FRACTURES 101
Anjan R. Shah MD
July 22, 2017

DESCRIBING THE FRACTURE

• Pattern
• Open vs closed
• Location

LANGUAGE OF FRACTURES

• Fracture Pattern
• Spiral
LANGUAGE OF FRACTURES

- Fracture Pattern
  - Spiral
  - Transverse

- Comminuted
- Open
LANGUAGE OF FRACTURES

- W.T.F!!!
  - Wow that's fractured

LOCATION OF FRACTURE

- Shaft

LOCATION OF FRACTURE

- Shaft
- Intra-articular
FRACTURES 101

- 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

FRACTURES 101

- Peri-Articular
  - Loading forces
  - Shear forces
- Shaft
  - Torsional forces
  - Bending forces
  - Direct forces

TYPES OF BONE HEALING

- Determined by mechanical stability
- Primary
  - When strain is less than 2%: Rigid
  - Direct or end to end healing
  - To restore a smooth joint surface
  - Plates/screws
- Secondary
  - Strain 2-10%
  - Non rigid fixation
  - Callous formation
  - Casts, Rods, Braces
TYPES OF BONE HEALING
- Determined by mechanical stability
- Primary
  - When strain is less than 2%: Rigid Fixation
  - Direct or end to end healing
  - Plates/screws.
- Secondary
  - Strain 2-10%
  - Non rigid fixation
  - Callous formation
  - Casts, Rods, Braces

INTRA-ARTICULAR FRACTURES
- Pose an unique set of challenges and goals!
  - Injury to joint surface and cartilage
    - Risk of post traumatic arthritis
  - Requires primary bone healing
  - Absolute stability
  - Small fragments
  - Limits fixation
CHOICE OF FIXATION FOR INTRA-ARTICULAR INJURIES

- Load bearing implants
  - Load of force transfers to implant
  - Plate(s) & screws
  - Often around articular and peri-articular injuries
INTRA-ARTICULAR FRACTURES
• Injury to cartilage
• Small fragments
• Limited fixation
• Absolute stability
• Primary bone healing
  • Restoring and maintaining congruity is critical for limiting post traumatic arthritis.

POST TRAUMATIC ARTHRITIS
• Osteoarthritis caused secondary to trauma
• Compromised bone health
• Inadequate reduction/stabilization
• Poor blood supply
  • Tobacco
  • DM

Important to maintain a good joint
INTRA-ARTICULAR FRACTURES

- Articular Fractures
  - Acetabular Fractures

SUMMARY

- Intra-articular fractures represent significant trauma with both acute and potential long term issues for the joint and patient overall health.
- Anatomic, rigid fixation
- Optimal joint reconstruction to achieve optimal outcomes
LONG BONE FRACTURES

WHAT ARE THE LONG BONES?
• Humerus
• Femur
• Tibia + Fibula

LONG BONE FRACTURE
LOCATION MATTERS
• Shaft
  • Surgical Goals
    • Re-establish stable axial alignment
  • Rehabilitation Goals
    • Mobilization
    • Strength
  • Long Term Goals
    • Restoration to preinjury state

Surgical Goals
Rehabilitation Goals
Long Term Goals

Re-establish stable axial alignment
Mobilization
Strength
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 x-rays 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

Relative
- Polytrauma
- Inability to maintain reduction with bracing
- Segmental
- Radial nerve dysfunction following manipulative closed reduction**
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%
  • 70% Stiffness in bending
  • 50% Stiffness in torsion

• Withstand 500,000 cycle at loads of 5X 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

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 Frx
  - “Floating Knee”
- Neurovascular Injury
  - More Common in:
    - High Energy
    - Proximal Fracture
    - Floating Knee
    - Knee Dislocation
COMPARTMENT SYNDROME

- Incidence: 5-15%
- History: High-Energy - Crash
- Exam: 4 Compartments
- 6 P's
  - Pain
  - Pain with passive stretch
  - Paresthesia
  - Pulsless
  - Pallor
  - Paralysis

CLOSED TIBIAL SHAFT FRACTURE

- Broad Spectrum of Injuries w/ many treatments
- Closed Management
  - Intramedullary Nails
  - Plates
  - External Fixation

NON-OPERATIVE TREATMENT INDICATIONS

- Minimal soft tissue damage
- Non-displaced
- Higher rate of nonunion & union with intact fibula
- Stable fracture pattern:
  - < 5° angulation
  - < 15° pronation
  - < 1cm shortening
- Ability to bear weight cast or in 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
  • w/ kneeling 90%
  • w/ running 56%
  • at rest 33%
Court-Brown JOT '96
Thank You!

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