



## **Sports Medicine and the Emergency Physician**

Patients with athletic injuries are commonly seen in the emergency department, and the emergency physician must be familiar with the presentation and management of these problems. This lecture will review the diagnosis and management of common sports injuries. The presenter will also discuss the growth of sports medicine as a specialty and the opportunities it presents for emergency physicians.

- Discuss the management and disposition of an athlete with a concussion.
- Recognize and manage common sports-related extremity injuries.
- Discuss the role of the team physician and on-field care of athletes and the opportunities for emergency physicians in this field.

MO-07

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Room # N219

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## **FACULTY**

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**SPORTS MEDICINE  
AND  
THE EMERGENCY PHYSICIAN**

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**06/99**

**A. OBJECTIVES**

- ◆ Discuss the management and disposition of an athlete with a concussion.
- ◆ Recognize and manage common sports-related extremity injuries.
- ◆ Discuss the role of the team physician and on-field care of athletes and the opportunities for emergency physicians in this field.

### **Emergency Medicine and Sports Related Injuries**

- ◆ Incidence: 2-3% of all ED visits
- ◆ Mechanism of Injury: Majority - Traumatic  
(Collision)  
Few - Overuse (Repetitive Stress)
- ◆ Age and Gender:
  - Second and third decade
  - Males > Females
- ◆ Patterns and Description of Injuries
  - Anatomic distribution: Face, neck, shoulder, knee, ankle, etc.
  - Sport specific: Football, basketball, hockey, etc.
  - **Types of injuries - Traumatic:**
    - Fractures, dislocations, sprains, strains, lacerations, contusions, apophyseal avulsions
    - Overuse: Bursitis, tendinitis, capsulitis, synovitis, apophysitis

### **Diagnosis and Management of Common Sports Related Injuries**

#### **A. Head Injuries - Care of Concussions**

- ◆ 300,000 TBI's year
- ◆ **Mechanism**
  - Direct blow: 'Collision' sports
- ◆ NCAA: Concussion rate:
  - Hockey: .49/1000
  - Football: .31/1000
- ◆ High School:
  - Hockey 10%
  - Football 20%
- ◆ 90% No LOC
- ◆ **Pathophysiology: Concussion**
  - Traumatic alteration of consciousness
  - Severity: Duration of LOC and/or presence of Post Traumatic Symptom (PTS)

- LOC does not need to occur

**B. Classification: Concussion Severity Scale  
(Cantu-86)**

- ◆ Grade:
  - 1 - No LOC, PTS < 30 min
    - Many go unreported
  - 2 - LOC < 5 min, PTS > 30 min < 24 hrs
  - 3 - LOC > 5 min, PTS > 24 hrs
- ◆ GCS -13 -15
- ◆ 'Normal' neurologic exam  
Traumatic

**C. Concussion Severity - AAN 1997**

- ◆ Grade:
  - 1 - Confusion, no LOC, abnormal mental status < 15 minutes
  - 2 - Confusion, no LOC, abnormal mental status > 15 minutes
  - 3 - Any LOC (seconds to minutes)

**D. Management and Treatment (Cantu 86)**

- ◆ Grade 1 - Remove from competition/training
  - Examine immediately and every 5 minutes
  - Return: asymptomatic

If First Concussion

- ◆ Grade 2 - Remove
  - Examine and re-examine
  - Return: after asymptomatic for 1 week
- ◆ Grade 3 - Transport from competition/training
  - **Helmet on** (C-Spine immobilization)
  - ED evaluation
  - Return: after asymptomatic: 1 month

**E. Return to Play (AAN 1997)**

- ◆ Grade:
  - 1 - Return when normal
  - 2<sup>nd</sup> - No return for one week until asymptomatic
  - 2 - One week - Asymptomatic
    - 2<sup>nd</sup> - Two weeks asymptomatic
  - 3 - ED evaluation
    - Admit - Abnormal MS
    - 1<sup>st</sup> - Return two weeks asymptomatic
    - 2<sup>nd</sup> - Return one month asymptomatic

**F. Return to Competition Guideline: Determined by:**

- ◆ Severity of initial injury
- ◆ Severity of PTS (PTA)
- ◆ Previous history of head trauma
- ◆ Second concussion: one month, third concussion: out for season

**G. Complications: Impossible to accurately predict which patients will deteriorate**

- ◆ PTS: 50%
- ◆ Second Impact Syndrome (SIS) (17 cases:92-96)
  - Athlete: a second (minor) head injury prior to resolution of the initial symptoms
  - Clinically: Sudden collapse followed by rapid brain swelling and herniation with or without intracranial hemorrhage

**H. Pitfalls:**

- ◆ Several Classifications Sysytems and Management Guidelines
  - Cantu - 1986
  - Colorado Medical Society - 1990
  - Academy of Neurology - **1997**
- ◆ Players often mislead examiners
- ◆ Mild concussions often go unnoticed
- ◆ Sequester equipment: Take helmet away
- ◆ Coaches and parents don't understand

**Cervical Injuries****A. Incidence:**

- ◆ 10-15% of all spinal fractures due to sport (4th freq)
- ◆ 40-50% have associated neurologic injury (2nd freq) (50% quad)
- ◆ Diving: Highest incidence of fractures
- ◆ Football: 25% neck injuries (HS and college)
  - 34 cases quadriplegic 1975

- 5 cases quadriplegic 1984
- Decrease due to: rule changes, equipment changes

## B. Predisposing Factors:

- ◆ Tackling techniques: Spearing  
Face tackling
- ◆ Spinal stenosis (Sagittal Spinal Canal Diameter)
  - Torg Ratio 1986:
  - Vertebral canal/vertebral body ratio
    - < 0.80
    - < 14mm
- ◆ Value Recently?

## C. Brachial Plexus Syndrome

- ◆ Stingers/Burners:
- ◆ Transient Brachial Plexopathy (C5-T1)
  - 50% college football players
  - 50% recurrence rate
- ◆ Mechanism: Traction with lateral neck flexion vs compression
  - C5-C6 most common
- ◆ Predisposing factors:
  - Cervical ribs
  - Previous injury with radiographic evidence
    - degenerative changes
- ◆ Hx and PE:
  - Burning in arm and shoulder (unilateral)
  - Usually resolve 5-10 minutes eg.
    - Bilateral symptoms - ominous
  - Remove from play
  - Re-examine
- ◆ Radiographic Evaluation:
  - Plain films (AP, odontoid, lateral)
    - 32% of college freshmen have X-ray evidence of previous injury
  - CT, MRI
    - Indications - Inadequate plain films
    - Transient or permanent neurologic deficits
- ◆ Return to Sport: Criteria Depend On:
  - Sensory/Motor abnormalities
  - Severity and duration of symptoms
  - Prevention: Neck strengthening

## Neck rolls and collars

**D. Special Topic: Helmet Removal**

- ◆ Leave Helmet On
  - Difficult to remove
  - Aids in immobilization and proper alignment
    - Eval airway integrity
- ◆ Remove Facemask
  - Bolt cutters
  - Screwdriver

**Shoulder Injuries****A. AC Joint Injuries**

- ◆ **12% of all Shoulder Injuries**
- ◆ **Mechanism:** Direct blow
- ◆ **Classification:** Degree of AC and CC ligament injury
  - 1st Degree: Contusion
    - Partial disruption AC ligaments
  - 2nd Degree: Complete AC ligament disruption
    - Subluxation (< 1 cm subluxation)
  - 3<sup>rd</sup> Degree: Complete AC and CC ligament disruption
    - Types IV-VI
      - Amt of: CC separation
      - Deltotrapezius injury
      - Position of the distal clavicle
- ◆ **Diagnosis:** PE and Radiographs (stress views)
- ◆ **Treatment:**
  - 1st and 2nd: Sling, isometrics 3-7 days, P and AROM 2-3 weeks
  - 3rd: Sling vs ORIF

**B. Traumatic Impingement**

**Definition:** Impingement of the periarticular soft tissue b/t the greater tuberosity of the humerus and the coracoacromial arch

- ◆ **Mechanism:**
  - Fall on outstretched hand
  - Fall onto proximal humerus
- ◆ **PE:**
  - GH pain and tenderness
  - Weakness
  - Jobe's Test



- ♦ **X-rays:**
  - Normal
- ♦ **Treatment:**
  - Ice, NSAID's, modified rest
- ♦ **Beware of associated Rotator Cuff Tear (RTC)**

### Hand Injuries

#### **A. Skier's (Gamekeepers) Thumb**

- ♦ **Ulnar collateral ligament injury 1<sup>st</sup> MCP joint**
- ♦ **Mechanism:**
  - Valgus (abduction) stress
  - Partial vs complete ligament injury
  - Stener lesion
  - 50% of complete ruptures
- ♦ **PE:**
  - Painful
  - Swollen joint of thumb
  - Joint instability?
- ♦ **Radiographically:**
  - Avulsion fx
  - Fx base proximal phalanx
  - Fx of volar plate: intra-articular
- ♦ **Treatment:**
  - Thumb spica (immediate and partial tears)
  - Complete tears: ORIF (delayed)

#### **B. Mallet Fingers - 'Baseball Fingers'**

- ♦ **Flexion deformity of the DIP:**
  - Loss of ext tendon continuity
- ♦ **Mechanism:** Forced flexion of DIP
- ♦ **PE:**
  - Tender dorsum DIP
  - Flexor deformity
- ♦ **Radiographically:**
  - Neg vs. avulsion fx
- ♦ **Treatment:**

- Splint (extension) 6-8 weeks
- ORIF: Selected cases

### LOWER EXTREMITIES

#### A. Hip Injuries

- ◆ **Apophyseal Avulsion Fractures**
  - Often track and field athletes
- ◆ **Hx and PE:** Tenderness over anatomic site
  - ASIS - Sartorius
  - AIIS - Rectus Femoris
  - Ischial Tub - Hamstrings
  - Greater Trochanter - Gluteal
  - Lesser Trochanter - Psoas
- ◆ **Radiographically:** AP pelvis with obliques
- ◆ **Treatment:** Crutches, weight bearing as tolerated, RICE

#### B. Quadriceps Contusions (Strains)

- ◆ **Sports:** Soccer, Football, Rugby, Track and Field
- ◆ **Mechanism:** Direct blow, sudden deceleration
- ◆ **Hx and PE:** Pain, swelling, limited ROM
- ◆ **Grades:**
  - 1 - Minimal disruption: ROM  $> 90^{\circ}$
  - 2 - Tearing with hemorrhage: ROM  $45-90^{\circ}$
  - 3 - Complete loss of continuity and function:  $< 45^{\circ}$
- ◆ **Treatment:** Acute (24-48 hrs)
  - Flex to maximum position, RICE
  - Subacute (2-5 days)
    - Stretching (PROM)
    - Isometrics
    - Elec stim
      - Weight bearing as tolerated
  - Rehab: Return to sport
    - AROM:  $10^{\circ}$  of normal
    - Strength  $90^{\circ}$
    - Pad
- ◆ **Complications:**
  - Sympathetic knee effusion
  - Compartment Syndrome - rare
  - Myositis Ossificans - 25%

## C. The Knee

- ◆ Incidence: Knee ligament injuries common in sports
  - Football - NCAA: 1 major knee injury per team/year
  - Basketball - Epidemic in women?
- ◆ Ligament Injuries:
  - Anterior Cruciate (ACL): Common
  - Posterior Cruciate (PCL): Dashboard injury
  - Medial Collateral (MCL): Common
  - Lateral Collateral (LCL): Rarely injured
- ◆ Mechanism:
  - ACL:
    - Valgus/deceleration/external rotation
    - Hyperextension
    - Post/ant force to a flexed knee
    - 78% non-contact: Noyes-JBJS 1983
  - PCL: Ant/post force to a flexed knee
  - MCL: Valgus
  - LCL: Varus
- ◆ Classification: Sprain
  - Grade:
    - 1 - Stretch
    - 2 - Partial tear: Majority progress to complete tear
    - 3 - Complete tear
- ◆ Hx and PE:
  - ACL:
    - 65% felt/heard pop
    - 92% acute hemarthrosis
    - Instability: Giving way
    - Beware - Traumatic hemarthrosis without fracture is ACL until proven otherwise
  - MCL: Medial knee pain and swelling
- ◆ Ligament Testing (compare with normal knee)
  - ACL: Anterior translation
  - Lachman's Test (90%)
    - Partial vs. complete >10mm
  - Anterior drawer (50%)
  - Instrument Testing: KT 1000
  - PCL: Posterior drawer
    - Quad active drawer
  - MCL: Valgus stress
  - LCL: Varus stress

## D. Acute Traumatic Knee Hemarthrosis (Effusion)

- ◆ Differential Diagnosis
  - Fracture (patella, tibial plateau)
  - Avulsion fx: Tibial spine, Segond (10% ACL)
  - Osteochondral fx

- Patella dislocation (subluxation)
- ACL/PCL rupture
- Meniscal injury (50% ACL)
- Epiphyseal disruption

◆ **Radiographically:**

- Plain films: Ottawa, Bauer Criteria
- MRI: Excellent for ligaments, cartilage, bone bruises

◆ **Complications:**

- Acute:
  - Knee dislocation (occult): 3 ligament tear
  - Popliteal Artery injury
  - Missed injury
- Chronic:
  - Instability
  - Cartilage tears
  - Degenerative changes

◆ **Treatment**

- Acute:
  - Ice
  - (1-7 days) NSAID's
  - Jones dressing vs. knee immobilizer
  - PT: Elec stim, cryotherapy
- Sub Acute:
  - Isometrics
  - (7-14 days) Cycling, swim
  - Brace (hinged)
- Chronic: MCL
  - Brace: 8-12 weeks
  - Return to play: 4-8 weeks
- ACL
  - Surgery vs conservative (hamstring strengthening, brace)
  - Noyes: 'Rule of Threes'
  - Decision based on:
    - Age
    - Occupation
    - Ligamentous laxity
    - Associated injuries
    - Athlete's activity
      - High demand: BB, soccer, vb, gymnastics
      - Moderate demand: Skiing, tennis
      - Low Demand: Jogging, skiing

**E. The Ankle**

◆ **Incidence:**

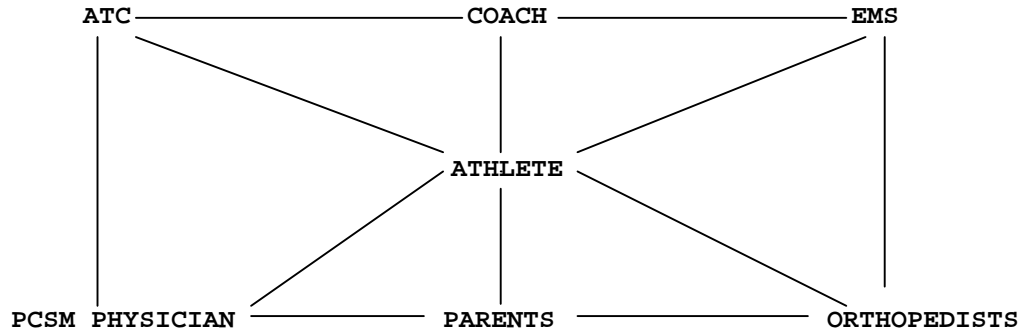
- Ligament Sprains
  - 14% of all sports related problems
  - 6 per 100 participants per season
  - 25% of all time loss in running and jumping sports

- 50% of injuries in basketball
- ♦ **Mechanism:** Inversion and Plantar Flexion
  - 85-95% of isolated sprains: lateral ligaments
  - Eversion: More serious (often assoc fxs)
  - IOM damage (diastasis)
- ♦ **Classifications:**
  - Grade 1: Stretch
  - Grade 2: Partial tear
  - Grade 3: Complete tear
- ♦ **Hx and PE:** ? Of previous injury
  - Ability to bear weight
    - Run - 1st Degree
    - Walk - 2nd Degree
    - Unable - 3rd Degree
  - Swelling and ecchymosis
  - Ligament testing
    - Anterior drawer: ATF
    - Squeeze test - Syndesmotic
- ♦ **Radiographically:** Ottawa criteria
  - "No STS, No X-ray":
  - Standard: AP, lat, mortise
- ♦ **Treatment:** Grade I-II:
  - Acute (1-5 days):
    - Aggressive RICE, brace (taping vs orthotic)
  - Sub Acute (5-10 days):
    - AROM
    - Strengthening
    - Balance
    - Alternative exercise
    - Brace
  - Chronic (> 10 days):
    - Strengthening
    - Jogging, sprinting
  - Grade III:
    - Conservative (as above) vs surgery
- ♦ **Complications:** T-F Diastasis
  - Occult Fracture - Persistent pain and swelling
  - Peroneal Subluxation
  - Chronic Instability

## F. Foot Injury

- ♦ **Common Types:**
  - Fx 5th Metatarsal (MT)
    - Jones Fx (proximal diaphysis)
    - Avulsion (tuberosity) Fx
  - LisFranc's Tarsometatarsal (MT-T) Fx - Dislocation/Sprain
    - 20-40% missed (2nd-3rd MT-T articulation)

- ◆ **Mechanism:** Inversion
  - Avulsion fx: Peroneal tendon avulses tuberosity
  - Jones Fx: Inversion injury
  - LisFranc's: Forceful plantar flexion or direct blow
  
- ◆ **Treatment:**
  - Avulsion fx
    - Protected Mobilization
  - Jones
    - 6-8 weeks non-weight bearing cast immobilization vs. screw fixation (ORIF)
  - LisFranc's
    - Cast immobilization vs. ORIF

Special Topics:A. The Team Physician and Sports Medicine Team

"Know the Athletes and the sport"

B. Practice Opportunities for the PCSM Physician

- ◆ Volunteer: Most: USOC, Special Olympic, community, HS, college
- ◆ Paid
  - Private practice
  - Professional teams
  - Collegiate teams (Div I, II)

C. Board Certification (CAQ) and Fellowship Training

- ◆ Combined Certification Exam: ABFP, ABEM, ABIM, ABP
  - CAQ: Start 1993, Next Exam 1999
  - Pathways
    - Fellowship (see list)
    - Practice tract (5 years-closed 1999)

Table 1:

What to take to the game

**BB and C-Spine immobilizer**

**Diagnostic Tools:**

Gloves, tongue blade, penlight, Q-tips, stethoscope, safety pins, reflex hammer

**Resus Tools:**

Oral airway, pocket mask

**Surg Tools and Bandages:**

Bandage scissors, syringes (5-10cc), needles (25g-21g-18g), suture set, nylon suture (4-0, 5-0, 6-0), iris scissors, splints, forceps, eye patch, bandaids, 2x2, 4x4 sterile, sling, finger splints, felt pads, crutches

**Meds:**

Lidocaine (with epi), Dextrose gel, Ibuprofen, Tylenol, Epinephrine (1:1000)

**Other Supplies:**

Tape - 2" Adhesive  
2" Elastic  
Prewrap



REFERENCES

1. Albright JP, Moses JM, Feldick HG, et al: Nonfatal Cervical Spine Injuries in Interscholastic Football. JAMA 1976;236(11):1243-1245.
2. Arendt E, Dick R: Knee Injury Patterns Among Men and Women Collegiate Basketball and Soccer. Am J Sports Med 1995; 23(6):694-701.
3. Aronen JG, Chronisten RD: Quadriceps Contusions. Phy Sports Med 1992; 20(7):130-136.
4. Bach BR, Van Fleet TA, Novak PJ: Acromioclavicular Injuries. Phy Sports Med 1992; 20(12):87-101.
5. Bergfield JA, Hershman E, Wilbourne A: Brachial Plexus Injury in Sports: A Five Year Follow-up. Orthop Trans 1988; 12:743-744.
6. Bishop PJ: Factors Related to Quadriplegic in Football and the Implications for Intervention Strategies. Am J Sports Med 1996; 24:235-239.
7. Blevins FT, Hayes WM, Warren RF: Rotator Cuff Injury in Contact Athletes. Am J Sports Med 1996; 24(3):263-267.
8. Brukner P, Khan K: Clinical Sports Medicine. McGraw Hill, NY NY, 1993.
9. Buss DD, Min R, Skylon M, et al: Nonoperative Treatment of Acute Anterior Cruciate Ligament Injuries in a Selected Group of Patients, Am T Sports Med 1995; 23(2):160.
10. Cantu RC: Cervical Spinal Stenosis. Phys Sports Med 1993; 21(9):57-63.
11. Cantu RC: Guidelines for Return to Contact Sports After a Cerebral Concussion. Phys Sport Med 1986; 14(10):75-83.
12. Cantu RC, Voy R: Second Impact Syndrome - A Risk in any Sport. Phys Sports Med 1995; 23:27-34.
13. Center for Disease Control and Prevention: Sports-related Recurrent Brain Injuries. United States. MMWR 1997; 46(10):224-227.
14. Clancy WG Jr, Brand RL, Bergfield JA: Upper Trunk Brachial Plexus Injuries in Contact Sports. Am J Sports Med 1977;5(5):209-216.
15. Clark TWI, Janzen, DL, Ho K, et al: Detection of Radiographically Occult Ankle Fractures Following Acute Trauma: Positive Predictive Value of an Ankle Effusion. AJR 1995; 64(5):1185-1189.
16. Cockshott WP, Jenkin JR, Poi M: Limiting Use of Routine Radiography for Acute Ankle Injuries. Can Med Assoc J 1983; 129:121.
17. Colorado Medical Society: Guidelines for the Management of Concussion In Sports. Sports Medicine Committee, Colorado Medical Society, May 1990.
18. Curtis MJ, Myerson M, Suzura B: Tarsometatarsal Joint Injuries in the Athlete. Am J Sports Med 1993; 21:297.

REFERENCES

19. Delacey G, Bradbrooke S: Rationalizing Request for X-Ray Examination of Acute Ankle Injuries. *Br Med J* 1979; 1:1597.
20. Donovan PJ, MacIntyre J: Emergency Department Patients with Sports Related Injuries: A Community Hospital Experience. Abstract Presented AMSSM, June, 1994.
21. Donovan PJ, Paulos LE: Common Injuries of the Shoulder: Diagnosis and Treatment. *West J. Med* 1995; 163:351-359.
22. Englanoff G, Anglin D, Jutson HR: Lisfranc Fracture-Dislocation: A Frequently Missed Diagnosis in the Emergency Department. *Ann Emerg Med* August 1995; 26:229-233.
23. Faciszewski T, Burks RT, Manasten BJ: Subtle Injuries of the Lisfranc Joint. *J Bone Joint Surg* 1990; 72:1519-1522.
24. Gelb HJ, Glasgow SG, Sapega AA, Torg JS: Magnetic Resonance Imaging of Knee Disorders. *Am J Sports Med* 1996; 24(1):99-103.
25. Herzog RJ, Wiens JJ, Dillingham MF, et al: Normal Cervical Spine Morphometry and Cervical Spinal Stenosis in Asymptomatic Professional Football Players: Plain Film Radiography, Multi-planar Computed Tomography, and Magnetic Resonance Imaging. *Spine* 1991; 16(6 suppl):S178-S186.
26. Hillard-Sembell D, Daniel DM, Stone ML, et al: Combined Injuries of the Anterior Cruciate and Medial Collateral Ligaments of the Knee. *J Bone and Joint Surg* 1996; 78(2):169-174.
27. Holmes CA, Bach BR: Knee Dislocations. *Phy Sports Med* 1995; 23(11):69-83.
28. Kelly JP, Rosenberg JH: Practice Parameter: The Management of Concussion in Sports (summary statement). *Neurology* 1997; 48(3):581-585.
29. Lambert MJ, Flinger, DJ: Avulsion of the Iliac Crest Apophysis: A Rare Fracture in Adolescent Athletes. *Ann Emerg Med* 1993; 22(7):143-145.
30. Loomer R, Fisher C, Lloyd-Smith R, et al: Osteochondral Lesions of the Talus. *Am J Sports Med* 1993; 21:13.
31. MacIntyre JG, Tauton JE, et al: Running Injuries: A Clinical Study of 4173 Cases. *Clin J Sports Med* 1991; 1:81-87.
32. Matelic TM, Aronsson DD, Boyd DW, Lamont RL: Acute Hemarthrosis of the Knee in Children. *Am J Sports Med* 1995; 23(6):668-671.
33. Matheson GO, Clement DB, McKenzie DC, et al: Stress Fractures in Athletes: A Study of 320 Cases. *Am J Sports Med* 1987; 15:46-58.
34. McGrew C, Lillegard W, et al: Profile of Patient Care in a Primary Care Sports Medicine Fellowship. *Clin J Sports Med* 1992; 2:126-131.

REFERENCES

35. Moellar JL, Lamb MM: Anterior Cruciate Ligament Injuries in Female Athletes. *Phy Sports Med* 1997; 25(4):31-48.
36. Nisonson B: Anterior Cruciate Ligament Injuries. *Phy Sports Med* 1991; 19(5):82-89.
37. Nissen SJ, Laskowski ER, Rizzo TD: Burner Syndrome. *Phy Sports Med* 1996; 24(6):57-64.
38. Noyes FR, Matthews DS, Mooar PA, et al: The Symptomatic Anterior Cruciate-Deficient Knee. Part 1 and Part 2 1983; 154-174.
39. O'Shea KJ, Murphy KP, et al: The Diagnostic Accuracy of History, Physical Examination and Radiographs in the Evaluation of Traumatic Knee Disorders. *Am J Sports Med* 1996; 24:164-167.
40. Patel MN, Rund DA: Emergency Removal of Football Helmets. *Phy Sports Med* 1994; 22(9):57-59.
41. Pavlov H, Torg, JS, Robie B, et al: Cervical Spinal Stenosis: Determination with Vertebral Body Ratio Method. *Radiology* 1987; 164(3):771-775.
42. Pienkowski D, McMorrow M, et al: The Effect of Ankle Stabilizers on Athletic Performance. *Am J Sports Med* 1995; 23:757-762.
43. Putukiam M, Echemendia R: Managing Successive Minor Head Injuries. *Phy Sports Med* 1996; 24(11):25-38.
44. Reid DC: Sports Injury Assessment and Rehabilitation. Churchill Livingstone NY NY, 1992.
45. Reid DC, Saboe L: Spinal Trauma in Sports and Recreation. *Clin J Sports Med* 1991; 1:75.
46. Saunders RL, Harbaugh RE: The Second Impact in Catastrophic Contact-Sports Head Trauma. *JAMA* 1984; 252(4):538-539.
47. Shirakura K, Terauchi M, Kizuki S, Moro S, Kimura M: The Natural History of Untreated Anterior Cruciate Tears in Recreational Athletes. *Clin Ortop* 1995; 317:227-236.
48. SooHoo NF, Rosen P: Diagnosis and Treatment of Rotator Cuff Tears in the Emergency Department. *J Emg Med* 1996; 14(3):309-317.
49. Stiell IG, Greenberg GH, Wells GA, et al: Prospective Validation of a Decision Rule for the Use of Radiography in Acute Knee Injuries. *JAMA* 1996; 275(8):611-615.
50. Sugerman D, MacIntyre J: Clinical Significance of Early Hemarthrosis on Knee Injuries: A Prospective Study. Abstract Presented AMAAM, April, 1995.

REFERENCES

51. Torg JS, Naranja RJ Jr, Pavlov H, et al: The Relationship of Developmental Narrowing of the Cervical Spinal Canal to Reversible and

## NOTES

- Irreversible Injury of the Cervical Spinal Cord in Football Players. An Epidemiological Study. J Bone Joint Surg 1996; 78A:1308-1314.
52. Torg JS, Pavlov H, Genuario SE, et al: Neurapraxia of the Cervical Spinal Cord with Transient Quadriplegia. J Bone Joint Surg (Am) 1986; 68(9):1354-1370.
  53. Voak Lander DC, Brisen RJ, et al: Ice Hockey Injuries Treated in Two Emergency Department Clinics. J. Sports Med 1994; 4:25-30.
  54. Whitelaw GP, Wetzler, MJ, et al: A Pneumatic Leg Brace for the Treatment of Tibial Stress Fractures. Clin Ortho and Related Research 1991; 270:301-305.
  55. Zogley RG, Baker BE: A Review of Non-Operative Treatment of Jones's Fracture. AJSM, 15:304, 1987.