Long Bone Fractures

Anjan R. Shah MD

July 23, 2016
What Are The Long Bones?

- Humerus
- Femur
- Tibia + Fibula
Long Bone Fractures

• Location and Pattern
Long Bone Fractures

• Location and Pattern
• Depends on bone quality and mechanism of injury (i.e. deforming forces)
Long Bone Fractures

• Location and Pattern
• Depends on bone quality and mechanism of injury (i.e. deforming forces)
• Dictates treatment options
Long Bone Fractures

• Location and Pattern
• Depends on bone quality and mechanism of injury (i.e. deforming forces)
• Dictates treatment options
• Directs rehabilitation plan
• Affects long term outcomes and expectations
Long Bone Fracture

forces determine fractures

• Peri-Articular
  • Loading forces
  • Shear forces

• Shaft
  • Torsional forces
  • Bending forces
  • Direct forces
Long Bone Fracture

location matters

• Articular / Peri-Articular
  • Surgical Goals
    • Anatomic reconstruction
    • Joint Preservation
  • Rehabilitation Goals
    • Restore motion
    • Limit stiffness
  • Long Term Goals
    • Prevent/delay arthritis
Long Bone Fracture

*location matters*

**• Shaft**

  - Surgical Goals
    - Re-establish stable axial alignment
  - Rehabilitation Goals
    - Mobilization
    - Strength
  - Long Term Goals
    - Restoration to preinjury state
Humeral Shaft Fractures

- 5% of all fractures
- Young patients (20s, male)
  - High energy
    - MVC, fall from height, GSW
- Older patients (60s, female)
  - Low energy
    - GLF
Mechanism of Injury

- Torsional, bending, axial, combo
- Direct impact or blast (GSW)
Clinical Evaluation

- Pain
- Swelling
- Deformity
- Careful neurovascular examination
Imaging

- Standard radiographic examination
  - AP
  - Lateral view
  - Joints above and below
  - Traction xrays may help
- CT for joint involvement
- MRI for pathologic process
Treatment Goals

- Maintain acceptable alignment of the fracture
- Provide enough stability to allow healing
- Preserve joint motion
- Avoid complications
Non-Surgical Treatment

- Generally successful
  Rigid immobilization not required for successful healing
  Perfect alignment not essential for a good result
Non-Surgical Treatment

Requirements

- Cooperative, upright patient
- Absence of major soft tissue injury
- Ability to obtain and maintain an adequate reduction
Non-Surgical Treatment

- Hanging Arm Cast
- Coaptation Splint
  - Better support of proximal fragment
- Functional Orthosis 7-10 days
  - Tighten as swelling decreases
  - Flex/ext elbow helps align
Non-Surgical Treatment

Zagorski et al: JBJS 1988
- Good functional restoration
- Complications minimal

More recent reports (JOT 06):
- Nonunion rates 10-20%
- Caution: simple oblique pattern
Indications for Surgical Treatment

Absolute

- Failed closed treatment
- Open fracture
- Vascular injury
- Floating elbow
- Severe soft tissue injury
- Pathologic
Indications for Surgical Treatment

Relative
- Polytrauma
- Inability to maintain reduction with bracing
- Segmental
- Radial nerve dysfunction following manipulative closed reduction**
Femur Fractures

• Common injury due to major violent trauma
• 1 femur fracture/ 10,000 people
• More common in people < 25 yo or >65 yo
• Motor vehicle, motorcycle, auto-pedestrian, aircraft, and gunshot wound accidents are most frequent causes
Femur Fracture Management

• Initial traction with portable traction splint

• Timing of surgery is dependent on:
  • Resuscitation of patient
  • Other injuries - abdomen, chest, brain
  • Isolated femur fracture
Femur Fracture Management

• Shaft fractures are managed by intramedullary nailing

• Proximal or distal 1/3 fractures **MAY** be managed best with a plate or an intramedullary nail depending on the location and morphology of the fracture
Intramedullary Nailing of Femur Fractures
Immediate Weight Bearing

• Axial Load to Failure 300%
  • 75% Stiffness in Bending
  • 50% Stiffness in torsion

• Withstand 500,000 cycle at loads of 3X body
Femur Fracture Technique

- Retrograde Intramedullary Nailing
Tibia Fractures

• Most common long bone fracture

• 492,000 fractures yearly

• Average 7.4 day hospital stay

• 100,000 non-unions per year
History & Physical

• Low Energy
  • Minimal soft-tissue injury
  • Less complicated fracture pattern and management decisions
History & Physical

• High Energy
  
  • High incidence of neurovascular energy and open injury
  
  • Low threshold for compartment syndrome
  
  • Complete soft-tissue injury may not declare itself for several days
Radiographic Evaluation

• Full length AP and Lateral Views
  • Check joint above & below

• Oblique views may be helpful in follow-up to assess healing
Injuries Associated

• 30% of patients will have multiple injuries
  • Ipsilateral Fibula Fracture
  • Foot & Ankle injury
  • Syndesmotic Injury
  • Ligamentous knee injuries
Injuries Associated

• Ipsilateral Femur Fx
  • “Floating Knee”

• Neurovascular Injury
  • More Common In:
    • High Energy
    • Proximal Fracture
    • Floating Knee
    • Knee Dislocation
Compartment Syndrome

- Incidence:
  - 5-15%

- History
  - High-Energy
  - Crush

- Exam
  - 4 Compartments
  - 6 P's
    - Pain
    - Pain with passive stretch
    - Parasthesias
    - Pulsless
    - Pallor
    - Paralysis
Closed Tibial Shaft Fracture

• Broad Spectrum of Injuries with many treatments

• Closed Management
• Intramedullary Nails
• Plates
• External Fixation
Non-Operative Treatment Indications

- Minimal soft tissue damage
- Non-intact fibula
  - Higher rate of nonunion & varus with intact fibula
- Stable fracture pattern
  - < 5° varus/valgus
  - < 10° pro/recurvatum
  - < 1 cm shortening
- Ability to bear weight in cast or fx brace
  - Requires frequent follow-up

• Schmidt ICL 52, 2003
Surgical Options

- Intramedullary Nail
- ORIF with Plate
- External Fixation
- Combination of fixation
Advantage of IM Nail

- Less malunion
- Early weight-bearing
- Early motion
- Early WB (load sharing)
- Patient satisfaction
  - L Bone, JBJS
- Cost
  - Less expensive to society when compared to casting
  - Busse Acta Ortho ’05
Complications

- Infection 1-5%
- Union >90%
- Knee Pain 56%
  - w/ kneeling 90%
  - w/ running 56%
  - at rest 33%

Court-Brown JOT ‘96
Summary
Long Bone Fractures

• Injury can occur at any location
• Shaft fractures unique to long bones
• IM nailing allows early WB
• Restoration of alignment and function