Terrible Triad Elbow Fracture-Dislocation With Triceps and Flexor-Pronator Mass Avulsion

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abstract

Terrible triad elbow injuries, consisting of fractures of the radial head and coronoid with ulnohumeral dislocation, are challenging to treat. They require a comprehensive understanding of the complex anatomy of the elbow to effectively treat all of the pathology and create a stable, congruent joint. The authors present a case of a terrible triad injury with avulsion of the triceps and flexor-pronator mass after a low-energy fall in a young patient. Although most terrible triad fracture-dislocations can be successfully treated with coronoid fixation, radial head fixation or replacement, and repair of the lateral collateral ligament complex, this case involved a completely circumferential injury to the elbow. The coronoid and anterior capsule were disrupted anteriorly, the radial head and lateral collateral ligament complex were disrupted laterally, the triceps was disrupted posteriorly, and the flexor-pronator mass was disrupted medially. Although the authors prefer to address most terrible triad injuries through a lateral approach, they suspected a circumferential injury preoperatively and elected to use a single posterior incision to address all of the pathology conveniently. This injury required treatment of all disrupted structures, because the elbow remained unstable until the triceps and flexor-pronator mass avulsions were ultimately repaired. With any elbow fracture-dislocation, surgeons should look for evidence of additional injuries that do not fit the commonly described patterns, because they may necessitate modifications to the treatment plan. Given the relatively common complications of stiffness and instability despite modern surgical techniques, additional injuries may further compromise functional outcomes unless they are addressed properly. [Orthopedics. 2015; 38(2):e143-e146.]
The injury pattern consisting of a posterior ulnohumeral dislocation along with fractures of the radial head and coronoid has been referred to as the “terrible triad” because of the historically high rates of complications and challenges to achieving good outcomes, even in the hands of experienced elbow surgeons. Surgery is almost always indicated. Frequently encountered complications include instability, stiffness, malunion, nonunion, heterotopic ossification, wound healing problems, infection, and nerve injury. Because the native elbow is inherently a very stable and congruent joint, even a slight residual abnormality may lead to disappointing functional outcomes.

The authors present a case of a terrible triad injury with simultaneous avulsions of the triceps and flexor-pronator mass, an injury pattern that has not been described in the literature. This case highlights the importance of evaluating for sometimes subtle additional injuries on imaging studies and treating them adequately to fully stabilize the elbow joint and allow for the best possible functional outcomes. The patient agreed to have the details of her injury prepared as a case report.

**CASE REPORT**

A 29-year-old right-hand-dominant woman fell onto her outstretched right hand. She had immediate pain, swelling, and deformity about the right elbow and presented to the emergency department for evaluation. She had no neurologic symptoms or other injuries from the fall. The rest of her medical history was unremarkable.

Examination of the right elbow showed no open wounds, but significant ecchymoses were noted posteriorly just proximal to the olecranon tip. Active elbow motion could not be assessed because of pain, but motor function of the extensor pollicis longus, flexor pollicis longus, interossei, and wrist extensors was intact. Sensation was intact to light touch in the distribution of the lateral antebrachial cutaneous, medial antebrachial cutaneous, median, ulnar, and radial nerves. She had palpable radial and ulnar pulses.

Injury films (Figure 1) showed an intra-articular radial head fracture with posterior subluxation of the ulnohumeral joint and small cortical flecks of bone both medially and posteriorly about the elbow joint. Closed manipulative reduction was performed under conscious sedation, and postreduction computed tomography scan of the elbow was obtained. Three-dimensional computed tomography reconstruction (Figure 2) showed a highly comminuted intra-articular radial head fracture, a possible coronoid tip fracture, medial cortical debris, and cortical debris posteriorly just proximal to the olecranon tip, concerning for triceps tendon avulsion. After informed consent was obtained, the patient underwent surgery on postinjury day 1. A posterior utility incision was used. On raising medial and lateral flaps, it was evident that the triceps insertion was completely avulsed off the olecranon tip. Medially, after the ulnar nerve was dissected out and protected, cortical debris was seen in the elbow joint and the flexor-pronator mass was noted to be avulsed off the medial epicondyle. All cortical debris was evacuated from the joint medially. Laterally, Kocher’s interval was used and the comminuted radial head fragments were removed. The lateral collateral ligament complex was disrupted. The degree of radial head comminution precluded fixation, and a replacement was planned. Before the radial head prosthesis was implanted, the anterior elbow capsule, which was completely torn off the coronoid tip, was repaired to the coronoid with No. 2 FiberWire (Arthrex, Naples, Florida).
through drill holes in the proximal ulna. After the radial head was replaced, the avulsed triceps was reattached to its native anatomic insertion on the proximal ulna with a Krackow 4-strand repair with No. 2 FiberWire and drill holes. The lateral collateral ligament complex was then repaired with No. 2 Ethibond (Ethicon, Somerville, New Jersey) with drill holes into the lateral epicondyle at its anatomic insertion. The fascia over Kocher’s interval was repaired by oversewing with No. 2 Ethibond. Persistent ulnohumeral instability was noted, and the avulsed flexor-pronator mass was repaired with a suture anchor to its anatomic insertion on the medial epicondyle, which stabilized the elbow through its arc of motion, including maximal extension with gravity. Intraoperative range of motion was from 20° to full flexion, with full supination and pronation. Postoperatively, the patient was splinted in 90° flexion in neutral rotation for 2 weeks.

At the 2-week postoperative visit, the patient was placed in a hinged elbow brace with an extension block at 30°. Active flexion and passive extension were allowed. The patient began to work on stretching and range of motion with a physical therapist. At the 6-week visit, the patient had a 60° to 90° arc of motion, with 40° supination and 80° pronation. She could actively extend the elbow within the limited arc of motion. Weight bearing as tolerated with unrestricted motion was initiated. A dynamic extension splint was recommended but not obtained by the patient. At the 3-month visit, the patient was pain-free, with a flexion-extension arc of 50° to 135° and full supination and pronation of 80°. Radiographs showed a concentrically reduced elbow joint (Figure 3). The patient was advised to continue physical therapy, and a dynamic extension splint was again recommended. The patient began using the dynamic extension splint. At the 6-month visit, she continued to improve, with a 38° to 150° arc of motion with soft end-points, full supination and pronation, and 4-plus triceps strength. She had no pain on activity, but noted a lack of terminal extension. At 9 months, further improvement was noted, with a 25° to 150° arc of motion, full supination and pronation, and no symptoms.

**DISCUSSION**

Terrible triad injuries were historically treated with closed reduction techniques and cast immobilization or with radial head excision alone. Outcomes were universally poor, with many patients experiencing persistent instability or stiffness.1-3 With the advent of modern surgical techniques, most authors now advocate repair of the coronoid, radial head fixation or replacement in cases of severe comminution, and repair of the lateral collateral ligament complex. In patients with persistent instability, it is recommended to address the medial side with medial collateral ligament repair. A hinged external fixator is the last resort in the setting of instability despite these measures.2-9

A terrible triad injury occurs with axial loading of the extended elbow that is in valgus and supination. Gross instability occurs because of sequential injury to the lateral collateral ligament complex, anterior capsuloligamentous structures, and anterior band of the medial collateral ligament or entire medial collateral ligament. With sufficient axial loading, radial head and coronoid fractures also occur. These fractures further destabilize the elbow because the radial head normally acts as a valgus stabilizer and the coronoid tip and anterior capsule together serve as an anterior buttress against posterior ulnohumeral dislocation.2,3 With this sequence of injury, the triceps is not typically involved. However, the current patient may have had a complex mechanism of injury, with eccentric contraction of the triceps during her fall leading to avulsion in addition to the typical findings of a terrible triad injury. There is only a single report of 2 cases of elbow fracture-dislocation with triceps avulsion in the literature; neither case had the terrible triad injury pattern, with simultaneous triceps and flexor-pronator mass avulsions, resulting in complete circumferential loss of static soft tissue restraints about the elbow.10

A missed triceps avulsion injury could result in late weakness of elbow extension.
and further limitation of passive extension, which is already likely to be compromised in this injury, even with appropriate treatment.\textsuperscript{1,2,5,7} Therefore, it is critical to evaluate the imaging carefully before surgery for signs of triceps avulsion. Recent data support surgical treatment of all components of a terrible triad injury, including fixing the coronoid, fixing or replacing the radial head, and repairing the lateral collateral ligament complex to obtain the best outcomes.\textsuperscript{6-9} Similarly, the avulsed triceps should be surgically repaired to impart the greatest stability to the elbow joint and preserve active elbow extension and maximum range of motion. Intraoperatively, the authors observed ulnohumeral instability far beyond what is normally seen with terrible triad injuries alone. Early treatment of terrible triad injuries leads to better final range of motion, and inadequate early treatment because of a missed triceps injury can compromise outcomes.\textsuperscript{11}

**Conclusion**

The surgical approach for these injuries is an important consideration. The 2 most common approaches are midline posterior skin incision, which allows complete access to the medial and lateral aspects of the elbow, and lateral skin incision directly over Kocher’s interval, combined with a separate medial approach as needed.\textsuperscript{2,3} With separate medial and lateral approaches, the triceps avulsion injury could easily be missed unless it is noted preoperatively. Imaging may yield clues to a triceps injury, as in this case, but no bony injury may be visible on imaging, which can make diagnosis challenging, with the limitations of physical examination after acute injury. In this case, a posterior skin incision is advantageous, facilitating identification and treatment of concomitant injuries on the posterior and medial aspects of the elbow.

**References**