Humeral shaft fractures in overhead throwing athletes: A case series

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Abstract

Humeral shaft fractures occurring in athletes exposed to repetitive overhead throwing are a rare but recognized phenomenon. Thrower’s fractures are most frequently seen in baseball but are also documented in other activities such as javelin and grenade throwing. There are many biomechanical studies and retrospective cohort studies supporting explanations for mechanism of injury but little data exists to support surgical intervention and post-operative functionality after the injury occurs.

This case series examines the treatment and management of three baseball players who suffered thrower’s fractures. Three Caucasian recreational male athletes in their mid-20s presented with thrower’s fractures. None had prodromal symptoms. All were neurovasculally intact upon presentation and underwent open reduction internal fixation within 2 weeks of the injury. Follow-up time for each patient was variable but occurred as early as 3 weeks and as late as 3 months.

Humeral shaft fractures from atraumatic overhead throwing can be considered rare stress fractures often preceded by prodromal pain. Radial nerve palsy is a potential complication of humeral shaft fractures. While the traditional treatment for humeral shaft fractures has been functional bracing, over the last decade surgical management has increased. Young, active patients with humeral fractures due to throwing related activities respond positively to early surgical intervention with plate fixation. Because the demographic of those with thrower’s fractures tends to be young, active males, we advocate for surgical fixation unless underlying medical conditions preclude the patient from surgery. This investigation supports recent literature promoting the operative fixation of not just humeral shaft fractures, but also thrower’s fractures. It is one of the largest examinations of thrower’s fractures to date.

Keywords: Humeral shaft fractures, phenomenon, injury occurs

Introduction

Humeral shaft fractures occurring in athletes exposed to repetitive overhead throwing motions is a rare but recognized phenomenon. The incidence of humerus fractures in the general population is approximately 13 per 100,00 people per year with most being secondary to trauma in young men (<17) [18, 24]. The incidence of humerus fractures from atraumatic throwing is much lower and most of the literature is in the form of case reports. Not surprisingly, Ogawa and Yoshida showed that the most common demographic for thrower’s fractures were also younger males [29]. Thrower’s fractures are frequently seen in the sport of baseball but are also documented in other sports and activities such as javelin and grenade throwing [29]. The goal of this case series is to review the biomechanics leading to fracture, discuss current management principles, address common complications, and examine the author’s treatment of these rare cases.

There are several theories as to why this injury occurs in this demographic. The first theory attributes this type of fracture to the violent biomechanics that come with forcefully throwing an object. The throwing cycle is broken down into 6 phases: wind-up, stride, arm-cocking, arm acceleration and follow-through (Fig 1). During late-cocking and early acceleration, the humerus is subjected to a significant amount of torsional stress due to internal rotation pull of the subscapularis, latissimus dorsi, and pectoralis major. This force starts proximally and is transmitted down an already externally rotated arm which creates a transition point of opposing forces leading to fracture [18, 24, 33]. This theory, however, fails to explain certain fracture patterns and instances where fractures occur with minimal effort. An alternative explanation, which accounts for this limitation, faults deconditioning of the humerus as the main cause for fracture.
This explanation is compelling as it has been shown that thrower’s fractures are more likely to occur in amateur athletes with improper conditioning and a lesser degree of cortical adaptation, compared to those with an increase in bone mass when throwing is performed regularly [37, 39]. In these cases, the torsional force needed to produce a fracture is much less. Patients may present with disuse muscular atrophy or prodromal arm pain in these instances.

The primary complication associated with humeral shaft fractures is neurovascular injury. There is a predisposition for injury to the radial nerve with a ball thrower’s fracture because of its anatomical location in the spiral groove. Perturbations in the winding course of the radial nerve as it wraps around the cylindrical shaped humerus makes the nerve susceptible to traction or laceration injuries when the humerus fractures. The prevalence of radial nerve palsy increases as the fracture site moves distally in the humerus, with a prevalence rate of 2% in the proximal third, 15% in the middle third and 24% in the distal third. Though radial nerve injury is a serious sequelae of humerus fractures, it is not a contraindication to functional bracing. Surgical exploration is indicated in open fractures and palsies that do not resolve in 3-6 months.

Humeral shaft fractures can be managed both surgically and nonsurgically. The traditional treatment for humeral shaft fracture is functional bracing [5, 21, 38]. Sarmiento et al demonstrated good functional outcomes with union rates approaching 96% with functional bracing alone. They also proved that there was no statistically significant difference in functional outcomes when compared with surgical treatment groups [10, 15]. Recent nonsurgical nonunion rates challenge this, ranging from 23%-33% as compared to 4%-10% for surgical intervention [43]. Nonsurgical treatment is also associated with a high conversion rate to surgery [38]. Surgical management with open reduction internal fixation has increased 13.1% over the last decade, especially in younger patients [26, 34]. Surgical management is preferred if important contraindications to functional bracing exist, including open fractures, vascular injury, unacceptable angulation, or more recently, thrower’s fractures. Operative treatment of thrower’s fracture has been shown to reduce time to return to sport, at 13.5 in the operative group versus 22.6 weeks in the non-operative group [1].

![Fig 1: The throwing cycle](image)

Materials and Methods
We performed a multicenter retrospective review to investigate three consecutive patients presenting with thrower’s fractures. Study inclusion criteria included the presence of a thrower’s fracture in an otherwise healthy patient stable for surgery. Definitive management of all fractures was obtained with open reduction internal fixation. All surgeries were performed by the senior author (H.A.). Three patients were treated, all male, with open reduction and internal fixation of the fragments using a posterior approach. All patients were treated within 2 weeks of injury. Postoperatively, each patient was evaluated clinically by their treating surgeon. All procedures were performed in compliance with institutional guidelines and all appropriate institutional committees approved them. Informed consent was obtained for all procedures.

Results
Case 1: 27 year-old right hand dominant male graphic designer presents with right arm pain after he felt a pop while throwing a baseball. He denied any prodromal pain. Post injury radiographs revealed distal third spiral humeral shaft fracture (Fig 2). He was neurovascularly intact on exam with no evidence of radial nerve palsy. Both nonoperative and operative management was discussed with the patient. The patient ultimately underwent open reduction and internal fixation using plate and screws through a posterior triceps sparing approach 8 days after injury. Postoperative course was uneventful at 6 weeks and he was not seen again until 18 months after surgery for medial arm pain after working out. He was thought to have triceps tendonitis which was treated with anti-inflammatory medication and activity modification.
Case 2: 26 year-old right hand dominant male who presented to clinic with right arm pain after throwing a baseball and hearing a loud pop. He denied any prodromal arm pain but did start playing baseball a couple of months ago after a long hiatus. Radiographs demonstrated a spiral humeral shaft fracture (Fig 3). Patient was neurovascularly intact on exam. Patient underwent open reduction and internal fixation 3 days after injury. He did well post operatively and had follow up of 3 months. At that time, the fracture was completely healed with no hardware complication on radiographs. The patient developed shoulder soreness with overhead activities which was treated with steroid injection into proximal biceps tendon.

Case 3: 26 year-old right hand dominant male barber presents to the emergency department with acute right arm pain after throwing a softball. He was found to have a right humeral shaft fracture with a butterfly fragment (Fig 4). He had no neurological deficits and was placed in a coaptation splint. Patient then underwent open reduction and internal fixation of humeral shaft fracture with plate and screws through a triceps split approach 10 days after injury. The patient was observed overnight in the hospital and was discharged postoperative day one in stable condition. He was seen in clinic 3 weeks postoperatively and was subsequently lost to follow up. At that visit, the incision was well approximated and he was neurovascularly intact.
Discussion
Overhead throwing is an uncommon mechanism for humerus fractures. In the cases presented above, all were recreational male athletes in their mid 20s who presented with thrower’s fractures. None of the patients had prodromal symptoms. All were neurovasculary intact upon presentation and underwent open reduction and internal fixation within 2 weeks of injury.

As stated previously, a concerning complication associated with humeral shaft fractures is neurovascular injury. Though rare, there are case reports of radial nerve palsies secondary to humerus fractures caused by playing tennis, grenade throwing, javelin throwing, and dodgeball. The radial nerve has a propensity to be injured after a thrower’s fracture because it wraps around the humerus in the spiral groove directly adjacent to the cortex, making it susceptible to traction, laceration, compression, or contusion by fracture fragments. The prevalence of radial nerve palsy increases as the fracture site moves distally in the humerus, with a prevalence rate of 2% in the proximal third, 15% in the middle third, and 24% in the distal third. Typically, treatment of the fracture itself is generally all that is necessary for proper healing of the nerve. However, in cases of open fracture or where the nerve does not show recovery in 3-6 months, surgical exploration is indicated. In the previously presented cases, no radial nerve palsies were observed before or after surgery.

The traditional treatment option for humeral shaft fracture is functional bracing. Sarmiento et al demonstrated that bracing achieve good functional outcomes, similar to those treated surgically, with union rates approaching 96%. Recent data has questioned this claim, and over the last decade surgical management with open reduction and internal fixation has increased 13.1%. Surgical management is indicated in open fractures, vascular injury, or unacceptable alignment. The presence of radial nerve palsy is not an indication for open reduction and internal fixation. Many radial nerve injuries recover with time; however, several current studies have shown that surgical exploration has a higher likelihood of regaining radial nerve function as compared to nonsurgical treatment. Definitive fracture fixation can be accomplished using external fixation, plates and screws, or intramedullary implants. Utilization of direct compression plates for absolute stability is ideal especially if minimal cosmetic deformity is desired. Other methods such as intramedullary nail fixation have been studied but results have shown suboptimal outcomes when compared to plating techniques. Importantly, shoulder pain is often reported following intramedullary fracture fixation due to rotator cuff violation during the procedure. This sequela is less than ideal in patients who participate in activities requiring overhead motion.

Despite recent trends towards surgical fixation for humerus fracture in young and active males, operative intervention does not come without risks like secondary radial nerve palsy. The incidence of iatrogenic nerve palsy has been reported between 6% and 32%. Higher rates are seen during the use of external fixators and the lateral approach during fracture fixation. All of the cases presented underwent open reduction and internal fixation with no apparent complications. We advocate for surgical fixation of thrower’s fractures unless there are underlying medical conditions precluding the patient from surgery.

Conclusion
In summary, humeral shaft fractures from atraumatic overhead throwing can be considered rare stress fractures often preceded by prodromal pain. Radial nerve palsy is a potential complication of humeral shaft fractures, although it is not an indication for surgical fixation in the general population. Because the demographic of those with thrower’s fractures tends to be young, active males, we advocate for exploration and fracture fixation in the setting of radial nerve injury. In the absence of radial nerve palsy, conservative treatment with functional bracing can be considered, however, we prefer open reduction and internal fixation in these cases as well.

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References


