Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Chapter 24: The Forearm, Wrist, Hand, and Fingers**

**Guided Notes**

Blood and Nerve Supply

* Most of the flexors are supplied by the median nerve
* Most of the extensor are controlled by the radial nerve
* Blood is supplied by the radial and ulnar arteries

Recognition and Management of Injuries to the Forearm

* Contusion
  + Etiology
    - Ulnar side receives majority of blows due to arm blocks
    - Can be acute or chronic
    - Result of direct contact or blow
  + Signs and Symptoms
    - Pain, swelling and hematoma
    - If repeated blows occur, heavy fibrosis and possibly bony callus could form w/in hematoma
  + Management
    - Proper care in acute stage involves RICE and followed up w/ additional cryotherapy
    - Protection is critical - full-length sponge rubber pad can be used to provide protective covering
* Forearm Fractures
  + Etiology
    - Common in youth due to falls and direct blows
    - Ulna and radius generally fracture individually
    - Fracture in upper third may result in abduction deformity due pull of pronator teres
    - Fracture in lower portion will remain relatively neutral
    - Older patients may experience greater soft tissue damage and greater chance of paralysis due to Volkmann's contracture
  + Signs and Symptoms
    - Audible pop or crack followed by moderate to severe pain, swelling, and disability
    - Edema, ecchymosis w/ possible crepitus
  + Management
    - Initially RICE followed by splinting until definitive care is available
    - Long term casting followed by rehab plan
* Colles’ Fracture
  + Etiology
    - Occurs in lower end of radius or ulna
    - MOI is fall on outstretched hand, forcing radius and ulna into hyperextension
    - Less common is the reverse Colles’ fracture (Smith fracture)
      * Anterior displacement of distal fragment
    - Intraarticular fracture is referred to as a Barton fracture
  + Signs and Symptoms
    - Forward displacement of radius causing visible deformity (silver fork deformity)
    - When no deformity is present, injury can be passed off as bad sprain
    - Extensive bleeding and swelling
    - Tendons may be torn/avulsed and there may be median nerve damage
  + Management
    - Cold compress, splint wrist and refer to physician
    - X-ray and immobilization
    - Severe sprains should be treated as fractures
    - In children, injury may cause lower epiphyseal separation

Blood and Nerve Supply

* Three major nerves
  + Ulnar, median and radial
* Ulnar and radial arteries supply the hand
  + Two arterial arches (superficial and deep palmar arches)
* Special Tests
  + Tinel’s Sign
    - Produced by tapping over transverse carpal ligament
    - Tingling, paresthesia over sensory distribution of the median nerve indicates presence of carpal tunnel syndrome
  + Phalen’s Test
    - Test for carpal tunnel syndrome
    - Position is held for approximately one minute
    - If test is positive, pain will be produced in region of carpal tunnel
  + Valgus/Varus and Glide Stress Tests
    - Tests used to assess ligamentous integrity of joints in hands and fingers
    - Valgus and varus tests are used to test collateral ligaments
    - Anterior and posterior glides are used to assess the joint capsule
  + Circulatory and Neurological Evaluation
    - Hands should be felt for temperature
      * Cold hands indicate decreased circulation
    - Pinching fingernails can also help detect circulatory problems (capillary refill)
    - Allen’s test can also be used
      * Patient is instructed to clench fist 3-4 times, holding it on the final time
      * Pressure applied to ulnar and radial arteries
      * Patient then opens hand (palm should be blanched)
      * One artery is released and should fill immediately (both should be checked)
    - Hand’s neurological functioning should also be tested (sensation and motor functioning)
* Functional Evaluation
  + Range of motion in all movements of wrist and fingers should be assessed
  + Active, resistive and passive motions should be assessed and compared bilaterally
    - Wrist - flexion, extension, radial and ulnar deviation
    - MCP joint - flexion and extension
    - PIP and DIP joints - flexion and extension
    - Fingers - abduction and adduction
    - MCP, PIP and DIP of thumb - flexion and extension
    - Thumb - abduction, adduction and opposition
    - 5th finger - opposition

Recognition and Management of Injuries to the Wrist, Hand, and Fingers

* Wrist Sprains
  + Etiology
    - Most common wrist injury
    - Arises from any abnormal, forced movement
    - Falling on hyperextended wrist, violent flexion or torsion
    - Multiple incidents may disrupt blood supply
  + Signs and Symptoms
    - Pain, swelling and difficulty w/ movement
  + Management
    - Refer to physician for X-ray if severe
    - RICE, splint and analgesics
    - Have patient begin strengthening soon after injury
    - Tape for support can benefit healing and prevent further injury
* Triangular Fibrocartilage Complex (TFCC) Injury
  + Etiology
    - Occurs through forced hyperextension, falling on outstretched hand
    - Violent twist or torque of the wrist
    - Often associated w/ sprain of UCL
  + Signs and Symptoms
    - Pain along ulnar side of wrist, difficulty w/ wrist extension, possible clicking
    - Swelling is possible, not much initially
    - Patient may not report injury immediately
  + Management
    - Referred to physician for treatment
    - Treatment will require immobilization initially for 4 weeks
    - Immobilization should be followed by period of strengthening and ROM activities
    - Surgical intervention may be required if conservative treatments fail
* Tendinitis
  + Etiology
    - Repetitive pulling movements of (commonly) flexor carpi radialis and ulnaris; repetitive pressure on palms (cycling) can cause irritation of flexor digitorum
    - Primary cause is overuse of the wrist
  + Signs and Symptoms
    - Pain on active use or passive stretching
    - Isometric resistance to involved tendon produces pain, weakness or both
  + Management
    - Acute pain and inflammation treated w/ ice massage 4x daily for first 48-72 hours, NSAID’s and rest
    - When swelling has subsided, ROM is promoted w/ contrast bath
    - PRE can be instituted once swelling and pain subsided (high rep, low resistance)
* Carpal Tunnel Syndrome
  + Etiology
    - Compression of median nerve due to inflammation of tendons and sheaths of carpal tunnel
    - Result of repeated wrist flexion or direct trauma to anterior aspect of wrist
  + Signs and Symptoms
    - Sensory and motor deficits (tingling, numbness and paresthesia); weakness in thumb
  + Management
    - Conservative treatment - rest, immobilization, NSAID’s
    - If symptoms persist, corticosteroid injection may be necessary or surgical decompression of transverse carpal ligament
* Dislocation of Lunate Bone
  + Etiology
    - Forceful hyperextension or fall on outstretched hand
  + Signs and Symptoms
    - Pain, swelling, and difficulty executing wrist and finger flexion
    - Numbness/paralysis of flexor muscles due to pressure on median nerve
  + Management
    - Treat as acute, and sent to physician for reduction
    - If not recognized, bone deterioration could occur, requiring surgical removal
    - Usual recovery is 1-2 months
* Scaphoid Fracture
  + Etiology
    - Caused by force on outstretched hand, compressing scaphoid between radius and second row of carpal bones
    - Often fails to heal due to poor blood supply
  + Signs and Symptoms
    - Swelling, severe pain in anatomical snuff box
    - Presents like wrist sprain
    - Pain w/ radial flexion
  + Management
    - Must be splinted and referred for X-ray prior to casting
    - Immobilization lasts 6 weeks and is followed by strengthening and protective tape
    - Wrist requires protection against impact loading for 3 additional months
* Wrist Ganglion
  + Etiology
    - Synovial cyst (herniation of joint capsule or synovial sheath of tendon)
    - Generally appears following wrist strain
  + Signs and Symptoms
    - Appear on back of wrist generally
    - Occasional pain w/ lump at site
    - Pain increases w/ use
    - May feel soft, rubbery or very hard
  + Management
    - Old method was to first break down the swelling through distal pressure and then apply pressure pad to encourage healing
    - New approach includes aspiration, chemical cauterization w/ subsequent pressure from pad
    - Ultrasound can be used to reduce size
    - Surgical removal is most effective treatment method
* Extensor Tendon Avulsion (Mallet Finger)
  + Etiology
    - Caused by a blow to tip of finger avulsing extensor tendon from insertion
    - Also referred to as baseball or basketball finger
  + Signs and Symptoms
    - Pain at DIP; X-ray shows   
      avulsed bone on dorsal   
      proximal distal phalanx
    - Unable to extend distal end   
      of finger (carrying at 30   
      degree angle)
    - Point tenderness at sight of injury
  + Management
    - RICE and splinting for 6-8 weeks
* Boutonniere Deformity
  + Etiology
    - Rupture of extensor expansion dorsal to the middle phalanx
    - Tendon slides below axis of PIP joint  
      Forces DIP joint into extension and PIP into flexion
  + Signs and Symptoms
    - Severe pain, obvious deformity and inability to extend DIP joint
    - Swelling, point tenderness
  + Management
    - Cold application, followed by splinting
    - Splinting must be continued for 5-8 weeks
    - Athlete is encouraged to flex distal phalanx
* Flexor Digitorum Profundus Rupture (Jersey Finger)
  + Etiology
    - Rupture of flexor digitorum profundus tendon from insertion on distal phalanx
    - Often occurs w/ ring finger when athlete tries to grab a jersey
  + Signs and Symptoms
    - DIP can not be flexed, finger remains extended
    - Pain and point tenderness over distal phalanx
  + Management
    - Must be surgically repaired
    - Rehab requires 12 weeks and there is often poor gliding of tendon, w/ possibility of re-rupture
* Gamekeeper’s Thumb
  + Etiology
    - Sprain of UCL of MCP joint of the thumb
    - Mechanism is forceful abduction of proximal phalanx occasionally combined w/ hyperextension
  + Signs and Symptoms
    - Pain over UCL in addition to weak and painful pinch
  + Management
    - Immediate follow-up must occur
    - If instability exists, athlete should be referred to orthopedist
    - If stable, X-ray should be performed to rule out fracture
    - Thumb splint should be applied for protection for 3 weeks or until pain free
    - Splint should extend from wrist to end of thumb in neutral position
    - Thumb spica should be used following splinting for support
    - If a complete tear occurs, surgical repair is necessary to allow normal function to return
* Swan Neck Deformity and PsuedoBoutonniere Deformity
  + Etiology
    - Distal tear of volar plate may cause Swan Neck deformity; proximal tear may cause PsuedoBoutonniere deformity
  + Signs and Symptoms
    - Pain, swelling w/ varying degrees of hyperextension
    - Tenderness over volar plate of PIP
    - Indication of volar plate tear = passive hyperextension
  + Management
    - RICE and analgesics
    - Splint in 20-30 degrees of flexion for 3 weeks; followed by buddy taping and then PRE
* Metacarpal Fracture
  + Etiology
    - Direct axial force or compressive force
    - Fractures of the 5th metacarpal are associated w/ boxing or martial arts (boxer’s fracture)
  + Signs and Symptoms
    - Pain and swelling; possible angular or rotational deformity
  + Management
    - RICE, analgesics are given followed by X-ray examinations
    - Deformity is reduced, followed by splinting - 4 weeks of splinting after which ROM is carried out
* Bennett’s Fracture
  + Etiology
    - Occurs at carpometacarpal joint of the thumb as a result of an axial and abduction force to the thumb
  + Signs and Symptoms
    - CMC may appeared to be deformed - X-ray will indicate fracture
    - Patient will complain of pain and swelling over the base of the thumb
  + Management
    - Structurally unstable and must be referred to an orthopedic surgeon
* Fingernail Deformities
  + Changes in normal appearance of the fingernail can be indicative of a number of different diseases
    - Scaling or ridging = psoriasis
    - Ridging and poor development = nutritional deficiencies
    - Clubbing and cyanosis = congenital heart disorders or chronic respiratory disease
    - Spooning or depression = thyroid problems, iron deficiency anemia

Rehabilitation of the Forearm, Wrist, Hand, and Fingers

* General Body Conditioning
  + Must maintain pre-injury level of conditioning
  + Cardiorespiratory, strength, flexibility and neuromuscular control
  + Many exercise options (particularly lower extremity)
* Joint Mobilizations
  + Wrist and hand respond to traction and mobilization techniques
* Flexibility
  + Full pain free ROM is a major goal of rehabilitation
  + The program should include active assisted and active pain free stretching
* Strength
  + Exercises should not aggravate condition or disrupt healing process
  + A variety of exercises are available for strength (wrist and hand)
* Neuromuscular Control
  + Hand and fingers require restoration of dexterity
    - Pinching, fine motor activities (buttoning buttons, tying shoes, and picking up small objects)
  + It is important to incorporate functional activities designed to restore patient’s ability to perform daily activities
* Return to Activity
  + Grip strength must be equal bilaterally, full range of motion and dexterity
  + Thumb has unique strength requirements
  + A variety of customizable bracing and splinting devices are available to protect injured wrist and hand