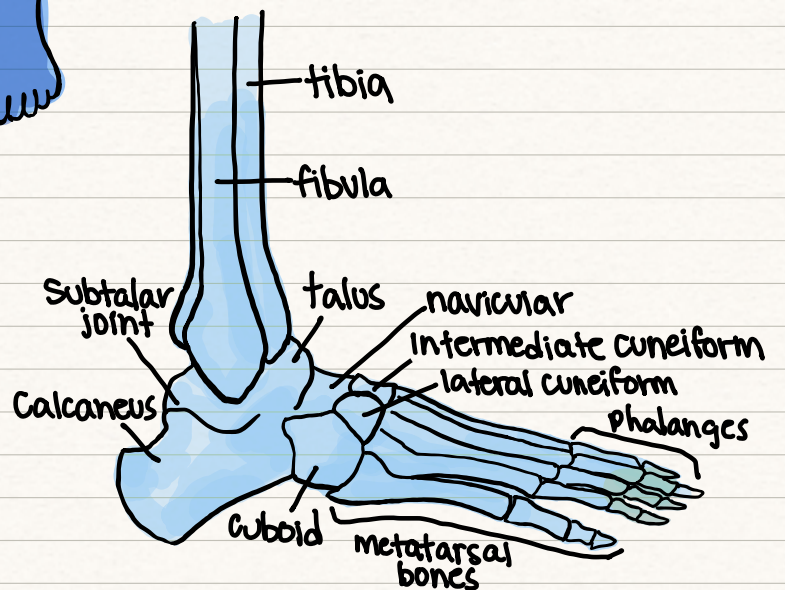
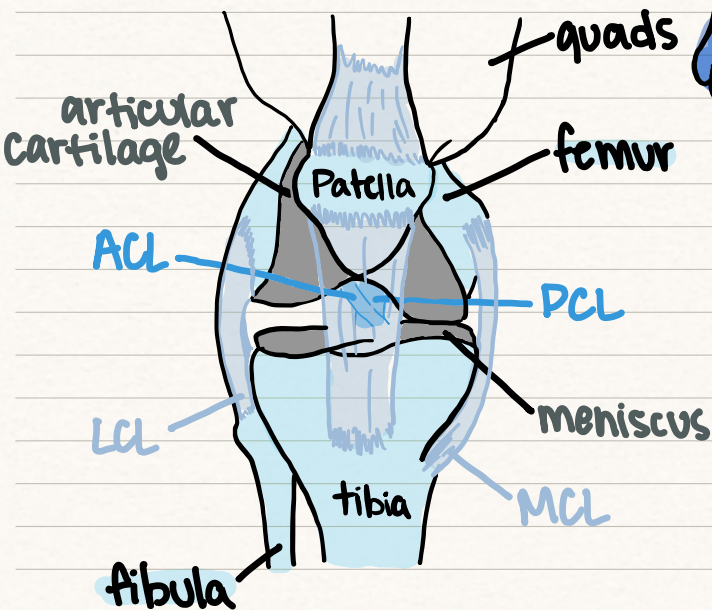
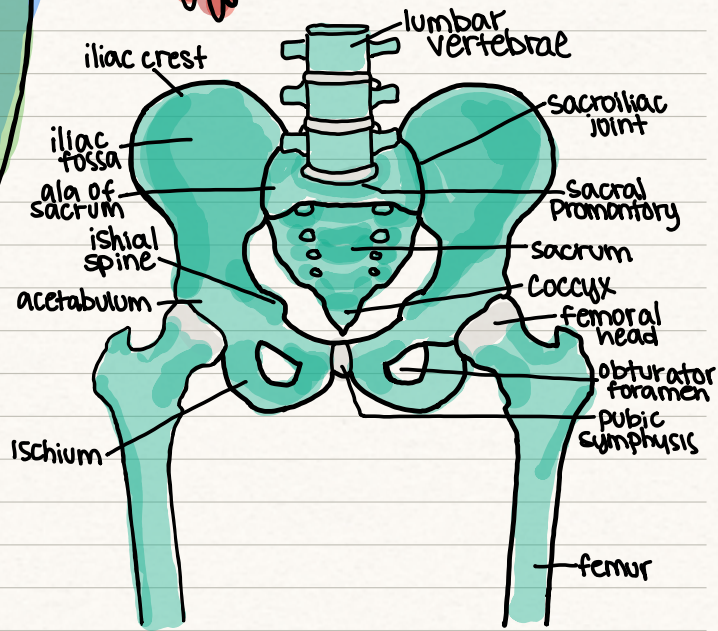
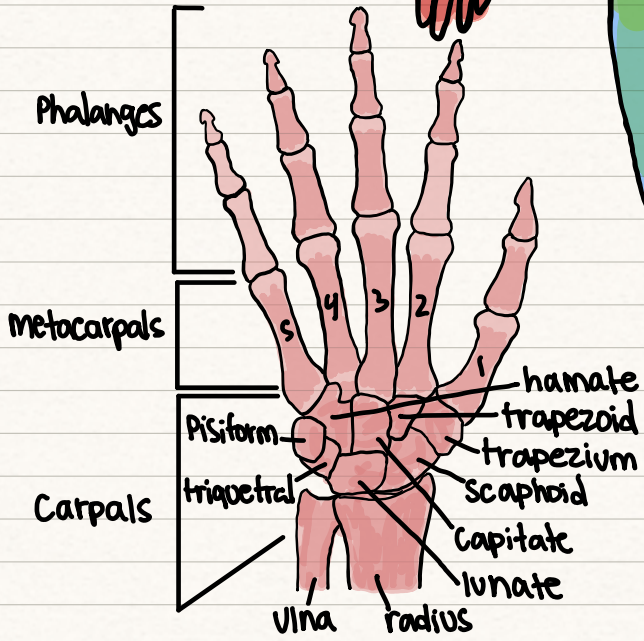
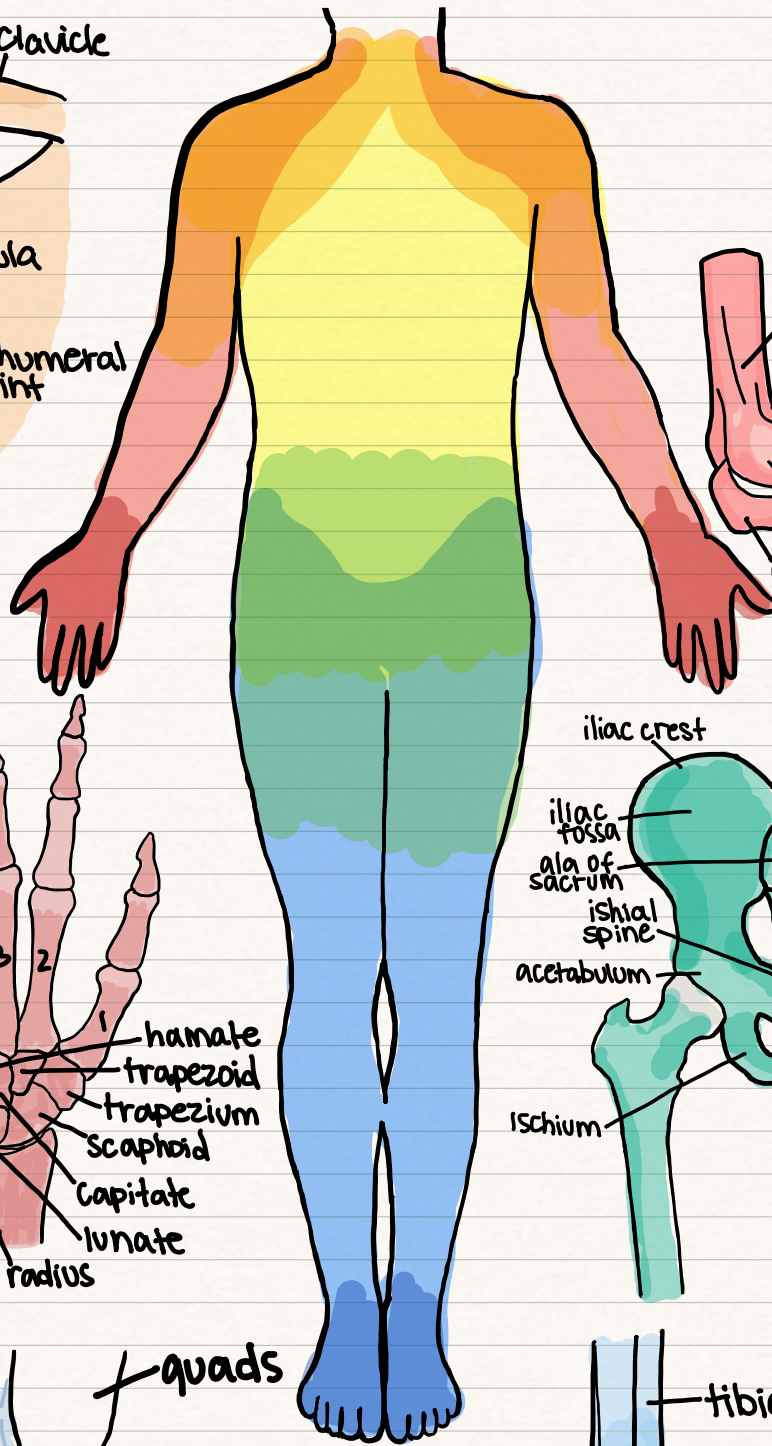
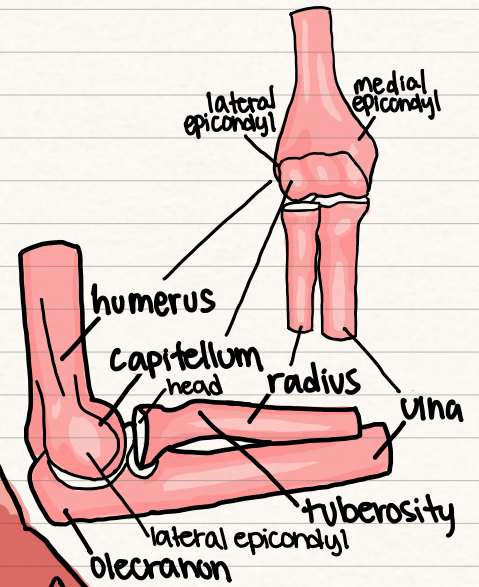
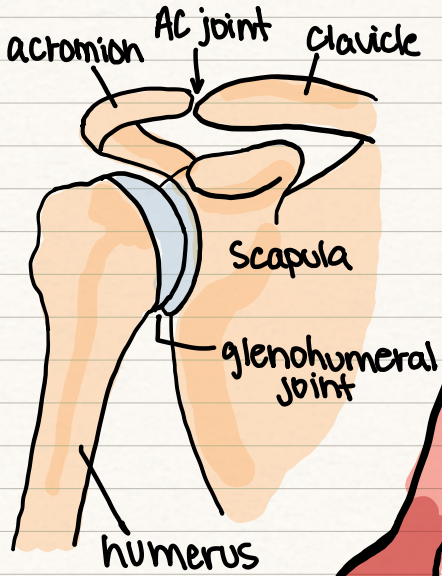
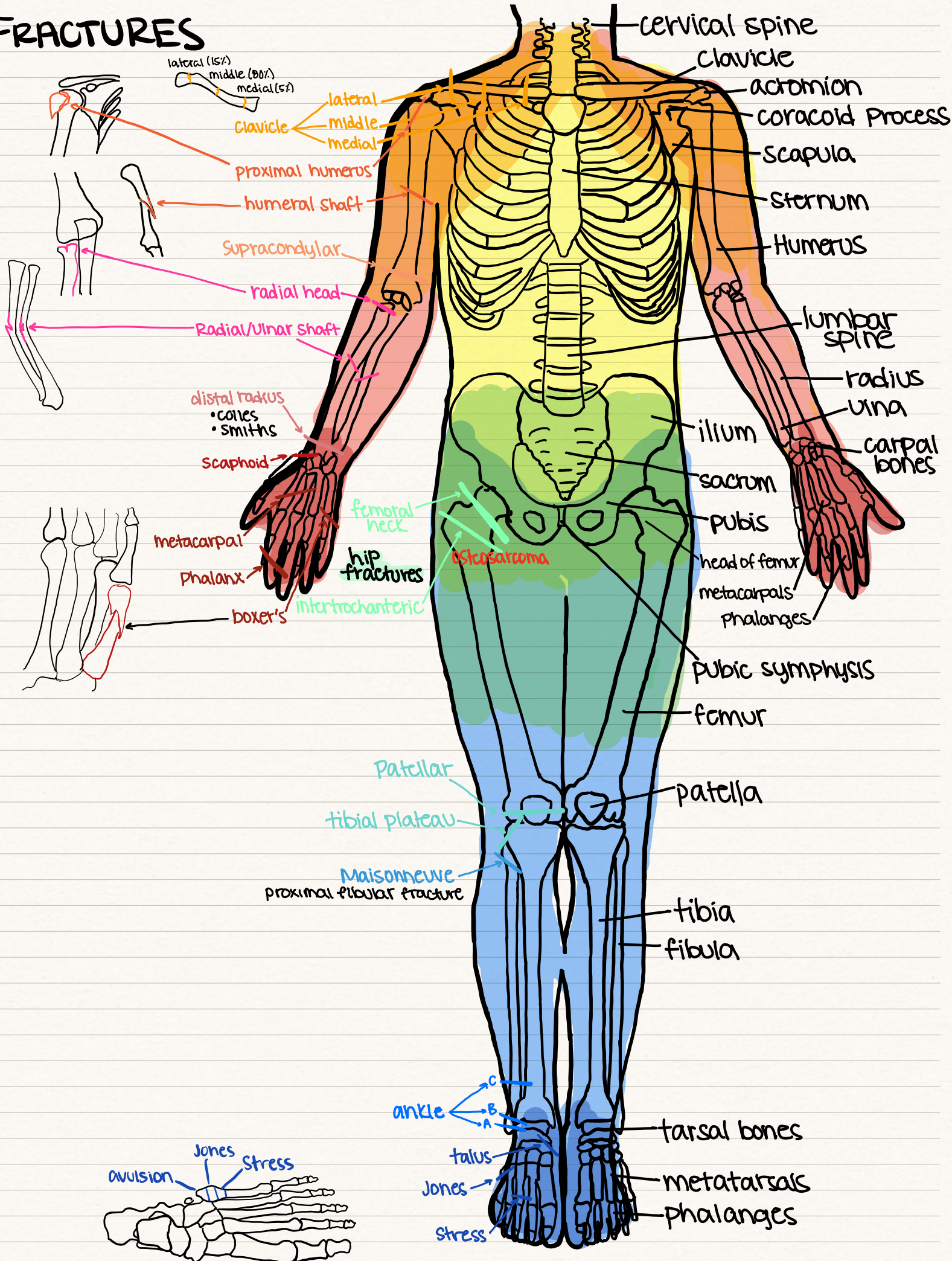


# MUSCULOSKELETAL SYSTEM



# FRACTURES





# TRAUMA

## COMPLICATIONS OF FRACTURES

### ACUTE

**Arterial injury**: Always palpate distal and proximal pulses

→ Immediate reduction if neurovascular compromise

Consider **angiography** w/ high-velocity  
◦ cool extremity, mottled color, sensory loss

**Popliteal artery injury**: high energy injury.  
↳ leading cause of amputation

**Nerve injury**: due to fracture fragments, casting complications, bony callus formation

◦ distal radius → median nerve injury

• **transient neurapraxia** resolves in 2-3 months if nerve is allowed to heal w/out stretching/prolonged compression

**Thromboembolic**: major ortho trauma increases risk (**hip, femur, tibia**)

**Fat embolism syndrome**: associated w/ long bone fractures (**femur shaft**)

↳ lead to dyspnea, tachypnea, hypoxia

**Open fractures**: direct communication btwn fracture and environment

◦ ↑ risk of infection

Management: **abx, immobilization**

◦ tetanus prophylaxis

◦ pain control as needed

◦ **prompt irrigation and debridement** (sterile saline and low pressure)

**Fracture blisters**: develop over the site of traumatic fracture where skin swollen or soft tissue injury

◦ develop within first 1-2 days

◦ **tibia, ankle, elbow**

**COMPARTMENT SYNDROME** due to increased pressure in compartment compromising circulation/function

◦ long bone fractures - **tibia, distal radius, supracondylar humerus, femur**

◦ tight cast/bandage

◦ **Immediate fasciotomy** may be limb sparing

**Rhabdomyolysis**: breakdown of muscle fibers w/ release of cellular contents into blood  
**dark urine, myoglobinuria, fluids**

### NON-ACUTE

**Osteomyelitis**: fractures that are healing slower than expected or that remain extremely painful despite mgmt

◦ gradual progression of tenderness, fever, rigors, ↓ ROM

◦ **IV abx and surgical debridement**

**Nonunion**: incomplete fracture healing where fragments do NOT reconnect

**Malunion**: fracture healing w/ deformity

**SCAPHOID, femur, tibia, talus, SMT**

◦ present w/ persistent pain

◦ often requires **ORIF** if symptomatic

◦ **Causes** - ↓ blood supply, poor bone healing due to **smoking/ETOH**, poor alignment, infection, immunosuppression, open fractures

**Complex regional Pain syndrome**

AKA reflex Sympathetic Dystrophy

◦ localized pain, swelling, ↓ ROM, vasomotor instability, skin changes, bone demineralization

### Management

① **Open reduction internal fixation**

Surgical procedure to stabilize bone to allow optimal healing

↳ **urgent/emergent** if severe

◦ open reduction → incision made in OR

◦ internal fixation → hardware repair (screws, plates, rods, pins)

± external fixation → temporary frame

→ **Post-op**: OT/PT/case management/social work/nutrition

② **Immobilization** → **Splint vs. Cast**

Splinting allows for swelling and may prevent neurovascular compromise

◦ **Pre-formed**: plaster, fiberglass, malleable aluminum, air splint. "off-the-shelf"

◦ **Custom made**: cotton bandage (padding), plaster roll or pre-padded FG + water

◦ **Plaster**: gauze w/ plaster + water → heat releasing. 2-8 min to set. Cheap. Soggy

◦ **Fiberglass**: synthetic, no water, sets quicker. "sticky", expensive, longer-wear.

**Immobilize above and below the joint**



# Aftercare Instructions

- ① return or call for numbness, tingling, increased pain under/distal splint
- ② RICE
- ③ check 24-48 hrs after for fit and NV status
- ④ 5Ps: **Pallor, Pain, Paresthesia, Pulselessness, Paralysis**
- ⑤ ortho FU 5-10 days after  
↳ will remove splint and place in cast

## COMPLICATIONS

- skin breakdown → prevent w/ adequate padding
- infection
- NV compromise → don't splint circumferentially
- contact dermatitis
- thermal burn

# INFECTIONS

## OSTEOMYELITIS infection of the bone

patho may be caused by direct inoculation - **open fracture**, surgery, etc.

◦ pathogen: **S. aureus**

Clinical dull ache

- may be overlying abscess/ulcer, warmth, erythema, edema, fever, malaise
- draining sinus tracts occur in chronic infection or infected foreign body implants

diagnosis **blood culture** → S. aureus

- bone scan and gallium scan
- plain film normal early on  
↳ CT more sensitive
- MRI → epidural abscess

treatment prolonged abx, preferably IV

- **cefazolin, nafcillin, oxacillin** drugs of choice
- PNC allergy or methacillin resistant → **vancomycin**
- oral → **levofloxacin or ciprofloxacin + rifampin**

surgery → staph w/ abscess, spinal cord compression, extensive or recurrent

## SEPTIC ARTHRITIS

risks previous joint damage and **IV drug use** (E. coli and pseudomonas)

patho acute onset of inflammatory monoarticular arthritis, most often in large weight bearing joints and wrists

◦ pathogen: **S. aureus**. MRSA and group B strep also common

Clinical acute, painful, erythema, worsening, chills, fever. Knee most common

diagnosis **Synovial fluid analysis** → WBC count > 2,000 usually > 50,000

radiographs → normal early on → demineralization (within days of onset)

**CT/MRI** more sensitive → detect fluid in joints

◦ bony erosions, narrowing of joint space. later osteomyelitis and periostitis

treatment **Vancomycin + 3rd gen cephalosporin** (ceftriaxone, cefotaxime)

duration: 4-6 weeks



# NEOPLASMS

## Malignant

invades surrounding tissue and/or spreads to other parts of the body  
◦ poorly defined, cortical destruction, periosteal reaction (inflammation)

### OSTEOSARCOMA

epi most common primary malignancy in **pediatrics**  
◦ Peaks @ **13-16** and **>65 yo**

patho production of **osteoid** or **immature bone**  
mets → **lung**, other bone

clinical localized pain, may wax/wane, present **over several months**  
◦ **ST MASS** - large and tender  
◦ distal **femur** (75%), proximal tibia, humerus

diagnosis **Sunburst pattern** on x-ray  
◦ Labs: ↑ **LDH**, **alk phos**, **ESR**  
◦ **MRI** → staging  
◦ **Chest CT** → mets  
◦ **diagnostic biopsy**

treatment  
low grade: **resection** → **chemo**  
high grade: **chemo** → **resection** → **chemo**  
metastatic: **resect** → **chemo**

### EWINGS

epi 10-25 yo

patho bone cancer of long bone and pelvis

clinical localized pain and swelling, **worse at night**  
◦ **ST swelling, erythema**  
◦ constitutional sx in 10%  
◦ **femur** most common

diagnosis **"moth-eaten"** appearance on x-ray  
◦ **MRI/CT vs PET/CT** for mets is controversial  
◦ **bone marrow biopsy**  
◦ **definitive biopsy**

treatment **Chemo** first  
◦ response → **surgery vs XRT**  
◦ disease progression → **XRT**

### CHONDROSARCOMA

epi older adults (**>50 yo**)  
90% are slow growing

patho production of **chondroid** (cartilaginous) **matrix** within the bone.

clinical localized pain and swelling, **worse at night**  
◦ **proximal femur and humerus**, bone of pelvis

diagnosis **"popcorn"** appearance on x-ray - mixed radiolucent and sclerotic, ring/arc calcifications  
◦ **MRI/CT** → characterize  
◦ **definitive biopsy**

treatment **Surgery** for non-metastatic disease  
◦ highest cure rate  
**chemo/XRT not effective**  
↳ limited vascularity

## BONE METASTASES

Bone is 3rd most common organ affected by mets after lung, liver  
◦ Breast (70%), **prostate** (70%), thyroid (60%), lung (40%), bladder (40%), kidney (20%)  
↳ mixed      ↳ osteoblastic (sclerotic)      osteolytic (lytic lesion) ←  
◦ Presenting Sx: **PAIN**      ◦ **multiple myeloma**, NON-small cell lung  
◦ Management: radiation, bisphosphonate, surgery

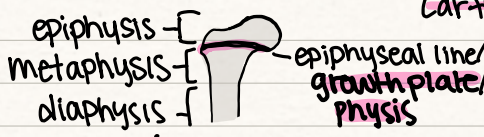
## Benign

well-defined, **obvious zone of transition**, confined by natural barriers, **lack of cortex destruction**  
◦ **Osteochondroma**, **HMO**, **enchondroma**, **osteoid osteoma**, **giant cell tumor**, **non-ossifying fibroma**, **simple bone cyst**



# PEDIATRICS

## HISTOLOGY



derive nutrients from **epiphyseal vessels**  
 Cartilage cells grow  
 Neuvascularization by **metaphyseal vessels**  
 When vascular beds touch, physis closes  
 no further bone growth

Damage to vascular supply → premature growth arrest

## Ossification Centers

- Capitellum 1yo
- Radial head 3yo
- Internal epicondyle 5yo
- Trochlea 7yo
- Olecranon 9yo
- External epicondyle 11yo

## FRACTURES

heal quicker, shorter immobilization  
 normal process of bone remodeling may correct malalignment

A deformity is more likely to correct itself if:

- child is younger
- fracture is closer to physis
- angulation in same plane of motion as nearest joint

**Severity of injury** is the most important prognostic factor

## SALTER HARRIS

- I. Slipped** - minimal risk of growth arrest, immobilization splint/cast
- II. Above**
- III. Lower** - articular fractures, definitive → orthopedic surgeon
- IV. Through**
- V. Rammed** - Crush injury of GP. Growth disturbance

## FAT PADS

**ANTERIOR**  
 "sail sign"  
**POSTERIOR** marked distension of joint capsule  
 • always pathologic



**Clavicle Fracture**: most common - midshaft, greenstick. Sling and pain control

**Shoulder dislocation**: rare. Anterior - abducted, externally rotated (from fall)

**Humerus fracture**: more common. 80% of growth at proximal physis.

- proximal (SH2) → 50-70% angulation tolerated → sling. Shaft - 2cm overlap tolerated.

**Supracondylar fractures** T1: non-displaced (posterior splint). Type II: displaced w/ posterior cortex intact → reduction. T3: displaced. no cortex intact → reduction, pinning

**Monteggia Fracture**: ulnar fracture w/ radial head dislocation → urgent referral

**Nursemaid elbow**: annular ligament becomes partially detached from the head of radius and slips into radiohumeral joint. Reduction - supinate, flex OR hyperpronate  
 • arm held in pronation w/ elbow flexed

**Galeazzi fracture**: radial shaft fracture w/ radioulnar joint disruption → refer

**Scoliosis**: Infantile (0-3yo), juvenile (4-9), adolescent (≥10)

- Cobb angle > 10°, forward (Adams) bend test → refer

**Metacarpal fractures**: Salter-Harris I/II and proximal MC can occur → ulnar gutter splint

## Slipped capital femoral epiphysis

Adolescent w/ limp. Male, obese, black  
 • ice cream falling off cone → Klein line

## Leg calve Perthes

idiopathic AVN of capital femoral epiphysis of femoral head  
 • limp. M > F. 3-12yo

## Knee Fractures

tibial/femoral physis, tibial spine or tubercle, patella

## Patella Dislocation

usually occurs laterally reduction → extend knee, medial pressure on patella

**Toddler Fracture**: oblique, nondisplaced distal tibia fracture → consider abuse (twist)

**Tillaux fracture**: SH3 as medial tibial physis closes. Due to foot external rotation

**Triplane fracture**: Salter-Harris II + Tillaux fracture → SH4 and GP damage → CT

**Osgood-Schlatter**: tibial tuberosity apophysitis - microinjury to growth plate due to overuse during adolescent growth spurts

**NEOPLASIA** if limping → suspect ALL. Surgery + chemo (± radiation)

**Osteosarcoma** - MOST COMMON. Distal femur/proximal tibia. "sunburst" on x-ray

**Ewing's** - extremity or pelvis. Soft tissue component. "onion-skinning" on x-ray

**Rhabdomyosarcoma** - most common ST sarcoma. GU, extremity, head/neck