Fractures and Complications

2024

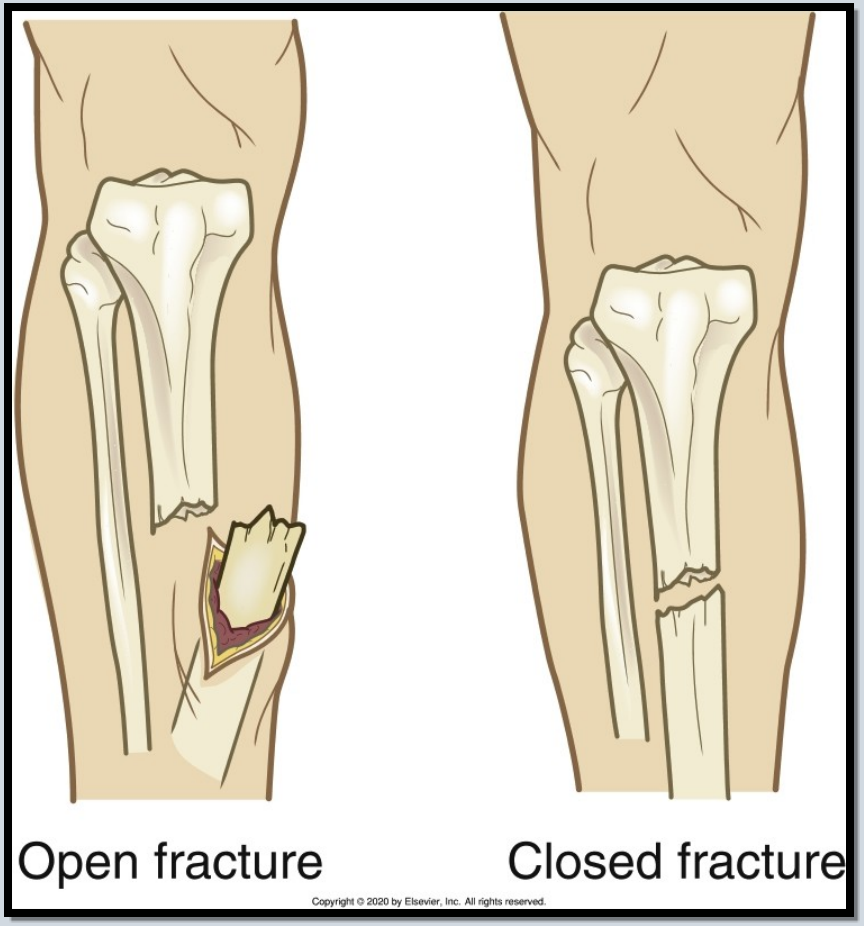
Fracture Definition

- Disruption or break in continuity of structure of bone
- Majority of fractures from traumatic injuries
- Some fractures secondary to disease process (pathologic)
  - Cancer or osteoporosis

Classification (1 of 4)

- Communication with environment
  - Open—skin broken, bone exposed
    - Usually from severe external forces
  - Closed—skin intact
- Extent of break
  - Complete—completely through bone
  - Incomplete—partly across bone shaft

Fracture Classification According to External Environment



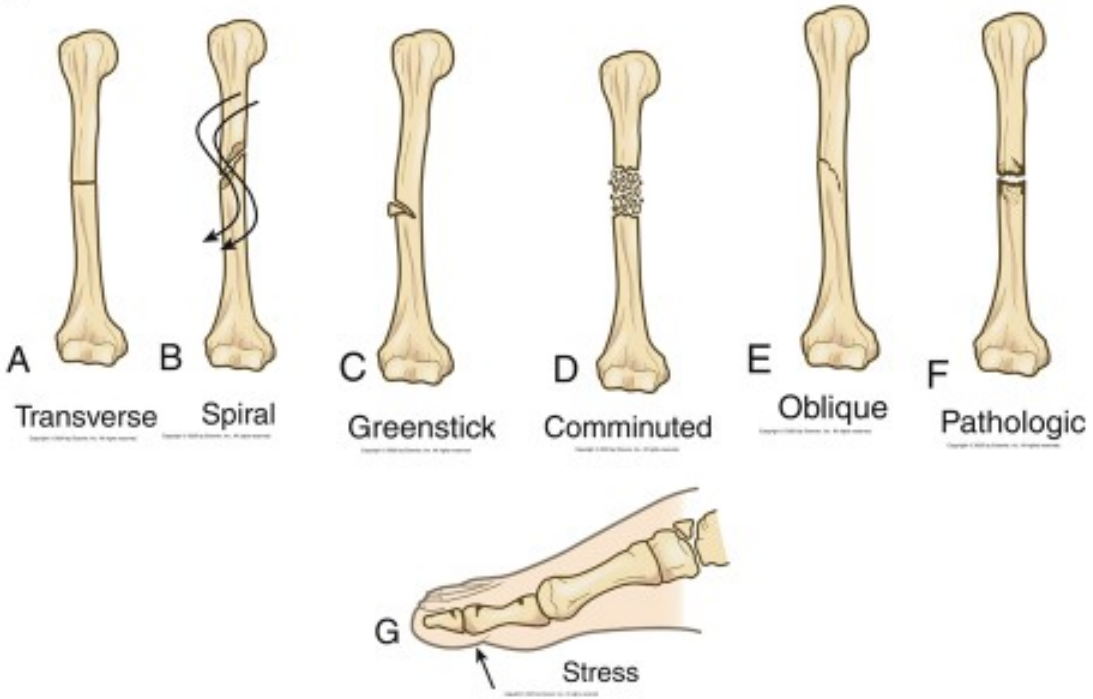
Classification (2 of 4)

- Based on direction of fracture line:
  - Linear
  - Oblique
  - Transverse
  - Longitudinal
  - Spiral

Classification (3 of 4) - Types of Fractures

Classification (3 of 4)

- Types of Fractures



Classification (4 of 4)

- Displaced or nondisplaced
  - *Displaced*: two ends separated from one another
    - Often comminuted or oblique
  - *Nondisplaced*: periosteum is intact and bone is aligned
    - Usually transverse, spiral, or greenstick

Clinical Manifestations

S/S of fractures vary according to:

- The location
- The bone involved
- The type of fx
- The amount of related soft tissue damage

Clinical Manifestations

Signs & Symptoms Include:

- Pain/tenderness
- Edema
- Muscle Spasms
- Loss of Normal Function
- Obvious Deformity
- Excessive Motion at Site
- Crepitus
- Guarding
- Warmth Over the Injured Area
- Ecchymosis of Skin
- Loss of Sensation

Bone Healing Stages

1. Hematoma Formation
   - Hematoma surrounds the ends of the fragments
   - Begins within 24 hours
2. Cellular Proliferation Stage
   - Fibrin meshwork formation – phagocytosis of necrotic tissue
   - Hematomas changes to granulation tissue
   - New bone formed
   - Invasion of osteoblasts

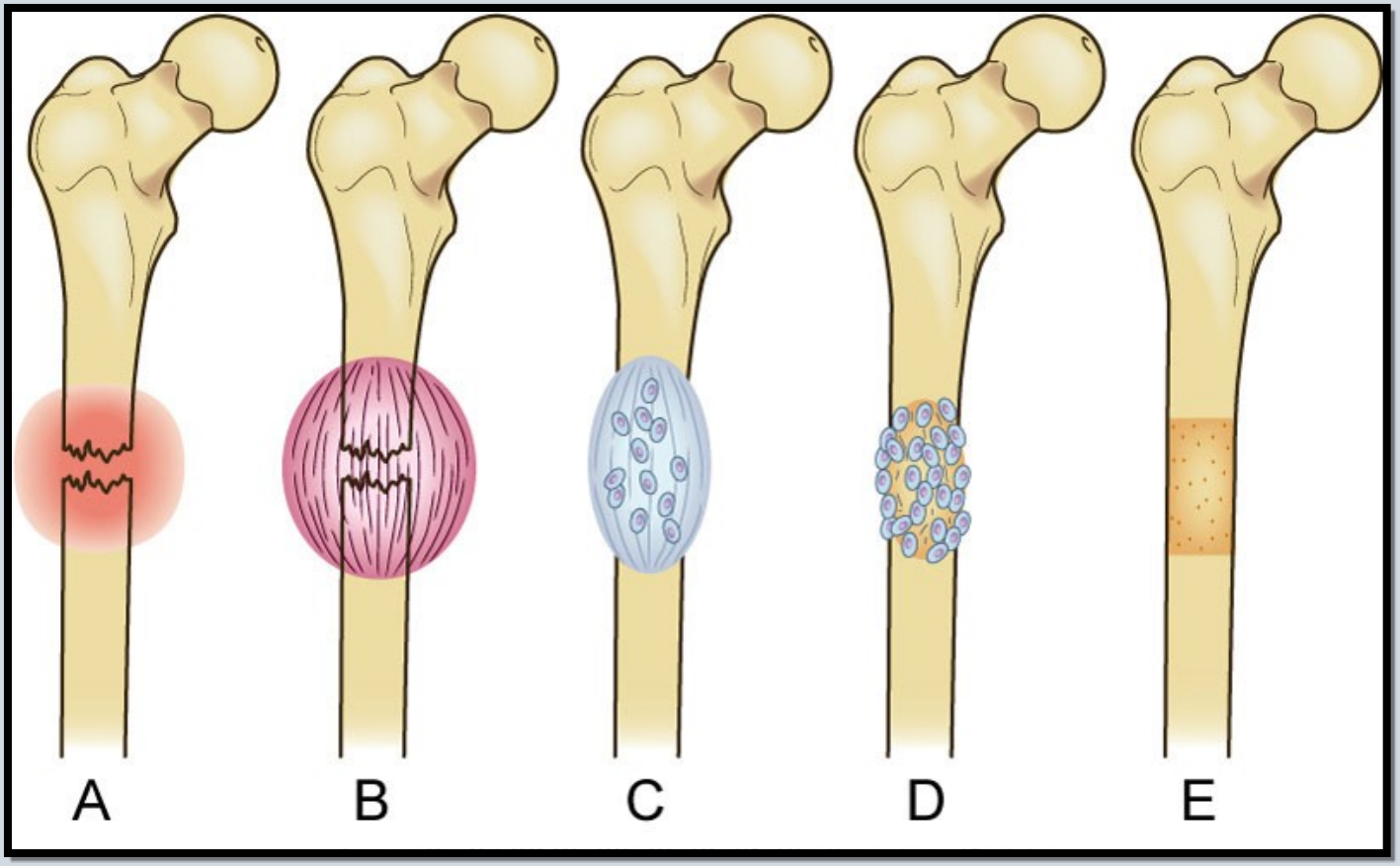
Bone Healing Stages

3. Callus Formation
   - Osteoclasts destroy old bone & new bone formed by osteoblasts
   - Collagen strengthens
   - Occurs 6-10 days after the injury
4. Ossification
   - Formation of new bone ≈ 3-10 weeks

Bone Healing Stages

5. Consolidation
   - ↓ distance between bone fragments until closed
6. Remodeling
   - Excess cells reabsorbed & union complete

Stages of Bone Healing



Bone Healing

Factors That Enhance Bone Healing:

- Immobilization of fracture fragments
- Maximum bone fragment contact
- Sufficient blood supply
- Proper nutrition
- Exercise – weight-bearing for long bones
- Electric stimulation across fracture

Bone Healing

Factors That Inhibit Bone Healing:

- Excessive local trauma (edema)
- Bone loss (OP)
- Inadequate immobilization
- Space between bone fragments
- Infection
- Tobacco use
- Poor nutrition
- Age
- Corticosteroids
- Denervation

Healing Time of Fractures

- Flat bone fractures (pelvis, scapula) heal rapidly.
- Epiphysis (cancellous bone) fractures heal more quickly than diaphysis (compact) fractures.
  - Femoral shaft fracture: 18 weeks
  - Pelvic fracture: 6 weeks
  - Proximal humerus fracture: 3-6 weeks
  - Scapula: 10 weeks

Interprofessional Care

Overall Goals of Treatment

- Anatomic realignment of bone fragments (reduction)
  - "Setting the bones"
- Immobilization to maintain alignment (reduction) until healing occurs
- Restoration of normal function or near-normal function

Collaborative Care

Drug Therapy

- Muscle relaxant
- Bone penetrating ABX
  - Cephalosporins
- Tetanus and diphtheria toxoid
  - Given for open fracture when immunization is unknown

Nutrition Therapy

- Optimal soft tissue and bone healing
  - Increase protein (1 g/kg of body weight)
  - Increase vitamins (B, C, D)
  - Increase calcium, phosphorus , and magnesium
  - Increase fluid (2000 to 3000 mL/day)
  - Increase fiber
    - Body jacket and hip spica cast patients: six small meals a day

Immediate Fracture Management

- Immobilize the area by splinting
- Elevate the body part
- Apply cold packs or ice
- Assess for Δ in neurovascular status
- Assess for signs of shock
- Administer analgesics

Fracture Reduction

Closed Reduction

- Non-surgical, manual realignment
  - *Manual manipulation of the bones to their correct position*
- Can do under local anesthetic, conscious sedation, or general anesthesia
- No incision!
- Usually traction → reduction → cast

Fracture Reduction

Open Reduction

- *Correction of bone alignment through a surgical incision*
- May use internal fixation
  - Wires, screws, pins, plates, rods, or nails
- Risk for infection
- Early mobilization

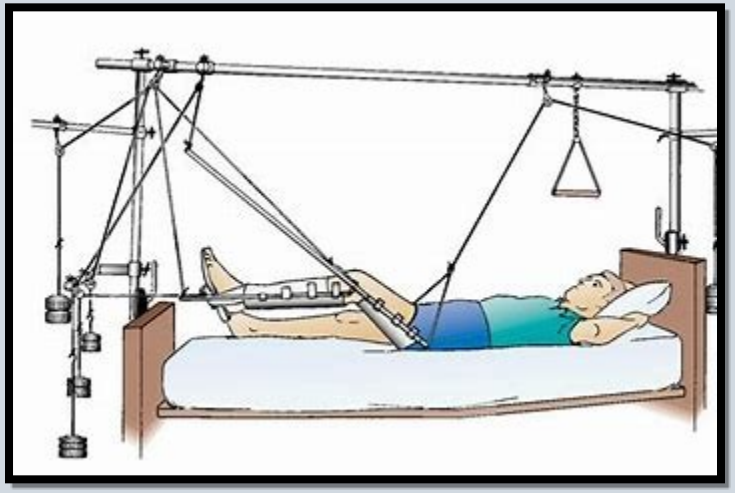
ORIF:

- **O**pen **R**eduction, **I**nternal **F**ixation

Fracture Redu

Traction

- Skin traction → short term
- Skeletal traction → longer time period



Fracture Immobilization

Fracture Immobilization

Casts

- Temporary circumferential immobilization device
- Allows patient to perform many normal ADLs while maintaining immobilization
- Incorporates joints above and below fracture for stabilization during healing
- Common treatment following closed reduction

Casts

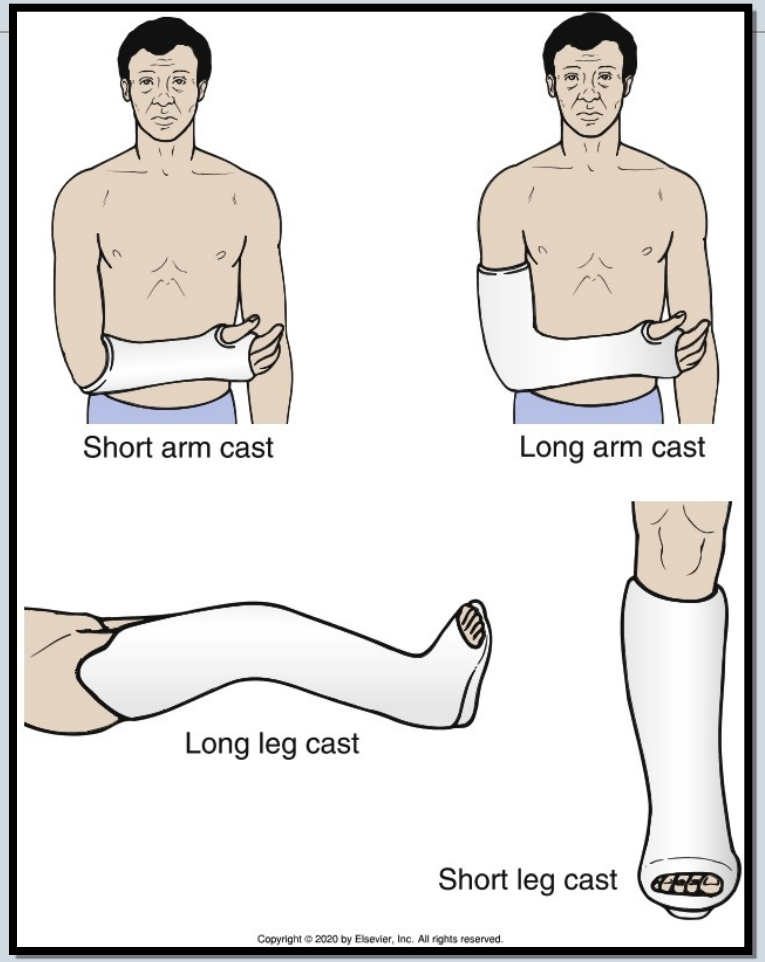
- **Types:**
  - Short / long arm casts
  - Short / long leg casts
  - Body jacket cast
  - Walking Cast
  - Hip spica cast

- **Two most common materials:**
- Plaster of Paris
- Fiberglass

Synthetic Casting Materials

- Lightweight, stronger, more waterproof
- Early weight bearing
- Activated by submersion in cool or tepid water, then molded to fit body part

Common Types of Casts



Fracture Immobilization

Casts

- Cast Application
  - Clean skin & assess for lacerations or lesions – dry completely
  - Wrap area with cotton padding or stockinette
  - Plaster rolls submersed in warm water until no bubbling occurs
  - Plaster or fiberglass applied
  - After application, place on pillow & reposition q 2-3°
  - Allow to air dry

Fracture Immobilization

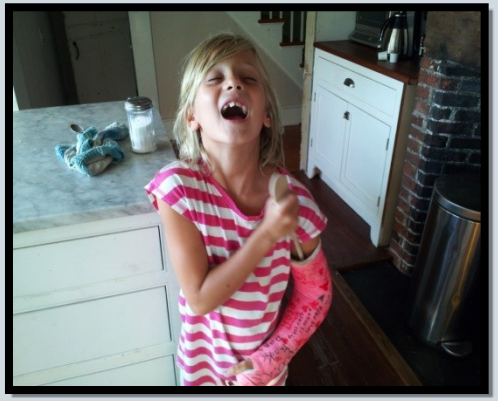
Casts

- Cast Application Cont'd…
  - Handle a damp cast with palms of hands, do not touch with fingertips!
  - Once cast is dry, finish the edges to prevent skin irritation
    - Trim and smooth edges

Fracture Immobilization

Casts

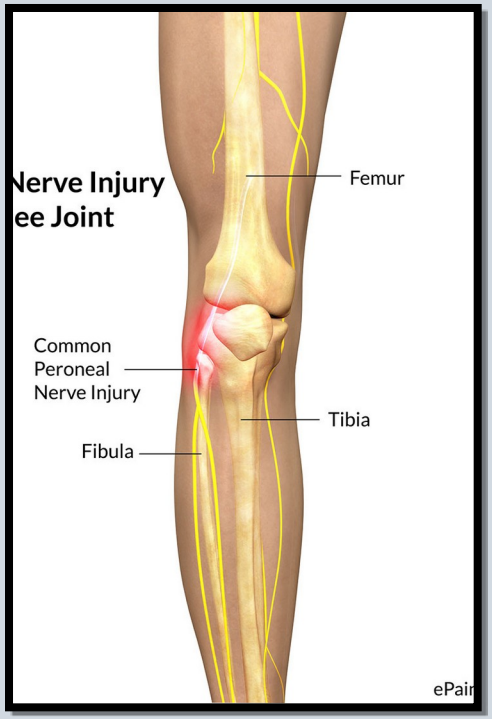
- Cast Care:
- Skin care – maintain good skin integrity – prevent breakdown!
  - Inspect skin at edges of cast & underlying the cast for redness or irritation
  - Don’t use powders
  - No lotions
  - No scratching in the cast



Fracture Immobilization

Casts

- Risk for Neurovascular Compromise
  - Need a baseline – do bilateral assessment before cast application
  - Be aware of nerves and vessels in the casted area (peroneal, ulnar)
  - Teach S/S of Compartment Syndrome



Fracture Immobilization

Casts

- Drainage on the Cast:
  - May have with an open wound or surgery prior to cast application
  - Wet plaster – drainage is absorbed & spreads rapidly
    - Amount you see is not equal to amount draining
  - 24-72° after trauma - ↑ risk for drainage
  - Concerned if bright red drainage on cast

Fracture Immobilization

Casts

- Edema of the extremity:
  - raise leg, raise foot of bed
- Pressure areas under cast
  - ↑ pain
  - Infection under the cast – ✓ for odor, temp, pain, burning, drainage

Fracture Immobilization

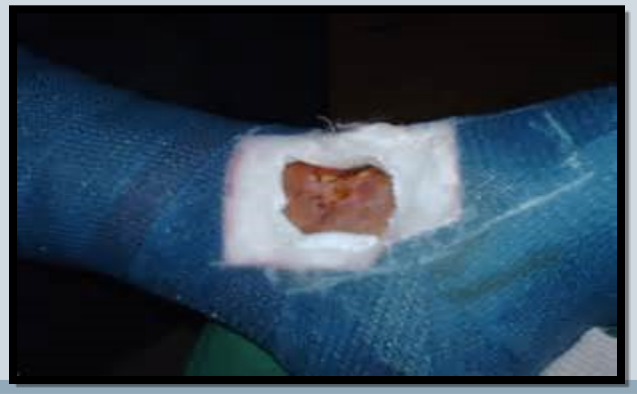
Casts

- Maintain a clean, dry cast
- Mobility
  - Full ROM of all other joints
  - Isometric or muscle setting exercises
    - No joint movement, tighten muscle & relax
    - Prevent venous stasis & atrophy
    - Wt.-bear with MD order

Fracture Immobilization

Casts

- Windowing = cut in dry cast to inspect the skin, wound, or remove drains
- Bivalving = splint along both sides



Fracture Immobilization

Casts

- Cast removal: electric cast saw
  - Not painful
  - Very noisy, can be frightening
  - Skin is often sensitive – covered with yellow/brown scales or crusts of dead skin
  - Muscle may be flabby/weak
  - Altered balance after the extra weight from the cast is removed
    - Gently soak & wash the skin
    - Pat dry
    - Mineral oil to remove dried skin


Medscape
Source: J Med Case Reports © 1999-2011 BioMed Central Ltd

Fracture Immobilization

Knee Immobilizer

- This type of immobilization is easy to apply and remove
  - Permits close observation of the affected joint for signs of swelling and skin breakdown.
- Depending on the injury, removal of the splint or immobilizer
  - Facilitates ROM of the affected joint
  - Faster return to function.

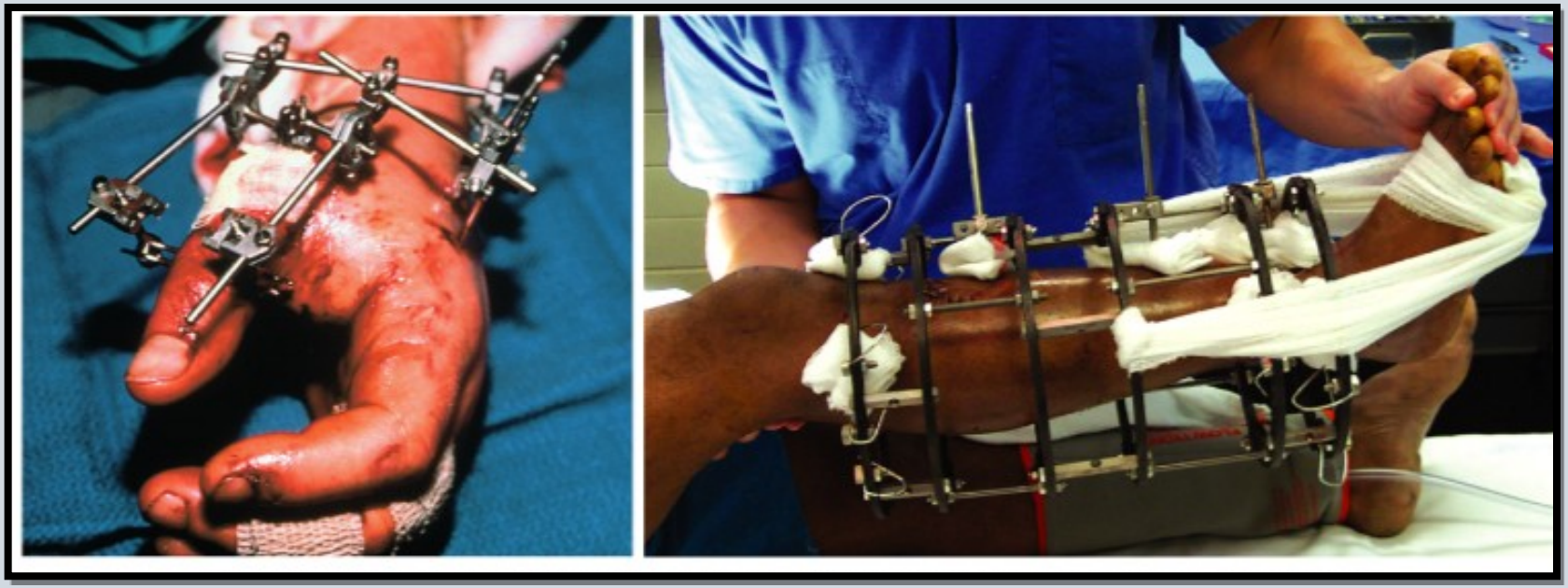
(From Maher AB, Salmond SW, Pellino T, editors: *Orthopedic nursing*, ed 3, Philadelphia, 2002, Saunders.)

Fracture Immobilization

External Fixation

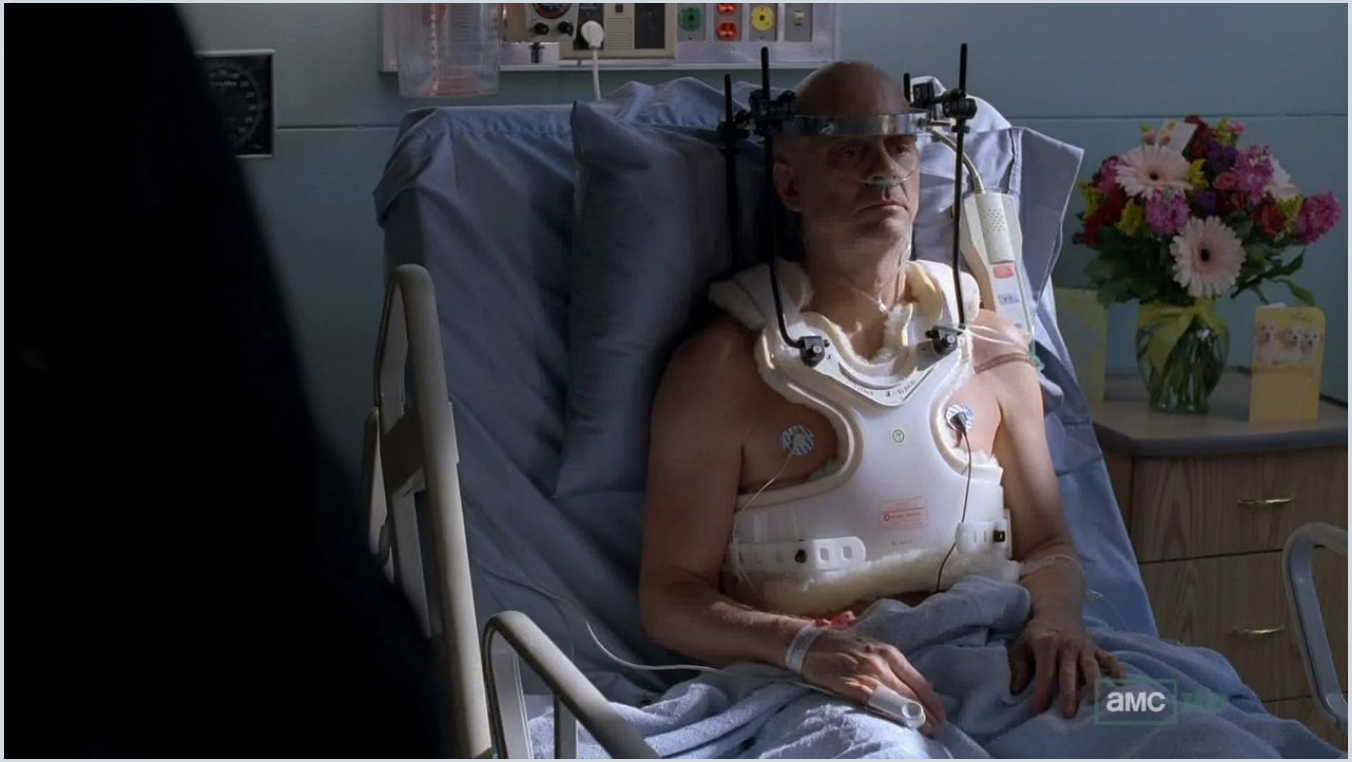
- Pins and wires that are inserted into the bone & attached to external rods
  - Used to compress fx fragments & immobilize reduced fx's when a cast and traction are not appropriate
  - Hold fragments in place
  - Used to treat complex fx's with associated soft tissue trauma
  - Applied to save extremity that may gave required amputation

External fixation for a wrist and a tibia-fibula fracture



Halo Vest

Ted Beneke – “Breaking Bad”



Fracture Immobilization

External Fixation

- Assess for S/S infection & pin loosening
  - Sterile drgs may be placed over entry & exit sites of pins or may be left uncovered to observe
- Pin Site Care
  - Attached directly to the bones
  - Depends on MD preference
  - Keep skin areas around pin sites clean & dry
  - Directly remove the exudate with water, rinse with sterile NS, dry with sterile gauze, may use antibiotic ointment

Fracture Immobilization

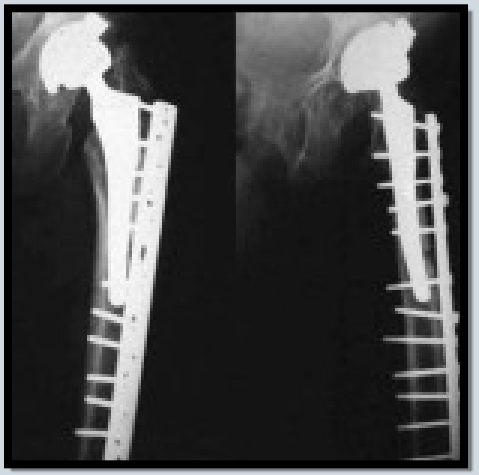
External Fixation

- Pt with an external fixator on the lower leg can be OOB in a wheelchair or even ambulate without wt. Bearing on the affected limb
- Nursing care is the same as pt in cast or skeletal traction, except that these pts are mobile earlier

Fracture Immobilization

Internal Fixation

- Pins, plates, intramedullary rods, & screws
- Surgically inserted at the time of realignment
- X-ray eval of alignment and healing



Views of Internal Fixation Devices

(From Jeremy Lewis, MD, Albuquerque, NM.)

Fracture Immobilization

Traction

- Application of a pulling force to an injured part of the body while counter-traction pulls in the opposite direction
- Purpose/goals of Traction:
  - Prevent or reduce muscle spasms & pain
  - Immobilization/realign bone fragments
  - Reduce a fracture or dislocation
  - Treat a pathologic condition or correct deformities

Fracture Immobilization

Traction

Terms to Know:

- Counter traction
  - Force that counteracts the pull of traction
  - Pulls in the opposite direction
  - Prevents the pt from sliding OOB
    - Ie; usually the pt's own body wt or bed position
- Suspension
  - Use of traction equipment to suspend a body part

Fracture Immobilization

Traction

Terms to Know:

- Balanced Suspension
  - Weights used to suspend the part correctly & continuously
  - Often used with traction to allow pt to move in bed

Fracture Immobilization

Traction

Three Types of Traction

1. Manual = hands are used to exert a pulling force on the bone that is to be realigned
   - Used for stable fx's or dislocations prior to splinting or casting or tx application

Fracture Immobilization

Traction

2. Skin Traction = strips of tape or special traction strips are applied directly to the skin
   - Pull of the weights is transmitted indirectly to the involved bone
   - Used for fx's which require only a moderate amount of pulling force for a relatively short period of time (48-72 hrs)
   - Need careful skin assessment!

Fracture Immobilization

Traction

- *Types of Skin Traction:*
  - Buck's & Hare Traction
  - Russell's traction
  - Cervical traction
  - Pelvic traction

Fracture Immobilization

Skin Traction

- 1. Buck's = simplest form of skin traction
  - Straight pull on the affected extremity
  - Used to relieve muscle spasms & immobilize a limb temporarily
    - fx hips, or femur fx's prior to OR
  - Buck's boot used mostly
  - Counter-traction maintained by keeping HOB flat
  - Perform active ROM on extremity not in traction

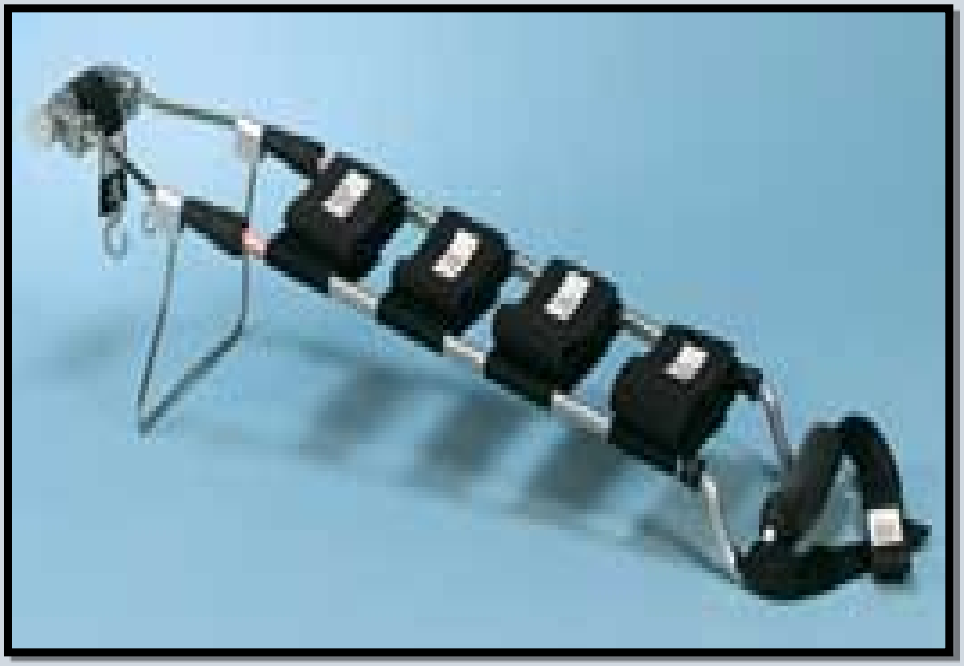
Buck's traction with a hook-and-loop fastener (Velcro) boot

Buck’s Traction Boot

(Courtesy Mary Wollan, RN, BAN, ONC, Spring Park, MN.)

Skin Traction

2. Hare Traction → fractured femur



Fracture Immobilization

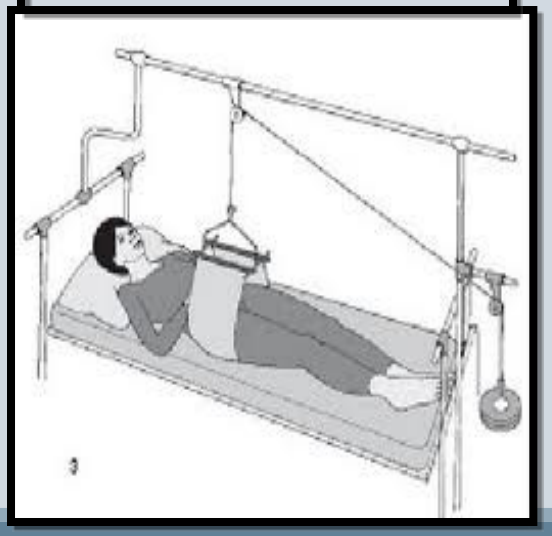
Skin Traction

- 3. Cervical = head holter used to apply tx to cervical spine
  - Used for relief of neck pain, whiplash, dislocations, and minor cervical fx's
  - Assess skin on chin & under holter

Fracture Immobilization

Skin Traction

- 4. Pelvic = disposable belt with straps that attach to cords & weights to exert pull on the lower back
  - Used for pain relief from muscle spasms and minor fx's of the lower spine

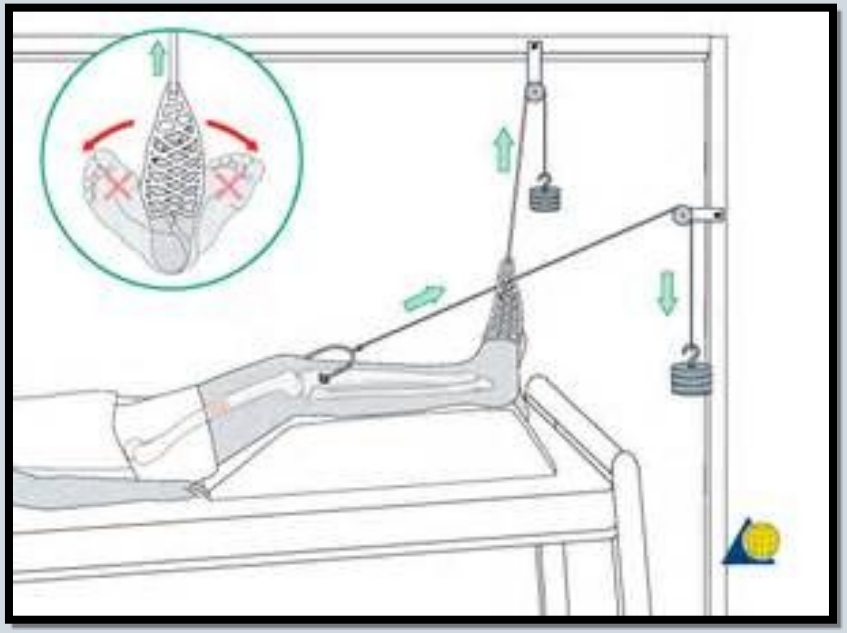


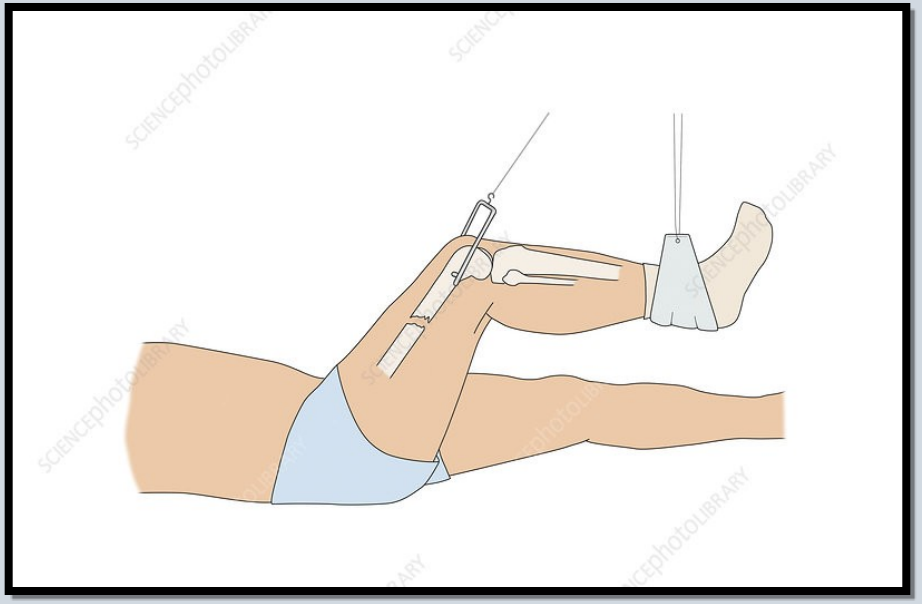
Fracture Immobilization

Traction

3. Skeletal Traction = traction force is applied directly to the bone using pins, wires, or screws
   - Use tongs for cervical tx, applied directly to the skull
   - Used for fx's requiring ↑ pulling force, over extended periods of time
   - Used for fx's of the tibia, femur, humerus, cervical spine, & unstable fx's
   - You do not remove the weights!

Skeletal Traction





Balanced Suspension Skeletal Traction

(Courtesy Zimmer, Inc.)

Fracture Immobilization

Traction

- *8 General Principles of Traction: ***
  - Do not re-use the traction cord
  - Assess area –skin traction can not be applied over a wound
  - Avoid pressure over bony prominences
  - Keep weights *hanging free*
  - Don’t add/remove weight without MD order
  - Don’t allow weights to hang over a patient or on the bed
  - Make sure ropes are in the pulleys & knots are free from pulleys!!!
  - Keep bed linens from interfering with traction

Fracture Immobilization

Traction

- Nursing Care
  - Assessment: skin, N/V, pain, activity, nutrition, elimination
  - Planning: set goals with pt
    - NV Compromise
    - Anxiety?
    - Pain
    - Impaired Physical Mobility
    - Immobility Complications
    - Knowledge Deficit
    - Self-Care Deficit

Immobilization: Traction

- Nursing Care
  - Implementation:
    - Position
    - Make sure counter-traction is in place
    - Avoid friction
    - Make sure traction is continuous
    - Maintain correct line of pull
    - Prevent venous stasis
    - Maintain neuro-vascular status
    - Skin care!
    - Isometric & isotonic exercises
    - Promote ADL's

Secondary Management for Compound Fractures

- Surgical Debridement
- Tetanus toxoid
- Wound culture
- Wound packing

Secondary Management for Compound Fractures

- IV antibiotics
- Assess for S/S of infection
- Reduction of a fracture
- Immobilization of a fracture
- Treat any complications

Fracture Diagnosis

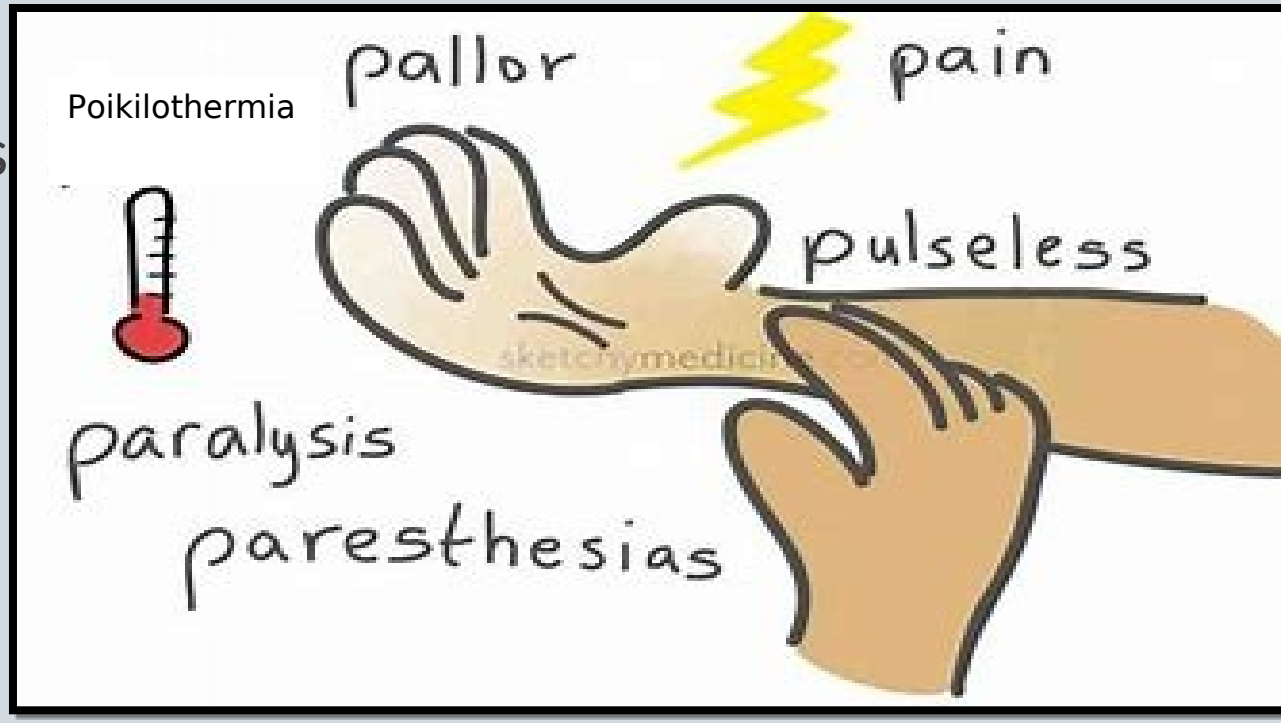
- History
- Physical Exam
  - Signs & symptoms of Fracture
- X-ray

Nursing Assessment

- Brief history of the accident
- Mechanism of injury
- Special emphasis focused on the region distal to the injury site

Neurovascular Assessment

- Color
- Temperature
- Capillary refill
- Peripheral pulses
- Edema
- Sensation
- Motor function
- Pain



Nursing Diagnosis

R/F Peripheral Neurovascular Dysfunction

Acute Pain

R/F Infection

R/F Injury

Anxiety

R/F Impaired Skin Integrity

Impaired Physical Mobility

Ineffective Therapeutic Regimen Management

Self Care Deficit

Deficient Knowledge

Nursing Management

Planning: Overall Goals

- Physiologic healing with no associated complications
- Pain relief
- Achieve maximal rehabilitation potential

Nursing Management

Implementation:

- Acute Intervention
  - **Pre-operative Management**
    - Skin preparation
    - Assess last oral intake
    - Monitor VS, need baseline NV assessment
    - Obtain consent
    - Administer prescribed meds
    - Explain all post-op treatments
    - Pain relief

Nursing Management

Implementation:

- Acute Intervention
  - Post-Operative Management
    - Monitor VS – maintain patent airway!!
    - Frequent NV assessments – assess cast & skin too
    - Pain relief – analgesics, cold compresses, elevation
    - Encourage participation in ADL's
    - Maintain mobility and muscle tone

Nursing Management

Implementation:

- Acute Intervention
  - Post-Operative Management Cont'd..
    - Teach care of devices –pin care
    - Prevent skin breakdown
    - Ambulation – usually started in mobility training when able to sit in bed & dangle feet over the side
    - Assistive devices
    - Counseling and referrals

Nursing Management

Implementation:

- Acute Intervention
  - **Other measures:**
    - Activity
    - Maintain ↑ fluid intake
    - Diet high in bulk

Nursing Management

Implementation:

- Ambulatory & Home Care
  - **Cast care:**
    - Frequent NV assessments
    - Teach signs of complications
    - ↑ extremity above level of heart
    - Exercise joints above & below cast

Nursing Management

Implementation:

- Ambulatory & Home Care
  - **Psychosocial Problems:**
    - Assist pt to adjust to any problems caused by the injury
    - Address complaints of extreme pain, unrelieved by elevation, analgesics, or repositioning
    - Assess any complaints of heightened or ↓ sensation/parasthesia distal to the injury, or due to an external fixation device

Nursing Management

Evaluation:

-Expected Outcomes

- Normal NV assessment
- Tolerable or no pain
- No evidence of infection
- No evidence of skin breakdown
- Crutches used correctly
- Minimal loss of muscle bulk of affected extremity

Fractures of Specific Bones

Hip Fractures

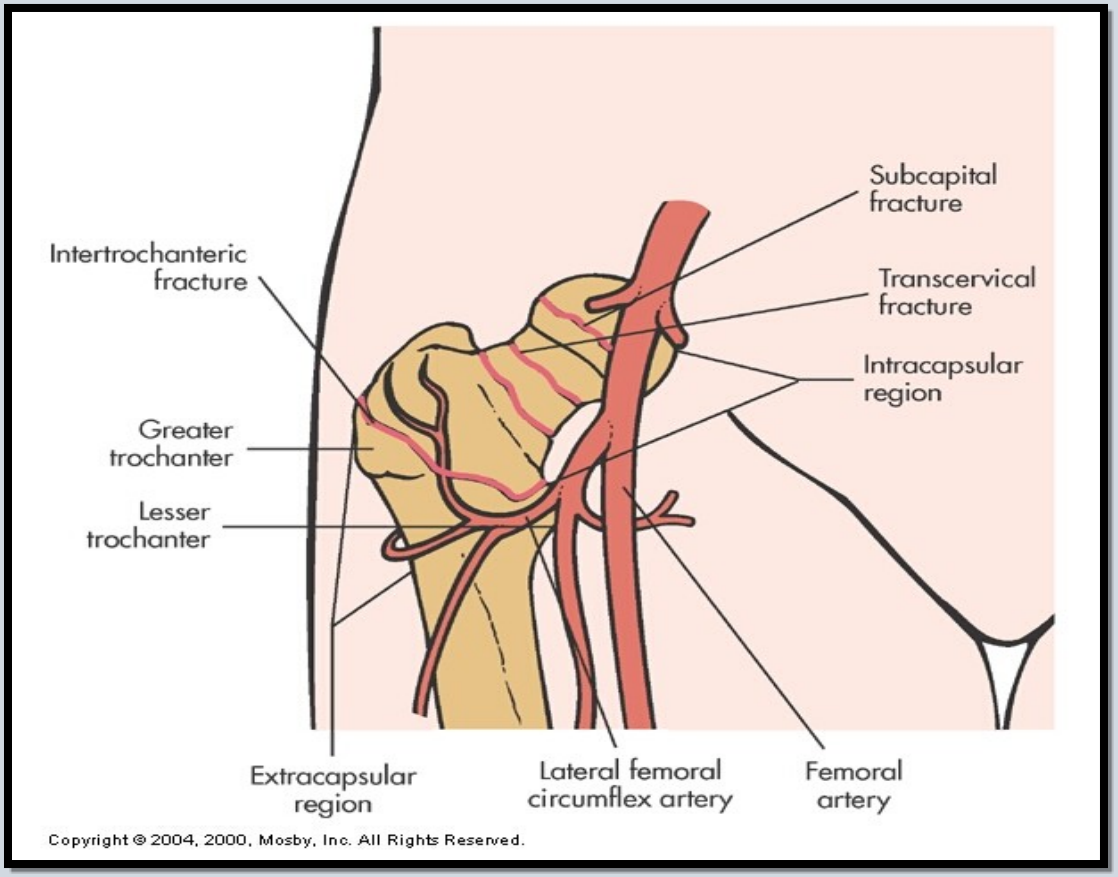
Most common fx seen in the hospital

Occurs more frequently in women than men due to osteoporosis & an ↑ life expectancy

****2 Categories****

- Intracapsular = occurs within the hip joint & capsule
- Extracapsular = inter-trochanteric fx

Hip Fractures



Hip Fractures

S/S of a Hip Fx:

- Severe pain at the fx site
- Inability to move the leg voluntarily
- External rotation of the leg
- Shortening of the leg

Diagnosis:

- X-Ray plus the S/S

Hip Fractures

Nursing Diagnosis:

- Pain
- Impaired Physical Mobility
- High Risk Peripheral NV Compromise
- Anxiety
- HR for Thrombophlebitis, Impaired Skin Integrity, Respiratory Complications, GI Function, GU Function
- Knowledge Deficit
- Impaired Home Maintenance

Hip Fractures

Medical Management

- Bucks traction can be applied prior to surgery.
- Choice of fixation device depends on the location of the fx, potential of avascular necrosis, & surgeon's preference

Hip Fractures

- Open Reduction Internal Fixation (ORIF) → Extracapsular fx's (intertrochanteric)
  - Use of intramedullary rod, pins, and screws to stabilize & reduce the fx.
  - Advantage = early ambulation.
  - Risk hip dislocation & subluxation post-op
  - Hip precautions: avoid hip adduction & rotation

Hip Fractures

Medical Management:

- Prosthetic Implant (Hip replacement) – to replace the femoral head & neck
  - Used for Intracapsular fx's
  - Implies some position restrictions for up to 2 months
  - Partial wt. bearing restrictions for up to 2 months
  - Same hip precautions post-op (avoid adduction & rotation)

Hip Fractures

Medical Management:

Closed reduction, Buck's traction, and pain management only if pt's general medical condition precludes surgery (Not candidate for Sx)

Nursing Management:

- Same interventions as with all other fractures
- Assess NV status – frequent VS immediately post-op!
- ✓ dressing & drains frequently.

Hip Fractures

Nursing Management

- Special restrictions (Hip Precautions):
- No hip flexion beyond 90° for 10 days-2 months
- No adduction of the affected leg beyond midline for 2 months
- No hyperextension
- No Internal rotation

Hip Fractures

Nursing Management

- **Special restrictions:**
  - These positions are avoided with an abduction splint & pillows between the legs
  - Carefully monitor pt's position during transfer – get pt OOB on their operative side
  - Sling back chair for transfer to PT
  - Avoid elevation of the leg above hip level

Hip Fractures

Nursing Management

- Post-op anti-coagulant therapy
  - Monitor PT or PTT times & administer the appropriate med & dose
- Maintain Anti-embolism stockings or EPC's
- Coughing and Deep Breathing
- Encourage leg exercises with the unaffected leg & foot pumps with the affected leg
- Maintain skin integrity – turning & meticulous skin care

Hip Fractures

Nursing Management

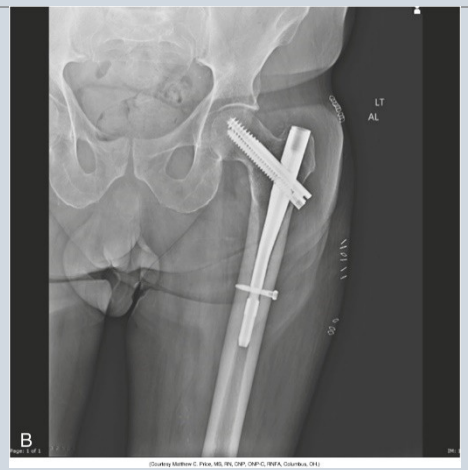
- Administer pain meds prior to PT
- Teach the use of overhead trapeze
- Monitor bowel elimination & UO
- Ambulate when permitted & with assistance
- Maintain a sterile drsg & use aseptic technique when changing it

Hip Fractures

Nursing Management

- Drains are placed in the wound to prevent formation of hematomas
  - Need constant suction applied
  - Note amount & type of drainage
- Do not turn on the affected hip
- Raised toilet seat
- Lifelong need for abx prophylaxis to protect the prosthesis from bacteremic infection

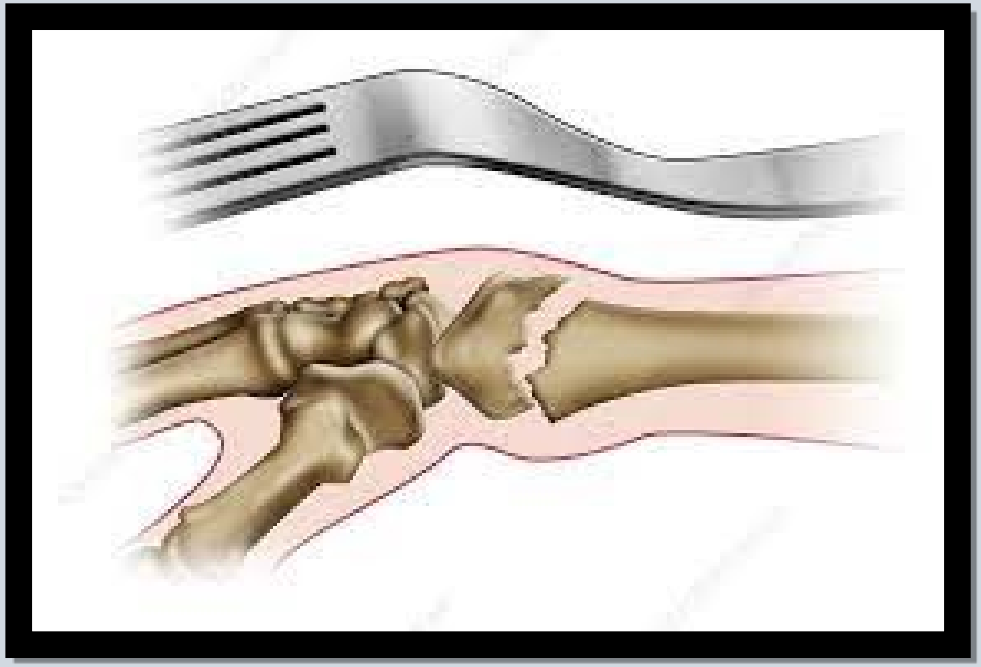
Types of Surgical Repair for a Hip Fracture



Colles Fracture

- Fracture of distal radius
- Fall on an outstretched hand
- Wrist appear deformed , see a hump when viewed from the side
- Major complication is vascular insufficiency from the edema
  - Need to ↓ edema & and do frequent NV assessments
- Takes 6-8 weeks to heal for an adult
- TX: Closed reduction w/ splint or cast, may need ORIF if displaced

Colles Fracture



Facial Fractures

NURSING MANAGEMENT

- Check for loose teeth
- Do not insert an NG tube
- Maintain a patent airway!!
- Oral hygiene q2°
- Wire cutters available
- No straws or nose blowing
- Soft toothbrush & rinsing
- Monitor for infection & pain

Clavicular Fractures

Frequently broken bone in children and young adults

- Usually the result of a fall
- May occur from direct trauma to bone

85% are midshaft fractures

Common manifestations

- Pain at fracture site
  - Obvious deformity may/may not occur
- Limited shoulder ROM

Clavicular Fractures

Surgery done if fracture is open

Comfort measures

- Splinting
- Ice
- Analgesics

PT

- Early ROM
- Strength exercises

Usually heal without complication

Pelvic Fracture

Minor to life-threatening

- Depends on mechanism of injury, vascular damage
- 3% of adult fractures

High mortality rate

- May have intraabdominal injury, compartment syndrome, paralytic ileus, sepsis, FES, or VTE

Symptoms

- Abdominal swelling, tenderness, deformity, unusual pelvic movement, and bruising
- Also check lower extremities

Pelvic Fracture

Diagnosis

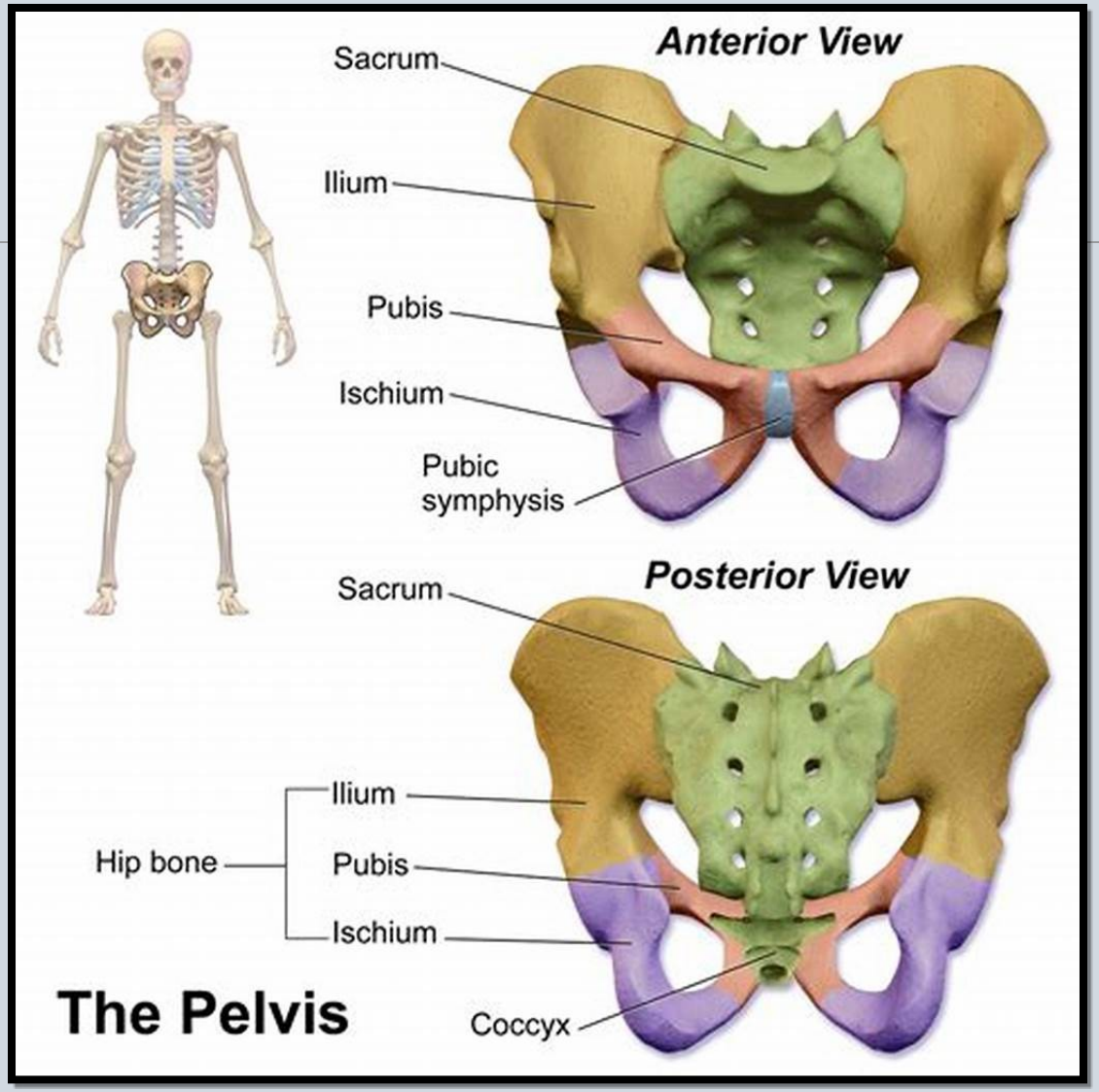
- X-ray and CT scan

Treatment

- Stable, nondisplaced—require little intervention
- Complex, displaced—external fixation or ORIF

Nursing

- Careful handling/moving
- Assess bowel and bladder elimination
- Regular distal neurovascular assessment
- Back care


Anterior View
Sacrum
Ilium
Pubis
Ischium
Pubic symphysis
Posterior View
Sacrum
Hip bone
Ilium
Pubis
Ischium
Coccyx
The Pelvis

Complications of Fractures

Complications of Fractures

- Majority heal without complication
- Medical emergencies needing immediate attention required with
  - Open fractures with severe blood loss
  - Fractures that damage vital organs
- Death is usually the result of
  - Damage to underlying organs and vascular structures
  - Complications of fracture or immobility

Complications of Fractures

Direct

- Bone infection
- Bone nonunion or malunion
- Avascular necrosis

Indirect

- Compartment syndrome
- VTE
- Fat embolism
- Rhabdomyolysis
- Hypovolemic shock

Complications of Fractures

1. Compartment Syndrome

- Swelling and increased pressure within a limited space (muscle compartment)
  - Compromises neurovascular function of tissues within that space
    - 38 compartments in upper and lower extremities
    - Associated with fractures with extensive tissue damage and crush injury
    - Most common: distal humerus and proximal tibia
    - May occur after knee or leg surgery or with prolonged pressure (limb trapped under body)

Compartment Syndrome

Arm Compartments:

- Deltoid
- Upper Arm
- Forearm – One of the most common!
- Hand

Leg Compartments:

- Buttock
- Thigh
- Lower leg
- Foot

Compartment Syndrome

2 Basic Etiologies:

- ↓ Compartment Size
  - Restrictive drsgs
  - Splints
  - Casts
- ↑ Compartment Content / Volume
  - Bleeding
  - Edema

Compartment Syndrome:

Pathophysiology

Decreased Venous Emptying

↓

Increased Capillary Permeability

↓

Edema

↓

Venous Obstruction & Increased Intra-compartmental Pressure

↓

Venous-Arterial Compression

↓

Arterial Occlusion

↓

Tissue Death

Compartment Syndrome

Prognosis

- Functional changes of muscle in 4°
- Functional loss of nerves in as little as 4°
- As time of ischemia ↑, damage is increasingly irreversible
- Within 4-6° after onset, may have irreversible damage
- Contractures can develop after 12° of ischemia, extremity may be useless in 24-48°

Compartment Syndrome

Clinical Manifestations

Compartment Syndrome

S/S:

- Early detection is **essential** to prevent permanent deficits!!
- May occur initially w/ injury or may be delayed several days
- Pain -(Most distinctive & usually the earliest sign!)
  - Out of proportion to magnitude of injury
  - Unrelieved by narcotics or elevation
  - Pain with passive stretch
  - Absence of pain does not rule out CS

Compartment Syndrome

S/S:

- Paresthesia getting progressively worse (early sign)
- Pressure
  - Tense on palpation
  - Direct measurement
- Paresis progressing to paralysis of the affected limb
- Pulses, Cap Refill, Color, Temperature are all unreliable indicators
  - Generally not ↓ until late since circulation to the skin may not be compromised (pulselessness, pallor, cool/cold)

Compartment Syndrome

Clinical Manifestations

- Myoglobinuria – dark reddish-brown urine
  - Injured muscle releases myoglobin into circulation = Myoglobinuric Renal Failure

Compartment Syndrome

Prevention

- Elevate & ice application
- Document NV assessments frequently
- Teach the patient S/S to look for
- This is a medical emergency!!
  - **Call the MD!**

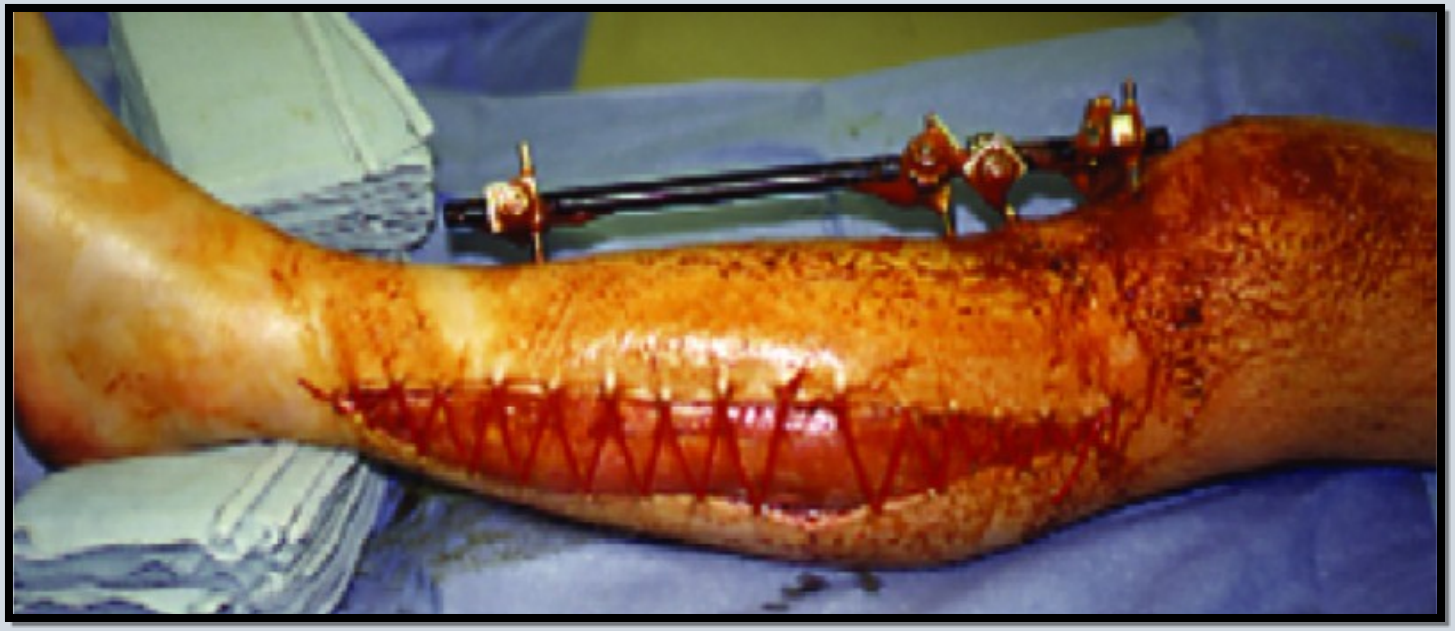
Compartment Syndrome

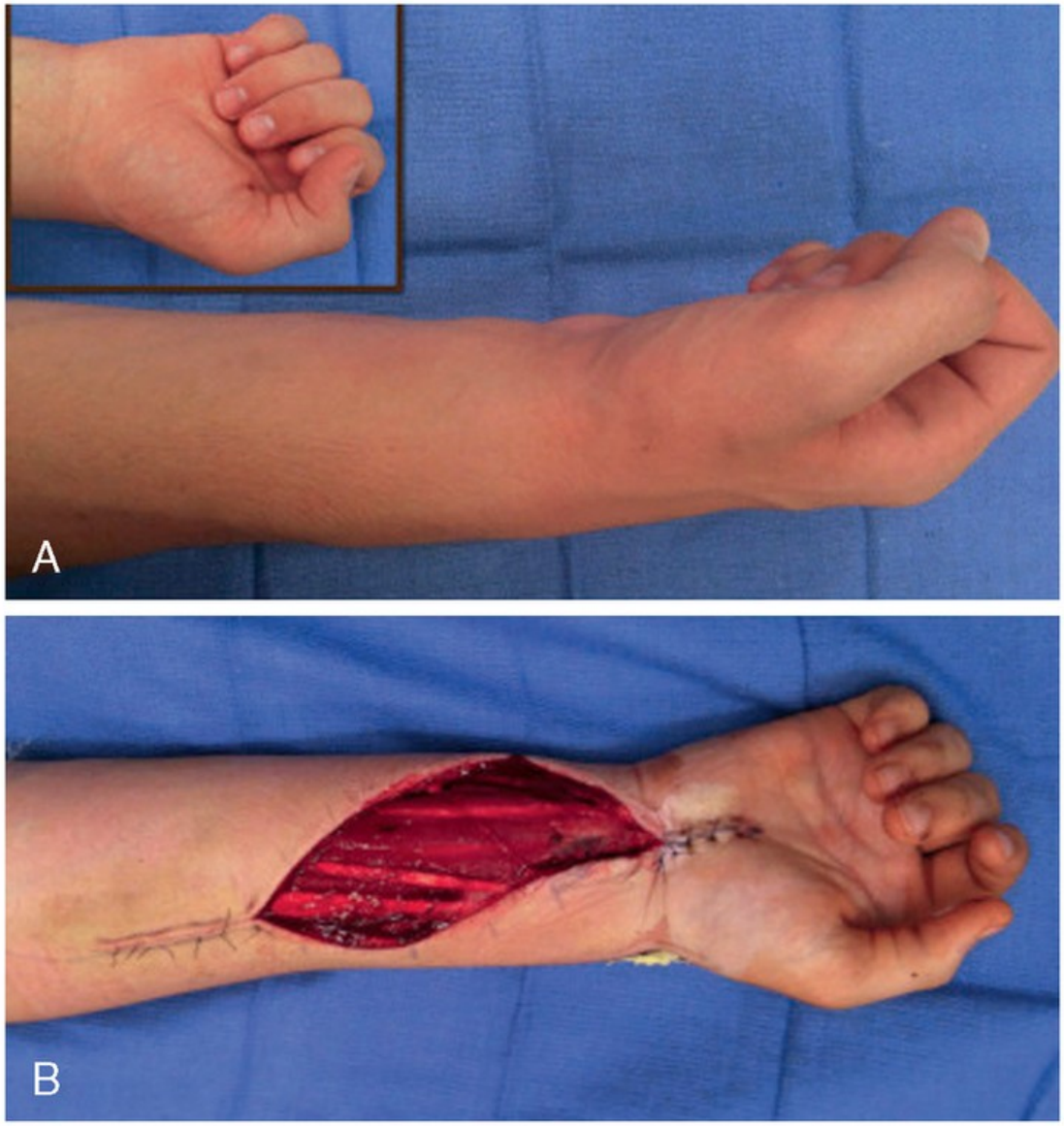
Treatment

- Remove pressure!
  - Constrictive dressing, bivalve cast
- Elevation, but not > heart level
- Fasciotomy if S/S don't decrease or pressure remains consistently high
- Amputation for severe cases

Compartment Syndrome

Fasciotomy



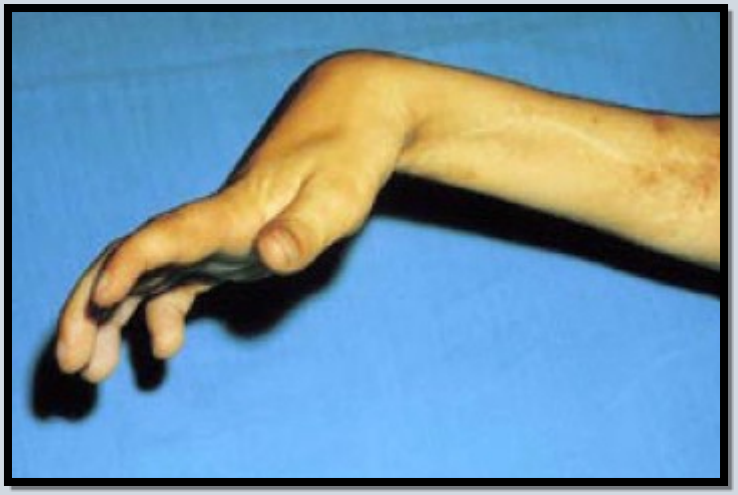


From Stevanovic MV, Sharpe F: *Green's operative hand surgery*, ed 7, Philadelphia, 2017, Elsevier.

Compartment Syndrome

Complications:

- Infection
- Renal Failure
- Hyperkalemia
- Metabolic Acidosis
- Volkman's Contracture



Complications of Fractures

Crush Syndrome

- Result of prolonged, continuous pressure on large muscles
- Muscle tissue disintegrates
- After pressure is released & circulation restored myoglobin, K+, and Phos leak into circulation
- Rhabdomyolysis = myoglobin released from skeletal muscle into the bloodstream.
  - Acute tubular necrosis / renal failure

Complications of Fractures

Peripheral Nerve Damage

- Can occur at the time of injury or after treatment
- Prevent by keeping the injured extremities well aligned
- Keep pressure off peripheral nerves - ↓ edema!

Complications of Fractures

Fat Embolism Syndrome (FES)

- Characterized by the presence of fat globules in tissues & organs after a traumatic skeletal injury

Fat Embolism Syndrome (FES)

Predisposing factors:

- Fractures!
  - Especially of long bones , ribs, tibia, pelvis, multiple fx's, and crush injuries
  - Occasionally seen with TJR
- Other
  - Burns, pancreatitis, diabetes, alcoholism, osteomyelitis, sickle cell crisis, some poisonings, sepsis, neoplasm, possible genetic predisposition

Fat Embolism Syndrome (FES)

Tissues Most Often Affected:

- *Lungs
- Brain
- Heart
- Kidneys
- Skin

Fat Embolism Syndrome (FES)

Pathophysiology

- Mechanical theory
  - Most lodge in the capillaries of the lungs

Complications

- Pulmonary, coronary, & cerebral occlusions
- Pulmonary edema, ARDS, DIC

Fat Embolism Syndrome (FES)

Clinical Manifestations

- Usually occur 12-72° after the injury
- Mental status change is usually 1st sign*
- Interstitial Pneumonitis
  - Produces S/S of ARDS → chest pain, tachypnea, cyanosis, ↓ PaO_2, dyspnea, apprehension, tachycardia
- Fever > 101

Fat Embolism Syndrome (FES)

Clinical Manifestations

- Petechia
  - Late but classic sign!
  - Tiny, red, flat spots located on neck, chest, axialla
- Rapid & acute course
- Feeling of impending disaster
- May become comatose in a short time

Fat Embolism Syndrome (FES)

Diagnostic Studies

- ABG's → hypoxia
- CXR → "snowstorm effect" , pulmonary consolidation
- Fat in Urine & Sputum
- ↑ serum lipase & sed rate
- ↓ Hgb, Hct, RBC, Plt, Ca+, Albumin

Fat Embolism Syndrome (FES)

Prevention

- May ↓ incidence by immediate immobilization, minimal manipulation, and adequate support when turning & positioning
- Assess LOC frequently in high risk pts
- Steroids in high risk pts → investigating

Fat Embolism Syndrome (FES)

Treatment

- Most important is Prevention!
  - Immobilize long bone fractures!
- Symptom Management
- Fluid resuscitation
- O_2 - high concentration
- High Fowler's position
- Reposition as little as possible

Fat Embolism Syndrome (FES)

Treatment

- Steroids for lung inflammation & cerebral edema
- Dextran to improve pulmonary & capillary flow → desludging effect
  - ↓ RBC aggregation
- Heparin for the lipolytic effect → helps break down the fat
  - May cause hemorrhage at the fx site
- Analgesics prn

Fat Embolism Syndrome (FES)

Prognosis

- Good if identified & treated early before full blown FES
- If identified late or left untreated, mortality can be as high as 80%

Complications of Fractures

Venous Thrombosis

- Most common complication following trauma of the lower extremity in adults!
- Most common fatal complication of orthopedic surgery
- Veins in the lower extremities & pelvis are highly susceptible to thrombus formation after a fracture
  - Especially a hip fracture!

Venous Thrombosis

Precipitating Factors

- Vein trauma
- Venous stasis caused by incorrectly applied casts or traction
- Local pressure on a vein
- Immobility
- Hypercoagulability
- Dehydration

Venous Thrombosis

Clinical Manifestations

- Begin 24-48° after the injury, but not apparent for 7-10 days
- Only 40-50% have clear S/S
- 1st indication may be a PE with sudden onset
- Inflammation to the LE & fever
- Homan's sign is not specific

Venous Thrombosis

Prevention Interventions

- Active & passive exercises as appropriate
- Early ambulation
- Elevation of lower extremities
- Elastic stockings or EPC's
- Adequate hydration
- Cough & Deep Breath
- Anticoagulants
- Dextran

Complications of Fractures

Shock

- Average adult blood volume = 4-5L or 70-75ml/kg
- Bones are very vascular
  - Esp the Femur
  - Longest & strongest bone in the body
  - Can bend 2in. prior to fx
  - Usually has a lot of soft tissue damage
- Check expanding thigh & S/S Shock

Shock

Pelvis also has a rich blood supply

- Check urine output
- Can have a massive hidden bleed
  - **Remember…1st sign is probably a Δ in mental status!

Complications of Fractures

Infections

- Open fractures & soft tissue injuries have an ↑ incidence
  - Open fractures require aggressive surgical debridement
  - Post-op antibiotics for 3-7 days
- Need to be immunized if there is an open wound = Tetanus**
- Osteomyelitis can become chronic
- Gas Gangrene

Complications of Fractures

Avascular Necrosis

- Bone loses its blood supply & dies
- Etiology:
  - Fractures – esp. femur head & neck, carpals, scaphoid & talus
  - Dislocations
  - Prolonged high dose steroids
  - Chronic renal disease
  - Sickle cell anemia

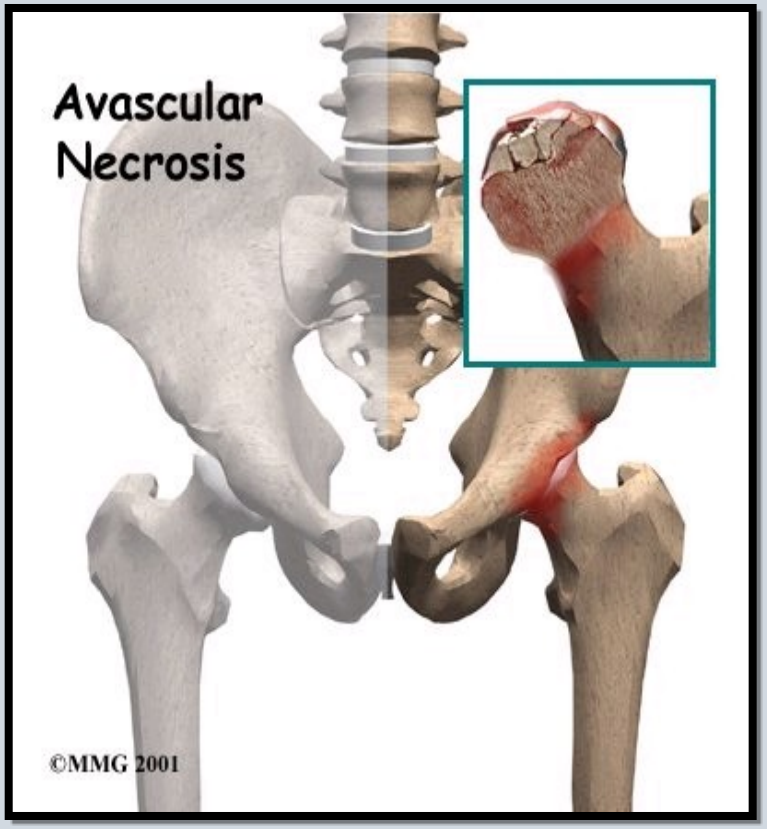
Avascular Necrosis

S & S

- ↓ Rom & pain

Treatment

- May require OR



Complications of Fractures

Kidney Stones

- High risk for renal stones due to bone destruction
- ↑ serum calcium
- Prevent by ↑ fluids

Complications of Fractures

Complications of Bone Union

Delayed Union

- Fracture healing progressing more slowly than expected; healing eventually occurs
  - Taken > 6 months
- **Causes = inadequate immobilization, infection, multiple bone fragments, tobacco use

Complications of Fractures

Treatment of Delayed Union

- Electrical Bone Stimulation
- Used to facilitate healing process by
  - Increasing calcium uptake and production of bone growth factors
  - Increasing collagen synthesis
  - Promoting growth of new blood vessels
  - Electrode surgically implanted into fx site
    - Implant the entire device
    - Or external electrodes over skin or cast

Complications of Fractures

Complications of Bone Union

Nonunion

- Complete failure of healing to take place
- May have motion at the site of fx due to pseudoarthrosis

Treatment = ORIF, bone graft

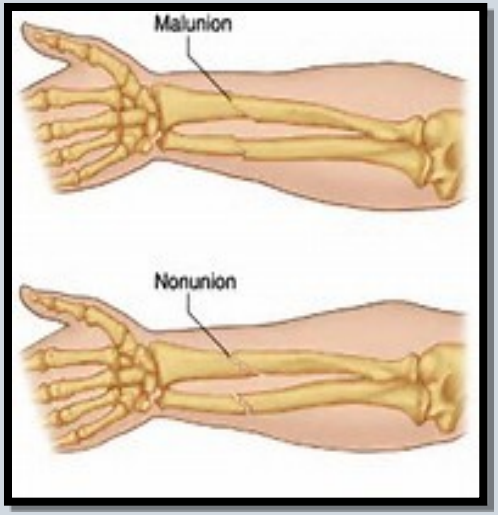
Complications of Fractures

Complications of Bone Union

Malunion

- Fracture heals in expected time but in unsatisfactory position, which may result in deformity or dysfunction
  - If ↓ function,

    may re-fracture and ORIF



Complications of Fractures