with the distal humerus at the capitellum laterally and with the radial fossa at high flexion angles. It can be palpated just below the antecubital crease with the elbow flexed. It forms an inverted equidistant triangle with the olecranon and lateral epicondyle, which serves as a key landmark for gaining access to elbow joint in arthroscopy and arthrocentesis. Multiple studies have demonstrated that the radial head is not perfectly circular in nature and it is concave to its articulation with the capitellum, forming a slight depression in its midportion.[11-14] With the arm in neutral rotation, the long axis of the radial head is perpendicular to the lesser sigmoid notch of the ulna and is bound to it by the annular ligament.[11] The radial head is an intraarticular structure, with the capsular insertion of the joint attaching to the annular ligament. The radial head and neck are collinear with each other; however, they form a 15° angle with the radial shaft, away from the bicipital tuberosity.[15]

Ligamentous anatomy as it pertains to the lateral side of the elbow is variable in nature. Classically, Morrey defined 4 discrete ligaments including the lateral ulnar collateral, radial collateral, accessory lateral collateral, and annular ligaments.[16] However, in recent years, it has become clear that these distinct bundles are inconsistent and that significant individual variation exists.[17-23] Because of this, some authors have referred to this constellation of ligaments as the lateral collateral ligament (LCL) complex rather than naming individual bands. At present, the LCL complex is believed to be of Y-shaped configuration with origin at the isometric point on the lateral epicondyle with fanning of the capsuloligamentous attachments distally onto the radius and ulna and functions to resist varus and posterolateral stresses on the elbow.[24]

The neurovascular anatomy of the elbow is complex. Regarding the vasculature, the lateral aspect of the elbow is relatively safe, consisting only of the anastomosis of the radial collateral artery (profunda artery) and the radial recurrent artery (radial artery) at the level of the lateral epicondyle. Furthermore, the radial recurrent artery may be sacrificed as it traverses the supinator muscle traveling proximally near the radial head.[25] The radial nerve proper and posterior interosseous nerve (PIN) are of greatest concern regarding the radial head, as the proximity of the nerve has been reported by some authors to be within millimeters.[26] As the radial nerve descends into the antecubital fossa, it divides into the superficial, radial sensory nerve, and deep, PIN. The PIN then dives deep to the supinator muscle that overlies the proximal radius, opposite to the bicipital tuberosity.[27] As it passes over the anterior elbow, the radial nerve lies directly over the radial head, with only capsule interposed. Fortunately, pronation of the forearm displaces the radial nerve further medially, making surgical exposures of the lateral elbow structures safer.[28]

The radial head functions biomechanically as a secondary stabilizer to valgus stress about the elbow and in the longitudinal stability of the forearm. In his classic study, Morrey et al[29] demonstrated the importance of the radial head in cadaveric elbows with medial collateral ligament deficiency. Regarding axial stability of the forearm, multiple structures contribute, including the radial head, interosseous membrane, distal radioulnar joint ligaments, and the triangular fibrocartilage complex. Markolf et al[30] showed that comminuted radial head fractures and disruption of the interosseous membrane in a cadaveric model, treated with an appropriately sized radial head prosthesis was sufficient to restore distal ulnar load sharing and prevention of proximal migration of the radius.

Standard radiographic examination of the elbow consists of anteroposterior and lateral views of the elbow; if a radial head fracture is suspected or diagnosed, further radiographs of the forearm and wrist are obtained. In addition to the fracture, the examiner should pay special attention on the anteroposterior view to the radiocapitellar and ulnohumeral joint lines to assess for symmetry, as well as degenerative changes that may preclude fixation. Moreover, on this view, the common fracture line across the anterolateral aspect of the radial head may be discernible. On the lateral view, the presence and concentricity of the 3 arcs should be present, indicating a true lateral.[31] In addition, assessment for coronoid tip fractures is often best performed on this view as well, and care should be taken by the treating provider not to misdiagnose these injuries as just a displaced fragment of the radial head, as these fractures generally represent a masquerading "terrible triad" injury. Additionally, assessment for anterior and posterior fat pad signs in the presence of normal osseous anatomy may indicate an occult fracture. If a radial head fracture is suspected, or needs to be further delineated, a 45° lateral oblique view of the radial head can be obtained; this is classically known as the radial head–capitellum view.[32] This view is obtained by angling the beam toward the radial head at a 45° angle to the forearm.[32] This allows the normal overlap of the radial head and proximal ulna to be removed, allowing complete evaluation of the osseous anatomy of the radial head and capitellum.[32]

Some authors have assessed the use of a computed tomography scan or magnetic resonance imaging when evaluating fractures about the elbow owing to its complex osseous anatomy.[33,34] Certainly this seems reasonable when evaluating complex injury patterns; however, for simple nondisplaced or minimally displaced fracture patterns without mechanical blocks to motion, where further elucidation of the fracture pattern is not going to influence treatment, we routinely negate the added costs of a computed tomography scan. In addition, the additional information provided by magnetic resonance imaging has not been shown to change treatment.[35]

Mechanisms or Patterns of Injury

Probably the most crucial aspect in the diagnostic evaluation of radial head fractures is for the evaluator to be aware of certain patterns of injury that masquerade as simple fractures but are really just the tip of a more complex pattern of injury. Specifically, posterior transolecranon fracture dislocations of the elbow or the classic "terrible triad" injuries (consisting of fracture of the radial head and coronoid as well as disruption