

Shoulder and Elbow Problems in the Athlete

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Objectives

- Understand the anatomy, biomechanics, and pathophysiology of common shoulder and elbow injuries
- Develop an evaluation and treatment plan for the common injuries
- Develop a return to play protocol

I. Introduction

- A. Upper extremity injury in the scope of sports
 1. Acute shoulder injury common in sports with collisions and falls
 - a. Fall on outstretched arm
 - b. Direct blow to superior shoulder
 2. Overuse common in throwing sports and overhead activity
- B. Persistent shoulder pain (Meislin, 2005)
 1. High societal cost and patient burden
 2. Year 2000 direct costs for treatment of shoulder dysfunction in US
 - a. \$7 billion
 3. Common condition often has multifactorial underlying pathology
 - a. Result from bursitis, tendinitis, rotator cuff tear, adhesive capsulitis, impingement syndrome, avascular necrosis, glenohumeral osteoarthritis (OA), and other causes of degenerative joint disease or from traumatic injury
 - i. Either in combination or as separate entity
 4. Rotator cuff disorders (10%), adhesive capsulitis (6%), and glenohumeral OA (2-5%) common causes of all shoulder pain
 - a. All 3 conditions have complex etiologies
 - b. Diagnosed in the majority of patients on the basis of medical history, focused physical examination, and plain film radiographs

II. Shoulder

- A. Anatomy
 1. Bones
 - a. Humerus
 - b. Scapula
 - c. Clavicle
 - d. Sternum
 - e. Rib cage
 2. Muscle tendon units
 - a. Rotator cuff SITS on humerus
 - b. Deltoid
 - c. Peri-scapular
 3. Capsule and labrum
 4. Neurovascular bundle

- a. Brachial plexus
- B. Biomechanics
 - a. Highly mobile joint
 - i. Mobility sacrifices stability
 - ii. Ball on a plate vs ball in a socket
 - b. Rotator cuff functions as stabilizer
 - c. Consider entire shoulder girdle in evaluation
 - d. Shoulder power comes from body “core”
- C. Common problems
 - 1. Acute shoulder injury
 - a. Fracture
 - i. Clavicle fracture
 - ii. Scapular fracture
 - iii. Proximal humerus fractures
 - b. Dislocation
 - i. Anterior dislocation
 - ii. Posterior dislocation
 - iii. SC joint dislocation
 - c. Sprain
 - i. AC joint
 - d. Strains
 - i. Rotator cuff tears
 - e. Neurovascular bundle injury
 - i. Brachial plexopathy
 - ii. Vascular injury
 - f. Pediatric shoulder trauma is relatively uncommon (Bishop, 2005)
 - i. Rare injuries requiring surgical intervention
 - ii. Differentiate nonoperative injuries from urgent and potentially operative injuries
 - iii. Missing surgical injury potentially life threatening or long-term disability
 - iv. Posterior sternoclavicular dislocations should be differentiated from medial clavicular physeal injuries and promptly reduced
 - v. Open fractures or neurovascular threatening fractures should be attended to immediately
 - vi. Severely displaced proximal physeal humerus fractures in the older child often have a better long-term outcome after anatomic reduction
 - vii. Glenohumeral dislocations are not life threatening or limb threatening after reduction
 - 1) High incidence of recurrence in adolescent patients
 - 2) Consider when formulating treatment plan
 - 2. Chronic shoulder disorders and soft tissue injury
 - a. Common in throwing sports, racquet sports, volleyball, and swimming
 - i. Baseball and softball injuries result of acute and overuse injuries (Wang, 2006)
 - 1) Soft tissue injuries include contusions, abrasions, and lacerations
 - a) Return to play when risk of further injury is minimized
 - 2) Common shoulder injury sites
 - a) Rotator cuff
 - b) Biceps tendon
 - c) Glenoid labrum
 - b. Usual causes are overuse, muscle imbalance, instability, and overstretching

- c. Tendinitis, tendonosis, and impingement usually caused by underlying instability
- d. Older athletes develop degenerative changes and osteoarthritis
- D. History is critical to diagnosis
 1. How and when symptoms started
 - a. Post traumatic
 - b. Activity at onset
 2. History of shoulder dislocation
 - a. How many
 - b. What circumstances
 - c. How reduced
 3. Hear or feel a clunk, click, or crunch
 4. Locks up or clicks in certain positions (labral tear)
 5. Gradual (tendonosis or multidirectional instability) or sudden (inflammatory)
 6. Can the problem be reproduced and demonstrated
 7. Any restricted movements
 8. What has been tried and what has helped
 9. History of neck problems
 10. Pain description
 - a. Pain at rest or pain with restricted range (adhesive capsulitis)
 - b. Pain with loading
 - c. Pain lying on affected arm (tendonosis or rotator cuff)
 - d. Pain lifting arm or working above shoulder level (tendonosis or rotator cuff)
 - e. Pain with abduction and external rotation (anterior instability)
- E. Clinical exam
 1. Inspection
 2. Range of motion
 3. Palpation
 4. Neuromuscular function
 - a. Strength testing
 - b. Sensation
 5. Special tests
 - a. Drawer or translational test
 - b. Sulcus sign
 - c. Apprehension test
 - d. Relocation test
 - e. Jobe relocation test
 - f. General joint laxity
 - g. Labral and SLAP lesion testing
 - h. Impingement testing
 - i. AC joint cross body test
 6. Clinical exam differences abstract (Chahal, 2007)
 - a. To quantify inter-observer agreement in the diagnosis and treatment of shoulder instabilities among expert North American shoulder surgeons. We hypothesized that inter-observer consistency among this group will be significantly low in both diagnosis and treatment.
 - b. DESIGN: Survey/Descriptive Epidemiology Study. SETTING: Self-administered survey via e-mail.
 - c. PARTICIPANTS: Active members of American Shoulder and Elbow Surgeons (ASES) and JOINTS Canada (Joined Orthopaedic Initiatives for National Trials of the Shoulder), whose practices consisted primarily of shoulder surgery.

- d. INTERVENTIONS: Participants were sent a self-administered survey via e-mail and polled as to their choice of diagnosis and treatment in 5 different shoulder conditions.
 - e. MAIN OUTCOME MEASUREMENTS: A Kappa coefficient of agreement, Ksc, was used to measure relative interobserver reliability.
 - f. RESULTS: Overall response rate was 62.7% (42/67 surveys). The level of interobserver reliability was fair (Ksc 0.38, $P < 0.0001$) to almost perfect (Ksc 0.97, $P < 0.0001$) in diagnosing shoulder instability and slight (Ksc 0.23, $P < 0.0001$) to substantial (Ksc 0.69, $P < 0.0001$) for therapeutic approach. The greatest diagnostic differences were noted for a painful shoulder in a throwing athlete with subtle anterior instability (Ksc 0.43, $P < 0.0001$) and for a patient with voluntary posterior instability with an asymptomatic sulcus sign (Ksc 0.38, $P < 0.0001$). The greatest differences in treatment choice were for the throwing athlete with subtle anterior instability (Ksc 0.38, $P < 0.0001$), a patient with voluntary posterior instability (Ksc 0.34, $P < 0.0001$), and a patient with bidirectional instability (Ksc 0.23, $P < 0.0001$).
 - g. CONCLUSIONS: These inconsistencies highlight the need for greater awareness and standardization of diagnostic criteria. This work may serve as the foundation for more universal treatment plans and subsequently more meaningful clinical outcomes.
- F. Imaging
1. Plain film radiographs
 2. MRI
 - a. MRI in Little leaguer's shoulder (Song, 2006)
 - i. Stress injury of the proximal humeral physis in differential diagnosis for an adolescent baseball player with shoulder pain
 - 1) Especially in pitchers
 - ii. Roentgenographs may or may not be helpful depending on duration and severity of the injury
 - iii. MRI appearance in little leaguer's shoulder helpful in diagnosing injury to the growth plate that was radiographically occult
 - iv. Document progress with a follow-up MRI examination
 3. CT
 4. Ultrasound
 5. Diagnostic imaging requires knowledge of overhead throwing biomechanics to understand specific injuries in throwing athletes (Ouellette, 2005)
 - a. Throwing athletes are susceptible to rotator cuff tears from tensile overload and external and internal impingement
 - b. Labrum commonly degenerated or torn secondary to overuse syndrome, internal impingement, and microtrauma
- G. Common injuries
1. Frank anterior dislocation
 - a. Exam
 - i. Humeral head bulges anteriorly and is palpable
 - ii. Deltoid muscle appears and feels flattened
 - iii. Patient often holds arm slightly abducted and externally rotated
 - iv. ROM testing restricted in all planes because of pain
 - v. Unable to place the hand of the affected side on the opposite shoulder (positive Dugas test)
 - vi. Examination of sensory, motor, and vascular status is essential
 - vii. Evidence of vascular injury constitutes a medical emergency

- b. AP and axillary X-rays
 - i. Axillary
 - 1) Head of humerus out of position
 - 2) Bankart and Hill Sachs lesions
- c. Reducing dislocations
 - i. Treatment objective after acute shoulder dislocation diagnosis is immediate reduction avoiding additional pain and complications (Walz, 2006)
 - 1) Reduction technique which is performed by a single person with the patient sitting on a chair and the physician standing behind him at the affected side.
 - 2) Positioning one fist in the anterior part of the axillary fossa for countertraction but avoiding direct pressure into the axillary fossa, the other hand uses traction grasping the patient's forearm.
 - 3) Only gentle traction is maintained until muscle relaxation is achieved and reduction mostly happens in this moment.
 - 4) Otherwise slow external rotation of the fist placed in the axilla can relieve reduction pushing the humeral head laterally.
 - 5) Additional leverage maneuvers are not necessary.
 - 6) Technique was successful in 98 of 108 (90.7%) patients.
 - a) Premedication used in 16.3% (intravenous analgesics)
 - b) 10 required general anesthesia was to achieve reduction.
 - c) No complications occurred in any of the patients.
 - 7) Technique allows a gentle and painless reduction mostly avoiding premedication
 - ii. Self-Reduction of Anterior Shoulder Dislocation (Joy, 2000)
 - 1) Boss-Holzach-Matter method
 - 2) Atraumatic, simple, and quick for medical and nonmedical personnel
 - 3) Possible without analgesics or general anesthesia
 - 4) Any setting, including a medical facility
 - a) Use outdoors or in the backcountry
 - 5) Prospectively studied with successful reduction $\geq 60\%$ of cases
 - 6) Safe with displaced fracture of the greater tuberosity or depression fracture of the humeral head
 - 7) Muscle relaxation is absolutely essential to successful shoulder reduction
 - a) Voluntarily relaxing shoulder muscles facilitates reduction
 - 8) Patient sits on the ground with the ipsilateral knee bent 90° and hands clasped around the knee and leans backward to reduce the injury
 - 9) Reasonable to attempt 3 times
 - 10) After reduction, the arm is placed in a sling for comfort
- d. Treatment strategies may be changing for first dislocation
 - i. Strengthening is cornerstone of initial dislocation care
 - 1) Considered "standard care"
 - 2) Surgery if unable to perform tasks after first dislocation
 - ii. Primary open surgical repair in patients ages 15 - 39 yrs after a first-time traumatic anterior shoulder dislocation (Jakobsen, 2007)
 - 1) Results in fewer subsequent dislocations, decreased instability, and improved patient satisfaction
 - 2) Major change in the current standard of care of conservative therapy for first dislocations and surgery for recurrent dislocations only. (LOE = 1b-)
 - iii. Open stabilization procedures are able to improve shoulder function and to reduce recurrence rates (Meller, 2007)

- 1) Return to preinjury shoulder function is not guaranteed
 - 2) **STUDY DESIGN:** Retrospective longitudinal cohort study on 19 consecutive athletes with recurrent, post-traumatic shoulder instability. All patients were treated with an open, capsulo-labral repair. The minimum follow-up was 24 months. Two years after surgery, the clinical scoring systems revealed good-to-excellent results in all patients. Quality of life physical component summary remained diminished by 9.2% despite the surgical procedure and was therefore significantly lower as compared to preinjury levels ($p < 0.05$). Sports activity was also significantly lower at the time of follow-up ($p < 0.05$). In this specific procedure, external rotation was not impaired postoperatively. EMG testing showed an overall reduction of muscle activity, however not significant. Isokinetic muscle strength was significantly diminished for external rotation and shoulder abduction.
 - 3) **CONCLUSIONS:** Open reconstruction procedures for recurrent shoulder instability can restore shoulder function and stability to near-normal values. Despite good-to-excellent clinical results, there is a significant impairment of quality of life and sports activity 2 years after surgery. Muscle activity and muscle strength are diminished. Recurrent shoulder instability remains a disabling condition to the young athlete. Future strategies have to emphasize restoration of quality of life, sports activity, and muscle function.
 - 4) **LEVEL OF EVIDENCE:** Level IV, therapeutic case series.
- iv. Assess whether traumatic anterior shoulder dislocations should be immobilized; for how long should they be immobilized; and whether the position of immobilization affects outcomes (Smith, 2006)
- 1) Traumatic anterior dislocations of the shoulder are common and disabling injuries
 - 2) Managing this injury has been to immobilize the affected shoulder after reduction, for up to 8 weeks, in an adducted and internally rotated position
 - 3) Electronic literature search performed to February 2005. Human clinical trials, written in English, which could assist in answering the research questions, were included. Sixteen (of 168) papers met the inclusion criteria and were reviewed.
 - 4) Review suggests that it remains unclear whether patients with traumatic primary anterior shoulder dislocations should be immobilized, for how long, or immobilized in internal, or external rotation
 - 5) Uncertainty is due to the limited size of the evidence base, which exhibited numerous methodological weaknesses (e.g. small sample sizes, no control groups, not evaluating findings against statistical tests)
- v. Acute anterior dislocation is more susceptible to redislocation, especially in active young adults. (Handoll, 2006)
- 1) **OBJECTIVES:** To compare methods of conservative (non-surgical) management versus no treatment or different methods of conservative management after closed reduction of traumatic anterior dislocation of the shoulder. Interventions include methods of postreduction immobilization and rehabilitation.
 - 2) **SEARCH STRATEGY:** We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialized Register (March 2005), the Cochrane Central Register of Controlled Trials (The Cochrane Library Issue 3,

- 2005), MEDLINE, EMBASE, the National Research Register (UK), conference proceedings and reference lists of articles.
- 3) **SELECTION CRITERIA:** Randomized or quasi-randomized controlled trials comparing various conservative interventions versus control (no or sham treatment) or other conservative interventions applied after closed reduction of traumatic anterior dislocation of the shoulder.
 - 4) **DATA COLLECTION AND ANALYSIS:** All authors selected trials, assessed methodological quality and extracted data. Study authors were contacted for additional information.
 - 5) **MAIN RESULTS:** One flawed quasi-randomized trial was included. A "preliminary report" gave the results for 40 adults with primary traumatic anterior dislocation of the shoulder treated by post-reduction immobilization with the arm in either external or internal rotation. There was no statistically significant difference between the two groups in the failure to return to pre-injury sports by previously active athletes, in redislocation or shoulder instability. Similar numbers of participants of the two groups removed their immobilizer before one week had passed.
 - 6) **AUTHORS' CONCLUSIONS:** There is a lack of evidence from randomized controlled trials to inform the choices for conservative management following closed reduction of traumatic anterior dislocation of the shoulder. Sufficiently powered, good quality, well reported randomized controlled trials with long-term surveillance of conservative management are required. In particular, trials examining the type and duration of immobilization would be useful.
- vi. Collision athletes are reported to be at high risk for redislocation after anterior stabilization of shoulder instability. Some authors have suggested that arthroscopic stabilization produces results similar to those of open stabilization (Rhee, 2006)
- 1) **PURPOSE:** To evaluate the results of anterior shoulder stabilization in collision athletes and to compare the clinical results between the arthroscopic and open methods.
 - 2) **HYPOTHESIS:** Open stabilization might produce better results than does arthroscopic stabilization in collision athletes.
 - 3) **STUDY DESIGN:** Cohort study; Level of evidence, 4.
 - 4) **METHODS:** Forty-eight shoulders of 46 collision athletes were enrolled for this study. The mean age of the patients at the time of surgery was 20 years, and the mean follow-up period was 72 months (range, 30-136 months). Sixteen shoulders underwent arthroscopic stabilization; 32 shoulders had open repairs.
 - 5) **RESULTS:** Visual analog scale, Rowe, and Constant scores improved after surgery, but no statistically significant difference was found between the arthroscopic and open repair groups. Thirty-seven athletes (83%) returned to near-preinjury sports activity levels ($\geq 90\%$ recovery) after operation. Two patients (4%) had subluxation and 6 (12.5%) had redislocation after surgery. The number of shoulders with postoperative subluxation or dislocation was 4 (25%) in the arthroscopic group and 4 (12.5%) in the open group ($P = .041$). Revision surgery was performed on 5 shoulders (10.4%).
 - 6) **CONCLUSIONS:** There were 8 (16.5%) instances of postoperative instability among the collision athletes studied. The arthroscopic group yielded a higher failure rate than did the open group. The authors believe

- open stabilization to be a more reliable method for anterior shoulder instability in collision athletes.
- vii. Define the prevalence and the progression in time of injury of the axillary nerve in patients with recurrence of anterior shoulder dislocation (Gumina, 2005)
 - 1) Observed 185 patients with primary shoulder dislocation without associated fracture for 2 years
 - 2) During the study 98 patients had recurrence of the dislocation
 - a) 89 over age 60 years
 - b) 9 below age 60 years
 - 3) All of the patients were evaluated clinically and had EMG to check axillary nerve
 - 4) 4 patients (4%) had neurapraxia of axillary nerve
 - a) 1 also had neurapraxia of radial nerve
 - b) 1 male aged 34 years
 - c) 3 over 60 years old
 - d) All recovered completely in 3-5.3 months
 - 5) Injury of the axillary nerve can occur at first recurrence of injury
 - a) Prevalence is significantly lower than after primary dislocation
2. Post traumatic shoulder instability
 - a. Dislocation tears glenoid labrum and glenohumeral ligaments away from anterior-inferior glenoid (80%)
 - i. Overstretches capsular ligaments
 - b. Instability sensation
 - i. May only feel sensation of uncertainty
 - ii. Pain when arm externally rotated
 - c. Typical exam
 - i. Positive apprehension and relocation tests
 - ii. Increased translation
 - d. AP and axillary X-rays
 - a) Axillary – Bankart and Hill Sachs lesions
 - e. Treatment
 - i. 24 overhead athletes with posttraumatic, chronic anterior shoulder instability underwent surgery (Fremery, 2006)
 - 1) 22 examined after average follow-up of 2.8 ± 0.7 years
 - 2) Redislocation rate was 9 %
 - 3) Despite the good clinical results, only 12 of 22 (55 %) returned to their previous sports activity level
 - 4) Relatively high percentage of overhead athletes can not return to their previous performance level due to impaired joint position awareness
 - ii. The effectiveness of arthroscopy in the selection of surgical procedure and treatment of both acute and recurrent traumatic anterior shoulder instability in rugby players by use of pre-established selection criteria (Larrain, 2007)
 - 1) Results in patients treated with the arthroscopic suture anchor technique.
 - 2) METHODS: 204 rugby players with acute or recurrent traumatic anterior instability underwent an initial arthroscopic examination. Criteria such as type of Bankart lesion, tissue quality, and presence of bony defects were evaluated and used to determine the method of stabilization: arthroscopy or open stabilization. Open surgery was indicated in patients with bone humeral deficiencies greater than one fourth of the articular humeral head, bone glenoid deficiencies greater than 25% of the glenoid

- extension, capsular laxity with poor tissue quality, and humeral avulsion of the glenohumeral ligament; all other patients underwent arthroscopic reconstruction via the bone suture anchor technique.
- 3) **RESULTS:** The mean follow-up was 5.9 years (range, 3.9 to 8.9 years). We performed arthroscopic stabilization in 39 cases of acute instability; only 1 case (2.5%) required the mini-open technique for reinsertion of humeral avulsion of the glenohumeral ligament. Of 158 cases of recurrent instability, 121 underwent arthroscopic stabilization, and 37 (23.4%) required reconstruction with open surgery. The main cause was bony deficiency (treated with the Latarjet procedure). The results of the arthroscopic reconstructions were evaluated by use of the Rowe scale and analyzed according to stability and range of motion. Good or excellent results were found in 94.9% of cases in the acute instability group and in 91.8% in the recurrent instability group, the poor results were due to instability recurrence. In the acute instability group there were 2 cases of recurrence (5.1%) while playing rugby. In the recurrent instability group there were 10 recurrences (8.3%).
 - 4) **CONCLUSIONS:** Arthroscopic stabilization was possible in 97.5% of our patients with acute instability and 76.6% of patients with recurrent instability based on the selection criteria for this population. We were able to obtain excellent results in 90% of cases using the suture anchor technique in rugby players with our selection criteria.
- iii. Prospectively evaluate results of arthroscopic Bankart repairs at a minimum 2-year follow-up for shoulder dislocation and anterior-inferior labral tear at the time of diagnostic arthroscopy. (Carreira, 2006)
- 1) **STUDY DESIGN:** Case series; Level of evidence, 4.
 - 2) **METHODS:** A consecutive series of 85 patients (70 men, 15 women; mean age, 26 years) with Bankart lesions were treated with arthroscopic repair using suture anchors; 18 patients (27%) had extension of the labral injury into the superior labrum affecting some or all of the biceps anchor. Anchors were loaded with no. 2 nonabsorbable braided suture and placed 2 mm into the edge of the glenoid surface. A low anterior (5-o'clock) portal through the subscapularis tendon was used in all patients; 72 patients were evaluated at a minimum of 2 years postoperatively (mean, 46 months).
 - 3) **RESULTS:** Seven patients (10%) experienced recurrent instability after repair. Four patients had redislocations; 3 experienced recurrent subluxation. One patient had pain with the apprehension test without a clear history of recurrent instability. Of 18 collision athletes, 2 had dislocations at 22 and 60 months postoperatively. There were no complications, including no neurologic deficits. Clinical strength testing of the subscapularis muscle was normal in all patients. The mean Rowe score was 88 of 100 points, with 90% excellent or good results. Simple Shoulder Test responses improved from 66% positive preoperatively to 88% positive postoperatively. The American Shoulder and Elbow Surgeons scoring index averaged 92 of 100 points postoperatively. Pain analog scales improved from 5.5 preoperatively to 0.35 postoperatively on a 10-point scale. SF-12 scores improved for physical function. Patient satisfaction was rated 8.9 on a 10-point visual analog scale.
 - 4) **CONCLUSION:** Bankart repairs performed arthroscopically using properly implanted suture anchors and nonabsorbable sutures and in which

associated pathoanatomy is addressed demonstrate low recurrence rates (10%) similar to historical open controls.

3. Labral injury – SLAP lesions
 - a. Mechanism is strong eccentric contraction on long head of biceps brachii muscle tearing the labrum biceps tendon complex from the upper glenoid
 - b. Pain in upper posterior shoulder with external rotation and abduction
 - c. Instability sensation, clicking, or sliding in joint
 - d. O'Brien's and Crank tests sometimes positive
 - e. Often signs of anterior instability
 - f. MR arthrogram will differentiate causes
 - g. Treatment
 - i. Surgical repair is usually indicated
 - ii. Describe the clinical presentation and sensitivity of testing of unstable isolated SLAP (superior labrum anterior posterior) lesions and to evaluate the efficacy of arthroscopic treatment (Rhee, 2005)
 - 1) TYPE OF STUDY: Case series.
 - 2) METHODS: A retrospective review was made of 44 unstable SLAP lesions in 41 patients (40 male, 1 female) who did not have other pathologic shoulder findings. The mean follow-up period was 33 months (range, 25 to 67 months) and the mean age at the time of surgery was 24 years (range, 17 to 43 years). Twenty-six patients had an injury on the dominant shoulder and 3 had bilateral shoulder involvement. Arthroscopic fixation was performed with the use of a biodegradable tack (Suretac; Acufex, Mansfield, MA) in 14 cases, and with a screw-type metallic suture anchor (mini-Revo; Linvatec, Largo, FL) in 30 cases.
 - 3) RESULTS: Pain (100%) and clicking (57%) were the most common symptoms. The compression-rotation test was positive in 84% of the patients before surgery. The average UCLA score at the last follow-up was 32.3 points; 22 cases were graded excellent, 16 good, and 6 poor. Based on the postoperative performance data collected from 33 athletes, 25 of them (76%) were able to return to their athletic activities. Among them, throwing athletes showed statistically better performance than did nonthrowing athletes ($P = .011$).
 - 4) CONCLUSIONS: Pain, followed by clicking, was the most common symptom, and the most common sign was a positive compression rotation test. Arthroscopic treatment of unstable isolated SLAP lesions resulted in good or excellent UCLA scores in 86% of the patients. Throwing athletes showed more satisfactory results than nonthrowing athletes.
 - 5) LEVEL OF EVIDENCE: Type IV, case series with no, or historical, control group.
 - iii. Pathology of the superior aspect of the glenoid labrum (SLAP lesion) poses a significant challenge to the rehabilitation specialist (Wilk, 2005)
 - 1) Thorough clinical evaluation and proper identification of the extent of labral injury is important to determine the most appropriate nonoperative and/or surgical management
 - 2) Postoperative rehabilitation is based on the specific surgical procedure as well as the extent, location, and mechanism of labral pathology and associated lesions.

- 3) Emphasis is placed on protecting the healing labrum, while gradually restoring range of motion, strength, and dynamic stability of the glenohumeral joint.
4. Multidirectional instability
 - a. Mechanism is repeated “minor” injuries
 - i. Stretch joint capsule
 - ii. Associated ligaments
 - b. Congenital generalized joint laxity is predisposing factor
 - c. More common in younger athletes
 - i. Especially girls
 - d. Throwers increase external rotation
 - i. Predisposes to anterior-inferior capsule and ligament stress
 - e. Sports with extreme movement of shoulder joint increase injury
 - i. Swimming
 - ii. Gymnastics
 - f. Dynamic shoulder stabilizers compensate for initial stress loads
 - i. Eventual rotator cuff fatigue allows humeral head to move within the glenoid fossa
 - ii. Causes labral injury with wear and tear
 - g. Typical exam
 - i. Sulcus sign, apprehension test, and relocation test positive
 - ii. Rotator cuff inflammation signs
 - h. Imaging
 - i. Radiographs negative
 - ii. MRI arthrogram – may demonstrate increased joint volume
 - i. Treatment
 - i. Hold from sport
 - ii. Stretching, strengthening, and neuromuscular re-training
 - iii. Surgical “tightening” of joint capsule
 - 1) Prognosis – about 50% return to previous level
 - iv. Bankart repair for shoulder instability experience since 1998 (Loughead, 2005)
 - 1) Rowe et al modification using suture anchors but without a coracoid osteotomy
 - 2) If inferior instability present; procedure combined with a capsular shift
 - 3) Retrospective case note review and postal questionnaire incorporating the Oxford Instability Score (OIS) on all patients
 - 4) 50 Bankart repairs
 - a) 3 had further dislocations
 - b) 3 had ongoing symptoms of instability
 - 5) Response rate to the questionnaire was 62%
 - 6) Mean OIS following primary stabilization was 21.7 (possible scores from 12-excellent to 60-poor)
 - 7) Results compare favorably to original surgery or physiotherapy scores published by Dawson et al. (1999)
5. Subacromial pain syndrome – impingement syndrome
 - a. Inflammation or degeneration pain from rotator cuff tendons and subacromial bursa
 - b. Increased tissue volume in subacromial space
 - i. Decreases function of rotator cuff
 - ii. Loss of depressor action on humeral head

- 1) Deltoid pulls the humerus more superiorly and worsens symptoms
- c. Stages of rotator cuff dysfunction
 - i. Stage 1 – acute inflammation with swelling and edema
 - ii. Stage 2 – scar formation and chronic irreversible change
 - iii. Stage 3 – degeneration and rupture
- d. Age usually >40 years
- e. Often minor or repeated trauma
 - i. Long sport career
 - ii. Repetitive overload occupation
 - iii. Overhead activity in job or recreation
- f. Pain located anterior-lateral surface of acromion
 - i. Initially non specific pain
- g. Night pain common
- h. Painful to carry or lift above shoulder level with elbow extended
- i. Typical exam
 - i. Painful arc from 70° to 130° of abduction
 - ii. Tender at supraspinatus insertion
 - iii. Supraspinatus atrophy
 - iv. Active and passive ROM reduced
 - v. Weakness upper limb flexion, abduction, and external rotation
 - vi. Scapulohumeral rhythm disrupted
 - vii. Neer (near ear) and Hawkins (hawk wing) tests positive
 - viii. Diagnostic anesthetic injection
 - 1) Symptoms reduced
 - 2) Strength improves
 - 3) Neer and Hawkins tests improved
 - 4) Painful arc improved
- j. Imaging
 - i. Radiograph - supraspinatus outlet view for acromion shape
 - 1) Type 1 – flat
 - 2) Type 2 – curved
 - 3) Type 3 – hooked
 - ii. MRI or Ultrasound to identify tears
- k. Treatment
 - i. Posture correction
 - ii. Stabilize scapula
 - iii. Strengthen rotator cuff
 - iv. Surgical correction of Type 3 acromion and/or bursectomy
 - v. Rotator cuff injuries are one of the most common causes of shoulder pain
6. Rotator cuff tears
 - a. Common cause of pain in repetitive overhead and shoulder level work
 - b. Rotator cuff injuries are one of the most common causes of shoulder pain (Bytowski, 2006)
 - i. Anatomy and biomechanics of the shoulder guide the history and physical exam toward the appropriate treatment of rotator cuff injuries.
 - ii. Rotator cuff tears are rare under the age of 40 unless accompanied by acute trauma.
 - iii. Throwing athletes are prone to rotator cuff injury from various causes of impingement (subacromial, internal, or secondary) and flexibility deficits, strength deficits, or both along the kinetic chain.
 - c. Most common in “middle age” athletes

- d. Poor blood supply to supraspinatus tendon contributes to onset
- e. Degenerative problem
 - i. Starts anteriorly at long head of biceps tendon intersection
 - ii. Can spread proximally to infraspinatus tendon
- f. Large tear allows biceps tendon to dislocate
- g. Throwing athletes tear from eccentric overload during deceleration phase
- h. Investigate the characteristics of anterior rotator cuff tears in throwing athletes (Nakagawa, 2006)
 - i. **BACKGROUND:** In throwing athletes, partial rotator cuff tears are usually located posterior to the site of the common rotator cuff tears seen in the general nonthrowing population. Sometimes tears located around the anterior aspect of the supraspinatus tendon.
 - ii. **METHODS:** We divided 37 athletes with partial rotator cuff tears into those with anterior tears (n = 17) and those with posterior tears (n = 20). The clinical profile, range of motion and joint laxity with patient under general anesthesia, and operative findings were retrospectively compared between the 2 groups.
 - iii. **RESULTS:** Among the 17 anterior rotator cuff tears, 12 tears were confined to the anterior one third of the supraspinatus tendon. Interestingly, concealed intratendinous degenerative tears were found in 6 shoulders. These appeared to be very shallow articular-side tears located around the attachment of the greater tuberosity, but severe tears were exposed after resection of the residual capsular portion of the tendon. Posterior capsular tightness was significantly related to the occurrence of anterior tears, whereas a greater tuberosity notch was significantly related to posterior tears.
 - iv. **CONCLUSIONS:** Anterior rotator cuff tears are not uncommon in throwing athletes, and a concealed type of tear was a representative lesion. Different mechanisms may be involved in the development of anterior and posterior rotator cuff tears resulting from throwing injuries. Posterior capsular tightness might influence the occurrence of anterior tears.
 - v. **LEVEL OF EVIDENCE:** Level IV, prognostic case series.
- i. History
 - i. Over 40 years old
 - ii. Repetitive loading activity
 - iii. Several episodes of anterior shoulder pain
- j. Physical exam
 - i. Similar to subacromial pain syndrome or impingement
 - ii. Rotator cuff weakness
 - iii. Loss of active abduction
 - iv. Unable to hold in abduction (slap test)
- k. Imaging
 - i. US examiner dependent
 - ii. CT arthrography – contrast leak
 - iii. MRI (+/- contrast)
 - iv. Investigate the epidemiology and magnetic resonance imaging findings associated with rotator cuff contusions of the shoulder in professional football players. (Cohen, 2007)
 - 1) **PURPOSE:** To determine a single professional football team's incidence, treatment, and magnetic resonance imaging appearance of players sustaining rotator cuff contusions of the shoulder.
 - 2) **STUDY DESIGN:** Case series; Level of evidence, 4.

- 3) **METHODS:** From 1999 to 2005, a North American professional football team's injury records were retrospectively reviewed for athletes who had sustained a rotator cuff contusion of the shoulder during in-season participation. Those patients who had magnetic resonance imaging of the shoulder with a 1.5-Tesla magnet were reviewed by a musculoskeletal radiologist and graded according to the appearance and severity of clinical injury.
- 4) **RESULTS:** 26 players had a rotator cuff contusion. There was an average of 5.5 rotator cuff contusions per season (47% of all shoulder injuries). The predominant mechanism of injury was a direct blow in 70.3%. Magnetic resonance imaging findings included peritendon edema at the myotendinous junction, critical zone tendon edema, and subacromial bone bruises. Treatment consisted of a protocol involving modalities and cuff rehabilitation in all patients. 6 patients had persistent pain and weakness for a minimum of 3 days and were given a subacromial corticosteroid injection. Overall, 3 patients (11.4%) required later surgical treatment on the shoulder.
- 5) **CONCLUSION:** Rotator cuff contusions accounted for nearly half of all shoulder injuries in the football players in this study. Magnetic resonance imaging is an extremely useful tool in determining severity of injury and integrity of the rotator cuff. The majority of athletes are able to return to sports with conservative treatment; a minority of shoulders might progress to more severe injuries such as rotator cuff tears.

I. Treatment

- i. Most rotator cuff injuries may be treated conservatively by using regimens of nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, and functional rehabilitation therapy. (Bytomski, 2006)
 - 1) Surgical management is reserved for refractory cases that have exhausted conservative measures.
- ii. Initial conservative treatment
 - 1) Controversial for higher grade tears
- iii. Surgical repair and acromioplasty
 - 1) Despite the relative frequency of partial-thickness rotator cuff tears seen in baseball players, full-thickness rotator cuff tears in baseball players are uncommon. (Mazoue, 2006)
 - a) **HYPOTHESIS:** Return to competitive baseball is difficult after surgical treatment of a full-thickness rotator cuff tear.
 - b) **STUDY DESIGN:** Case series; Level of evidence, 4.
 - c) **METHODS:** We evaluated the results of 16 professional baseball players after a mini-open repair of a full-thickness rotator cuff tear. Twelve patients were pitchers with injury to their dominant shoulders. Four patients were position players; 2 had injuries involving their dominant shoulders, and 2 had injuries to their nondominant shoulders.
 - d) **RESULTS:** At a mean follow-up of 66.6 months for the pitchers, only 1 player (8%) was able to return to a high competitive level of baseball with no significant shoulder dysfunction after mini-open repair of a full-thickness rotator cuff tear. Of the 2 position players with mini-open repairs of the full-thickness rotator cuff tear of their dominant shoulders, 1 was able to return to professional baseball. Of the 2 position players with mini-open repairs of the full-thickness rotator cuff

tear of their nondominant shoulders, both were able to return to professional baseball at the same or higher level.

- e) CONCLUSION: It is very difficult for a professional baseball pitcher to return to a competitive level of pitching after a full-thickness rotator cuff repair with a mini-open approach.
- 2) Evaluate the long-term functional outcome of full thickness rotator cuff tears treated by open repair and acromioplasty and to determine various factors affecting the outcome. (Prasad, 2005)
- a) Prospective clinical study on 42 patients who underwent full thickness rotator-cuff repair by a single surgeon between 2000 and 2003. The mean follow-up was 26 months. In patients with massive rotator cuff tear (n = 15), increase in the mean postoperative Constant score was significantly less compared to patients with small and moderate tears ($p < 0.01$).
 - b) In patients older than sixty years, the improvement in postoperative Constant score was significantly less compared to the rest of the patients ($p < 0.001$). However, the postoperative Constant score significantly improved from the preoperative score in all patient groups ($p < 0.0001$).
 - c) There was a significant negative correlation with size of cuff tear, age of the patient and Constant-Murley score ($p < 0.05$). Body mass index, smoking, gender, and the duration of symptoms did not have a significant effect on either Constant-Murley score or visual analogue score.
 - d) Conclusion: Older patients and those with massive rotator cuff tear could benefit from surgical intervention, although not as much as younger patients and those with small/moderate size cuff tears.
- m. Injury prevention programs (Bytowski, 2006)
- i. Essential for the long-term care of patients with rotator cuff disease, for primary prevention, and for prevention of recurrent injuries, unless a traumatically torn rotator cuff is present

H. Less common problems

1. Recurrent posterior shoulder dislocation
- a. Recurrent posterior shoulder instability is often unrecognized, leading to incorrect diagnoses, delays in diagnosis, and missed diagnoses. (Millett, 2006)
 - i. Posterior instability encompasses a wide spectrum of pathology, ranging from unidirectional posterior subluxation to multidirectional instability to locked posterior dislocations.
 - ii. Nonsurgical treatment of posterior shoulder instability is successful in most cases; however, surgical intervention is indicated when conservative treatment fails.
 - iii. For optimal results, accurately define the pattern of instability and address all soft-tissue and bony injuries present at the time of surgery.
 - iv. Arthroscopic treatment of posterior shoulder instability has increased application, and a variety of techniques has been described to manage posterior glenohumeral instability related to posterior capsulolabral injury.
 - b. Review the results of posterior capsulorrhaphy in a consecutive series of patients with recurrent posterior instability (Shin, 2005)
 - i. Surgical treatment via a posterior approach has variable success with reported recurrence rates ranging between 8% and 45%

- ii. 17 consecutive male patients with an average age of 28.1 years (range: 16 to 54 years) underwent operative management for posterior glenohumeral instability
 - 1) Dominant shoulder was involved in 10 patients
 - 2) 10 had a specific injury which precipitated the instability
 - 3) 6 required formal closed reduction maneuvers
 - 4) Remainder described episodes of recurrent subluxation with spontaneous reduction
 - iii. All patients underwent a posterior capsulorrhaphy using an infraspinatus splitting approach
 - 1) 8 shoulders required repair of a posterior capsulolabral detachment
 - 2) 1 required augmentation with a posterior bone block for significant glenoid rim deficiency
 - iv. Outcomes assessed by personal interview, clinical assessment, and standardized radiographs
 - 1) Average follow-up of 3.9 years (range: 1.8 to 10.8 years)
 - 2) Self estimated overall shoulder function to be 81% of the contralateral unaffected shoulder
 - 3) Subjective result was excellent for 8, good for 5, fair in 2, and poor in 2
 - a) Poor outcomes
 - i) Patient with glenohumeral degenerative changes at the index procedure which progressed and eventually required a total shoulder arthroplasty
 - ii) Patient found to have a full-thickness rotator cuff tear 10.6 years after the index procedure
 - 4) 2 patients (12%) had recurrence of their instability
 - a) Both sustained a significant re-injury precipitating symptoms
 - 5) 5 complained of occasional night pain at last follow-up exam
 - 6) 1 who was re-injured had to change professions as a result of shoulder symptoms.
 - v. Conclusion: Posterior capsulorrhaphy for treatment of isolated posterior glenohumeral instability yields satisfactory clinical results. Recurrent instability in this series was associated with a specific re-injury and did not appear to increase with longer follow-up.
2. AC joint osteoarthritis
 3. Suprascapular nerve entrapment
 - a. Loss of muscle mass
 - b. Secondary impingement syndrome
 - c. Early diagnosis and intervention = better outcome
 4. Adhesive capsulitis
 - a. Common in elderly
 - b. Aggressive physical therapy
 5. Posterior capsule tightness
 - a. Posterior capsular tightness with glenohumeral internal rotation deficit
 - b. Considered to be an acquired condition of the throwing shoulder
 - c. Usually treated conservatively
 - d. Posterior capsular tightness is sometimes irreversible
 - e. Arthroscopic capsular release for painful throwing shoulder with posterior capsular tightness (Yoneda, 2006)
 - i. The true loss of internal rotation and posterior stiffness was confirmed by examination with the patient under anesthesia, and contracture of posterior

capsule and posterior band of the inferior glenohumeral ligament was observed arthroscopically.

- ii. Because an extensive adhesion between the capsule and the fascia of the external rotators was noted, a capsular release was performed from 6 o'clock to 11 o'clock (in the right shoulder) to completely expose the muscle belly of the external rotators.
- iii. Of the first 16 consecutive patients, 4 had no concomitant lesions and underwent posterior capsular release alone.
- iv. With a minimum of 2 years' follow-up, it was ascertained that the throwing pain completely disappeared in 14 patients and improved in 2. In all, 11 patients returned to their preinjury performance level, and 5 returned to a lower level of function.
- v. In the 4 patients who had no concomitant lesions, throwing pain completely disappeared, and all were able to return to their preinjury performance level.

6. Neurapraxia

- a. Transient posttraumatic paralysis of the motor and/or sensory tracts in the spinal cord
 - i. May be a career-ending event in an athlete.
- b. Management, rehabilitation, and return-to-play decisions remain controversial
- c. Surgical intervention (Maroon, 2007)
 - i. METHODS: Five elite football players were evaluated after experiencing episodes of neurapraxia.
 - ii. RESULTS: All patients experienced bilateral paresthesias--three in all four extremities and two in the upper extremities--lasting a few minutes to more than 24 hours. Transient motor deficits occurred in two individuals but caused no permanent sequelae. Neuroimaging confirmed the presence of herniated discs, focal cord compression, and no parenchymal changes in all cases. All patients underwent anterior cervical microdiscectomy and fusion, and cervical plates were placed in four. After aggressive rehabilitation and confirmation of fusion ranging from 9 weeks to 8 months postoperatively, the players were allowed to return to active play. Two of the players developed recurrent career-ending disc herniations, one above and the other below the fusion level. One player required repeated spinal cord decompression.
 - iii. CONCLUSIONS: Neurologically intact athletes with focal cord compression due to a single-level herniated disc may safely return to football after undergoing decompressive surgery and confirmation of fusion. It appears, however, that there may be an increased chance of repeated herniation above or below a fused level.

III. Elbow

A. Anatomy

1. Bones
 - a. Humerus
 - b. Radius-ulna
2. Ligaments
 - a. Medial (ulnar) collateral ligament
 - i. Anterior - strong, cord like
 - ii. Posterior - weaker, fan like
 - iii. Oblique
 - b. Lateral (radial) collateral ligament
 - c. Radial head annular ligament
3. Muscle tendon units

- a. Triceps, biceps, brachioradialis
- b. Wrist extensor group
- c. Wrist flexor group
- 4. Neurovascular bundles
 - a. Antecubital
 - b. Ulnar
- B. Biomechanics
 - 1. Hinge at olecranon-humerus
 - 2. Pivot (rotation) at radius-humerus
- C. Imaging
 - 1. Diagnostic imaging requires knowledge of overhead throwing biomechanics to understand specific injuries in throwing athletes (Ouellette, 2005)
 - a. Elbow typically injured secondary to excessive valgus forces during throwing
 - i. Ulnar collateral ligament, ulnar nerve, and common flexor tendon origin at increased risk of injury
 - ii. Capitellar osteochondral injuries and loose intra-articular bodies frequent
- D. Common acute elbow problems
 - 1. Common elbow injuries in baseball and softball (Wang, 2006)
 - a. Medial epicondylitis, ulnar collateral ligament injury, and osteochondritis dissecans
 - i. Conservative treatment with relative rest, medication, and a rehabilitation program will usually allow return to play
 - ii. Surgical intervention may be needed
 - 2. Fracture and dislocation
 - a. Elbow dislocation +/- fracture
 - i. Common wrestling injury
 - ii. Often lateral humerus dislocation
 - iii. Check pulses, if absent reduce immediately
 - iv. Associated fractures 5-10%
 - v. Document pre and post reduction CMS
 - b. Medial apophyseal fracture
 - i. Little league elbow
 - 1) Repeated plastic deformation from throwing
 - ii. Fall on outstretched arm
 - iii. Tender above one of the epicondyles
 - 1) Little league elbow on medial side
 - 2) Associated with "pop" during throw
 - iv. Plain film x-ray
 - v. Cast 3 weeks, surgery if >2mm gap or fragment is rotated
 - c. Suprachondylar fracture of humerus
 - d. Olecranon fracture
 - e. Antebrachial fracture
 - f. Monteggia fracture
 - 3. Soft tissue injury
 - a. Sprain is most common injury
 - b. Medial or ulnar collateral ligament (UCL) rupture (Langer, 2006)
 - i. Career threatening injury, particularly in overhead throwing athletes.
 - ii. Several clinical and basic science research efforts to investigate the pathophysiology of UCL disruption, the biomechanics specific to overhead throwing, and the various types of treatment modalities.
 - iii. UCL reconstruction is the most common surgical treatment

- iv. 30 years evolution of the original UCL reconstruction
- v. Despite the variability in modifications
 - 1) Docking technique, interference screw fixation, and use of suture anchors
 - 2) Improved outcomes still are related to decreased dissection of the flexor-pronator mass and decreased handling of the ulnar nerve.
- c. Distal biceps tendon rupture
 - i. Forceful extension from 90°
 - ii. Mostly men in dominant arm
 - iii. Rare
 - iv. Steroid users
- d. Triceps tendon rupture
 - i. Thompson test positive in full thickness tear
- e. Olecranon bursitis
 - i. Observe vs aspirate and inject
 - ii. Septic requires drainage and antibiotics
- f. Vascular and nerve injury
 - i. Acute with distal glove distribution
 - ii. Surgical emergency
- g. Posttraumatic stiffness
 - i. Capsule shrinks easily
 - ii. Degree related to severity of injury and length of immobilization
- E. Common overuse injuries
 - 1. Lateral epicondylalgia (Tennis elbow)
 - a. Tendonosis without inflammatory cells
 - i. Hence –algia rather than -itis
 - b. Repetitive and long term loading
 - i. Golfers, throwers, swimmers, fencers, baseball players
 - ii. Carpenters, factory workers, homemakers, travelers
 - c. Pain with activation of extensor muscles
 - d. Clinical diagnosis from history and exam
 - e. Treatment
 - i. Take stress of tendons with technique changes
 - ii. Stretch and strengthen
 - iii. Brace wrist
 - iv. Analgesics
 - v. Ice and cross friction massage
 - vi. Injection
 - vii. Surgery rare
 - 2. Medial epicondylalgia (Golfer's elbow)
 - a. Similar to lateral
 - b. Look at mechanics of activity
 - c. Golfers, tennis players (upper level), throwers
 - 3. Handball goalie's elbow
 - a. Shot blocking with hyperextended supinated elbow
 - b. Partial ligament tears
 - 4. Cartilage injury (Osteochondritis dissecans)
 - a. Loose bodies
 - b. Osteochondral autografts
 - i. Treat articular cartilage defects
 - ii. Used for unstable osteochondritis dissecans lesions as a means of biological fixation.

- iii. Evaluate the clinical results of osteochondral autograft transfer for osteochondritis dissecans of the elbow. (Yamamoto, 2006)
 - 1) STUDY DESIGN: Case series; Level of evidence, 4.
 - 2) METHODS: Osteochondral autograft transfer was performed on 18 baseball players (mean age, 13.6 years) with osteochondritis dissecans of the elbow. These included 9 lesions that were grade 3 (separated but in situ) and 9 lesions that were grade 4 (displaced fragment with osteochondral defect) based on magnetic resonance imaging. All patients were evaluated with a scoring system, radiographs, and magnetic resonance imaging, with the mean follow-up at 3.5 years.
 - 3) RESULTS: In patients with grade 3 lesions, the subjective score was increased, but the objective score did not change. Six of 9 patients returned to their previous sports performance levels. One quit baseball because of academic reasons, 1 changed his position, and 1 changed to softball. In patients with grade 4 lesions, both subjective and objective scores were increased significantly. All but 1 patient returned to their previous sports performance levels. In the 3 grade 4 lesions with a wide osteochondral defect, the irregularity of the articular surface remained on magnetic resonance imaging.
 - 4) CONCLUSION: Osteochondral autograft transplantation is a useful treatment for reattachment of the lesion as well as osteochondral resurfacing of elbow osteochondritis dissecans.
5. Triceps tendonosis
 - a. Pain and tenderness at triceps junction on the olecranon
 - b. Stretch and strengthen
 - c. Inject near tip of olecranon
 - i. Not into tendon
6. Snapping triceps
 - a. Ulnar nerve subluxation
 - b. Anomalous triceps tendon
7. Ulnar nerve entrapment
 - a. Nerve entrapment at elbow in ulnar groove
 - b. Paresthesia and numbness in digits 4 and 5
 - c. Positive Tinel's over ulnar groove
 - d. Treat with relative rest and avoid activities that provoke symptoms
8. Radial nerve entrapment
 - a. Symptoms like lateral epicondylitis
 - b. Pain worse at night
 - c. Muscle weakness
 - d. Tender deep in muscle 2 cm distal and 2 cm medial to lateral epicondyle
 - e. Pain is increased with resisted supination
 - f. Pain with extending middle finger against resistance with straight arm
9. Median nerve entrapment
 - a. Compression sites – Ligament of Struthers, within pronator teres, at anterior interosseous nerve, or in the carpal tunnel
 - b. Proximal forearm weakness, discomfort, and pain
 - c. Worsened by pronation and weight lifting
 - d. Decreased skin sensation late in course
 - e. Positive Tinel's sign over anterior interosseous nerve
 - f. Painful lump in forearm
 - g. Pain with resisted flexion of middle finger (elbow at 90°)

- h. Treat with rest and alternate activity
 - i. If fails, surgical release
- 10. Chronic compartment syndrome
 - a. Static prolonged muscle contraction
 - b. Differentiate from radial or medial nerve entrapment
 - c. Gradually progressive cramp in extensor compartment with weakness and paresthesias in forearm and fingers
 - d. Rapidly relieved by rest
 - e. Pressure testing false negatives
 - f. Fasciotomy successful
- 11. Chronic olecranon bursitis
 - a. Tender and swollen over bursa
 - b. Inject with corticosteroid
 - c. Surgical excision
- 12. Ulnar (Olecranon) stress fracture
 - a. Usually in mid olecranon area
 - b. MRI to make diagnosis
 - c. Conservative treatment often fails and surgical intervention necessary
 - d. Adolescent athletes participating in overhead throwing sports develop nonunion stress fractures of the olecranon across the epiphyseal plate (Retig, 2006)
 - i. STUDY DESIGN: Case series; Level of evidence, 4.
 - ii. METHODS: Five adolescent baseball pitchers (mean age, 15 years) who suffered chronic elbow pain and who were diagnosed with olecranon epiphyseal stress fracture nonunions were treated with open reduction and internal fixation using a 7.0 cancellous screw and washer with or without 18-gauge tension banding.
 - iii. RESULTS: Return to preoperative range of motion was achieved at a mean of 8.6 weeks (range, 3.4-16.6 weeks). Patients were clinically asymptomatic at a mean of 11 weeks (range, 7.7-13.6 weeks) after surgery. Radiographic evidence of stress fracture union was achieved at a mean of 15.4 weeks (range, 6.1-33 weeks), including 1 patient with a delayed union according to radiographs, which healed at 33 weeks. Patients were started on a light strengthening program at 5 to 7 weeks and a throwing progression program at 15.6 weeks (range, 6.4-28.1 weeks). All 5 patients were able to return to their previous level of activities, with a mean return time of 29.4 weeks (range, 18.9-40.4 weeks).
 - iv. CONCLUSION: Surgical management of olecranon apophysis stress fractures provided excellent results with minimal complications in this series of 5 consecutive cases.

IV. Summary

- A. Anatomy and biomechanics shape diagnosis and treatment plan
- B. Accepted treatment strategies not all evidence based and some in flux
- C. Core strength essential to shoulder function
- D. Surgical role seems to be increasing
- E. Overuse, improper use, and trauma contribute to causes
- F. Return to play when biomechanics and function normal

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