Introduction to Orthopaedic Trauma for OR staff

Hans-Christoph Pape MD, FACS, FAAOS
Professor and Chairman
University of Zurich
Switzerland
Objectives

• Working under sterile conditions
• Bone anatomy and function
• Modes of fracture healing
• ABC’s of fracture healing
• Implants
Working under sterile conditions

• Move with a purpose – planned actions
• Keep distance – know where the sterile areas are
• Communicate closely – you are part of a team
• Avoid turning your back to others in sterile gown
• Watch for subtle contamination
• Establish a consistent work flow
  • Position your tools always on the same place
  • Keep trays and tables apart
Terminology

**Displacement** - Describes direction of cortical discontinuity between the distal fragment compared to the proximal fragment

**Angulation** - Describes angle of apex between fragments
- Varus (lateral) vs. Valgus (medial)
- Anterior vs. Posterior
**Terminology**

**Distraction** - Fracture has lengthened the affected segment usually due to rupturing of muscle.

**Shortening** - Fracture has shortened the affected segment usually by muscle spasm.
**Terminology**

**Rotation** - torsion of the distal fractured limb segment

**Avulsion** - pulling apart the bone by a tension force from a ligament or tendon
Terminology

- **Open Fracture** - Skin integrity is disrupted and communicates with the fracture site

- **Closed Fracture** - Skin integrity is maintained
Terminology

- **Simple** - Single Circumferential Fracture line
- **Spiral** - fracture caused by a twisting force

- **Transverse** - Fracture pattern perpendicular to long axis of the bone (<30 degrees)

- **Oblique** - Fracture pattern at oblique angle to long axis of the bone (>30 degrees)
Terminology

- **Multifragmentary** - multiple bone fragments

- **Depressed** - cortical joint surface is pushed into the cancellous bone beneath
**Terminology**

**Wedge**-
fractures are characterized by contact between the main fragments after reduction usually restoring the normal length of the bone. The wedge fragment may be intact, or in multiple fragments (fragmentary wedge)
**Terminology**

**Extraarticular**—The fracture line may be metaphyseal or epiphyseal, but it always spares the articular surface

**Partial articular**—The fracture involves part of the articular surface

**Complete articular**—The fracture disrupts the articular surface which is completely separated from the diaphysis.

- Meinberg, EG MD; Agel, J MA, ATC; Roberts, CS MD, MBA; Karam, MD MD; Kellam, JF MD* Fracture and Dislocation Classification Compendium—2018, Journal of Orthopaedic Trauma: January 2018 - Volume 32
Terminology

- **Impacted** - Bone is compressed upon itself (Torus Fracture)

- **Greenstick** - Pediatric fracture with cortex broken on one side but only buckled or bent on the other side

- **Epiphyseal Plate Involvement** – injury to the growing area of a child’s bone
  - Salter Harris Classification
Implants & Techniques
Spectrum of Fracture Fixation Stability

Increasing Stability

Less vascular/biologic damage

Cast
K wire fixation
External Fixation
IM Nail
Bridge Plate
Lag screws and Protection plate
Screw Design

- **Head:** various types for screwdriver purchase
- **Shaft:** core of the screw = drill diameter for screw insertion
- **Thread:** purchase power of screw, larger diameter than shaft
- **Tip:** blunt, self tapping or drilling
Screw Design

• Head

Hex  Phillips  Torx
Screw Design

• Core (root)
• Thread
• Profile
• Pitch
• Lead
• Root area of tapped thread (purchase)
Screw Design - Thread Profile

• Buttress shape
• Flat broad surface to resist pullout, increase holding power
• Differs between cortical and cancellous designs
Screw Design - Types

CORTICAL
• Decrease thread to core diameter ratio
• Small pitch
• More threads to purchase in cortex
• Thus better “bite” when used despite smaller width of screw when used in cortex

CANCELLOUS
• Larger pitch
• Don’t usually tap for these
• Relies on surface area of thread to obtain a bite in the softer bone of the metaphysis
• Bigger thread – increased thread / core ratio
Screw Types - Cannulated Screws

- “More Accurate” placement?
- Thread depth is less to accommodate guide wire – weaker
- Guide wire may shear off
- Cost

- Over used!!!
Screw Design - Size

- **Large fragment**
  - 3.2 and 4.5

- **Small fragment**
  - 2.5 and 3.5

- **Mini fragment**
  - 2.0 and 2.7 and smaller
Screw Design - Locking head Screws

• Smaller pitch = greater number of threads per given distance

• Better holding strength in dense bone eg. Cortex

• “Star drive” or Torx rather than hex – head
Screw Function

- **Position screw** - hold something like a plate or bones in a position

- **Lag screw** – compresses two fragment together
Plates

- Function to hold fracture reductions
- Attached to bone with screws
- Plate types - manufacture or generic names
  - e.g. Limited contact dynamic compression plate (LCDCP)
- Plate Function
  - What the plate is doing
  - Any generic plate can perform any function
Plate Functions

**Neutralization plate** – protects a lag screw against rotation and axial load

**Compression plate** - compresses the two fragments of a transverse fracture

**Buttress plate** - supports and neutralizes axial load (also know as antiglide)
Plate Functions

**Tension Band Plate** – on eccentric loaded bones to convert tension to compression

**Bridge plate** - spans an area of fragmentation
Intramedullary Nails

- Conventional Nails

- Reconstruction nails

- Cephalomedullary Nails
External Fixators

Standard frames

Thin Wire Ring Frames
ABC’s of Xrays

- Alignment
- Bones
- Cartilage
- Soft Tissues
Alignment

• Joint Alignment - most joints have two fairly congruent joint surfaces.

• Most joints in the extremities have one convex “ball” side and a concave “cup,” so that when in anatomic alignment the ball is centered in the cup.

• **Subluxation** - Displacement of one joint surface in relation to the opposing side, resulting a **partial loss of continuity** of the joint surface.

• **Dislocation** - Displacement of one joint surface in relation to the opposing side, resulting a **complete loss of continuity** of the joint surface.
Ankle subluxation as the two joint surfaces remain in partial continuity
Ankle has been congruently reduced and stabilized with a plate and screws
Lisfranc (tarsal/metatarsal) joints are dislocated as no part of any joint in continuity with it opposite articular side.
Lisfranc joint has been congruently reduced and stabilized with multiple K wire
Anterior Knee Dislocation
Subtalar Joint Dislocation
Alignment

• Diastasis - A displacement of one joint surface in relation to the other in a slightly moveable (sacro-iliac/pubic symphisis) or synarthrodial (cranial sutures) joint.

Symphysis diastasis reduced and stabilized with a plate
Bones

• Radiographic abnormalities of the bones usually fall into one of the following categories:
  
  • Abnormality in opacity (determined by bone density)
    • Decrease manifests as lucency
    • Increase manifests as sclerosis
  
  • Abnormal contour
  
  • Abnormal size or shape
Abnormalities in Opacity: Evaluating Lucencies

- Lucent Line - indicates a FRACTURE
- Focal Lucencies
  - Tumor
  - Infection
  - Simple Bone Cysts
- Diffuse Lucency
  - Drugs
  - Endocrine / Metabolic
  - Tumor
Examples of Fractures & Fixation
Iliac Wing Fracture
Tibia Pilon Fracture

Fracture reduced and stabilized in a thin wire ring external fixator
Supracondylar Femur Fracture
Tibia Plateau Fracture
Proximal Humerus Fracture
Clavicle Fracture
Trimalleolar Ankle Fracture
Trimalleolar Ankle Fracture
Humeral Shaft Fracture
Summary

Working under sterile conditions - requires care and communication

Bone biology– bone has metabolic and mechanical roles

Fracture healing – primary/direct and secondary/indirect healing

ABC’s of fracture healing – Alignment, Bones, Cartilage, Soft tissues

Implants – nails, plates, tension band wiring, external fixateurs
References

AO Surgery Reference manual
https://www2.aofoundation.org/AOFileServerSurgery

Hospital infection control and behaviour of operating room staff.

Creating a safer operating room: Groups, team dynamics and crew resource management principles.

Control of the Environment in the Operating Room.