Injuries to the lower extremity II

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Topics

• Fracture of the shaft of the femur
• Fractures around the knee
• Knee dislocation and fracture dislocation
• Fractures of tibia and fibular
• Fractures around the ankle
• Fracture and fracture dislocation of the foot
Common symptoms and signs of fractures

- Pain
- Deformity
- Shortening
- Swelling
- Ecchymosed
- Loss of function
- Open injury
  - Gross finding of fractures
Radiographic evaluation for fractures

- **At least, 2 different planes of Fx site**
  - Includes joint above and below
  - Some types of Fx, special views
  - Sometimes, 2 different times
  - Sometimes, calls second opinion
Complications

- **General**
  - Delayed union
  - Nonunion
  - Malunion
  - Shortening
  - Infection

- **Severe**
  - Neurovascular injuries
  - Compartment syndrome
  - Fat embolism
  - Adult respiratory distress syndrome
Fat embolism

- Common in Fx of long bone and pelvis
- Multiple Fxs >> single Fx
- Respiratory insufficiency
- Usually manifests within 48 hr
- Clinical
  - Fever
  - Tachepnea
  - Tachycardia
  - Alters consciousness
- Treatment
  - Respiratory support
  - Early Fx stabilization
Compartment syndrome

- Impaired circulation and function of tissues within a closed space
- Most common: closed Fx in
  - Leg, forearm
- Irreversible damage to muscles if > 6 hr
- Irreversible damage to nerves if > 12 hr
- Clinical
  - Pain out of proportion, pain with passive ROM
  - Discoloration
  - Paresthesia
  - Paralysis
  - Pulseless
Compartment syndrome

- **Risks injuries**
  - Fx tibia
  - Knee dislocation
  - Crush injury: leg, foot
  - Prolong Fx with vascular compromised

- **Treatment**
  - Fasciotomy
Type of fractures

- **Closed**
  - *No wound connects to Fx site*

- **Open**
  - **Grade 1**
    - Simple fracture
    - Wound less than 1 cm
  - **Grade 2**
    - Moderate-severe fracture
    - Wound bet 2-10 cm
  - **Grade 3**
    - Severe fracture
    - Wound > 10 cm
    - Loss of skin coverage
    - Vascular compromised
Fracture of the shaft of the femur

- **General**
  - *The strongest and longest bone*
  - *Canal widening: proximal and distal*
  - *Gluteal and psoas muscles*
    - Proximal third: flex, external rotate, abduct
  - *Adductors*
    - Varus deformity
  - *Gastrocnemius muscles*
    - Supracondylar: distal part: posterior angulation
Fracture of the shaft of the femur

- **Mechanisms of injury**
  - **General**
    - Major trauma
    - High-energy injury
  - **Pathological**
    - Lesser degree of trauma
    - Often: metaphysis-shaft junction
  - **Common mechanisms of Fx**
    - Bending load >> transverse Fx
Fracture of the shaft of the femur

- Type of fractures (according to geometry of Fx line)
  - Transverse
  - Oblique (angle > 30 deg to transverse line)
  - Spiral
  - Segmental
  - Comminution
Fracture of the shaft of the femur

• **Symptoms and signs**
  – Common S&S of fracture

• **Radiographic evaluation**
  – *Standard*: AP, lateral, CXR
  – *Including*: hip and knee joint
  – *Findings*: fracture
Fracture of the shaft of the femur

• **Initial evaluation and management**
  – *Live support: as major traumatized patient*

• **Assessment of associated orthopaedic injuries**
  • Pelvic fracture
  • Hip fracture
  • Ligamentous injury: around the knee
  • Neurovascular injury

• **Immobilization**
Fracture of the shaft of the femur

• Complications
  – Common Fx complications
  – Fat embolism
  – ARDS (multiple Fx)
Fracture of the shaft of the femur

- **Treatment**
  - Nonoperative
    - Traction
    - Cast brace
Fracture of the shaft of the femur

• **Treatment**
  – **Operative**
    • Plating
    • Intramedullary nailing
    • External fixator
Injury to lower extremity

Fracture of the shaft of the femur

- **Traction**
  - *Commonly used in the past*
  - *Now, indicated in*
    - Fracture in children
    - Temporary purpose
    - Surgery is limited

- **Type**
  - Skeleton
    - Proximal tibia
    - Distal femur
  - Skin
Fracture of the shaft of the femur

- **Traction**
  - **Disadvantages**
    - Limited rotational control of fracture
    - Limb-length discrepancy
    - Loss of range of motion (ROM)
    - Prolonged hospitalization
    - Pin tract infection
Fracture of the shaft of the femur

- **Cast brace**
  - Provides external support effect
  - Permits progressive weight bearing
  - **Prerequisites**
    - Good reduction
    - Traction until pain swelling have subsided
  - **Indicated in**
    - Distal third fracture
Fracture of the shaft of the femur

- **Cast brace**
  - *Disadvantages*
    - Limb-length discrepancy
    - Varus angulation
    - Limb-length discrepancy
    - Limited area of usage
Fracture of the shaft of the femur

• **Operative treatment**
  – Immediate fracture stability
  – More anatomical reduction
  – Early ambulation and ROM
  – Less hospitalization
Fracture of the shaft of the femur

- **Plating**
  - *No need for special instruments*
  - *Favorable results*
  - *Ipsilateral neck-shaft fracture (same side)*
  - **Disadvantages**
    - *Extensive tissue exposure*
    - *Higher complications than nailing*
Fracture of the shaft of the femur

- **Intramedullary nailing**
  - Treatment of choice
  - Load-sharing implant
  - Predictable shaft alignment
  - Early recovery
- **Type**
  - Open nailing
  - Closed nailing
Fracture of the shaft of the femur

- Intramedullary nailing
  - Closed nailing
    - Interlocking nailing
    - Less invasive
    - Minimal surgical surgical scar
    - Rapid fracture healing
Fracture of the shaft of the femur

- **External fixator**
  - Open fracture: need wound care
  - Severe comminution
  - Marked contaminated wound
  - Temporary device
Fracture of the shaft of the femur

• **Disadvantages of operative treatment**
  – Infection
  – Nonunion
  – Delayed union
  – Loss of fixation
  – Others surgical complications
Fracture of the shaft of the femur

- Postoperative rehabilitation
  - Early mobilization
  - Muscle activity: following stability
  - Progressive weight bearing: stable
  - Delayed weight bearing: less stability, proximal or distal fracture
Fractures around the knee

- Fracture of the distal femur
- Fractures of the tibial plateau
- Fractures of the tibial spine and intercondylar eminence
- Fracture of the patella
Fracture of the distal femur

- **General**
  - *Supracondylar area*
    - 5 cm above the flare of metaphysis
  - *Intercondylar area*
  - *Require careful neurovascular assessment*
  - *Distal part: posterior angulation*
- **Joint**
  - Tibiofemoral joint (TF)
  - Patellofemoral joint (PF)
Fracture of the distal femur

- **Mechanisms of injuries**
  - High energy trauma in young patients
  - Low energy trauma in the elderly

- **Symptoms and signs**
  - Pain around the knee
  - Swelling around the knee
  - Tenderness over the fracture site

- **Radiographic evaluation**
  - Usually standard x-ray views
Fracture of the distal femur

**Treatment**
- Goal: restore joint surface and alignment
  - *Nonoperative*
    - Nondisplaced
      - Traction 4-6 wk
      - Cast brace with NWB and early ROM
  - *Operative*
    - Significant displaced
    - Implant
      - Condylar blade plate
      - Condylar sliding nail-plate
      - Intramedullary nail
Fractures of the tibial plateau

- **General**
  - Concomitant ligament injuries
  - Depression and displacement

- **Mechanisms**
  - Varus or valgus force with axial loading

- **Symptoms and signs**
  - Pain around the knee
  - Swelling around the knee
  - Tenderness over the fracture site
  - Valgus or varus deformity
Fractures of the tibial plateau

– *Nonoperative*
  - Long leg cast (LLC)
  - Brace with NWB and early ROM
  - Traction

– *Operative*
  - Screw or pin
  - Plate and screws

– *Rehabilitation*
  - Non weight bearing 6-8 weeks
  - Partial weight bearing until 12 weeks
  - Full weight bearing after 12 weeks
Fractures of the tibial plateau

• **Complications**
  – *Common Fx complications*
  – *Peroneal nerve injury*
  – *Popliteal artery injury*
  – *Compartment syndrome*

• **Associate injuries**
  – *Meniscal injury 15%*
  – *Cruciate ligament and collateral ligament injuries 22%*
Fractures of the tibial spine and intercondylar eminence

• *Mechanism of injury: tibial spine*
  – Knee twisting

• *Mechanism of injury: intercondylar eminence*
  – Hyperflexion
  – Hyperextension
  – Valgus-varus force
Fractures of the tibial spine and intercondylar eminence

• **Symptoms and signs**
  – Pain and swelling of the knee
  – A block to full extension

• **Treatment**
  – **Nonoperative**
    • Most fractures
    • Long leg cast in full extension 4-6 wk
  – **Operative**
    • Arthrotomy and screw fixation
    • Arthroscopy and screw fixation
  – **Complication**
    • Fragment becomes a loose body
Fracture of the patella

• General
  – The largest sesamoid bone
  – Accessory ossification center
    • Superolateral corner
    • Named “bipatite patetta”
  – Increases the extensor mechanism
  – Protect the femoral condyles
  – Forces across PF joint
    • Daily activity: >3 times body weight
    • Stair climbing and deep squatting: >7 times body weight
Injury to lower extremity

Fracture of the patella

• **Mechanisms of injury**
  – *Direct injuries: direct force*
    • Pattern: Comminuted
    • Usually minimal displacement
  – *Indirect injuries: muscle forces*
    • Pattern: Transverse
  – *Combined injuries*
    • Pattern: Comminuted with displaced

• **Symptoms and signs**
  – *Pain and tenderness at the anterior of the knee*
  – *Skin contusion: direct injuries*
  – *Ability to extend the knee*
    • Depends on the continuity of the extensor mechanism
Fracture of the patella

• **Treatment**
  – **Nonoperative**
    • Within 2-3 mm displacement or stepping
    • Cylinder cast for 4-6 wk
  – **Operative**
    • More than 2-3 mm displacement or stepping
    • ORIF
      – Circlage wiring
      – Tension band wiring
    • Patellectomy
Injury to lower extremity
Fracture of the patella

- **Complications**
  - *Common Fx complications*
  - *Results after treatment*
    - Late OA change of the PF joint
    - Painful retained hardware
Knee dislocation and fracture dislocation

- Knee dislocation
- Patella dislocation
- Fracture dislocation
Knee dislocation

• **Description**
  – *Position of the distal relates to the proximal*

• **Type of dislocation**
  – Anterior
  – Posterior
  – Medial
  – Lateral
  – Rotatory
Knee dislocation

• **Anterior**
  – Hyperextension injury
  – Injury to PCL, ACL and popliteal vessels
  – Common

• **Posterior**
  – Common

• **Medial**
  – Varus injury
  – Injury to lateral structures
Knee dislocation

- **Lateral**
  - Valgus injury
  - Injury to medial structures, cruciate ligaments

- **Rotatory**
  - Posterolateral
  - Often associate with peroneal nerve injury
Knee dislocation

• **Symptoms and signs**
  – *Gross distortion of the knee*
  – *Instability after reduction*
  – *May have neurological deficit (35% of cases)*
    • Most common: common peroneal nerve
  – *May have vascular compromise*
    • Most common: popliteal artery
Knee dislocation

- **Treatment**
  - **Principle**
    - Operative better than conservative
  - **Emergency vascular assessment**
    - Torn; vascular repair or graft
  - **Repairs ligament if possible**
  - **Nerve assessment**
    - Torn: repair
Knee dislocation

• **Postoperative care**
  – *Establishes ROM as early as possible*
  – *At 4-6 wk: begins muscle strengthening*

• **Prognosis**
  – *Depends on the extent of neurovascular injury*
Patellar dislocation

• General
  – Common in female

• Symptoms and signs
  – Pain
  – Distorted knee anatomy
  – Limited ROM in flexed position

• Treatment
  – Closed reduction (CR)
  – Cylinder cast 4-6 wk
  – Vastus medialis strengthening
Fracture dislocation around the knee

• **General**
  – *Combination of fractures and dislocation*

• **Symptoms and signs**
  – *The same as major fracture around the knee*
  – *Distorted knee anatomy*

• **Treatment**
  – *Immediate CR and immobilization*
  – *Definite fracture treatment*
Fractures of tibia and fibular

• **General**
  – *Anterior compartment*
    • Ankle and foot dorsiflexion
    • Deep peroneal N
  – *Lateral compartment*
    • Foot plantaflexion and eversion
    • Sup peroneal N
  – *Superficial posterior compartment*
    • Foot plantaflexion
  – *Deep posterior compartment*
    • Foot plantaflexion and inversion
    • Posterior tibial N
    • Posterior tibial vessels
**Fractures of the tibia**

- **Mechanism of injury of tibial shaft Fx**
  - Direct
  - Indirect
  - Penetrating

- **Symptoms and signs of tibial shaft Fx**
  - Usually obvious deformed leg
  - Pain
  - Swelling
  - Associated neurovascular injuries
Fractures of the tibia

- Treatment of tibial shaft Fx
  - Nonoperative
    - Criteria
      - Angulation < 10 deg
      - Rotation < 10 deg
      - Shortening < 1 cm
      - Apposition 50%
    - Closed reduction
    - Long leg cast
    - At 4 wk: progressive WB
    - At 12 wk: full WB
Injury to lower extremity

Fractures of the tibia

- Treatment of tibial shaftFx
  - Operative

  - Indications
    - Failed nonoperative
    - Multiple Fx
    - Associated vascular problems

  - Type
    - External fixator
    - Plate and screws
    - Intramedullary nail
Fractures of the tibia

• Complications
  – Common Fx complications
  – Vascular injury
    • Compartment syndrome
  – Nerve injury
Fractures of the fibular

• **General**
  – *Most are associated with fx of the tibia*
  – *Isolate fx results from direct injury*
  – *Local signs and symptoms*
  – *Difficulty in walking*

• **Treatment**
  – *Mild: elastic bandage support*
  – *Mod to sev: SLC or brace for pain relief*

• **Ambulation**
  – *Progressive weight bearing as possible*
  – *Remove cast within 6 wk*
FRACTURES AROUND THE ANKLE

- Fracture of the tibial plafond
- Ankle fractures
- Ankle dislocation and fracture dislocation
Fracture of the tibial plafond

- **Definition**
  - Fracture of the distal tibia extending into the ankle
  - May be called “pilon fracture”

- **Treatment**
  - **Nonoperative**
    - No significant articular displacement
    - Closed reduction and LLC
    - Non weight bearing for 6 wk
    - Progressive weight bearing until 12-18 wk
  - **Operative**
    - Significant articular displacement
    - Plate and screws
    - Distraction ring
Ankle fractures

- **General**
  - *Deltoid ligament*
    - Between med malleolus and talus
  - *Posterior tibial lip*
    - Posterior part of tibia
    - The third malleolus
  - *Distal tibiofibular syndesmosis*
    - Maintains ankle stability

- **Symptoms and signs**
  - *Pain*
  - *Swelling*
  - *Deformity*
  - *Difficult or unable weight bearing*
Ankle fractures

- **Investigation**
  - X-ray standard AP and lateral
  - X-ray mortise view

- **Treatment**
  - **Nonoperative**
    - Minimal displaced
    - CR and short leg cast 6-8 wk
  - **Operative**
    - Displaced
    - Internal fixation
      - Plating
      - Screws
      - Tension band wiring
Injury to lower extremity

Ankle dislocation and fracture dislocation

• **General**
  – *Combination of fractures around the ankle and dislocation*
  – *Associated fractures*
    • Malleoli
    • Talus
    • Distal tibia
  – *Require neurovascular assessment*
Ankle dislocation and fracture

- **Symptoms and signs**
  - Common symptoms and signs of fracture
  - Distorted ankle anatomy
  - May associated neurovascular deficits

- **Treatment**
  - Immediate CR and immobilization
  - Definite fracture treatment
Fractures of the foot and fracture dislocations

- Stress and neuropathic fractures
- Fracture of the talus
- Dislocation around the talus
- Fracture of the calcaneus
- Fractures of the tarsals and joint injuries
- Fractures of the metatarsals and phalanges
Stress fractures

- Excessive, repetitive stress applied to bone
- Most common: 2\textsuperscript{nd} metatarsal, calcaneus
- Mild to moderate pain and/or swelling

**Diagnosis**
- X-ray: from 2 wk
- Bone scan: from 2 days

**Treatment**
- Nonoperative: SLC 4-6 wk
Neuropathic fractures

- “Charcot joint”
- Associated with DM, peripheral nerve diseases
- Initiating event is fracture around the joint
- Rapid joint destruction without pain
- Usually, patients present late
- Treatment
  • Nonoperative: SLC with non weight bearing until heal
Injury to lower extremity

Fracture of the talus

- Neck, head, body and process
- Fracture of the talar neck
  - Hyperdorsiflexion injury
  - May associated dislocation
    - Subtalar joint
    - Ankle joint
    - Talonavicular joint

- Treatment
  - Nonoperative
  - Operative
Fracture of the talus

- **Treatment**
  - *Nonoperative*
    - No displacement, no dislocation
      - Short leg cast (SLC) 8-12 wk
    - Displaced and/or dislocation
      - CR and SLC 8-12 wk
  - *Operative*
    - Screws or K-wires fixation and cast

- **Complications**
  - Common Fx complications
  - Avascular necrosis (AVN)
  - Skin necrosis
  - Posttraumatic OA
Dislocation around the talus

• **Subtalar dislocation**
  – Inversion & eversion injuries to the foot
  – Common S&S of dislocation
  – Compromised neurovascular function
  – CR if failed open reduction
  – SLC 4 wk

• **Talar dislocation**
  – Most are open injuries
  – Reduction with soft tissue management
  – SLC (may be with pins) 6 wk
  – Results in AVN
Fracture of the calcaneus

• **General**
  – The most common tarsal bone Fx
  – Thin cortex with cancellous bone inside
  – Support the body weight

• **Mechanisms of injury**
  – Most are falling from heights
  – Associated spinal injury

• **Radiographic findings**
  – Standard AP, lateral
    • Bohler’s angle (tuber angle) 25-40 deg
  – Calcaneal axial view
Fracture of the calcaneus

• **Treatment**
  
  – **Nonoperative**
    
    • Non or minimal displaced
    
    • SLC 6-8 wk
  
  – **Operative**
    
    • Percutaneous pin and SLC
    
    • Open reduction and internal fixation (ORIF)
      
      – Plate
      
      – Screws
      
      – Staples
Fractures of the tarsals and joint injuries

- **General**
  - **Midfoot**
    - 3 cuneiforms
    - Navicular
      - Accessory navicular
    - Cuboid
  - **Midtarsal joint (Chopart’s joint)**
    - Talonavicular
    - Calcaneocuboid
  - **Tarsometatarsal joint (Linfranc’s joint)**
Fractures of the tarsals and joint injuries

- **Diagnosis**
  - Usually overlooked
  - Less appreciated

- **Treatment**
  - Tarsal bones
    - *Usually nonoperative*
      - *SLC 4-6 wk*
  - Midtarsal joint
    - *CR and/or pin and SLC*
    - *Arthrodesis in late case*
  - Tarsometatarsal joint
    - *Requires adequate Rx*
    - *CR and pinning*
    - *ORIF*
Fractures of the metatarsals and phalanges

• **General**
  – *Usually nonoperative treatment*
    • SLC 4-6 wk
  – *Some conditions*
    • Open Fx with problem of skin etc.
      – Posterior splint
  – *Operative treatment*
    • Soft tissue management
    • Displaced Fx
      – Longitudinal K-wire
      – Small screws
Fractures of the metatarsals and phalanges

- **Common Fx**
  - *Ballet dancer Fx*
    - Spiral Fx at distal of 5\textsuperscript{th} metatarsal
    - Treatment: SLC 6 wk
  - *Jones Fx (Dancer Fx)*
    - Fx base of 5\textsuperscript{th} metatarsal
    - Treatment: SLC 6 wk
- *Phalanges Fx*
  - Posterior splint 4 wk