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Operative Techniques in
Orthopaedics

Medial Epicondyle Fractures—To Fix or Not to Fix

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Medial epicondyle fractures are often written about and frequently discussed. The outcomes for these fractures do not clearly follow the over-arching themes for the management of displaced fractures in orthopaedics. Even in the face of a high nonunion rate, many patients treated conservatively with displaced fractures clinically perform well long term and show a low rate of elbow instability. The acceptable indications for conservative management include minimally displaced fractures, low energy injury, and a stable elbow. Fractures treated surgically have equally high rates of good and excellent outcomes with a higher rate of bony union. Fractures that should be treated surgically include those that are incarcerated as well as those that are open. There should be consideration for surgical management in patients with an ulnar nerve injury, the dominant arm in the overhead athlete and those that demonstrate valgus instability. Efforts should be made to avoid prolonged immobilization to minimize the risk of elbow motion loss.

KEYWORDS medial epicondyle fracture, controversy, medial epicondyle avulsion, thrower's elbow

Introduction

Medial epicondyle fractures occur most commonly between ages 9 and 14 and account for up to 20% of all elbow fractures in children with a male to female preponderance of 4:1.[1-4] The peak incidence occurs at 11-12 years old.[5] Nearly 60% of medial epicondyle fractures are associated with elbow dislocations and 5%-18% of those will be incarcerated.[3,6-8]

The optimal management for medial epicondyle fractures remains largely controversial. This stems from a lack of high-level evidence, demonstrating a clinical superiority for anatomic fixation in widely displaced fractures when compared to conservative management. Multiple reports note a high rate of nonunions in conservatively treated, displaced fractures that are clinically asymptomatic. There are also reports that cite concerns for elbow instability associated with medial epicondyle nonunions and marked displacement.[9-13]

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Anatomy

The medial epicondyle is an apophysis on the distal end of the humerus. It does not contribute to the overall length of the bone. Ossification of the medial epicondyle begins around 4-6 years of age, a little later in boys than in girls[5] (Fig. 1). This is the last elbow ossification center to fuse to the humerus, typically between ages 15 and 20 years.[14] The elbow capsule in younger children extends up to the physeal line, but as children grow, this moves distal to the medial crista of the trochlea.[15]

The medial epicondyle serves as the attachment for the flexor-pronator muscle group in the forearm as well as the anterior bundle of the ulnar collateral ligament (UCL).[6,16-18] The flexor-pronator attaches to the anterior aspect of the apophysis.[19] The ulnar nerve travels immediately posterior, through the cubital tunnel. The blood supply to the medial epicondyle is associated with the flexor-pronator muscle group of the forearm as well as from branches of the inferior ulnar collateral artery.[5,20]

The UCL is the primary static stabilizer to the ulnohumeral joint against valgus stress. The UCL has 3 components with the most vital component being the anterior band. The anterior band has 2 functional sections allowing it to stay taut in flexion and extension.[18,21,22] The flexor-pronator muscle group is a dynamic elbow stabilizer for the elbow and may protect the UCL during torsional moments.[23]

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Figure 1 Demonstrates the growth centers present in a skeletally immature elbow with the ages of appearance.

Mechanism of Injury

Three injury mechanisms have been described: direct trauma, avulsion injury from muscle pull, and elbow dislocation.[5] The most commonly described avulsion mechanism involves falling on an outstretched and supinated hand, with the elbow extended, producing a valgus stress on the elbow joint.[6,16,24] This positioning tensions the flexor-pronator muscle mass on the medial epicondyle leading to the avulsion injury. Avulsion injuries have also been described during arm wrestling as a result of the flexor-pronator tension.[25] These injuries have also been described in baseball players while throwing through the sudden contracture of the flexor muscle group.[26]

Given that roughly a third of medial epicondyle fractures associated with elbow dislocations are incarcerated, all radiographs must be scrutinized, and the medial epicondyle identified to ensure its location. For the medial epicondyle that cannot be readily identified, first verify the patient's age and that the epicondyle has developed. If the patient is in the age range that suggests their medial epicondyle should have developed, evaluate the joint line for symmetry, alignment, and possibly an incarcerated medial epicondyle fragment. Incarcerated fragments tend to lie between the trochlea and semilunar notch.[27] Do not mistake the capitellum for an incarcerated medial epicondyle fracture.

Physical Exam

The physical exam findings for medial epicondyle fractures present in a wide range. First, start with inspection for swelling about the elbow most notably along the medial aspect. Palpate for any crepitus. Range of motion may be limited which can be due to pain, swelling, apprehension, or a mechanical block from incarcerated fragments. Assess for valgus stability with the elbow in at least 15° of flexion to unlock the ulnohumeral joint and the forearm pronated to lock the radiocapitellar joint. This isolates the medial soft tissue structures for examination. Evaluate the neurovascular status of the limb, most importantly the ulnar nerve. Ulnar nerve dysfunction has been described in 10%-16% of cases of simple medial epicondyle fractures, but with a much higher incidence in an elbow dislocation.[28]

Imaging

Plain radiographs are an easy screening tool for medial epicondyle fractures. Recommended images include AP, lateral, internal oblique, and possibly an axial view. The radiographic center of the medial epicondyle apophysis is reported to be 0.5 mm inferior to a line drawn along the inferior olecranon fossa, tangential to the long axis of the humerus and 1.2 mm anterior to the posterior humeral line.[29]

Plain radiographs alone may be insufficient and unreliable for determining the exact amount of displacement. The interobserver disagreement for judging displacement on plain radiographs is 54%, 87%, and 64% on AP, lateral, and oblique radiographs, respectively.[30] To improve this reliability, standardize the internal oblique radiograph to 45°, regardless of elbow flexion, and multiply this displacement by 1.4 to better estimate the true displacement as it compares to CT.[31] The distal humerus axial view may also be added and has a better intraclass reliability of 0.974. This view is taken 15°-25° off axis from the humerus with the beam centered on the distal humerus.[32]

The easiest and best way to identify displacement is by obtaining a CT scan of the elbow. However, this would necessitate an unreasonable amount of radiation in the growing population along with increased cost. This should be reserved for cases where the medial epicondyle is not readily identifiable, or the amount of displacement is difficult to determine.

Classification

The classification for acute fractures is based on anatomic features and displacement. The classification is more descriptive and does not necessarily drive treatment decisions. The classification includes nondisplaced, minimally displaced, significantly displaced, incarcerated, and fractures through the apophysis.[33] Another descriptive classification proposed by Papavasiliou (Table 1).

Indications

Nonoperative indications include a low energy mechanism, elbow stable to valgus stress, and minimal displacement. Surgical indications include elbow dislocation with an incarcerated medial epicondyle and open fracture[5] (Table 2). Relative surgical indications include ulnar nerve injury, elbow instability, significantly displaced, and dominant arm in the overhead athlete.[2,6,9,34-38]

Table 1 Papavasiliou's Classification for Medial Epicondyle Fractures

Classification	
Type 1	Small avulsion
Type 2	At the level of the joint, not entrapped
Type 3	Incarcerated in the joint
Type 4	Associated elbow dislocation

Table 2 Displays the Generally Accepted Surgical Indications for Medial Epicondyle Fractures

Surgical Indications
Incarcerated fragment
Open fracture

Table 3 Represents Major Factors to Take Into Consideration When Making Management Decisions for Medial Epicondyle Fractures

Factors to Consider in Treatment Decisions
Displacement
Mechanism of injury
Elbow stability
Association with dislocation
Dominant arm
Patient's physical and athletic desires/demands

Management

When considering conservative management, it is important to note the mechanism of injury, displacement, elbow stability, and the functional goals of the patient.[9,38,39] Fractures that are nondisplaced or minimally displaced (<2 mm) without valgus instability of the elbow, it is generally accepted to treat conservatively (Table 3). The primary goals of conservative treatment are to promote bony healing, prevent symptomatic nonunion, prevent elbow instability, and limit loss of motion. Conservative management of medial epicondyle fractures involves long arm casting for 2-4 weeks with the elbow at 90° flexion and the forearm in neutral rotation. This is followed by a brief period of sling immobilization for comfort while promoting elbow and wrist range of motion in this immediate postcast period.[40] Physical therapy may begin at 4-6 weeks if necessary.

Surgical treatment for medial epicondyle fractures has been described for fractures with a wide range of displacement starting with as little as 2 mm of displacement almost all with good to excellent outcomes.[3,4,10,17,41] The goals of surgery are to restore stability to the elbow, early mobilization, earlier return to full function, and promote fracture healing. The current consensus on which patients should be treated surgically includes those patients with an incarcerated fragment and those with an open fracture. Surgical fixation can be accomplished with K-wires, screws with or without washers or suture anchors have all been described. A cannulated screw without a washer can be used (Fig. 2) safely without risking the risk of causing fracture fragmentation. A washer may be added (Fig. 3) for surgeon comfort in providing compression.[42] Adding a washer increases the likelihood for a second surgery due to prominent hardware[42] (Table 4).

The patient may be positioned supine with the shoulder externally rotated and a sterile bump underneath the humerus or prone with the elbow flexed and shoulder internally rotated. Surgical reduction can be facilitated with forearm supination and wrist flexion. Further reduction aides include wrapping an Esmarch from distal to proximal up the forearm providing for a "milking maneuver" and/or fractional lengthening of the flexor-pronator mass.

Treatment for incarcerated medial epicondyle fractures should be considered urgent, not emergent. Time to surgical treatment up to 40 hours did not have an effect on complications in regards to ulnar neuropraxia, need for second surgery or symptomatic hardware.[43]

Outcomes and Controversies

A recent survey among Pediatric Orthopaedic Surgeons demonstrates continued variation and a lack of consensus for the management of medial epicondyle fractures.[44] This group of 13 surgeons was given 60 case vignettes with radiographs and important patient details. The only variables noted to significantly influence surgeons to perform surgery were fracture displacement and the presence of an elbow dislocation.[44]

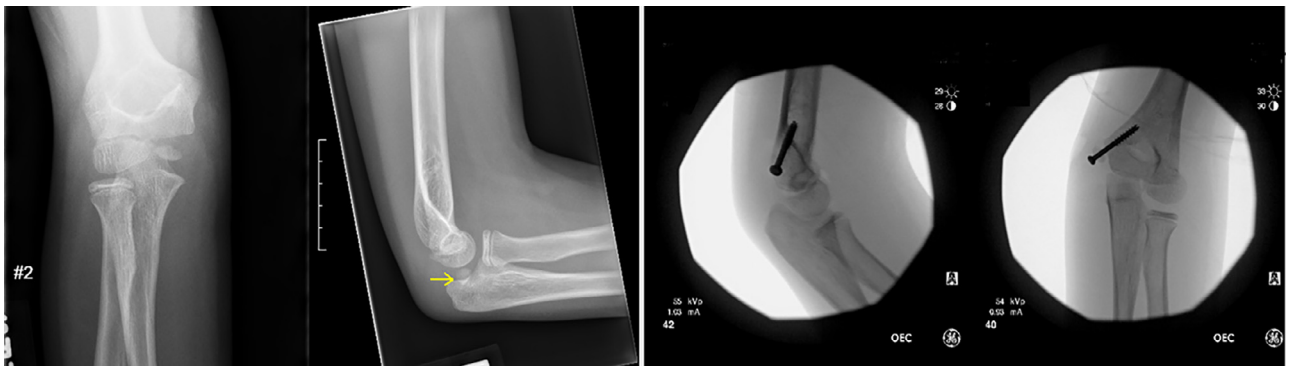

Figure 2 Demonstrates fixation of an incarcerated medial epicondyle fracture utilizing a cannulated screw without a washer.

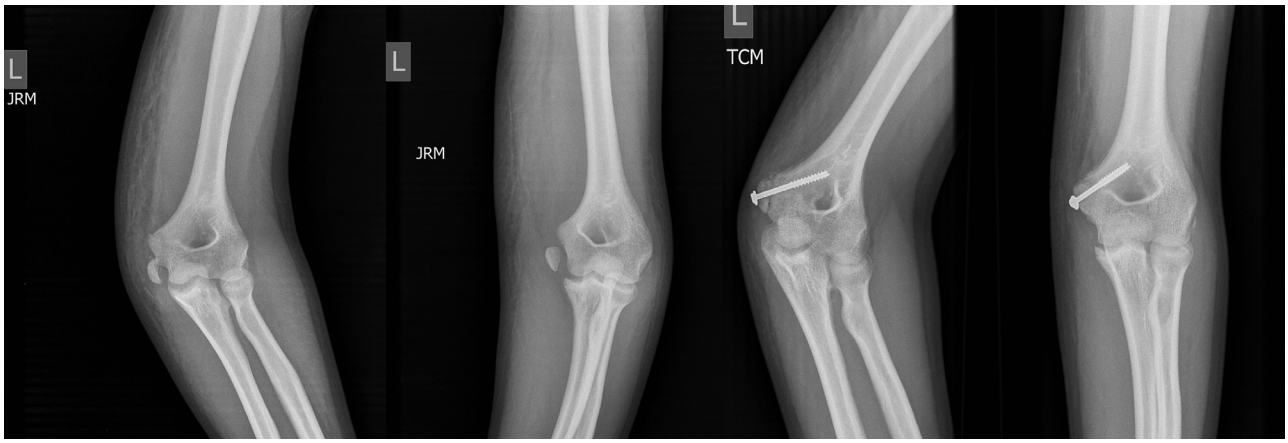

Figure 3 Demonstrates screw and washer technique for fixation of a displaced medial epicondyle fracture.

Table 4 Surgical Fixation Options Available

Surgical Options
Screw with/without washer
K-wires
Suture anchors

Conservative management of medial epicondyle fractures has demonstrated good and excellent long-term functional outcomes as well. Displaced fractures treated conservatively may have a nonunion rate up to 90% vs a 7% nonunion rate in those same fracture types treated with surgery.[4,12] The amount of displacement for the conservatively treated group range from 5 to 15 mm. The long-term functional outcomes in both groups surgical and conservative were similar even in the presence of nonunion.[12]

A computer-generated 3D model predicting possible changes in muscle function related to displacement demonstrated that for every 1 mm of anterior displacement, wrist flexion strength could be reduced by 2%.[39] This could dramatically weaken initial muscle strength and function in widely displaced fractures.[39]

A significant loss in range of motion at the elbow has been noted for a large proportion of patients with medial epicondyle fractures despite method of treatment. One report noted up to a 15° loss of extension in approximately 40% of patients treated conservatively and a 37° loss of extension in 2/3 of patients treated surgically.[1] The patients treated surgically were higher degree injuries including open, ulnar nerve injuries, and incarcerated fragments.

A small retrospective review of 20 adolescent athletes, including pitchers, compared the outcomes for those treated surgically as well as conservatively over a 5-year period with 2-year follow-up.[38] None of the patients had incarcerated fragments or ulnar nerve entrapment. Both groups achieved excellent DASH scores, 100% return to sport rates, and required the same amount of physical therapy. Of note regarding the 7 pitchers included in the study, 4 were treated operatively and 3 were treated conservatively. A benefit of surgery in overhead athletes and athletes in general is being able to more reliably return to full participation in sports in as little as 8 weeks.[45]

A 2015 report of medial epicondyle fractures compared 4 different treatment options including casting for nondisplaced fractures, casting for displaced fractures, surgery for displaced, and surgery for incarcerated.[46] A minimum 2-year follow-up was reported. There were no significant differences in functional outcomes between groups. There were instances of clinically asymptomatic radiographic instability noted in displaced fractures treated nonoperatively, and none in the operative group.[46]

One study did show improved DASH score and return to sports in patients treated surgically at 3-year follow-up.[47] The study itself was small with only 12 patients completing follow-up and being reported on.

Valgus instability of the elbow has been described in association with medial epicondyle nonunions.[9,46] A case series of 5 patients with medial epicondyle fractures, all initially treated conservatively and went on to develop nonunion. Three of them continued to be treated conservatively and the other 2 underwent surgical fixation but failed to form bony union. All were treated successfully with fragment excision and fixating the medial collateral ligament to the medial epicondyle[9] (Table 5).

Risk factors for less than excellent outcomes include the presence of multiple fractures, the need for surgery, prolonged immobilization, and fragment excision.[8,12] Immobilization beyond 2 weeks may result in a loss of motion.[8]

Complications

The complication rate for medial epicondyle fractures is relatively low.[6,48,49] Complications for conservative management include elbow stiffness, elbow instability, cubitus valgus, nonunion, and ulnar nerve neuropathy.[1,9,50-52] Complications for surgical treatment includes myositis ossificans, infection, radial nerve injury along with the complications described for conservative management.[7,41,52,53]

An unrecognized and incarcerated medial epicondyle fracture can have devastating complications such as pain, block to motion, elbow instability, and ulnar nerve injury.[5] If left

Table 5 Displays the Relative Surgical Indications for Medial Epicondyle Fractures

Relative Surgical Indications
Valgus instability
Ulnar neuropathy
Dominant arm of overhead athlete

untreated, the medial epicondyle can scar down to the coronoid making extraction difficult.[5,15] There will also be a thick fascial band binding the ulnar nerve to the underlying muscle which could lead to ulnar nerve dysfunction.[54,55]

Conclusion

Treatment for medial epicondyle fractures remains a hotly debated and controversial topic. Optimal management depends on a complex interplay of patient/parent preference, surgeon preference, individual patient functional demands, fracture displacement, and baseline stability of the elbow. The appropriate treatment recommendation would make consideration for all these factors.

Conservative management should be used in patients with displacement <2 mm without valgus instability. It is generally accepted that surgical management be considered in patients with open fractures and those with fractures incarcerated in the joint. Relative indications for surgery include valgus instability of the elbow, ulnar neuropathy, and involvement of the dominant arm in an overhead athlete. Good to excellent long-term functional outcomes have been demonstrated in patients treated both conservatively and surgically in displaced fractures and consideration for the above factors will help guide the optimal management for each patient.

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