Pediatric injuries about the elbow are common. Treatment requires accurate recognition and prompt management. In children, the cartilaginous and unossified distal humerus can confound the injury diagnosis. In equivocal cases, additional imaging is warranted to better detail the anatomy. This chapter's authors prefer intraoperative arthrography to delineate pathology and direct treatment. Early treatment of pediatric elbow injuries is more reliable than late management. This chapter discusses the acute and chronic complications of pediatric elbow dislocations and Monteggia fracture-dislocations.

**Pediatric Elbow Dislocations**

Pediatric elbow dislocations are relatively uncommon; however, the advent of extreme sports has resulted in an increasing number of high-velocity injuries in children. Similar to adults, posterior dislocations are the most common injury pattern. Children are prone to apophyseal injuries instead of ligamentous tears. After an elbow dislocation, the medial epicondyle with its attached collateral ligament is frequently displaced.

**Acute Complications**

When assessing radiographs of an elbow dislocation, identification of the medial epicondyle is crucial. Specifically, a diligent search is necessary to ensure that the medial epicondyle is not residing within the ulnohumeral...
joint \(^1\) (Figure 1, A). If there is any question about the location of the medial epicondyle, advanced imaging studies can accurately assess its position (Figure 1, B). Prompt recognition of the position of the epicondyle allows urgent surgical removal and fracture fixation. Failure to recognize the incarcerated medial epicondyle results in pain and stiffness (Figure 2).

When the elbow joint is not reduced, secondary calcifications with resultant stiffness in the elbow capsule are common. These calcifications may be misinterpreted as an additional injury. After the incarcerated medial epicondyle is recognized, urgent removal is indicated. Delayed extrication of the medial epicondyle is difficult and often results in suboptimal fixation. Intraoperative fluoroscopy is beneficial in terms of identifying the fragment and guiding relocation of the epicondyle into the optimal position. Fixation can be accomplished using a cannulated screw system or with tension wire fixation. The choice depends on the size and the consistency of the fragment. The goal is simply to obtain a stable ulnohumeral joint with adequate motion for activities of daily living.

Chronic Complications

Chronic complications after elbow dislocations are typically related to instability. Instability can occur in two different scenarios: valgus instability or recurrent elbow dislocations.\(^3,4\) Valgus instability is related to nonunion or malunion of the medial epicondyle fracture and associated medial collateral ligament insufficiency. The instability often presents years after an injury as the child increases his or her activity level and valgus stress. The diagnosis requires a physical examination and imaging studies, such as intraoperative fluoroscopy. Examination under anesthesia may be necessary to confirm the diagnosis. The initial treatments are activity modification and flexor-pronator strengthening. Failure to curtail the instability requires medial collateral ligament reconstruction\(^4\) (Figure 3). The procedure is complicated by malposition of the epicondyle and distortion of the anatomy. Therefore, medial collateral ligament reconstruction requires ingenuity with regard to distal humeral
Complications of Pediatric Elbow Dislocations and Monteggia Fracture-Dislocations

Chapter 43

Complications of Pediatric Elbow Dislocations and Monteggia Fracture-Dislocations

© 2015 AAOS  Instructional Course Lectures, Volume 64  495

The fragment may be left alone or excised depending on its location with reference to the ligament reconstruction. This reconstruction can restore stability and allow a return to normal activity; however, activities requiring a high level of valgus elbow motion, such as gymnastics, may not be possible.

Recurrent elbow dislocation is a rare problem. In contrast to valgus instability and medial insufficiency, recurrent dislocation is related to lateral collateral ligament deficiency. The diagnosis requires a physical examination and possible examination under anesthesia. The posterolateral pivot shift test is unreliable in the awake child, and examination under anesthesia is often necessary to confirm the posterolateral instability. Other tests, including the chair sign, the floor push-up sign, and the table-top relocation test, have undetermined reliability in children.

The initial treatment for recurrent elbow dislocation is activity modification and fabrication of a hinged elbow brace that blocks terminal extension and supination. Because the local tissue is usually inadequate for imbrication, lateral collateral ligament reconstruction is required. The procedure is complicated by the open physis because docking into the distal humerus must avoid crossing the growth plate. Reconstruction can restore stability and prevent further dislocations. Return to normal activity is possible after recovery.

Osteonecrosis and/or arthritis can occur after an elbow dislocation and may be more likely in patients with a delayed diagnosis and open reduction. Loss of articular cartilage is a challenging problem in children. Asymptomatic arthritis does not merit extensive intervention. Symptomatic arthritis requires consideration of biologic resurfacing procedures, such as distraction interposition arthroplasty or osteochondral autograft transplantation mosaicplasty. Osteochondral autograft transplantation mosaicplasty is indicated for defined symptomatic defects, whereas interposition arthroplasty is indicated for global loss of articular cartilage. Interposition arthroplasty is designed to resurface the elbow joint to eliminate pain and enhance motion. In the ginglymus, or elbow hinge joint, it appears more suitable than in multiplanar joints. Minimal resection of bone, careful repair of the collateral ligaments, and distraction of the joint surfaces (distraction interposition arthroplasty) improves stability, decreases shear forces, and promotes healing of the graft. A hinged external fixator is helpful to distract the articulating surfaces and permits immediate movement while protecting the

Figure 3  A 13-year-old adolescent was unable to participate in gymnastics after a right elbow dislocation that occurred 2 years earlier. The elbow examination under anesthesia showed valgus instability. A, Radiograph shows a displaced medial epicondyle at the ulnohumeral joint (arrow). B, Intraoperative photograph of medial collateral ligament reconstruction using autograft tendon. (Courtesy of Shriners Hospital for Children, Philadelphia, PA.)
interposition and soft-tissue repairs. Other treatment options include total elbow arthroplasty (contraindicated in a young patient), resection arthroplasty, and elbow arthrodesis. Elbow arthrodesis provides stability and eliminates pain; however, there is no optimum position that allows performance of all the activities of daily living.13

When performing interposition arthroplasty, a long posterior longitudinal incision centered over the olecranon is preferred.11 The common extensor origin and lateral collateral ligament origin are elevated from the lateral epicondyle and distal humerus. The joint surface is exposed by supinating the forearm and applying varus stress to the elbow. This maneuver rotates the ulna and radial head from the distal humerus. After dislocating the joint, the anterior and posterior capsules are elevated to increase motion. The deformed joint surfaces are refashioned to resemble an innate humerus. The goal is to re-create congruency between the trochlea and the olecranon.

The joint is reduced and assessed for satisfactory passive motion. The interposition material of choice is then procured. Allograft or autograft are both viable options. A two-ply interposition is fashioned that cloaks the distal humerus. The graft is secured to the distal humerus via transosseous mattress sutures (Figure 4). An external fixation distraction device is applied, with care taken to avoid injury to the radial nerve, and the joint is distracted 3 to 4 mm. The crucial step is to ensure the external fixator is aligned at the joint axis to allow the normal arc of motion. Accurate axis wire placement is the critical step because the fixator is constructed about this wire. Closure is then accomplished, with a focus on repair of the collateral ligament(s) and the common extensor and/or flexor origins with transosseous sutures or bone anchors. Radiographs should be checked before leaving the operating room to confirm joint reduction and correct positioning of external fixation. The olecranon should align with the trochlea, and the radial head should point to the capitellum. Posterior subluxation of the radial head infers posterolateral instability and must be corrected.

Monteggia Fracture-Dislocations

Acute Complications

Failure to make the diagnosis is the most common, acute complication of a Monteggia fracture-dislocation.14 The radial head should align with the capitellum regardless of the radiographic view. The diagnosis may be missed because the ulna fracture may be in the form of plastic deformation, which is difficult to appreciate without a full-length forearm radiograph, or the elbow radiograph may reveal subtle radial head subluxation instead of frank dislocation.15 Radial head subluxation will progress to dislocation during the ensuing weeks, secondary to the unrestricted biceps tendon pull on the radial tuberosity.

A patient with a delayed diagnosis requires prompt surgical management. Closed reduction is usually unsuccessful. Treatment includes correction of the ulna fracture and radiocapitellar joint reduction16-18 (Figure 5). An ulnar osteotomy is recommended to relocate the radial head and gain ulnar length. The apex of the osteotomy should be designed to redirect the radial head toward the capitellum. An extended lateral Kocher incision is performed. The ulna is cut with a saw at the point of maximum angulation. The radiocapitellar joint is opened, and the radial head is reduced. Débridement of the radiocapitellar joint may be necessary to remove any debris preventing reduction. The ulna is then fixed with a plate and screw construct, and the stability of the radiocapitellar joint is assessed clinically and under fluoroscopy. Frequently, the radial head is stable, and the remnants of the ligament are repaired. Persistent instability requires a reassessment of the ulnar osteotomy and/or ligament repair.

Chronic Complications

Chronic complications are related to persistent dislocation of the radial head. The radial head is usually dislocated in an anterior direction and can block elbow flexion. In addition, the loss of lateral column bony stability can lead to valgus instability. Treatment is directed at restoring radiocapitellar alignment and reestablishing lateral column stability. The procedure follows the same tenets as those for subacute management, although the level of difficulty is much greater. Instead of an acute ulnar
osteotomy, slow distraction osteogenesis may be necessary to gain adequate length.\(^{19,20}\) During the consolidation phase, open joint reduction is performed with adjustment of the fixator to optimize radiocapitellar alignment. The surgeon should be prepared to perform an annular ligament reconstruction to enhance stability of the radial head. Options for reconstruction include the Bell-Tawse procedure using a strip of triceps tendon\(^{16}\) or the technique using tendon graft described by Seel and Peterson.\(^{21}\) This chapter’s authors prefer the latter technique because the reconstruction is more anatomic and results in better centering of the radial head.

**Summary**

Elbow dislocations and Monteggia fracture-dislocations can result in both acute and chronic complications. Acute complications center on inaccurate diagnoses and a subsequent delay in treatment. Chronic complications involve instability at the ulnohumeral or radiocapitellar joints. The management of chronic complications is more difficult, and outcomes are less predictable.

**References**


**Video Reference**