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Special Issue

Common medial elbow injuries in the adolescent athlete

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ABSTRACT

Recently there has been increased year-round sports participation among children and adolescents with limited to no rest periods. This has led to increases in pediatric repetitive stress injuries, once considered a rarity. Whether in the throwing athlete or in the athlete that experiences repetitive axial loading; increased medial tension and overload syndromes can lead to stress reactions and fractures. This occurs in the developing athlete due to the bone being weaker than the surrounding tendons and ligaments. The medial elbow is a high stress area and is susceptible to many conditions including apophysitis , avulsion fractures and ulnar collateral ligament disruption. Valgus stress can cause injury to the medial elbow which can lead to increased lateral compression, Panner's disease and osteochondral lesions of the capitellum and olecranon. The purpose of this manuscript is to review common elbow disorders in the adolescent population, outline management and highlight important features of rehabilitation.

Introduction

Elbow injuries are becoming more frequent in the pediatric athlete. Not only are sports program run year round but they are frequently unidimensional. Children often begin to focus on one type of sports program at a young age in an effort to become proficient which can contribute to repetitive strain injury and subsequent tissue failure. To fully understand the mechanisms and rehabilitation strategies associated with pediatric elbow injuries clinicians must be familiar with the anatomy and key components of elbow motion. Treatment of overuse injuries in the pediatric population involves assessment beyond local structures to determine the cause of failing tissue. Thus, it is vital to perform a thorough evaluation of neuromuscular control of the core while performing upper extremity movements; since poor control could compromise stability through the stabilizing structures of the upper extremity.

Anatomy

The elbow is considered to be a gingliotrochlear joint due to its two axes of freedom in the sagittal plane and one in uniaxial rotation.[1] It is comprised of the ulnohumeral, radioulnar and radiohumeral joints and is viewed as one of the most congruent joints in the body.[2] Elbow flexion and extension are not pure hinge joint motions due to the slight deviation into varus angulation with movement. With the initiation of elbow motion there are concomitant rotational motions as well, with pronation (IR) occurring at the initiation of flexion and supination (ER) at the initiation of extension. These deviations take place at the extremes of flexion and extension.[3]

The rotational component of pronation and supination occur with movement of the radius over the ulna.[1] Zimmerman suggests that there is a degree of proximal movement of the radius and counterrotation of the ulna during pronation and supination. Rotational movement is considered independent from ulnohumeral motion. Thus, the degree of elbow flexion has no effect on rotation.[4]

The capsule surrounds all joints of the elbow. The anterior capsule is taut in extension and the posterior portion is taut in flexion with maximum extensibility at 70–80°. The medial elbow is stabilized by both muscular and ligamentous attachments. The medial elbow is comprised of 3 ligaments collectively referred to as the ulnar collateral ligament (UCL). Separately, these ligaments are named the anterior oblique, posterior oblique and transverse ligaments. Due to the position of the UCL posterior to the joint, it becomes taut with increasing flexion.[5] The anterior bundle is considered the strongest portion of the UCL and travels from the medial epicondyle to the medial coronoid process. These features of the UCL allow it to act as a valgus stabilizer at varying degrees of

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Table 1
Valgus stress resistance (Sebelski, 2006)[40]

Structure	0° of elbow extension (%)	90° of elbow extension (%)
MCL	31	54
Anterior capsule	38	10
Bony articulation	31	36

motion. The anterior portion is taut from full extension to 60° of flexion, the posterior portion of the anterior bundle is taut from 60 to 120°[6] and the posterior oblique provides the greatest restraint at 90°. The transverse ligament offers very little in terms of medial elbow stability.[5]

Additional medial elbow stabilization occurs through muscular attachment of the flexor pronator muscle group. The flexor carpi ulnaris is the primary dynamic stabilizer against valgus torque. The flexor digitorum superficialis is a secondary stabilizer, while the pronator teres provides the least dynamic stability.[7] See Table 1 for a summary of the resistors to valgus stress.

Epidemiology

The highest rates of adolescent elbow injuries occur in baseball, tennis and gymnastics with the medial elbow as the most common site of injury.[8] In the young child fractures occur more frequently. As the skeleton and child mature, sports-related overuse injuries are more prevalent.[9] Laterally, compressive injuries in younger adolescents and pre-adolescents manifest as Panner's disease while in the older adolescent, osteochondral lesion (OCD) are reported.[10] Injury to the medial elbow due to repetitive stress in the skeletally immature athlete often lead to physeal avulsion injury, while in the skeletally mature or adult athlete the same mechanism of injury contributes to injury of the UCL and common flexor tendon.[11] Posteriorly, a persistent olecranon physeal injury is the adolescent equivalent of an avulsion to the triceps.[12]

Medial epicondyle fracture/avulsion

The medial epicondyle is the elbow region most likely to sustain injury to apophyseal elbow structures. Approximately 50% of medial epicondyle injuries are associated with pediatric elbow dislocation. Medial epicondyle avulsion injuries are also seen with a fall on an outstretched arm (FOOSH), resulting in sudden traction on the flexor pronator mass. Medial epicondyle avulsion fractures also may occur due to repetitive valgus stress or overuse, as is the case of Little Leaguer's elbow.[13]

The most common presenting symptom with this type of injury is swelling or ecchymosis at the medial elbow.[13] Differential diagnosis should be made to rule out UCL sprain, and ulnar neuritis.[14] Radiographs taken in the oblique view may better approximate the amount of true displacement than standard AP and lateral views.[15] A three dimensional computed tomography (3D CT) scan has been reported as the most precise measurement of true displacement.[16]

Non-operative management of pediatric medial epicondyle fractures may be appropriate in young athletes with a stable elbow, a low-energy or isolated avulsion injury, or an injury with minimal fracture displacement (Fig. 1).[17]

In general, internal fixation is recommended when displacement is greater than 5 mm.[12] Open reduction, internal fixation (ORIF) is preferred in individuals who suffer traumatic or high-energy injuries, or those who present with elbow instability.[17] Open reduchildren with wide open growth plates, Kirschner wires are preferred over compression screw fixation. Wires need to be removed typically 4–6 weeks after fixation. The post-operative course of care may consist of several weeks of casting at 90°, followed by active and passive range of motion (ROM).

Ulnar collateral ligament injury

Injuries to the Ulnar Collateral Ligament (UCL) often occur due to repetitive valgus stress during throwing or other overhead sports. Overuse or poor mechanics may increase the risk of UCL injury. Less commonly, UCL injury may occur due to direct valgus force at the elbow.[14]

Palpatory tenderness 2 cm distal from the medial epicondyle has been shown to have good reliability in the diagnosis of UCL injuries.[18] Special tests to assess the integrity of the UCL include the *modified milking maneuver* and the *moving valgus stress test*.[19] Both of these tests place a valgus stress through the UCL simulating the force experienced when in the acceleration phase of throwing. Among individuals with an UCL deficiency, 26–53% experienced pain with assessment of valgus stability.[20] When performing special tests for the integrity of the UCL it is best to pronate the forearm, as

Fig. 1. Radiographs of a 10-year old pitcher with Little League elbow. a) Fragmentation of the elbow seen on initial exam. b) Progression of healing after 6 weeks of rest.[43]