

Shoulder and Elbow Injuries in the Young Athlete

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The skeletally immature athlete sustains upper extremity injuries unique to the epiphyseal plate, articular cartilage, musculotendinous units, and specific to the sport itself. In the young athlete involved in throwing or other repetitive overhead activities, shoulder and elbow injuries are frequent and unique. Specific shoulder and elbow conditions can be predicted based on the biomechanics of the sport and age of the patient. In the young athlete, recognition of these unique injury patterns with early activity modification and treatment can prevent permanent deformity and functional disability.

Many of these injuries are definitely age specific. Fractures from forces associated with macrotrauma involving the epiphyseal plate and joint require accurate reduction and stabilization.^{32, 47} Diaphyseal fractures that are closer to the epiphyseal plate and that angulate in the axis of motion have a better prognosis for complete remodeling in this young age group. Repeated microtrauma distraction or compression force can cause epiphyseal plate damage. In the elbow, the repetitive forces of throwing can cause articular surface injury and growth disturbance.

Predictable sport-specific injuries also occur. Upper extremity fractures and dislocations from macrotrauma occur commonly in football, wrestling, and ice hockey. Unique overuse injuries occur in sports requiring repeated overhead activities. The vector velocity forces generated in each sport result in specific injury patterns. The relationship of the forces of repetitive microtrauma and the inflammatory response contribute to well-described injuries. This cause-effect relationship of sport biomechanics to injury pattern has been described in overhead throwing sports by Atwater⁶ and Perry,⁵⁶ in swimming by Kennedy³⁰ and Richardson,⁵⁹ in gymnastics by Aronen,⁵ Goldberg,²¹ and Snook,⁶⁴ and in baseball by Pappas.⁵³ Barnes,⁷ Gugenheim,²³ Larson,³³ Lipscomb,³⁶ and Torg⁶⁸ reported on the incidence

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of injuries in young baseball throwers. Correlation of biomechanics to incidence of injury in each sport enables the practitioner to make the diagnosis more efficiently and institute earlier treatment.

The injuries seen in the young athlete can also be described as being joint specific. For example, shoulder injuries occur when the forces involved in the throwing act exceed the passive mobility, stability, and dynamic control of the glenohumeral joint.⁵⁶ Subluxation in an anterior direction is most common, but posterior and multidirectional subluxations are also seen. The normal hyperelasticity in juvenile joints, particularly the shoulder, predisposes this joint to asymptomatic passive and dynamic instability patterns.

The elbow has its own specificity to injury also. Repetitive injuries to the articular surface with subsequent damage to the cartilage cells are very common in the juvenile elbow. "Little Leaguer's elbow" was appreciated by Adams² and Bennett.⁹ The biomechanical forces of the elbow during pitching have been well analyzed by Hang,²⁴ Jobe,²⁹ Pappas,⁵⁰ and Wilson.⁷¹ The extreme compressive forces on the radiocapitellar compartment result in vascular insult to the capitellum and growth disturbance of the proximal radial head. Bright¹⁴ described the epiphyseal cartilage failure during recurrent compression and distraction modes. The occurrence of elbow injury with subsequent problems in the adolescent thrower has been described by Grana,²² Larson,^{32, 33} Lipscomb,³⁶ Micheli,⁴⁰ Pappas,⁵⁰ Slager,⁶³ and Torg.⁶⁸ Prevention of permanent joint deformity and functional disability is crucial. Rule changes limiting the number of innings and amount of pitches by the adolescent have decreased the likelihood of permanent disability. Any surgical treatment of these elbow injuries in the young athlete continues to be palliative. Correcting the biomechanical method of the overhead activity and limiting the exposure to the compressive forces will decrease incidence of injury.

The common injuries of the shoulder and elbow seen in the young athlete will now be discussed.

SHOULDER INJURIES

DIAGNOSIS

The diagnosis of shoulder injuries in the young athlete can be difficult and confusing. As with all athletic injuries, the diagnosis is primarily based on a thorough history and physical examination. The shoulder in the athlete is unique with regard to its physical examination. One finds an increased range of motion that is symmetric and characterized by excessive translation of the glenohumeral joint due to general hyperelasticity. Asymptomatic hypermobility of the acromioclavicular and sternoclavicular joints and increased scapulothoracic motion with winging are frequent findings in the adolescent. A thorough examination of the shoulder girdle specific to muscle strength discrepancies should be performed. Neurologic evaluation for nerve deficits involving both the sensory and motor patterns should be done bilaterally.

Routine radiographs should be taken of the symptomatic glenohumeral or acromioclavicular joint.^{12, 55, 60} Anteroposterior (AP) views with arm in internal and external rotation and axillary lateral views of the glenohumeral joint are routinely obtained. Special glenohumeral radiographs of a West Point view to assess anterior inferior glenoid, and of a Stryker notch view to assess posterior inferior glenoid may be needed. Bilateral AP views with and without weights and Alexander scapular lateral views are routine for acromioclavicular injuries.^{43, 60} Stress radiographs of the shoulder girdle are frequently needed. Special radiographic techniques, arthrograms, arthrotomograms, and arthro-CT can often be helpful in pinpointing the diagnosis.^{19, 59} Bilateral radiographs, particularly in the skeletally immature patient, are extremely important for comparison and documentation.

Acromioclavicular (AC) Joint Injuries

AC joint sprains in the immature athlete do occur with and without fractures of the clavicle. The skeletally immature athletes' grade I and grade II sprains are more common than are complete grade III dislocations. In grade III sprains, the clinical findings are deformity, swelling, instability, and point tenderness at the AC joint as seen in the acute right AC dislocation illustrated in Figure 1A. Bilateral AC AP radiographs with and without 10-pound weights are obtained, as in the right grade III separation and normal left illustrated in Figure 1B. Measurements from coracoid to

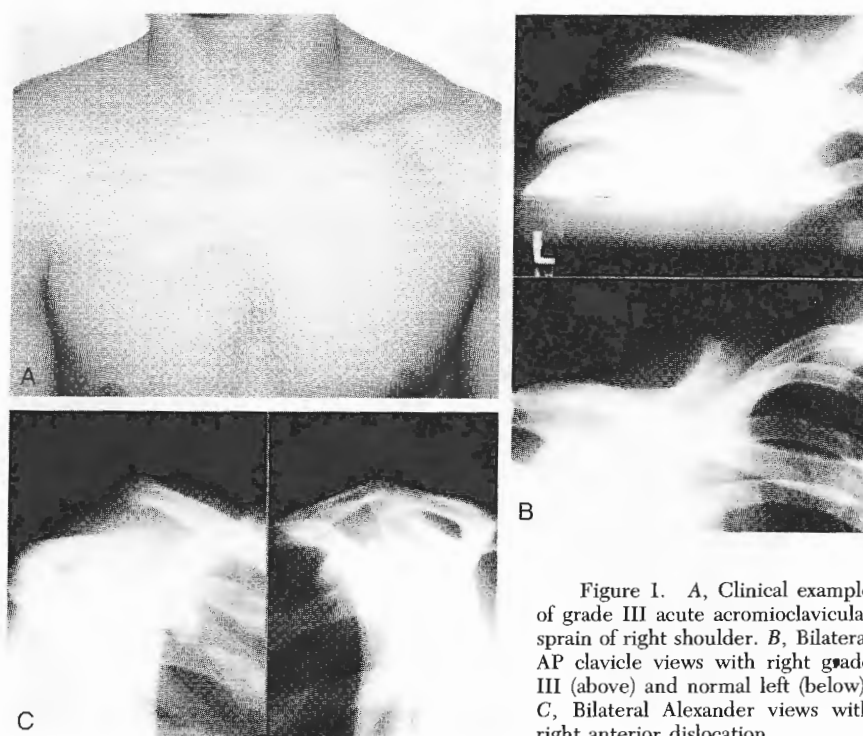


Figure 1. A, Clinical example of grade III acute acromioclavicular sprain of right shoulder. B, Bilateral AP clavicle views with right grade III (above) and normal left (below). C, Bilateral Alexander views with right anterior dislocation.

clavicle and acromion to clavicle are made bilaterally and compared. In Figure 1C, Alexander lateral scapular views in this dislocated right AC joint and normal left demonstrate acromial displacement inferior and anterior under the clavicle of the right shoulder. Radiographic documentation of grade of severity of the AC sprain helps design treatment plans.

Management of AC sprains in the adolescent is really symptomatic with sling for support. Grade I or II AC sprains can be complicated by a disruption of the intra-articular meniscus. When this happens, a persistent click and painful joint prevents overhead athletic activity. This joint can be evaluated and treated arthroscopically with debridement and meniscus removal with favorable results. Treatment of grade III injuries remains controversial.^{43, 60, 65} Taft⁶⁵ has reported on a series of severe grade III sprains with best results from nonoperative treatment.

In the skeletally immature athlete, clinical grade III AC sprains commonly rupture the dorsal clavicle periosteum but the AC and coracoclavicular ligaments remain intact.^{48, 60} Distal clavicle epiphyseal injuries also occur. A fracture of the clavicle can occur in the distal third associated with a complete AC separation. This makes the standard AC separation more complicated to treat.

Osteolysis of Distal Clavicle

Traumatic osteolysis of the distal clavicle has been described^{15, 49, 50, 57} as a late sequela in association with grade I and grade II AC joint sprains. In Figure 2, an AC radiograph demonstrates a typical case of traumatic osteolysis of the distal clavicle in a young skeletally immature athlete. This patient complained of AC joint pain while bench pressing with forces of horizontal adduction of the arm. He had no history of direct trauma and was only an occasional weightlifter. If standard measures of rest, injection, and rehabilitation fail, then surgery may be necessary. Surgical options include arthroscopic debridement of the AC joint or distal clavicular excision.

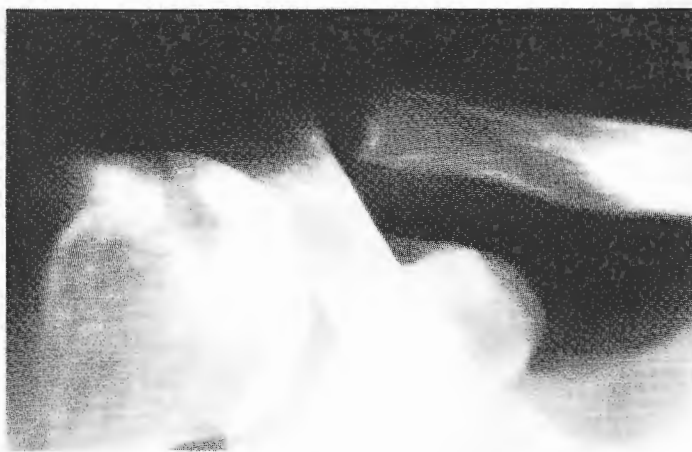


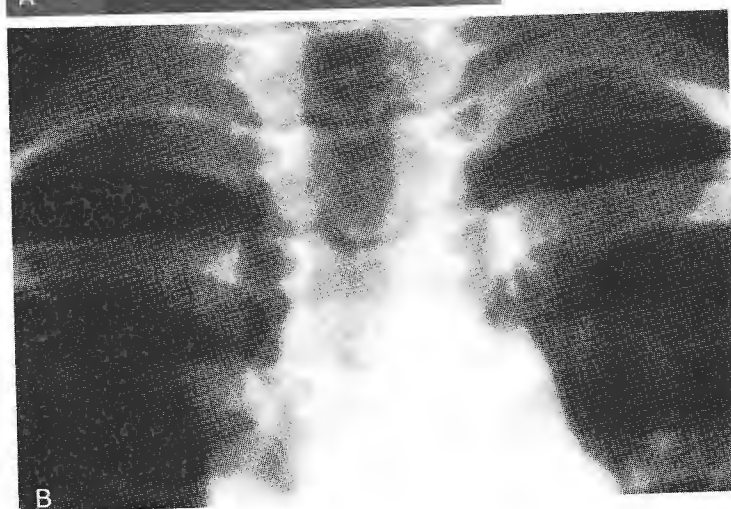
Figure 2. Osteolysis of distal clavicle in weightlifter, asymptomatic until throwing sports were begun.

Sternoclavicular (SC) Joint Injuries

SC joint injuries also occur and this joint should not be overlooked. Anterior subluxation of the SC joint can occur spontaneously and be asymptomatic. A young thrower was noted to have a painless anteriorly subluxable right SC joint (Fig. 3A) and normal radiographs (Fig. 3B). Posterior SC dislocations are rarer and occur as a result of significant force.³⁵



Figure 3. A, Clinical view of right anterior proximal clavicle subluxation. B, AP radiograph of chest is normal.



The treatment of these spontaneous subluxations of the SC joint is conservative. It is recommended, in such cases, that patients decrease their activities and protect their SC joint for a period of 4 to 6 weeks. Even if the subluxation of the SC joint continues, the symptoms will gradually abate so that there is no reason for further treatment.

Fractures About the Shoulder

Clavicle. Certainly, the most common entity is the fractured clavicle. This usually occurs from direct trauma and is most often seen in football. The usual radiographic finding is a mid-third fracture, but there may be comminution as in the acute injury view shown in Figure 4. This football athlete was treated with a figure-of-eight strap, then a sling for comfort. He returned to contact in 8 weeks when clinically healed. Generally, the athlete can return to contact sports in about 8 weeks, depending on healing determined by radiographic and clinical examination. Internal fixation is rarely, if ever, indicated. Delayed union may sometimes occur, but pseudarthrosis is rare in the young individual.

Little League Shoulder. Adams¹ first described Little League shoulder as a proximal humeral fracture. This fracture can occur during one throw,²⁰ but more commonly occurs with repetitive throwing.¹⁶⁻¹⁸ If a Little Leaguer complains of proximal shoulder pain, an epiphyseal fracture should be expected until proven otherwise. The athlete should not throw until pain subsides. If there is any doubt, radiographs should be repeated. Subsequent proximal humeral growth alterations have been reported.^{16, 66}

A more severe and less common variety is a spiral oblique fracture of the proximal humerus in a thrower even with open epiphyseal plates. From one throw, a 10-year-old right-handed pitcher sustained a spiral proximal humeral fracture as shown by radiographs acutely (Fig. 5A) and at 6 weeks after injury (Fig. 5B).

Epiphyseal avulsion fractures certainly can be seen in this age group. A unique example is an avulsion fracture of the coracoid process with con-



Figure 4. Acute comminuted mid-third clavicle fracture. The athlete may return to play at 8 weeks if clinical and radiographic results are good.



Figure 5. A, Acute proximal humeral fracture. B, Six weeks postinjury with good alignment and healing.

comitant AC separation. Other fractures about the shoulder certainly occur as a result of contact in various sports, but the previously mentioned ones are the usual types.

Instability

Frank anterior subluxation and dislocations of the shoulder are commonly seen in adolescent athletes. The radiographic evaluation of these lesions has been well described by Pavlov.⁵⁵ The sequelae^{69, 70} and prognostic factors⁶¹ associated with these conditions have been described. For many years, it was considered that posterior subluxation in the athlete was a very rare entity. With today's skills and radiographic documentation, the diagnosis of posterior subluxation is more commonly made. For example, spontaneous dynamic subluxation of the lead shoulder in a baseball batter swinging and missing is not uncommon. The diagnosis and management of posterior subluxation of the shoulder has been outlined by Hawkins,²⁶ Norwood,⁴⁶ and Somilson.⁶¹ Radiographic abnormalities of abnormal retroversion of the glenoid have been reported.¹³ Patients with posterior glenohumeral instability respond to conservative rehabilitation strengthening of the posterior shoulder musculature with a better prognosis for successful nonoperative treatment than anterior instability.^{27, 61, 62, 70} Occasionally, even in the young athlete, a glenoid osteotomy, posterior capsulorrhaphy, or posterior bone block may be necessary. These bony procedures obvi-

ously are postponed until the normal growth and bony development of the shoulder are complete.

Multidirectional instability is well described by Neer⁴² and can be involuntary. Other diagnostic techniques to help demonstrate direction of shoulder instability have been described by Norris.⁴⁴ Arthroscopic management of instability and rotator cuff problems has developed over the past several years. The association of tears of the glenoid labrum and rotator cuff has been documented by arthroscopy. Arthroscopic treatment of these tears has been successful.^{4, 51}

Clinical Examples. Glenohumeral subluxation prior to puberty can be physiologic and symmetric, with marked anterior and posterior translation of the humeral head in the glenoid joint. Often, clinically young patients are nonchalant and uncaring about their subluxation, as seen in a 13-year-old who habitually anteriorly subluxes his left shoulder (Fig. 6A).

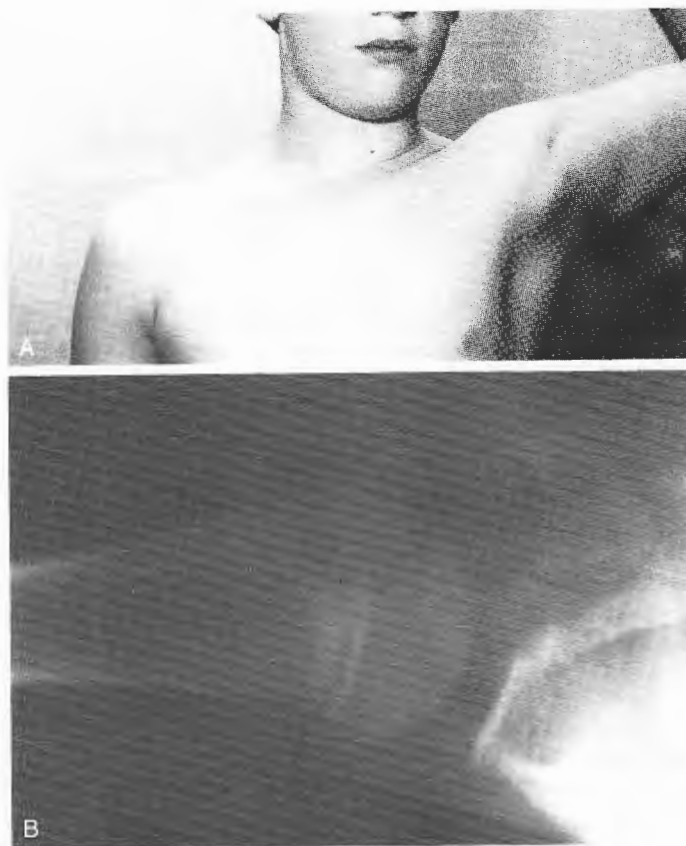


Figure 6. A, Clinical example of habitual anterior subluxation in an adolescent. There is no apprehension on luxation maneuver of the humeral head anteriorly. Prominence of humeral head is noted in axilla. B, Axillary lateral view of this patient, with secondary ossification centers of the coracoid and a prominence of the anterior glenoid lip with secondary ossification center versus avulsion injury of anterior glenoid.

Radiographs should be obtained to rule out any type of glenoid abnormality or fracture about the epiphyseal plates. Usually, the radiographs are normal with open epiphyseal plates, but there can be a chronic, avulsion-type injury of the anterior glenoid articular surface (Fig. 6B).

Usually, the abnormal translation clinically described as subluxation is bilateral and symmetric. Stability improves with conservative treatment based on muscular strengthening exercises and subsequent maturation of the skeleton and growth.

It should be pointed out that posterior subluxation in young athletes, particularly those athletes involved in the sports of swimming, gymnastics, and baseball, is extremely common and occasionally causes symptoms. Patients often can pop their shoulders posteriorly voluntarily by holding the arm in the 90-degree adducted forward-flexed position and then horizontally abducting the humerus to reduce the shoulder from a subluxed position back into a reduced position. These maneuvers can be demonstrated on physical examination by relaxing the patient while sitting, and forward flexing the arm, which will produce a posterior clunk palpable and observable beneath the posterior deltoid, as demonstrated by clinical overhead (Fig. 7A) and side lateral (Fig. 7B) views. Stability can be compared with the opposite side, which can be very helpful in determining whether the findings are physiologic and symmetric or pathologic and painful. Patients frequently have an associated rotator cuff weakness with instability patterns about the shoulder. The rotator cuff weakness is assumed to be a secondary finding occurring as a late sequela to the glenohumeral instability.

Special and stress radiographic views can show the humeral head subluxed posteriorly and assess the posterior glenoid to rule out avulsion fractures or exostoses. The patient can often sublux the shoulder for radiographs. Posterior subluxation is demonstrated by this position (Fig. 8A) and the corresponding lateral radiograph (Fig. 8B). Posterior glenoid osteophytes from forceful repetitive throwing in football and baseball can be seen on special plane radiographs. The Stryker notch view profiles the posterior and inferior glenoid. A right-hand dominant football quarterback had posterior shoulder pain resulting in decreased velocity and loss of accuracy in his throw. A Stryker view preoperatively shows the large posterior inferior osteophyte (Fig. 9A). Postarthroscopic debridement of posterior glenoid shows normal contour (Fig. 9B). The AC joint can also be well seen in this view.

When these instability patterns are confusing and when symptoms warrant, further assessment of the shoulder can be done to delineate specific intra-articular lesions such as labral detachments and substance tears of the labrum by arthrotomography or arthro-CT. The posterior osteophyte (see Fig. 9A) was assessed by arthro-CT (Fig. 9C), showing the prominence of the traction exostosis in the posterior inferior aspect of the glenoid. Deutsch¹⁹ and Rafii⁵⁸ have reported on CT arthrographic findings in correlation with pathologic clinical findings.

Rotator Cuff Injuries

In the throwing athlete, strains of the rotator cuff from the ongoing inflammatory response to microtrauma have been well described.^{17, 25, 66} Certainly, there is a potential for tearing of the rotator cuff even in the skel-

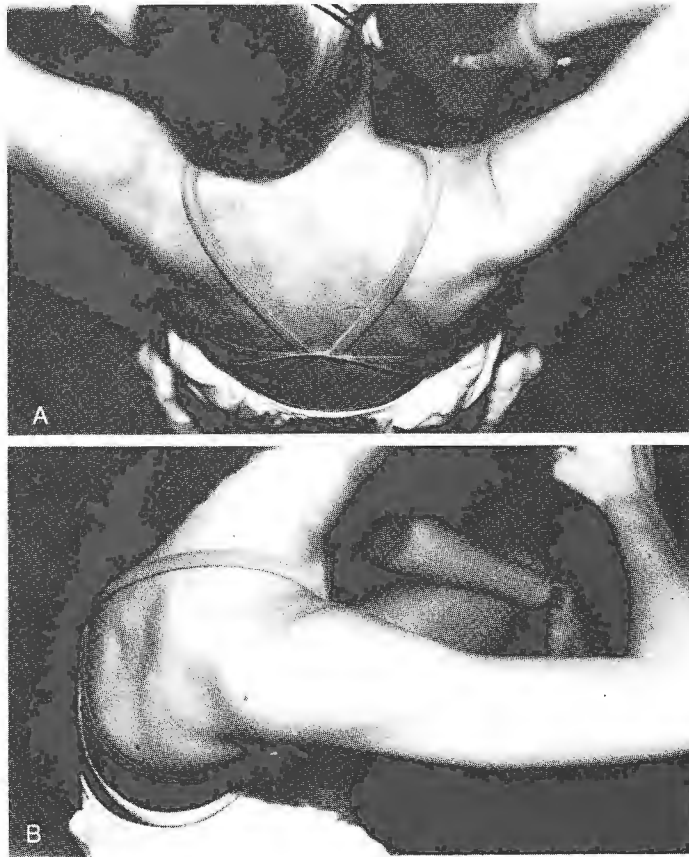


Figure 7. A, Symptomatic habitual right posterior shoulder subluxation is demonstrated on the right compared to the left. Note prominence of the posterior deltoid with humeral head subluxed in bird's eye view. B, Clinical view with prominence of humeral head subluxed posteriorly with arm held actively in forward flexion and horizontal adduction.

etally immature athlete, but injuries to the rotator cuff are not as common in young, skeletally immature athletes as they are in older athletes. There are those young athletes, particularly in the high-school age range, who tear their rotator cuff associated with baseball throwing, other overhead sports, and direct contact blows from football. Rotator cuff tendinitis certainly is a common entity seen in juvenile swimmers and tennis players. It is usual for the subjective findings to be much more prominent than the objective findings. These athletes will have mild tendinitis without evidence of rotator cuff tear. Radiographs are usually negative but os acromiale has been associated with rotator cuff problems as shown in Figure 10. This patient had right-sided pain but bilateral os acromiale.

Arthroscopic evaluation has proved to be of benefit both diagnostically and, in some cases, therapeutically. Partial tears of the undersurface of the cuff can be debrided and then rehabilitated with rewarding results. Associ-



Figure 8. A, Position of patient for radiograph with humeral head subluxed posteriorly and lying supine. B, Axial-type view shows humeral head subluxed posteriorly without any avulsion fractures or abnormalities.

ated intra-articular joint lesions, such as tearing of the biceps tendon labrum complex can be documented and treated arthroscopically.^{4, 38, 51} A thorough rehabilitation program with balancing of the internal and external rotator cuff strength is mandatory for future overhead throwing activity.^{10, 11, 28, 52}

Impingement syndrome has been well described.^{25, 30, 66} In the authors' experience, true impingement is uncommon in young athletes. When symptoms of impingement of the subacromial bursa are present, the underlying cause is generally an imbalance of musculature with an instability pattern. The rotator cuff acts as a fine tuner of the shoulder joint. Prior to puberty, the amount of subluxation may increase the distractive forces on the rotator cuff, resulting clinically in cuff tendinitis.^{25, 53}

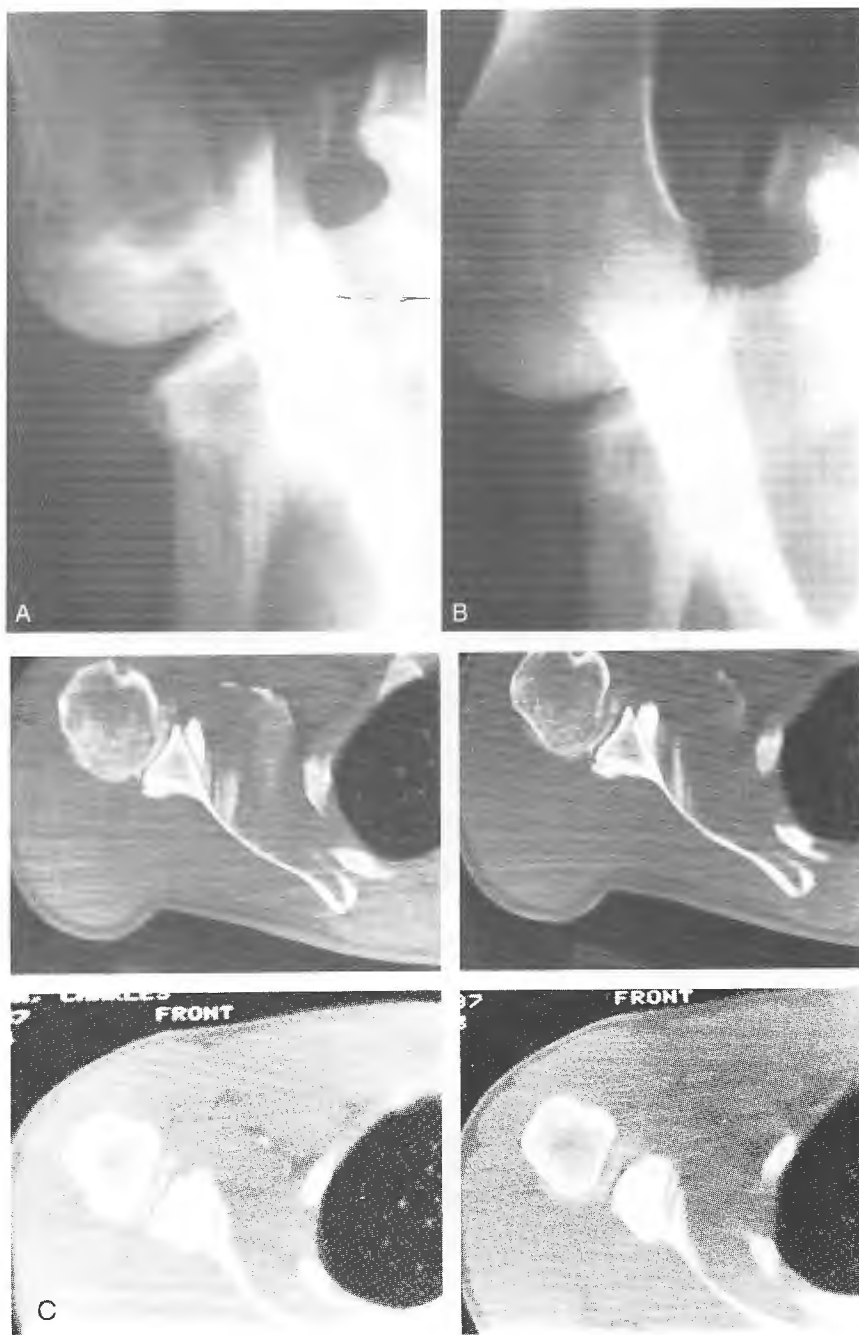


Figure 9. A, Stryker notch view of symptomatic posterior shoulder subluxation. Exostosis is well demonstrated at the inferior aspect of the glenoid preoperatively. B, Postarthroscopic exostosis excision. C, Arthrocomputed tomogram preoperatively well demonstrates the posterior glenoid exostosis.

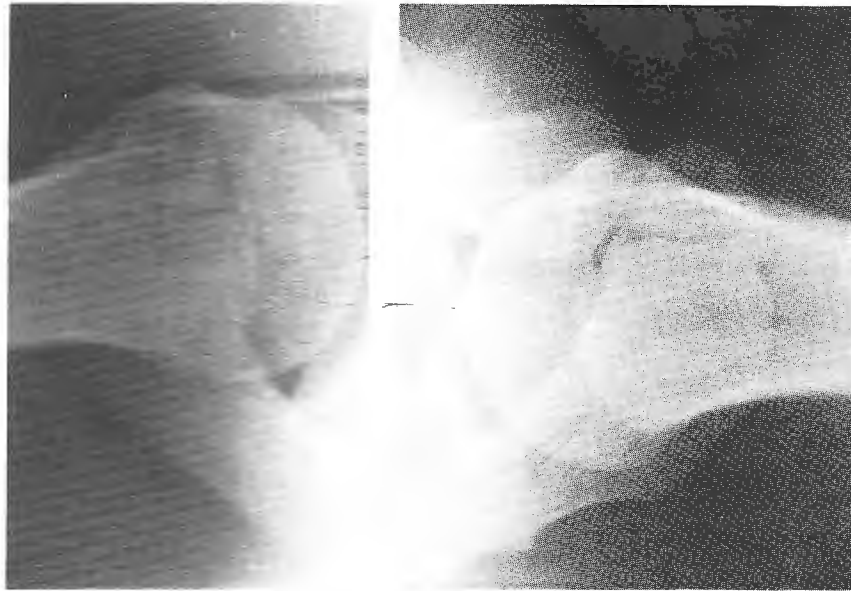


Figure 10. Bilateral os acromiale seen in a patient with bilateral rotator cuff strain and posterior shoulder subluxation.

Miscellaneous Injuries

Long Thoracic Nerve Palsy. Idiopathic long thoracic nerve palsy with subsequent scapular winging can be observed in the young athlete.³⁷ Scapular winging may be associated with shoulder pain and is usually idiopathic with an unknown mechanism of injury. It may be related to some traction-type force about the shoulder, as generated in bench pressing or other shoulder machines. Injuries to the long thoracic nerve can also be seen as a spontaneous occurrence in young throwers without apparent injuries. Clinically, there is winging of the scapula on attempted forward flexion maneuvers of the thorax from serratus anterior weakness. Crutch walking maneuvers, such as having the patient support his or her weight on the end of the examining table in the upright position with the arms extended using the palms of the hand for support, will demonstrate the winging. The usual test to have the patient demonstrate winging of the scapula is pushing on the wall with the arm in the forward abducted position and the elbow extended. These injuries are usually transient and the treatment, of course, is conservative with protection and avoidance of reinjury.

Biceps Tendon: Subluxation and Tendinitis. O'Donoghue⁴⁷ first described subluxation of the biceps tendon in the athlete. Although uncommon, this entity may be seen in the young athlete and should be considered during examination. In our experience, subluxation of the biceps tendon is not as common as has been clinically reported. In the same sense, "biceps tendinitis," a catch-all term, is much less frequent than rota-

tor cuff tendinitis and strain. Due to the anatomic proximity of the biceps tendon to the supraspinatus insertion of the rotator cuff, clinical differentiation of involvement of the two is difficult.

ELBOW INJURIES

EXAMINATION

Elbow injuries are most common in those participating in throwing or overhead sports, especially baseball. These injuries occur from repetitive microtrauma, and on this basis are quite common. In baseball, the number of pitches per game as well as the number per week are all important in trying to determine the etiology and importance of elbow complaints. The forces involved in the throwing act, especially that of the valgus compression forces on the radiocapitellar joint, have been well described.^{24, 29, 53} The association of pitching to specific elbow injuries is also well documented.^{2, 3, 9, 22, 23, 33, 36, 50, 66, 69} The management of osteochondritis dissecans of the capitellum has been described.^{39, 67} New arthroscopic techniques have been developed for documentation and debridement of articular surface injuries and removal of loose bodies.^{3, 72} The key to Little Leaguer's elbow problems is prevention. Bennett⁹ described Little Leaguer's elbow, and further Little League studies have documented his findings.^{2, 3, 22, 23, 29, 36, 50, 68}

The clinical examination is important for documentation of the range of motion and for noting any differences from the opposite, nondominant side. Stability of the ulnar collateral ligament by valgus stress testing is examined. A complete peripheral nerve examination, particularly the ulnar nerve, is performed routinely.

Radiographs include AP, lateral, and axial views.³ The axial view is obtained to demonstrate the articular cartilage and bony contour of the olecranon and trochlear groove. In older athletes, early osteophytes can be seen to develop along the posteromedial edge of the olecranon (Fig. 11), as well as loose bodies in the opposite lateral compartment. Stress views to assess the status of the ulnar collateral ligament and gravity stress views on both sides are quite helpful in documenting the medial stability.⁷² Oblique views may help show loose bodies.

Fractures

Ossification Centers. The appearance and fusion of secondary ossification centers about the elbow have been well documented.^{48, 60} Often, comparison views of the injured to the normal side are necessary to rule out the presence and possible avulsion of secondary ossification. For example, the medial epicondyle may be displaced in the joint and hidden, and absent from its anatomic location on the radiographs. The time of appearance and anatomic variations of epiphyseal and apophyseal secondary ossification centers make comparison views and clinical examination most important.

Medial Epicondyle Fractures. Avulsion fractures of the medial epicondyle are not uncommon in young athletes. This injury can occur in asso-

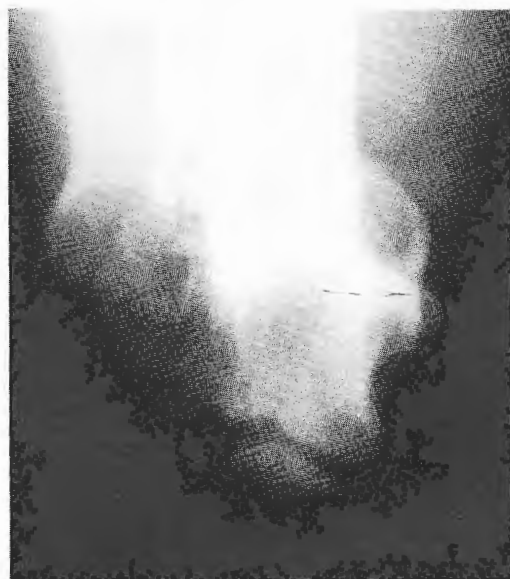


Figure 11. Axial view shows osteophyte medial olecranon and joint narrowing.

ciation with dislocations of the elbow from direct trauma, such as in football. It can also occur as an avulsion fracture-type injury that is associated with throwing sports, such as baseball. The treatment for this specific injury is to recognize the associated pathology, such as a subluxation or dislocation of the elbow, and to initiate early anatomic reduction. This usually requires internal fixation of the medial epicondyle, which allows early protected range of motion to ensure an adequate postinjury range of motion. Loss of motion in extension is less common when anatomic reduction and early protected range of motion exercises are performed.

We have advocated anatomic reduction of medial epicondylar humeral fractures and have not really accepted any degree of displacement. Late sequelae of old medial avulsion epicondylar fractures and associated radiocapitellar degenerative changes can be seen in AP and lateral radiographs (Fig. 12).

Radial Head Fractures. These are uncommon from macrotrauma, but repetitive microtrauma from similar valgus forces can produce epiphyseal plate fractures of the proximal radius. A history of repetitive loading of the radiocapitellar joint with clinical radial head tenderness, loss of full extension and supination, and a positive radiographic fat pad sign indicate proximal radial head or neck fracture. With undisplaced fractures and a positive fat pad sign, treatment is rest and repeat radiographs. Radial head overgrowth may occur if forces continue.

Supracondylar Fractures. Diagnosis and treatment of the supracondylar humerus fracture is well described.^{48, 60} After the forearm, the second most common fracture location in the skeletally immature patient is the supracondylar level of the humerus.^{48, 60} Most injuries are in the age group of

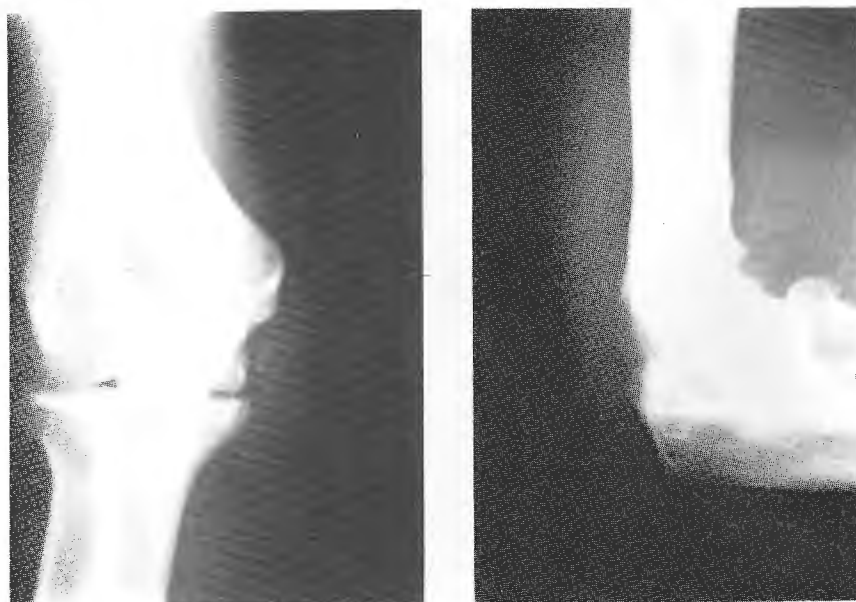


Figure 12. AP and lateral views demonstrate medial humeral epicondyle avulsion fracture and radiocapitellar degenerative change.

5 to 10 years and of the extension type due to significant forces.⁶⁰ Several factors including ligamentous laxity, thin bony architecture, and joint structure to bone relationship in hyperextension predispose the humerus to fracture in this location.⁶⁰ Radiographic views, stability assessment, and neurocirculatory status determine treatment plans.

Dislocations

Dislocations of the elbow joint are certainly not uncommon in contact sports such as football and wrestling and in noncontact sports such as gymnastics. Diagnosis and treatment have been well described.^{48, 60, 73} Early reduction of the dislocations should be done, and any associated fracture—such as of the radial head, coronoid process, or the medial epicondyle—should be looked for, reduced, and stabilized appropriately. Early protected range of motion of a dislocated elbow in young athletes is necessary. Common complications are partial ankylosis and heterotopic ossification.

Myositis Ossificans

Myositis ossificans occurs most commonly from direct blows as sustained in football. After the quadriceps, the second most common site for ectopic bone is the brachialis muscle. Treatment is very conservative, with protection initially and then an early active range of motion and general rehabilitation program. The ossification does not usually occur until about 3 weeks, so initial radiographs are normal. Treatment protocols are based

on early recognition and prevention of recurrence. These patients should be followed closely clinically and radiographically with conservative management.

Ligament Injuries

Ligament injuries are not as common in young as in older athletes. The authors⁴⁵ have treated some complete ulnar collateral ligament (UCL) injuries in high-school baseball pitchers that have occurred as a one-time, spontaneous traumatic event. These injuries are very difficult to diagnose. A high index of suspicion should be maintained even in young throwers. Generally, the UCL tears at its ulnar attachment. The diagnosis can be pinpointed by pain on direct palpation. It may be difficult to pick up the medial laxity owing to spasm and pain. Unless a medial epicondyle fracture is present, routine roentgenograms are generally of limited value. Woods⁷³ described the method of obtaining bilateral gravity and stress views to show medial openings with severer UCL sprains. Medial instability is demonstrated in external rotation by AP elbow views with gravity stress (Fig. 13A) and valgus weighted manipulation (Fig. 13B). If there is any question with regard to the diagnosis, an arthrogram should be obtained. Leakage of dye from the medial joint certainly confirms the diagnosis of a UCL tear. In these cases, a direct surgical repair is the most reliable form of treatment if the athlete desires to return to the repetitive valgus vector forces associated with throwing.



Figure 13. A and B, Gravity and weighted stress views of ulnar collateral ligament in a complete grade III tear.

Little League Elbow

Bennett⁹ described Little League elbow in 1959. Adams,² Grana,²² Gugenheim,²³ Larson,³³ and Pappas⁵⁰ have described elbow symptoms associated with baseball pitching in skeletally immature athletes. The elbow was described as the weak spot of the arm by Slager.⁶³

Arthroscopic management of loose bodies and debridement of irregular articular surfaces can now be done, negating the necessity of a formal arthrotomy. The key is recognition of the problem and prevention of repetitive stresses prior to injury. Without recognition of elbow injury during adolescence, radiocapitellar degenerative change will often result, as seen on AP view (Fig. 14).

Surgical treatment of osteochondrosis of the capitellum includes removal of loose bodies, drilling, debridement by arthrotomy,^{39, 65} or newer advanced arthroscopic techniques.^{3, 72}

Valgus Extension Overload

The forces of valgus compression on the radiocapitellar joint and subsequent posteromedial osteophyte formation on the olecranon tip have been well described.^{3, 71} The resultant osteophyte can either be excised by arthrotomy or removed by specialized arthroscopic techniques.^{3, 72} Generally, these osteophytic lesions are not readily appreciated in the young athlete but occur with time and repetitive forces. Radiographic findings



Figure 14. Radiocapitellar compartment degeneration.

are shown in AP (Fig. 15A) and lateral (Fig. 15B) views, demonstrating anterior and medial proximal ulnar osteophyte in an older throwing athlete.

Traction Apophysitis of Olecranon

Similar to Osgood-Schlatter disease with stresses on the tibial tubercle associated with musculotendinous imbalance and rapid growth, there can be abnormal stresses of the triceps attachment on the olecranon apophysis. Kovach³¹ and Micheli⁴¹ have described this with the separated olecranon secondary ossification center persisting into adulthood. Pavlov⁵⁴ also described an olecranon nonunion.

Other sites of pain about the elbow can be of inflammatory origin.⁷³ Larson³² described traumatic epiphysitis as an irritative, inflammatory reaction of the medial humeral epicondyle. Leach³⁴ has also described medial and lateral epicondylitis. Ligament injury and muscular avulsions have been described by Woods.⁷²

CONCLUSION

With knowledge and appreciation of the importance of the biomechanics of the sporting activity to the injury patterns, the practitioner can provide improved care and treatment.

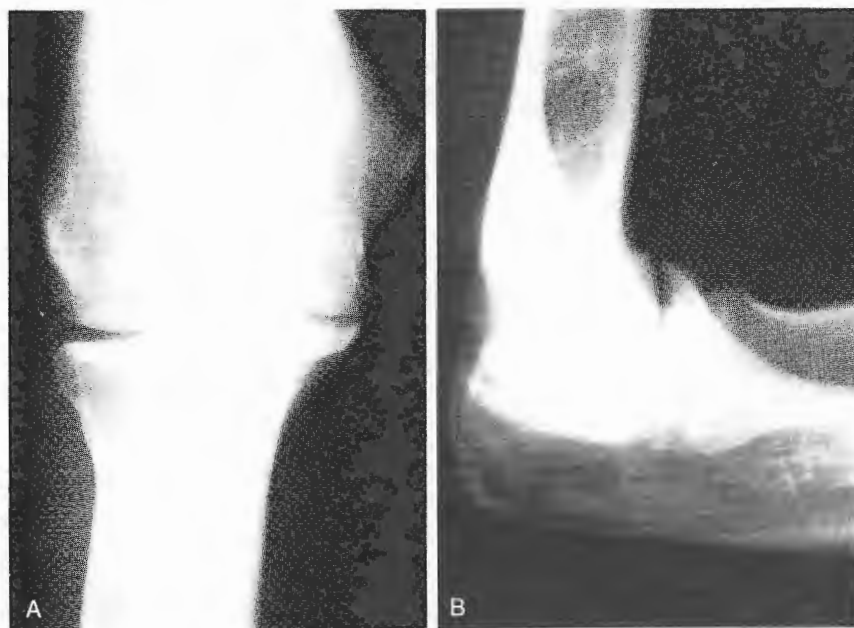


Figure 15. A and B, AP lateral view shows medial and anterior proximal ulnar osteophyte formation.

Injuries occur specific and unique to the sport, age, and shoulder or elbow joint.

Clinical and radiographic examinations are done with knowledge of these most common diagnoses.

Prevention of injury by proper biomechanical skills of the sport and early injury recognition and treatment, rather than palliative treatment, of chronic problems should be the ultimate goal.

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