

# Extremity X-ray Review

# Avascular Necrosis

# Avascular Necrosis: Adult

- Idiopathic, trauma, steroids, alcoholism, sickle cell disease, Gaucher's disease, celiac disease, radiation, SLE, and pancreatitis
- Most common location is femoral head
- Pain with weight bearing, decreased ROM
- Sclerosis, subchondral fracture (crescent sign), flattening and bone deformity (step sign). Secondary DJD may occur.
- Post traumatic AVN: Femoral head, lunate, proximal scaphoid, body of talus

# Avascular Necrosis: Adult

- SLE and sickle cell: Humeral head and talus
- AVN vertebral body: Increased density and collapse. Gas within vertebral body is pathognomonic.
- MRI is the most sensitive modality

# Legg-Calvé-Perthes Disease

- Males, between the ages of 3 and 12 years (peak age 4-8). It is bilateral in approximately 10% of cases. Rare in blacks
- The onset may be insidious or sudden. The patients have pain, develop a limp and have limitation of motion of the hip joint. The symptoms are worsened by activity and relieved by rest. It is a self-limiting disease of 2-6 years in duration.
- Stage 1 is the avascular stage. The early x-ray findings include: joint effusion with distention of the joint capsule. The joint space may be widened (tear drop distance). Lateral displacement of the head of the femur (Waldenström's sign).

# Legg-Calvé-Perthes Disease

- Stage 2 is the necrotic stage:
  - The earliest osseous manifestation is a radiolucent line (crescent or rim sign). This is an arc-like translucent zone that develops in the subchondral bone close to the articular surface.
  - There will be an apparent increase in the density of the epiphysis and is referred to as a “snow cap” appearance.
  - Radiolucent areas develop within the femoral epiphysis that represents areas of necrotic bone that are undergoing lysis (demineralization). The demineralization is due to an ingrowth of granulation tissue.
  - The epiphysis becomes irregular, fragmented and flattens (collapses).

# Legg-Calvé-Perthes Disease

- Stage 3 is the healing stage: Healing by replacement of the dead tissue with new bone takes from one to several years.
- Stage 4 is the end stage (hip deformity):
  - There is usually flattening of the femoral epiphysis (mushroom deformity) and a short, broad femoral neck.
  - Coxa plana, coxa magna, and coxa valga.
  - There may be enlargement of the acetabulum to accommodate the abnormal femoral head.
  - The development of degenerative changes early in adult life is common.

# Transient Synovitis of the Hip, Observation Hip, Acute Irritable Hip

- The most common diagnosis of hip pain during childhood
- Acute onset of pain in the hip, groin, or knee combined with a limp and limitation of motion in a child of about 3 years of age.
- With rest and conservative care, the clinical symptoms generally resolve in a week or two.
- The differential diagnosis would include: Legg-Calvé-Perthes disease, infection, inflammatory arthritis



# Osteochondritis (Osteochondrosis) Dissecans

- Fragmentation and possible separation of a portion of the articular surface
- The age of onset varies from childhood to middle age, but an onset in adolescence is most frequent
- Males > females
- The most common location is the lateral portion of the medial femoral condyle

# Spontaneous Osteonecrosis of Knee (SONK)

- Older person (60+ years of age) with sudden onset of medial knee pain
- Flattening of the weight-bearing portion of the medial femoral condyle
- Commonly associated with a meniscal tear

# Osgood-Schlatter's Disease

- Males 10-15 years of age, bilateral in 25% of cases
- Symptoms usually begin following athletic-type activities
- Pain, tenderness, and soft tissue swelling over the tibial tuberosity
- This is a traumatically induced avulsion injury
- X-ray: Soft tissue swelling, indistinct margin of patellar tendon, avulsion with fragmentation of tibial tuberosity
- Rare complications include nonunion of the tibial tubercle, bony ossicle or ossicles within the patellar tendon, or premature closure of the tibial tubercle with secondary genu recurvatum

# Köhler's Disease

- Males, 4-10 years of age. Foot pain and limp
- Regularity, fragmentation, disc-like compression (wafer-like), increased density, joint spaces maintained
- This is self-limited. Over a period of 2-4 years, the navicular bone will regain its normal size, density, and trabecular structure
- May be the result of stress-related compression of the navicular bone at a critical phase of growth

# Sever's Phenomenon

- Sclerosis and fragmentation of the secondary ossification center of the calcaneus is a normal variation

# Freiberg's Infracture

- Most commonly involves the head of the second metatarsal. Females between the ages of 13 and 18 years
- Local pain, tenderness, swelling and limitation of motion
- Flattening, sclerosis and cystic changes involving the metatarsal head

# Kienböck's Disease

- 20 to 40 years of age, history of trauma, progressive pain, swelling and disability. Sclerosis, collapse and fragmentation
- Complications include scapholunate disassociation and secondary degenerative joint disease
- Mechanical forces are accentuated by the presence of a short ulna - negative or minus ulnar variance (75% of cases)

# Ulnar Variance

- Negative ulnar variance
  - the ulna is shorter than the radius
  - increased incidence of avascular necrosis of the lunate (Kienbock's)
- Positive ulnar variance
  - the ulna is longer than the radius
  - increased incidence of triangular fibrocartilage tears



# Sinding-Larson-Johanssen Disease

- Avulsion and fragmentation of the inferior pole of the patella. 10-14 years of age. Tenderness and soft tissue swelling over the lower poles of the patella.

# Panner's Disease

- Capitulum of the humerus. Rare, males, 5-10 years of age. It sometimes is termed “Little Leaguer’s elbow” because of its frequency in young baseball pitchers.
- Pain and stiffness with restricted ROM
- Fissuring, sclerosis, fragmentation and decreased size.
- Differential diagnosis from osteochondritis dissecans is age of patient

# Blount's Disease (Tibia Vara)

- Disturbance of growth of the medial aspect of the proximal tibial epiphysis
- Infantile and adolescent types. The infantile type is most common.
- Limping and lateral bowing of the leg

# Extremity Tumors

# Most Common Primary Bone Tumors in Children

- Osteosarcoma
- Ewing's sarcoma

# Most Common Primary Malignancies of Bone

1. Multiple myeloma
2. Osteosarcoma
3. Chondrosarcoma

# Most Common Malignancy of Bone

- Metastatic carcinoma

# Round Cell Tumors

- Ewing's sarcoma
- MM
- Non-Hodgkin's lymphoma (reticulum cell sarcoma)



# Osteoma

- Arising in membranous bones: sinuses (frontal most common), skull and mandible
- Dense sclerotic mass
- Gardner's syndrome: intestinal polyposis, osteomas, fibromas of the soft tissue, and sebaceous cysts of the skin

# Osteoid Osteoma

- Night pain, relieved by aspirin
- Pain, tenderness, increased skin temperature over area. Pain with motion, convex scoliosis away from the involved site (painful scoliosis in children), torticollis-cervical spine
- 10-25 years of age. 2:1 males
- About 50% of the cases involve the femur and tibia
- 10% are spinal: Lumbar (59%) and cervical (27%). Lamina, articular process and pedicle.
- Radiolucent nidus surrounded by extensive reactive sclerosis. The nidus is usually less than 1cm in diameter (<2cm)

# Osteoblastoma

## (Giant Osteoid Osteoma)

- 2:1 male, below 30 years of age
- Involve spine (SP, TP, neural arch), long bones (femur and tibia) and small bones of hands and feet
- X-ray: Radiolucent expansile lesion with calcification. Usually 2cm or larger

# Osteogenic Sarcoma (Osteosarcoma)

- 10-25 years of age
- Distal femur 44%, proximal tibia 17\$, and proximal humerus 15%.
- X-ray: metaphysis, bone destruction, calcific neoplastic tissue, periosteal new bone formation (spiculated and Codman triangles). 50% are sclerotic, 25% mixed.

# Enchondroma (Chondroma)

- Most common benign tumor of the hand
- 50% occur in the hands and feet
- Femur, humerus and ribs. 10-30 years of age, 1:1
- X-ray: radiolucent lesion with sharp, sclerotic margins (scalloped). Punctate or stippled calcifications

# Multiple Enchondromatosis (Ollier's Disease)

- Bones of the hand, femur, tibia, and ilium
- Malignant transformation: 25-35%

# Maffucci's Syndrome

- Enchondromatosis combined with soft tissue hemangiomas (soft tissue mass with phleboliths)
- Hands and feet
- Malignant transformation is common

# Osteochondroma (Exostosis)

- Most common benign tumor of bone
- 75% below 20 years of age. 2:1 males
- Metaphysis of long bone – 50% involve the distal femur and proximal tibia
- Pedunculated (stalk or hook) and broad-based (sessile) types
- Malignant transformation is rare in solitary form (less than 1%)



# Hereditary Multiple Exostosis (HME) (Multiple Osteocartilaginous Exostosis)

- Autosomal-dominant disorder
- Most are broad-based. Lumps around joints. Diaphyseal aclasis.
- Malignant transformation 5-25%

# Chondroblastoma (Codman's Tumor)

- Arises in epiphysis or apophysis
- Teenagers (10-20 years of age) 2:1 males
- Pain and swelling
- Round or oval lytic lesion with stippled or fluffy calcifications (“fluffy, cotton wool” appearance)
- Proximal humerus (tuberosities), proximal femur (trochanters), distal femur, proximal tibia

# Chondrosarcoma

- 30-60 years of age
- Pelvis, femur, shoulder girdle, ribs, and sternum
- Most common malignant tumor of scapula and sternum
- Bone destruction with scattered calcifications (popcorn, stippled, or snowflake)

# Non-ossifying (Non-Osteogenic) Fibrous (Xanthoma, Fibroxanthoma) Fibrous Cortical Defect

- FCD
  - small intracortical lesion less than 2cm
  - 30-40% of all children have, 4-8 years of age
  - Distal femur, most common site
- NOF
  - larger lesion (> 2cm), possible path fracture
  - Metaphyseal: distal femur, proximal tibia, distal tibia, and distal fibula
  - Elongated lucent lesion with well-defined sclerotic border, thin cortex, scalloped margins

# Ewing's Sarcoma

- 80% under 30 years of age
- Pain and swelling. About one-third have fever, anemia, leukocytosis, and increased ESR (simulating infection)
- Before age 20, involves the shaft (diaphysis) of long bones (femur, tibia, fibula, and humerus)
- After age 20, involves pelvic bones
- X-ray: Diaphyseal, permeative bone destruction, soft tissue mass, periosteal reaction (laminated, onion skin)

# Giant-cell Tumor (Osteoclastoma)

- 80% occur in patients older than 20 years (median age of 30)
- 15% are malignant
- Distal femur, proximal tibia, distal radius, proximal femur, sacrum, spine (vertebral body)
- 50% involve distal femur and proximal tibia
- X-ray: geographic expanding radiolucent lesion involving end of long bone (subarticular extension). May have soap-bubble appearance.

# Simple Bone Cyst (Unicameral Bone Cyst, Solitary Bone Cyst)

- Fluid – containing cyst. 80-90% under 20 years of age. 3-14 years of age, males 2:1
- Proximal humerus (50%), proximal femur (20%), tibia and calcaneus
- X-ray: truncated radiolucency
  - Active cyst: abuts the epiphyseal plate
  - Latent cyst: is distal to the epiphyseal plate
  - Fallen fragment sign or hinged fragment sign

# Aneurysmal Bone Cyst

- Highly vascular expansive lesion containing a cavity or cavities filled with bloody fluid
- 80% occur below age 20
- Metaphysis of long bones: femur, tibia, humerus, fibula, radius
- 18% involve the spine (posterior elements)
- Very expansile, eccentric, lytic, metaphyseal lesion (“blown-out” appearance
- Most common benign tumor of the clavicle



# Chordoma

- Arises from remnants of the notochord
- Sacrum 50, clivus 35%, vertebrae 15%  
(C2 frequent site)

# Bone Island (Enostosis)

- Focus of compact bone within the cancellous bone
- Ilium and proximal femur
- Round or oval with radiating spicules (thorn-like radiations or brush border)
- Usually less than 2cm

# Osteopoikilosis

- Multiple round or oval areas of dense bone
- At the ends of long bones (epiphysis and metaphysis)

# Osteopathia Striata (Voorhoeve's Disease)

- Linear striations in the metaphyses

# Osteopetrosis (Marble Bone Disease, Albers-Schönberg Disease)

- Generalized bony sclerosis or bone-within-a-bone appearance
- Congenita or tarda forms
- Sandwich vertebra
- Dense but brittle bones

# Infection

# Suppurative (Pyogenic) Osteomyelitis

- Staph aureus most common
- Latent period: 10 days in extremities, 2-8 weeks in spine
- Cause: urinary tract infection (72%), lung infection (14%), dermal infection (14%)
- Spine: lumbar spine most commonly involved. Decrease in disc height with adjacent endplate irregularity and loss of cortex.

# Arthritis



# Osteoarthritis (OA)

## Degenerative Joint Disease (DJD)

- Primary: cartilage breakdown with bone remodeling and overgrowth
- Secondary: trauma, septic arthritis, inflammatory arthritis, congenital or developmental defects
- X-ray
  - cartilage destruction: focal, weight-bearing portion of the joint
  - osteophytes, subchondral sclerosis, subcondral cysts
  - chondrocalcinosis, loose bodies (synovial metaplasia or fractured osteophytes), enthesopathy

# Degenerative Joint Disease

- Hand
  - DIP joints: Heberden's nodes
  - PIP joints: Bouchard's nodes
- Elbow: post-traumatic
- Shoulder: post-traumatic
- AC joint: common
- SI joint: mid to upper third of joint

# Rheumatoid Arthritis (RA)

- Arthritis of unknown etiology that causes synovial inflammation and articular destruction-polyarticular
- The incidence is about 1% in the general population. 3:1 females. Peak onset is between the ages of 20-45 years.
- Lab: RF may be negative early, but eventually becomes positive in 90% to 95% of cases. ESR elevated and tends to parallel disease activity.

# Rheumatoid Arthritis

- Hand:
  - Early erosions at MCP (radial side of MC heads) and PIP joints.
  - MCP: ulnar deviation and volar subluxation
  - Swan-neck: PIP hyperextension and DIP hyperflexion
  - Boutonniere: PIP hyperflexion and DIP hyperextension
  - Hitchhikers thumb: MCP flexion and IP extension.

# Rheumatoid Arthritis

- Wrist:
  - Early erosions at distal radioulnar joint, ulnar styloid, radial styloid, waist of scaphoid, triquetrum, and pisiform
  - Deformities: ulnar translocation, radial deviation of hand, scapholunate dissociation, dorsi- and palmar flexion carpal instability patterns, and distal radioulnar dissociation.

# Rheumatoid Arthritis

- Elbow:
  - Positive fat-pad sign, erosions of the distal humerus, radial head, and coronoid
- Shoulder:
  - Lysis of the distal clavicle, marginal humeral head erosion
  - Later: signs of rotator cuff tear – humeral head elevation, concavity on the under surface of the acromion, mechanical erosion of the medial surgical neck of the humerus

# Rheumatoid Arthritis

- Feet:
  - MTP erosions (especially on the medial side of the MT heads)
  - Deformities: lateral deviation at MTP's, hammer toes (flexion of PTPs or DTPs) and cock-up deformities Hyperextended MTPs)
  - Calcaneal spurs

# Rheumatoid Arthritis

- Knee:
  - Suprapatellar effusions and popliteal synovial cysts (Baker's cysts). All 3 compartments demonstrate symmetric cartilage loss, erosion, and subchondral cysts. Valgus deformity. Distal femoral erosion – anterior mechanical erosion from patella pressure.



# Gout

- Asymmetric polyarthrititis caused by deposition of monosodium urate crystals in articular cartilage, synovium, subchondral bone, and periarticular tissues
- Acute gout most commonly affects the lower extremity joints, especially the first metatarsophalangeal joint (70%), with excruciating pain and swelling
- Middle-ages or elderly males, women after menopause
- Warm, tender, swollen, erythematous joint

# Gout

- First MTP joint (podagra)
- X-ray
  - Asymmetric, nodular deposits of calcium urate (tophi) in periarticular tissues
  - Intraarticular and periarticular erosions show sclerotic margins and often have elevated “overhanging edges” extending over tophaceous nodules

# Calcium Pyrophosphate Dihydrate Crystal Deposition Disease (CPPD)

- Pseudogout: clinical presentation with acute, self-limited attacks of pain and swelling mimicking gout
- Middle ages or elderly male
- Knee, wrist, second and third MCP joints
- X-ray
  - Chondrocalcinosis: calcification of hyaline or fibrocartilage. Most commonly involves fibrocartilage.
- Synovial and capsular calcification are common

# Chondrocalcinosis

- Calcification of hyaline or fibrocartilage
- CPPD, DJD, trauma, gout, hyperparathyroidism, hemochromatosis, Wilson's disease, ochronosis

# Extremity Trauma

# Stress Fractures (Fatigue or March Fractures)

- Result from repeated application of abnormal stress on normal bone
- Normally, bone remodeling occurs in response to applied stress and consists of bone resorption followed by new bone formation. If the applied stress is increased or is continuous during the period in which bone resorption predominates, a stress fracture may occur. Increased osteoclastic activity, microinfractures of bone, and finally frank fracture.

# Stress Fractures

- Bone scanning is useful to detect early stress fractures. The bone will demonstrate increased nuclide activity at the fracture site in 80% of patients within 24 hours and in 95% of patients within 72 hours.
- Characteristics of activities resulting in stress fractures:
  1. Activity is strenuous
  2. Activity is often new or different
  3. Activity is repeated with frequency

# Stress Fractures

- Most common in the lower extremity: metatarsal>calcaneus>tibia
- X-Ray
  - Cancellous bone: thin zone of sclerosis
  - Cortical bone: thin cortical lucency followed by localized periosteal reaction



# Acetabular Dysplasia

- Shallow, poorly developed acetabulum

# Congenital Dysplasia of Hip (CDH) Developmental Dysplasia of Hip (DOH), Congenital Hip Dislocation (CHD)

- M:F = 1:8
- Females (2/3 - first born), infants born in breech position (6:1)
- Putti's Triad
  1. Delay in ossification of the capital femoral epiphysis
  2. Acetabular angle greater than 30 degrees
  3. Proximal medial margin of the femoral metaphysis is displaced lateral to Perkin's line

# Pathologic Fractures

- A fracture involving bone in which the normal integrity and strength are compromised
- Osteoporosis (most common cause), osteomalacia, renal osteodystrophy, hyperparathyroidism
- Benign lesions
- Malignant lesions
  - Metastatic disease (second most common cause)
- The proximal femur is involved in over 50% of long bone pathologic fractures

# Insufficiency Fractures

- Fractures that occur when normal or physiological stress is applied to abnormally weakened bones
  - Osteoporosis
  - RA
  - Osteomalacia/rickets
  - Paget's disease
  - Hyperparathyroidism
  - Renal osteodystrophy
  - Radiation therapy
  - Steroid-induced osteopenia
- Location
  - lower extremity (femoral neck), sacrum, ilium, pubic bone

# Birth Fractures

- Clavicle fractures most common
- The humerus is the most frequently fracture long bone
- Clavicle, proximal humerus, proximal femur and distal humerus

# Slipped Femoral Capital Epiphysis (SFCE) (Epiphysiolysis)

- 13-14 years in boys, 11-12 years in girls, greater incidence in boys, overweight (Fröhlich's syndrome)
- Boys 2:1 left side, girls 1:1 right vs left side, 20-30% bilateral
- The proximal femoral epiphyseal plate is the only epiphyseal plate that is subject normally to shearing stress
- Salter-Harris Type 1 epiphyseal injury

# X-Ray of SFCE

- Do frog-leg view
- The head is displaced posteriorly, downward and medially
- Limp, leg externally rotated, decreased ROM (limited internal rotation), synovitis
- Often complain of knee pain or pain in the anterior thigh and do not associate their problem with the hip
- Deformity, osteoarthritis, avascular necrosis, chondrolysis

# Epiphyseal Injuries

- 80% of epiphyseal injuries occur between age 10 and 16 years. Distal humerus usually occur prior to the age of 10.
- Most common sites:
  1. distal radius
  2. distal tibia
  3. phalanges
- In children, ligaments are functionally stronger than bone (sprains in adults, fractures in children)
- Failure is usually from torsion and not tension at the physis



# Salter-Harris Classification

- I - 6% transverse fracture through physis
- II - 75% fracture throughout physis with metaphyseal fragment
- III - 8% fracture through physis and epiphysis
- IV - 10% fracture through epiphysis, physis, and metaphysis
- V - 1% crush injury of physis

# Epiphyseal Injuries

- Type II
  - distal radius is most common site (up to 50%)
  - distal tibia, distal fibula, distal femur, and ulna
  - the metaphyseal fragment = Thurston-Holland fragment
- Type III
  - distal tibia is most common site
- Type IV
  - under 10 years of age – lateral condyle of humerus
  - over 10 years of age – distal tibia
- Tibia V
  - distal femur (most common location)
  - proximal and distal tibia

# Complications of Epiphyseal Injuries

- Complete growth arrest
- Progressive limb length inequalities (short or long)
- Progressive angular deformities
- Other unusual joint deformities due to avascular necrosis

# Pelvis – Avulsion Fractures

- ASIS – sartorius
- AAIS – rectus femoris
- Ischial tuberosity – hamstrings

# Pelvic Fractures

- Fractures involving the ischial and pubic rami are the most common fractures of the pelvis

# Sacral Fractures

- Horizontal
- Vertical

# Acetabular Fractures

- Posterior rim
- Posterior column
- Central (most common)
  - Bursting: central fracture with dislocation
- Anterior column

# Hip Dislocation

- Posterior ( most common)
- Anterior
- Central fracture - dislocation



# Hip Fracture

- Hip fractures in the elderly can be very difficult to detect. A negative plain film in an elderly patient with hip pain following trauma does not exclude a femoral neck fracture. MRI imaging is very useful to demonstrate fractures that are occult.

# Proximal Femur Fractures

- Subcapital
- Midcervical (transcervical)
- Basic cervical (base of neck)
- Intertrochanteric
- Subtrochanteric
- Greater trochanteric

# Complications of Proximal Femur Fractures

- Nonunion
- Avascular necrosis

# Maisonneuve Fracture

- Ankle injury with a fracture of the proximal third of the fibula

# Dislocation of Patella

- Traumatic: usually lateral
- Recurrent: females

# Patella Fractures

- Most common fracture is transverse and involves the mid portion of the patella
- Other fractures include comminuted, stellate, and vertical
- Differential diagnosis
  - bipartite or tripartite patella

# Distal Femur

- Intercondylar (T.V.Y.)
- Condylar
- Supracondylar

# Proximal Tibia

- Depression fracture or tibial plateau
- Fractures of the lateral plateau are more common (valgus stress)
- Oblique views may be necessary to diagnose
- Often seen in auto-pedestrian accidents where the plateau was at the height of fenders and bumpers (bumper fracture)



# Segond Fracture

- Cortical avulsion fracture of proximal lateral tibia immediately distal to lateral plateau
- External rotation and varus stress (lateral capsular ligament)
- Associated with ACL tear (75-100%) and meniscal tear (67%)

# Pelligrini-Stieda Calcification

- Medial collateral ligament calcification

# Lipohemarthrosis

- Intra-articular fracture with marrow fat extruded into the joint
- The fat layers upon the superior surface of the blood and joint fluid in the suprapatellar bursa (horizontal-beam lateral)

# Pilon Fractures

- Tibial plafond (articular surface) of the distal tibia

# Osteochondral Fracture of Talar Dome

- Inversion injury of ankle

# Calcaneal Fractures

- 10% bilateral
- 10% are associated with thoracolumbar fractures (Don Juan fractures) since common mechanism is a fall from a height.

# Ankle-Malleolar Fractures

- Malleolar: medial or lateral (Pott's I)
- Bimalleolar (Pott's II)
- Trimalleolar (Pott's III)

# Base of the Fifth Metatarsal Fractures

- Avulsion (pseudo-Jones fracture). Acute inversion with plantar flexion of the foot. Avulsion caused by peroneus brevis or lateral plantar aponeurosis.
- Jones fracture (dancers): Fracture of the proximal shaft at the metaphyseal/diaphyseal junction. Inversion stress injury to the foot. Often a stress fracture that becomes an acute displaced fracture.
- Fracture lines are transverse or oblique
- Ossification center is longitudinal



# Lisfranc's Fracture

- Fracture-dislocation of tarsometatarsal joints.

# Shoulder Dislocation

- Anterior 97%
- Posterior 2%
- Superior 1%

# Anterior Dislocation of Shoulder

- Subcoracoid
- Subglenoid
- Subclavicular
- Intrathoracic
- Luxatio erecta
- Superior

# Posterior Dislocation of Shoulder

- Traumatic
- Electric shock
- Seizures (Epileptic convulsion)
- Shock therapy

# Complications of Shoulder Trauma

- Adhesive capsulitis
- Rotator cuff tear
- Associated fractures
  - greater tubercle with anterior dislocation (flap fracture)
  - lesser tubercle with posterior dislocation
  - Bankart lesions (fracture of inferior glenoid labrum)

# Complications of Shoulder Trauma

- The glenoid rim is fractured in 20% of patients with fracture/dislocation of the shoulder
- Hill-Sachs deformity (Hatchet defect): A compression fracture on the posterolateral aspect of the humeral head caused by impaction against the anterior rim of the glenoid fossa.
  - See in 27% of acute anterior dislocations and 74% of recurrent anterior dislocations.

# Fractures of the Proximal Humerus

- 80% have no significant displacement because fragments are held together by the rotator cuff, the joint capsule, and the intact periosteum
- Surgical neck fracture
- Greater tubercle (flap fracture)

# Pseudodislocation of Shoulder (Hanging, Drooping, Inferior Subluxation of the Humeral Head)

- Intra-articular fracture with hemarthrosis which results in inferior displacement of the humeral head
- This is mistaken for a dislocated shoulder



# Clavicle

- Most common fracture during childhood
- Most common birth fracture
- Location: 80% mid-third, 15% lateral-third, 5% medial-third

# AC Joint

- AC joint sprain: Widening of joint space and elevation of clavicle and/or increased in coracoclavicular space (3-4mm or more significant)
- AC Joint Sprains: Grade I – mild sprain AC ligament. Grade II – AC ligament rupture, mild sprain coracoclavicular ligaments (subluxation) Grade III – rupture of ligaments (dislocation)
- Do weight-bearing (15-20 pounds) and nonweight-bearing views bilaterally

# AC Joint

- Bottom edges aligned
- Joint space approximately equal
- AC joint space
  - 2-5mm
- Coracoclavicular space
  - 1.1 – 1.3cm

# Post-traumatic Osteolysis of Distal Clavicle

- Begins within 2 months following trauma
- Is self-limited

# Elbow Trauma

- Children
  - do bilateral views for comparison
- Fat pad sign
  - joint effusion with visible posterior fat pad on lateral view
- 90% of children and adolescents with + fat pad sign have fracture
- Inflammatory or traumatic
  - traumatic: synovitis or blood and marrow
  - inflammatory: infection or JRA

# Fat Pad Sign Elbow

- Displacement of the posterior fat pad is indicative of a fracture about the elbow
- In an adult, the fracture site is usually the radial head
- In a child, it is usually a supracondylar fracture
- The anterior fat pad is normally visualized as a small triangle. With a joint effusion, there is displacement superiorly and outward from the humerus (sail sign).

# Elbow Fractures

- Children: 60% supracondylar fracture, 15% lateral condyle, 10% medial epicondylar ossification center
- Avulsion medial epicondyle: flexor pronation tendon (little leaguer's elbow)
- Adults: Radial head fractures most common. Represent approximately 50% of all adult elbow fractures.
- Olecranon fracture: 20% of elbow fractures

# Elbow dislocation

- 80-90% are posterolateral
- Often have associated coronoid process or radial head fractures



# Pulled Elbow (Jerked or Nurse-Maid)

- Sudden pull on arm
- To correct supinate forearm with elbow flexed

# Colles' Fracture

- Most common fracture of the distal radius
- Transverse fracture of distal radius (approximately 1" from distal end of radius) with dorsal displacement of fragment
- Dinner or "silver fork" deformity
- May have associated with fracture ulnar styloid fracture
- Most common extremity fracture in adults over 50 years of age
- Associated with fractures of the proximal humerus and hip due to falls in osteoporotic patients

# Smith's Fracture (Reverse Colles')

- Fracture of distal radius with volvar displacement of distal fragment
- “Garden spade” deformity

# Barton's Fracture

- Intra-articular fracture of the dorsal lip of the radius with dislocation of the carpus

# Reverse Barton's Fracture

- Intra-articular fracture of the volar lip of the radius with dislocation of the carpus

# Radial Styloid Fracture

(Hutchinson's, Chauffeur's, Backfire)

- Intra-articular fracture of the radial styloid process
- Results from compression of the scaphoid against the styloid with the wrist in dorsiflexion and ulnar deviation

# Most Common Carpal Dislocations

1. Lunate
2. Scaphoid

# Perilunate Dislocation

- Normal radiolunar relationship with dorsal dislocation of the remainder of the carpus about the lunate



# Perilunate Fractures - Dislocations

- 2 or 3 times more common than lunate dislocations
- 75% are accompanied by a fracture of the scaphoid – transscaphoid perilunate dislocations

# Scapholunate Dissociation (Terry Thomas Sign)

- Widening of the scapholunate space
  - normally less than 2mm (4mm or more)

# Carpal Fractures

- Scaphoid most common
- Triquetrum second most common
- Fractures of the scaphoid and triquetrum account for 90% of carpal fractures

# Scaphoid Fractures

- 70% involve the waist
- Delayed union or nonunion occurs in approximately 30% of fractures involving the waist
- Avascular necrosis
  - proximal fragment

# Triquetrum Fractures

- Dorsal chip fracture

# Bennett's Fracture

- Fracture-dislocation at the first carpometacarpal joint
- A small fragment of the metacarpal continues to articulate with the trapezium, the remainder of the metacarpal is dislocated

# Rolando's Fracture

- Comminuted fracture of the base of the first metacarpal

# Gamekeeper's Thumb (Skier's Thumb)

- Disruption of ulnar collateral ligaments of MCP joint of thumb



# Boxer's (Street-Fighter's, Bar Room) Fracture

- Blow with clenched fist, fracture of metacarpal neck with angular deformity
- Boxer's fracture
  - second or third metacarpal
- Bar room fracture
  - fourth or fifth metacarpal

# Mallet, Baseball, Dropped, Cricket Finger

- Sudden unexpected passive flexion of DIP joint with avulsion of bone from the base of the distal phalanx by the extensor tendon (or rupture of tendon)

# Hook of Hamate Fracture

- The fracture is difficult to visualized on plain films
- Do CT study
- The fracture most commonly occurs from a fall on the outstretched hand
- The other mechanism of injury is an athlete who participates in an activity where the butt of a club, bat, or racquet is held in the palm of the hand
- Over-swinging can result in the butt of the club levering off the hook of the hamate (baseball, tennis, golf)

# Volar Plate Fracture

- Hyperextension injury
- Avulsion at insertion of the volar capsule (hyperextension deformity)

# Terminal (Distal) Tuft Fracture

- Probably most common phalangeal fracture