The elbow and forearm create a fascinating joint complex. It is a highly congruous joint that provides a wide range of motion required for functions such as sports. The adolescent athlete has the added dimensions of growth and development, which can affect forces around the joint, as well as motor function, and can be the source of multiple potential problems (1). The elbow has a complex maturation process, developing from multiple ossification centers, which can complicate the diagnosis and treatment of injuries. As a growing individual is able to perform with greater speed, strength, and endurance, the loading forces, torques, and risk of injury increase (2,3).

Injuries to the elbow and forearm can result from overuse or acute trauma. Throwing sports, such as baseball (4), lead to frequent elbow problems. Overuse elbow injuries are also commonly seen in athletes who use the upper extremities and are involved in repetitive training, such as gymnastics (5,6) weight lifting, tennis (1,7), and golf (8). Trauma, typically a fall on the outstretched arm, can result in fractures and dislocation. Fractures in the upper extremity in children most frequently involve the radius and ulna, followed by hand and carpal bones, and then the distal humerus (9).

The literature on management of elbow problems is extremely limited in clinical studies, especially for the adolescent athlete. The majority of elbow research includes cadaveric studies, case reports and series in adults, or kinematic and epidemiologic studies in youth pitchers, who are often preadolescent. Treatment of most sport-related elbow injuries for the adolescent athlete is based on expert experience and opinion often expressed in review papers and textbooks.

Anatomy

Bony Anatomy

The elbow joint is made up of the articulations between the humerus, ulna, and radius. The forearm is composed of the radius and ulna with its proximal and distal articulations, as well as its overlying muscles and soft tissue
structures. The distal humerus has two major articulating surfaces: the trochlea, which articulates with the coronoid and olecranon of the ulna, and the capitellum, which opposes the radial head. The elbow joint can be divided into the following three articulations:  
b) the radiocapitellar joint,  
c) the proximal radioulnar joint. The ulnohumeral joint allows flexion and extension, whereas the radiocapitellar and radioulnar joints allow supination and pronation of the forearm, with the radius pivoting around the ulna. The bony hinge of the elbow provides osseous stability with its greatest contribution below 20 degrees and greater than 120 degrees of flexion; between these ranges, the ligaments and capsule are the primary motion restraints (10). Children often demonstrate hyperextensibility of the elbow associated with capsular and ligamentous laxity (11,12).

Ossification Centers

The development of the elbow from multiple ossification centers makes the elbow vulnerable to fracture and apophyseal injuries. The growth plates are areas of vulnerability from traction or shearing forces. The ossification centers follow a predictable order of formation, which can help assess bony maturity, based on their appearances on x-ray. They appear in the following order: the capitellum (age 1–2), the radial head (age 3), the internal (medial) epicondyle (age 5), the trochlea (age 7), the olecranon (age 9), and the external (lateral) epicondyle (age 10 in girls and 11 in boys) (mnemonic “CRITOE”) (Figure 8.1) (13). Eighty percent of the growth of the humerus occurs at the proximal end. Therefore, there is less potential for remodeling at the elbow if fractures should occur there. (12)

Ligament Complexes

On the medial aspect of the elbow, the ulnar collateral ligament (UCL) complex is composed of three ligaments: anterior oblique, posterior oblique, and transverse (Figure 8.2). The anterior oblique ligament is functionally divided into anterior and posterior bands. The anterior band is responsible for most of the stability of the elbow and is most prone to injury with acute or repetitive valgus strain.

On the radial side of the elbow, the lateral collateral ligament (LCL) complex is composed of the radial collateral ligament (RCL), the lateral ulnar collateral ligament (LUCL), the accessory lateral collateral ligament (ALCL), and the annular ligament (AL), which wraps around the radial head (14). The LCL complex is the main ligament responsible for withstanding varus and external rotatory stress in the elbow. The LUCL has been shown to help control posterolateral rotatory motion around the elbow (15). Injuries involving the LCL at the humeral insertion, primarily involving the LUCL and the RCL, produce maximal rotatory instability (16,17).