Elbow Injuries in the Youth Athlete

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Elbow injuries are common in sports that involve throwing, overhead activity, and upper extremity weight-bearing, including baseball, volleyball, football, javelin throwing, and gymnastics. Although acute injuries of the elbow are somewhat common in pediatric patients, overuse injuries in youth athletes are very prevalent. Elbow pain in baseball players aged 9 to 12 years has been found to range from 20% to 40% of baseball injuries. Increases in overuse elbow injuries are related to single sport concentration, longer competitive seasons and year-round sports participation, inadequate rest, and poor biomechanics. This article will focus on common overuse injuries in young athletes.

ELBOW ANATOMY

Understanding the anatomy and skeletal development of the elbow is helpful in evaluation, diagnosis, and management of elbow pain in young athletes. There are six different ossification centers or apophyses in developing elbows that appear in a systematic fashion. Ossification begins at the capitellum at about 1 to 2 years of age. From there, each ossification center appears at about 2-year intervals in the following order: radius, medial (internal) epicondyle, trochlea, olecranon, and lateral (external) epicondyle. The mnemonic of CRITOE (Capitellum - Radius - Internal or medial epicondyle - Trochlea - Olecranon - External or lateral epicondyle) is a common way to remember the order of

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the appearance of these ossification centers. Fusion of ossification centers occurs in the mid-teens, with the medial epicondyle as the last to fuse around the age of 15 to 16 years (see Table 1).

The elbow joint has three articulations, including the ulnohumeral, radiocapitellar and proximal radioulnar. Soft tissue stabilizers include the medial (ulnar) and lateral (radial) collateral ligamentous complexes, the musculature of the flexors, extensors, pronators and supinators. Motion at the joint includes flexion and extension through the ulnohumeral articulation and pronation and supination from rotation of the radius over the ulna. The medial or ulnar collateral ligament (UCL) is composed of three separate bundles and is an important medial stabilizer of the joint. The UCL is subject to injury from medial stressors; however, it is not included within the scope of this article.

**BIOMECHANICS OF THROWING**

Familiarity with throwing biomechanics, in particular the phases of pitching, is helpful when evaluating patients with throwing-related elbow pain. The six phases of pitching include: windup; early cocking; late cocking; acceleration; deceleration; and follow-through. Early and late cocking phases result in significant valgus overload and distraction forces at the medial elbow, including medial epicondyle apophysitis and medial epicondyle avulsion. Valgus overload from late cocking and early acceleration phases of throwing result in compressive forces at the lateral elbow radiocapitellar joint and include injuries such as Panner’s and osteochondritis dissecans.

A 2002 study demonstrated that there was a significant relationship between the number of pitches thrown in a game and during the season to the rate of elbow and shoulder pain. Youth baseball pitchers that threw sliders and curveballs were also at increased risk for elbow and shoulder pain. In 2006, the USA Baseball Medical and Safety Advisory Committee made pitching recommendations to reduce risk for injury and maximize the athlete’s ability to perform and advance to a higher level (see Table 2). Pitch count recommendations pertain to pitches thrown in games only and do not include instructional pitching during practice sessions and throwing drills that are important for development of technique and strength; however, after games, pitching practice should be discouraged. Baseball pitchers should not compete in baseball more than 9 months of any given year and for at least 3 months of the year, not play any baseball, participate in throwing drills, or other stressful overhead activities such as javelin throwing, throwing the football, softball, competitive swimming, etc. In addition, proper mechanics should be developed as early as possible and emphasis placed on year-round conditioning programs with a focus on endurance, core strengthening, and neuromuscular control.

**LITTLE LEAGUE ELBOW**

The term “Little League elbow” has been used to encompass several valgus overload injuries to the elbow from repetitive and recurrent microtrauma. It most commonly refers to apophysitis of the medial epicondyle occurring in young athletes aged 9 to 12 years. Although most often described in baseball pitchers, Little League elbow can also occur in activities that do not utilize overhead-throwing such as when passing the football, throwing a javelin, and serving in tennis. The medial epicondyle apophysis is the weakest medial structure and most vulnerable to tensile forces from valgus overload activity, resulting in apophysitis in young athletes.
Diagnostic Imaging

Little League elbow is primarily a clinical diagnosis, with radiographs that are normal in up to 85% of patients. Radiographs should include anterior-posterior lateral, and oblique views. Comparison views are helpful in skeletally immature athletes to clarify normal developmental progression and variability vs. true pathology. Radiographs may reveal bony fragmentation of the medial epicondyle ossification and/or slight widening of the apophysis. Avulsion fractures of the medial epicondyle should be ruled out in patients who present with an acute onset of pain during their sport activity. Concomitant injuries should be evaluated for, as well, including osteochondritis dissecans (OCD) lesions (see Figure), most commonly at the lateral elbow, and loose bodies. Further imaging, including an MRI, is not typically indicated unless an OCD lesion is present or there is concern for an ulnar collateral ligamentous injury, at which point a referral to a sports medicine specialist or an orthopedic surgeon would be most appropriate.

PANNER’S DISEASE

Panner’s disease is a developmental osteochondrosis of the capitellum typically occurring in those aged 6 to 12 years. It is the most common cause of chronic elbow pain in young athletes aged younger than 10 years; it should be distinguished from OCD of the capitellum. Compressive forces to the lateral elbow occur during late cocking and acceleration during throwing. This exact pathophysiology is unknown; however, it is thought to be a result of repetitive radiocapitellar compression during a vulnerable period of growth, causing damage to the end-artery blood supply to the capitellum compromising endochondral ossification.

Presentation

Patients present with complaints of dull activity-related, lateral elbow pain. They may complain of stiffness and loss of motion. On physical examination, diffuse swelling predominately on the lateral side, as well as a mild effusion, may be present. Patients may have tenderness to palpation over the lateral elbow, and in particular, over the radial-capitellar region. A flexion contracture with extension limited to 15 to 20 degrees may be present when symptoms have been prolonged.

Treatment

Treatment of Little League elbow includes complete rest from throwing or pitching activities for about 4 to 6 weeks. Supportive care of ice and non-steroidal anti-inflammatories may be helpful to manage pain. During the time of more restrictive rest, athletes may continue to participate in conditioning programs that focus on stretching, core strengthening, and cardiovascular activity. After the initial 4 to 6 weeks of rest, athletes may then begin a gradual progressive throwing program during the next 6 to 8 weeks. Ideally, this is done in conjunction with a physical therapist knowledgeable in proper throwing biomechanics. Return to competitive throwing typically occurs at about 12 weeks.

Figure. Osteochondritis dissecans (OCD) lesion of the capitellum.

As athletes move toward skeletal maturity, similar forces may result in avulsion fractures, flexor muscle origin injuries, and ulnar collateral ligamentous sprains or tears.

Presentation

Athletes with Little League elbow typically present with a gradual onset of pain at the medial elbow. An acute onset of medial sided pain should raise concern for a possible avulsion injury. Throwers may complain of decreased throwing velocity and/or loss of control while throwing. History should include a discussion about how much throwing the athlete does, number of teams they play on, positions they play, and how much they play throughout the year.

On physical examination, patients have point tenderness over the medial epicondyle apophysis and localized swelling may be present. A flexion contracture of up to 15 degrees may be demonstrated as well. Instability and catching or locking are not typically present.
or orthopedic surgeon at this point is appropriate for monitoring of serial radiographs until radiographic resolution has been achieved. Once symptoms have resolved and radiographic appearance has normalized, a progressive return to throwing or other repetitive stress activities may be initiated. Less often, arthroscopy is indicated for cases that do not recover.

**OSTEOCHONDRITIS DISSECANS OF THE CAPITELLUM**

OCD of the elbow is an idiopathic disorder of subchondral bone degeneration resulting in separation and fragmentation of the articular cartilage.\(^9\) OCD at the elbow most commonly occurs at the capitellum, but may also occur in the trochlea, radial head, and olecranon. OCD of the capitellum is speculated to be similar to Panner’s; however, it occurs in young adolescent athletes aged 11 to 15 years and at a different time of endochondral ossification in presentation.\(^8\,9\) In addition, OCD lesions of the capitellum can result in destruction of the capitellum and is the leading cause of permanent elbow disability in adolescent athletes.\(^2\)

OCD of the capitellum is thought to occur as a result of overuse from compressive forces at the radiocapitellar joint in athletes involved in high-demand, repetitive overhead, or upper extremity weight-bearing sports activities, including throwing in baseball and football, racquet swinging, axial compression gymnastics, and weight-lifting.

**Presentation**

Patients with OCD of the capitellum present with an insidious onset of pain associated with activity. Pain may be at the lateral elbow or diffuse in nature. Stiffness and decreased motion may also be present. Mechanical symptoms of catching, locking, and grinding create concern for an unstable lesion and intra-articular loose bodies.

On physical examination, patients typically have pain at the radiocapitellar joint and an effusion is often present. With the presence of a flexion contracture to 15 to 20 degrees, extension may be limited. The active radiocapitellar compression test can be performed by having the patient fully extend their elbow, then actively pronate and supinate their forearm. This causes the radiocapitellar joint to compress and may reproduce symptoms.

**Diagnostic Imaging**

Radiographs of the elbow should be performed when an OCD lesion is suspected, including an anterior-posterior view with the elbow in full extension and lateral view. It is appropriate to refer the patient to a sports medicine specialist or orthopedic surgeon when an OCD lesion is suspected and/or visualized on radiograph. Initial radiographs may be normal in appearance if taken early in progression of the OCD; however, as it progresses, the subchondral bone injury may appear as rarefaction, radiolucency, or flattening of the articular surface. MRI is indicated when OCD is visualized or suspected to further assess the injury. Early injury will be detectable by MRI, and helpful in determining size, extent and stability of the lesion. An MR arthrogram is helpful to assess unstable lesions.

**Treatment**

Given the controversial and potentially complex nature of managing OCD of the capitellum lesions, patients should be referred to a sports medicine specialist or an orthopedic surgeon for management. In general, staging of the lesion will help guide management for OCD lesions. Stage I lesions are intact, focal subchondral lesions without articular cartilage involvement. Stage II lesions involve the articular cartilage with presence of fracturing or fissuring with or without partial detachment of the lesion. Stage III lesions are completely detached with loose body formation. Stable lesions are managed conservatively with rest from exacerbating activities until symptoms and radiographs have returned to normal. Unstable lesions and/or presence of loose fragments may require surgical intervention.

**CONCLUSION**

Overuse injuries of the elbow are common. Early recognition and intervention can decrease a youth athlete’s chances of more significant injury. Injury prevention measures, including proper mechanics, gradual progression into their sport, and appropriate rest, may help prevent athletes from experiencing these injuries that may have a significant impact on their season. Appropriate treatment measures that focus on progressive return to play under the guidance of a physical therapist knowledgeable in sports will help young athletes return to their sports successfully and in a healthy manner.

**REFERENCES**