

Surgical Skills Lab for Fracture Fixation: Internal Fixation and Lag Screws

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A PA's Guide to the Musculoskeletal Galaxy
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Disclosures

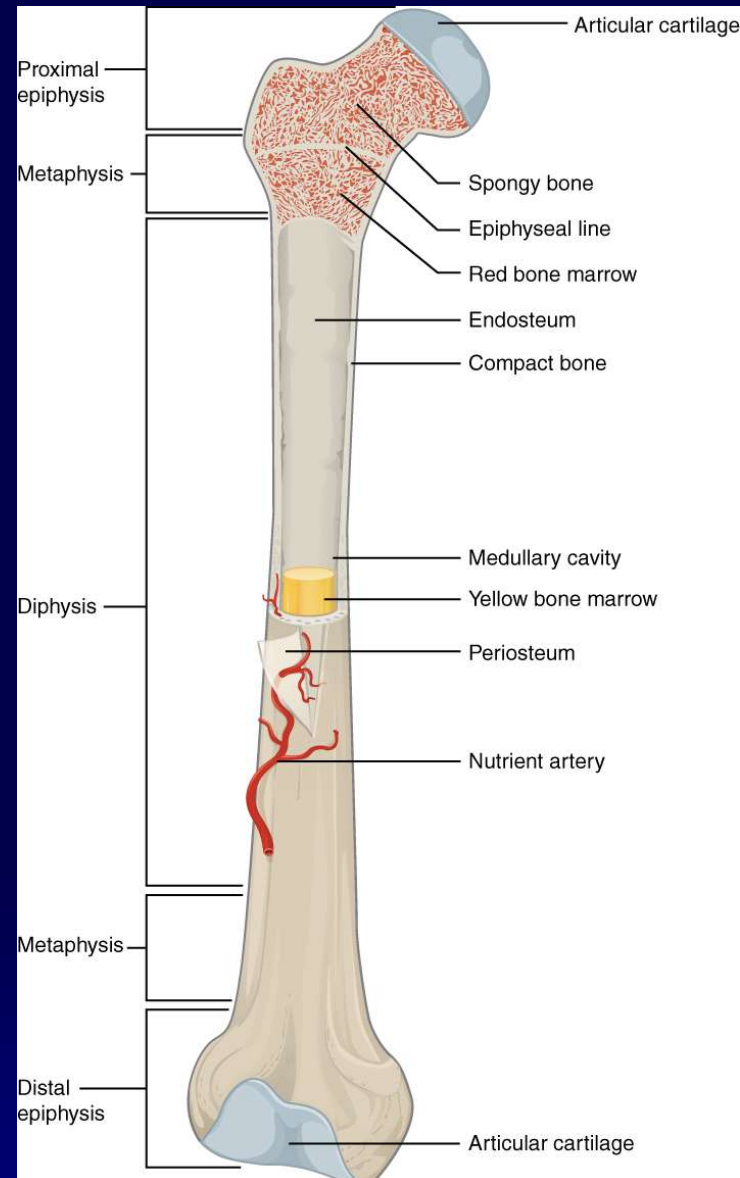
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Objectives of Breakout

- Review options for managing fractures
- Review bone anatomy and healing
- Indications for internal fixation
- Techniques
 - ❖ Lag screws
 - ❖ Compression and Locking Plates
- Understanding principles allows better assistance and participation during cases

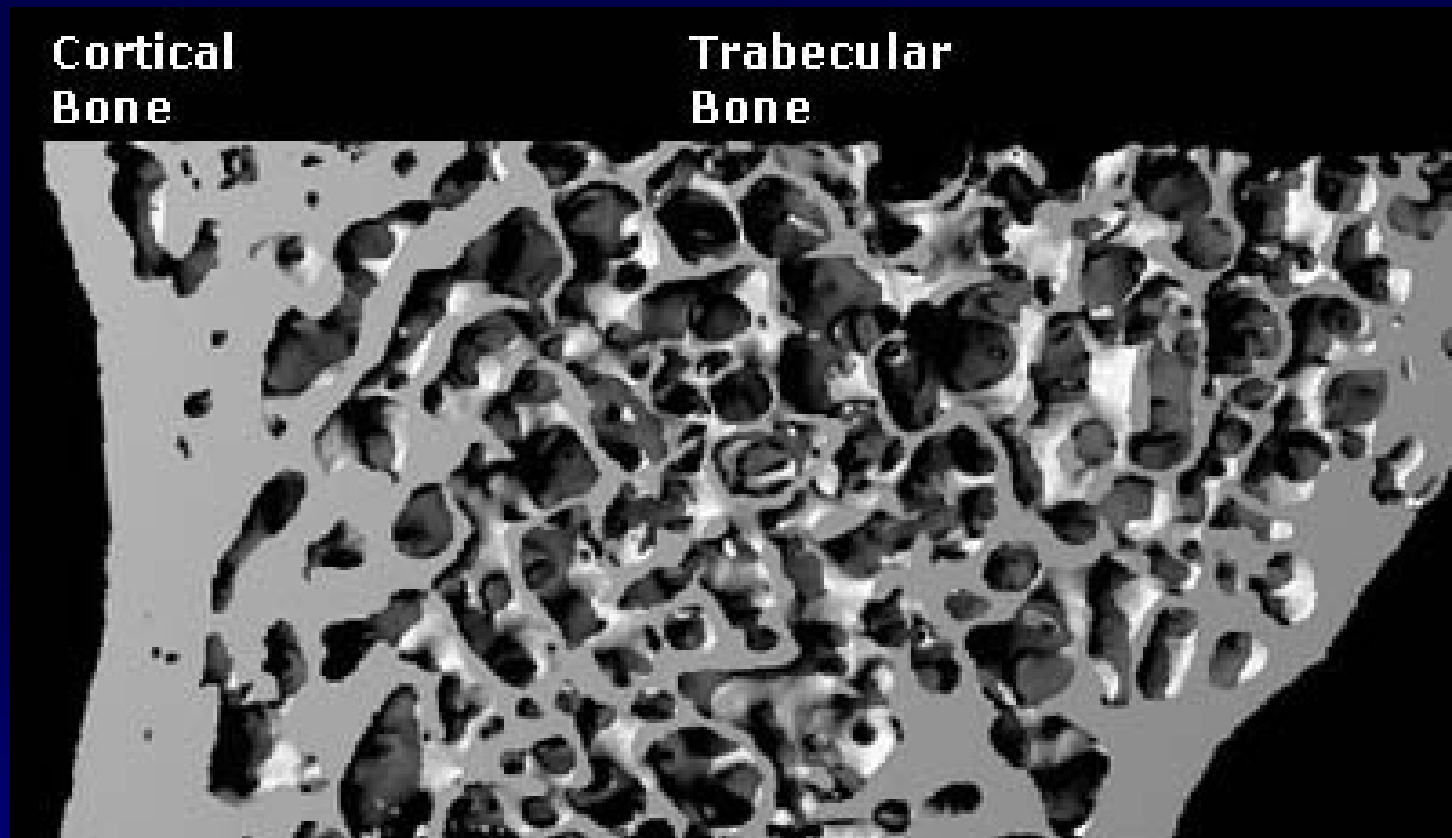
Bony Anatomy

- Long Bones
 - ❖ Epiphysis
 - ❖ Metaphysis
 - ❖ Diaphysis



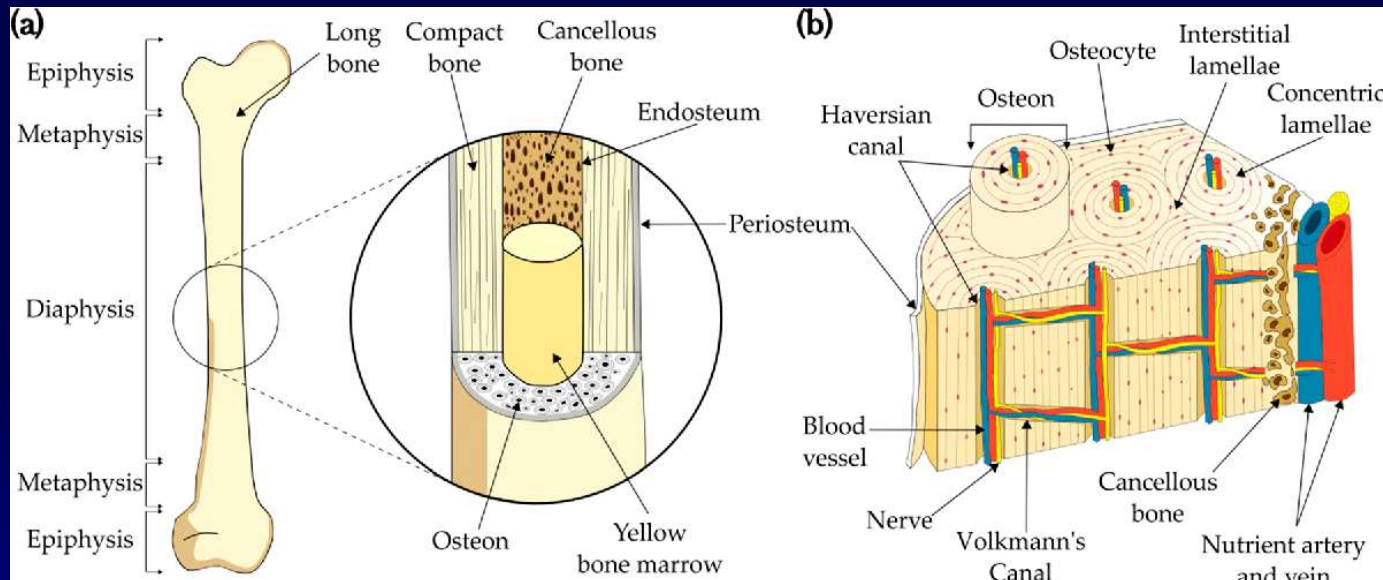
Bony Anatomy

- Cortical Bone
- Cancellous (Spongy) bone



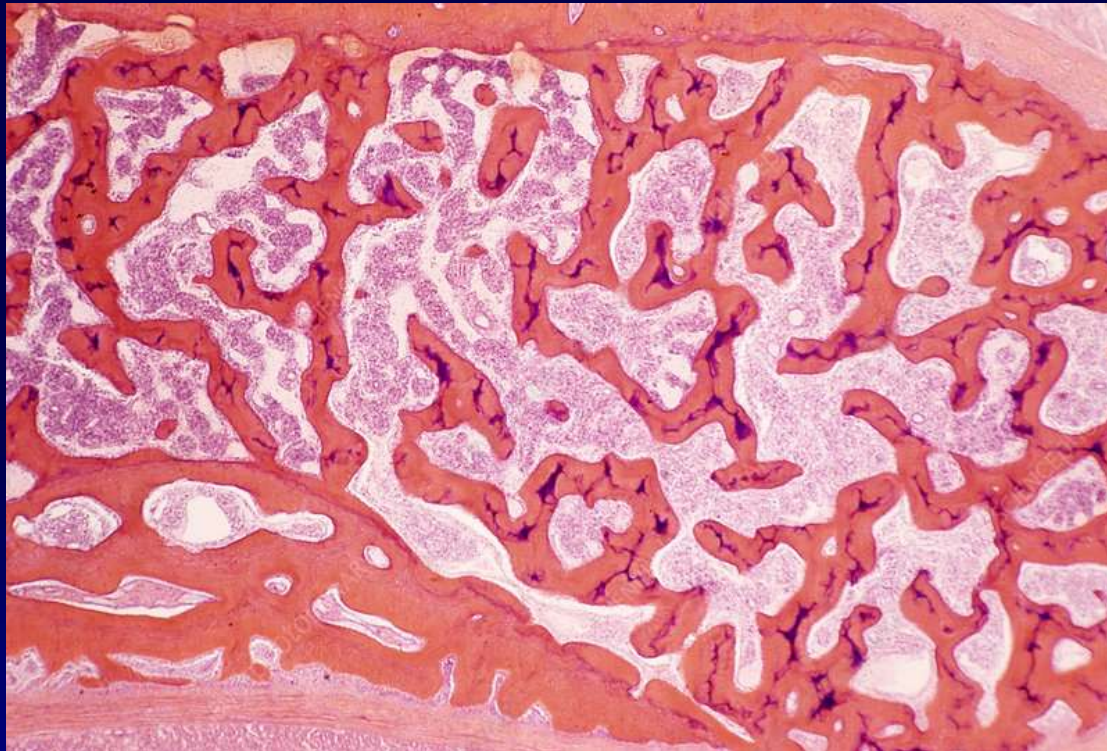
Cortical Bone

- Shell around most all bones
- Diaphyseal
- Compact and dense
- Very strong



Cancellous Bone

- Less dense
- Metaphyseal and Epiphyseal
- 25% mass and 10% strength of cortical bone



What is a Fracture?

- “Cracking or breaking of a hard object or material”
- Partial or complete loss of continuity of the normal architecture of bone
- Externally applied force exceeds the mechanical integrity of bone

Fractures

- Loss of continuity and support
- Associated soft tissue damage
- Loss of blood supply
- Types and patterns result from various forces
- Each fracture pattern requires different implants

Methods of Fracture Management

- Nothing!
- Splints
- Casts
- Percutaneous Pinning
- External Fixation
- Internal Fixation
 - ❖ Plates/screws
 - ❖ Nails
 - ❖ Wiring

Internal Fixation

- Developed in Switzerland in 1940s
- Poor outcomes and disabilities from war injuries, MVAs, and skiing accidents
- 1958: Arbeitsgemeinschaft für Osteosynthesfragen (AO)
- “Working group for bone fusion issues”
- Association of the Study of Internal Fixation (ASIF)

Principles of Internal Fixation

- Anatomic reduction of fractures
- Stable internal fixation
- Preservation of blood supply
- Early motion to improve rehab
- Reduce “fracture disease”

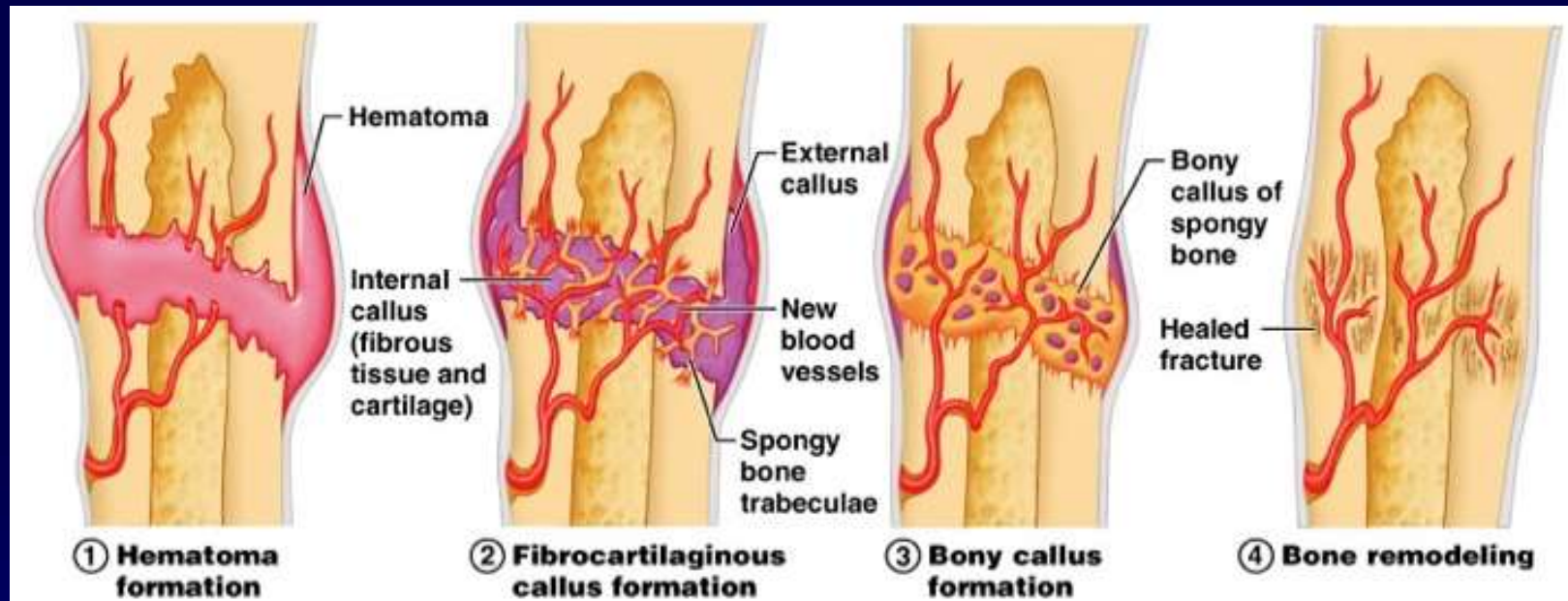
Bone Healing

- How bone heals depends on stability and motion
 - ❖ Indirect
 - ❖ Direct



Indirect Bone Healing

- Relative stability
- Some motion between fragments
- Callus formation



Fracture Callus

Day 1



Day 4



Day 7



2 Weeks

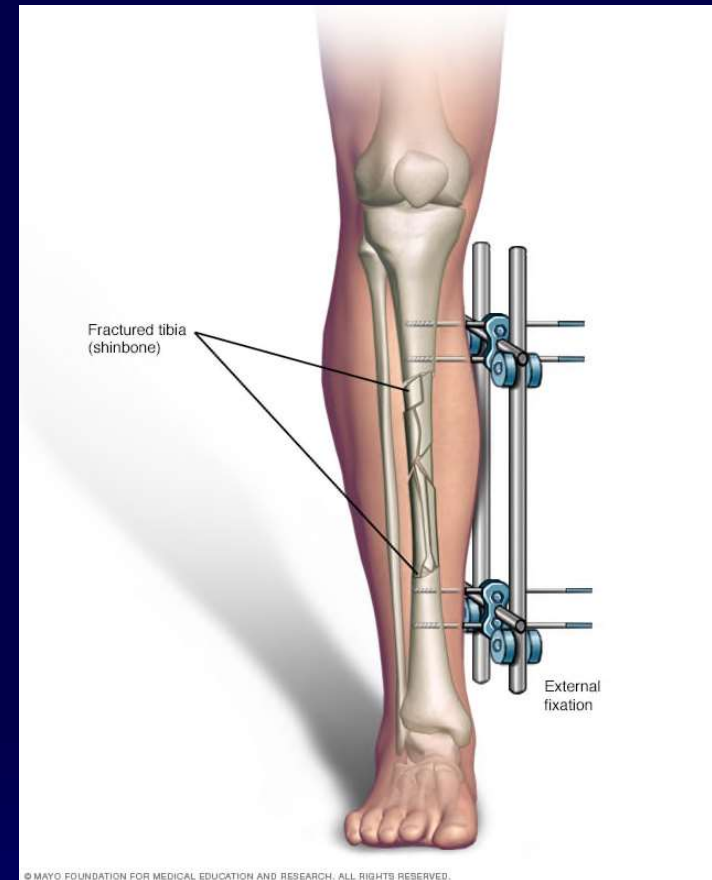


6 Months



Indirect Bone Healing

- Examples:
 - ❖ Splints
 - ❖ Casts
 - ❖ Intramedullary nails
 - ❖ External fixation

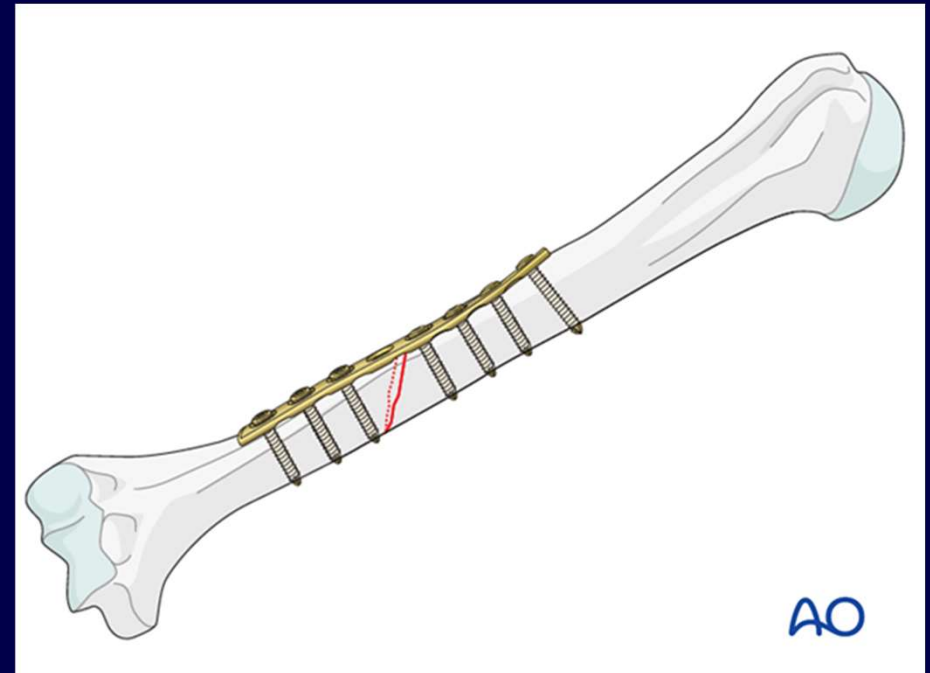
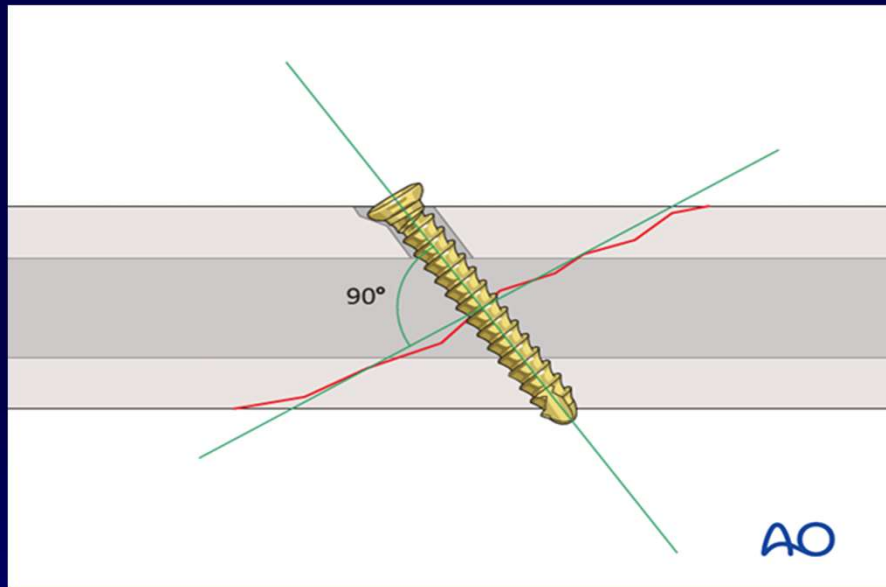


Direct Bone Healing

- Absolute stability
- Direct contact between fracture fragments
- Minimal or no motion between fragments
- No callus formation

Direct Bone Healing

- Examples:
 - ❖ Compression plates
 - ❖ Lag screws



Indications for Internal Fixation

- Should be considered if conservative management will result in disability or less than optimal outcomes.
- Benefits > Risks
- Open fractures
- Displaced and unstable fractures
- Most intraarticular fractures
- Most diaphyseal femur fractures
- Some other diaphyseal fractures
- NV Injury

Prerequisites for Internal Fixation

- Knowledge of anatomy and techniques required
- Trained surgeon and personnel
- Appropriate instruments and implants



Potential Benefits of Internal Fixation

- Anatomic reduction
- Stable fixation
- Earlier motion
- More predictable fracture alignment
- Potentially faster time to healing

Screws

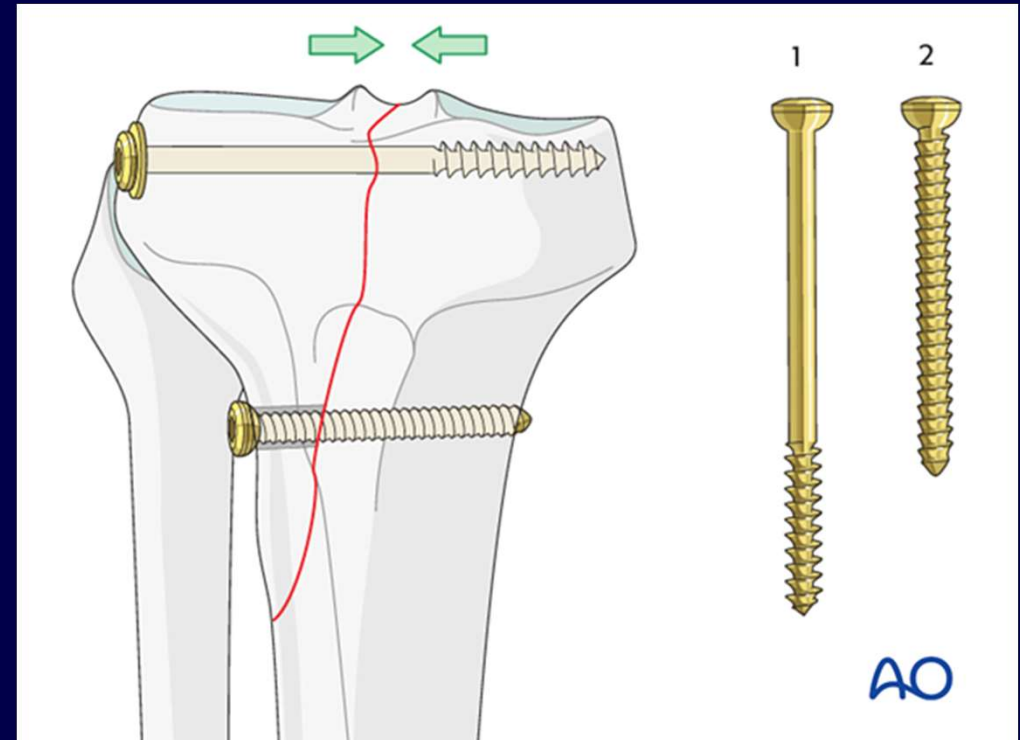
- Cortical Screws
 - ❖ Greater number of threads
 - ❖ Smaller pitch (threads closer together)
 - ❖ Lower outer thread:core diameter ratio
- Cancellous Screws
 - ❖ Fewer threads
 - ❖ Larger pitch
 - ❖ Higher thread:core ratio



Figure 1: Four-mm outer-diameter cortical (left)

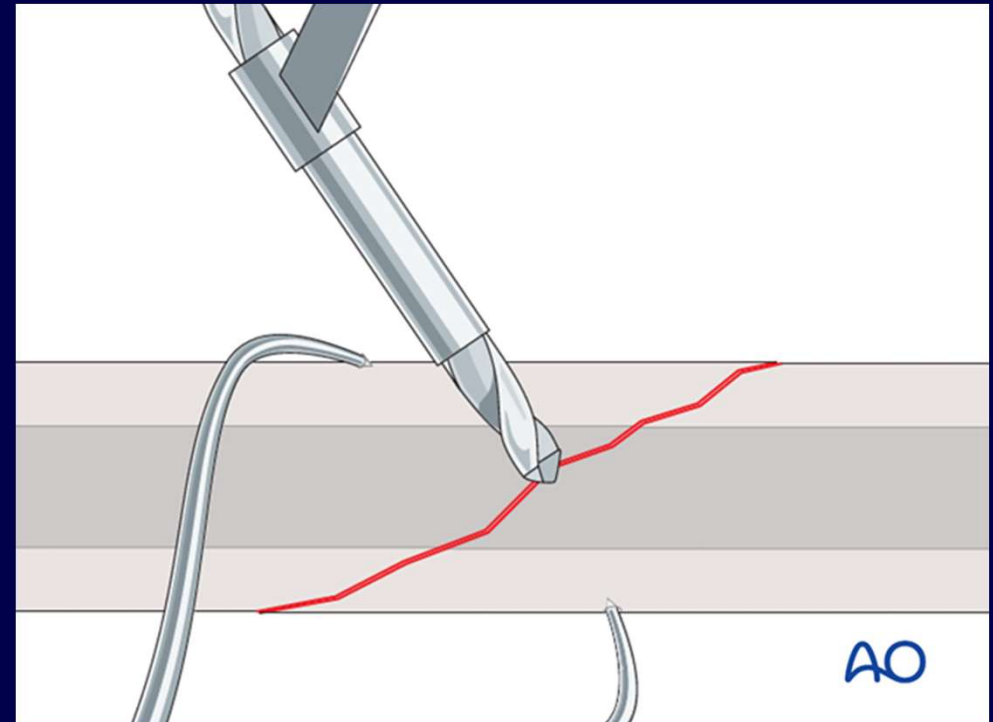
Lag Screws

- Used to compress fracture fragments
- Compress plates on bone
- Threads engage far cortex
- Can use:
 - ❖ Partially threaded cancellous screws
 - ❖ Cortical screws



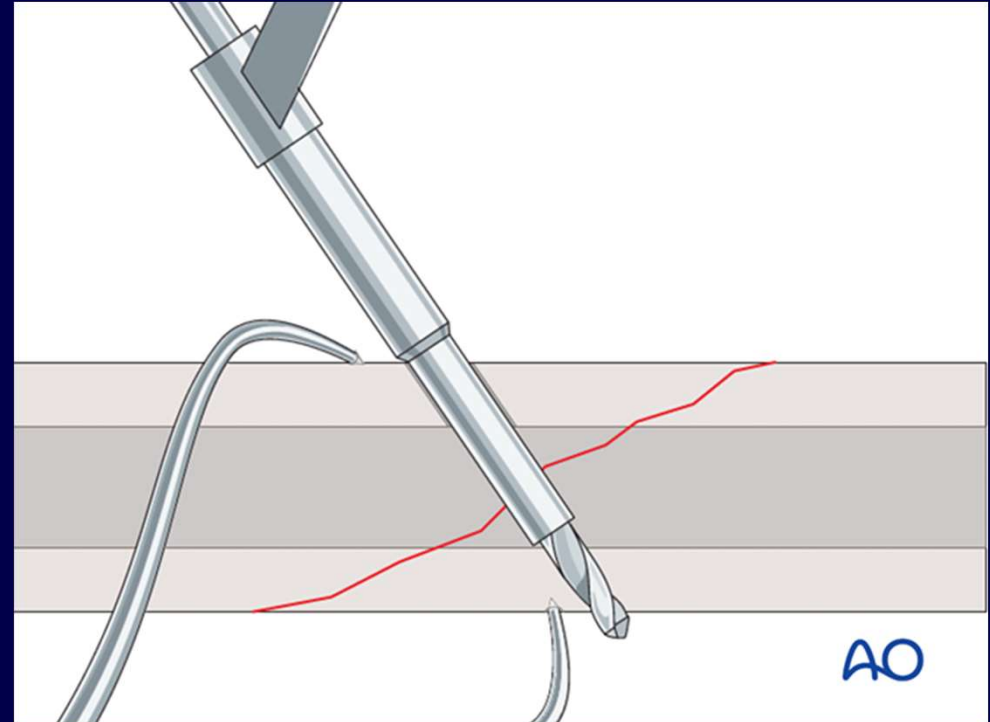
Lag Screws

- Reduce fracture
- Hold in place with reduction forceps or provisional pin
- Drill near cortex with bit that is the same diameter as the outer diameter of screw



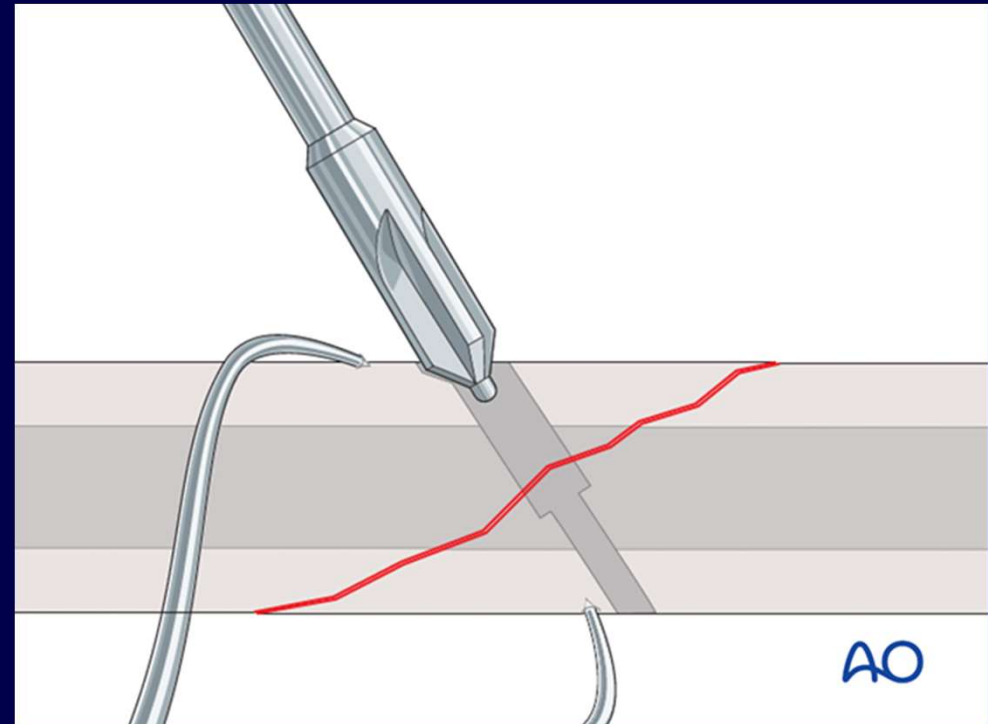
Lag Screws

- Drill far cortex with bit that is the same diameter as the inner (core) diameter of screw
- Can use drill guide as centering device



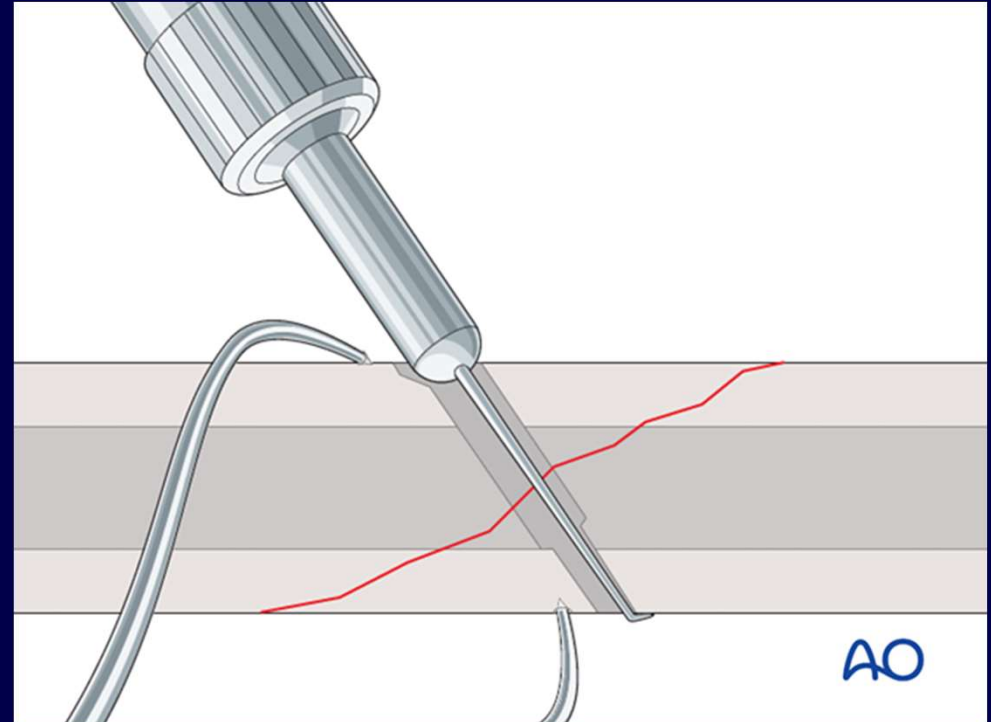
Lag Screws

- Countersink near cortex
 - ❖ Head of screw sits flush; not prominent
 - ❖ Allows distribution of compression forces



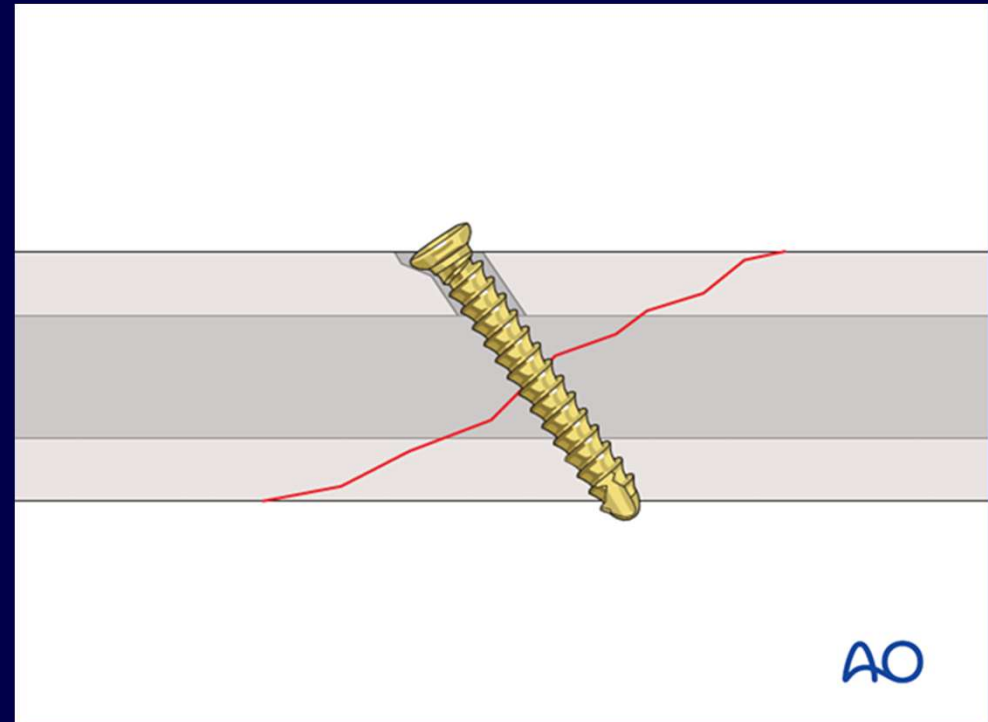
Lag Screws

- Use depth gauge to determine length of screw
- Measure off obtuse side of far cortex



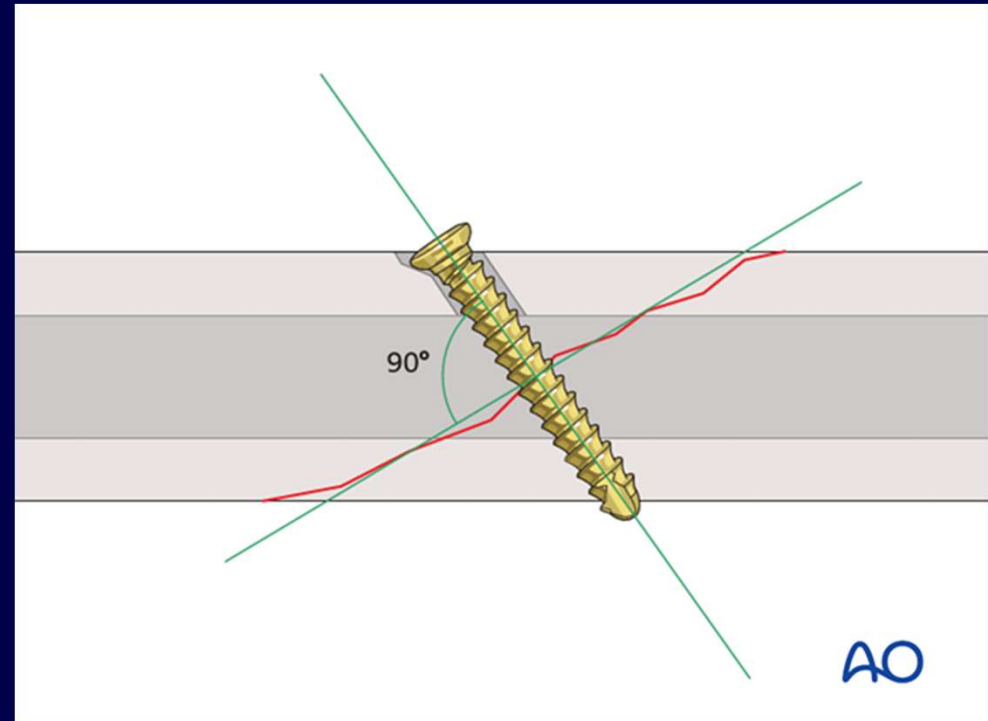
Lag Screws

- Place appropriate screw
- Remove reduction forceps
- Close the wound
- Time for coffee



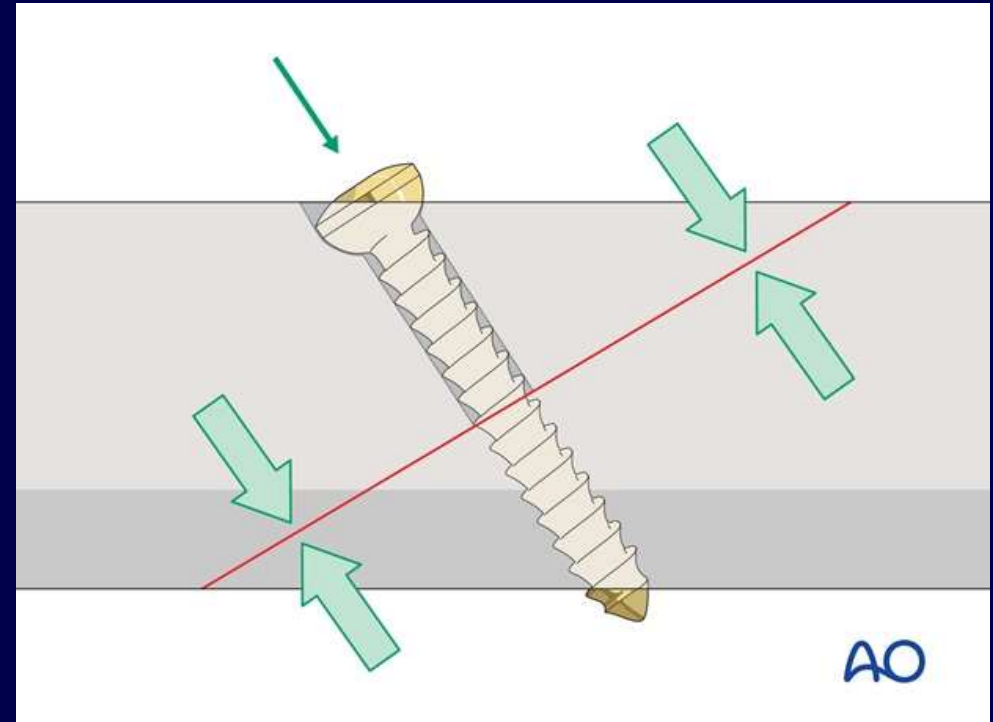
Lag Screws

- Remember to place lag screws as close to perpendicular to fracture as possible



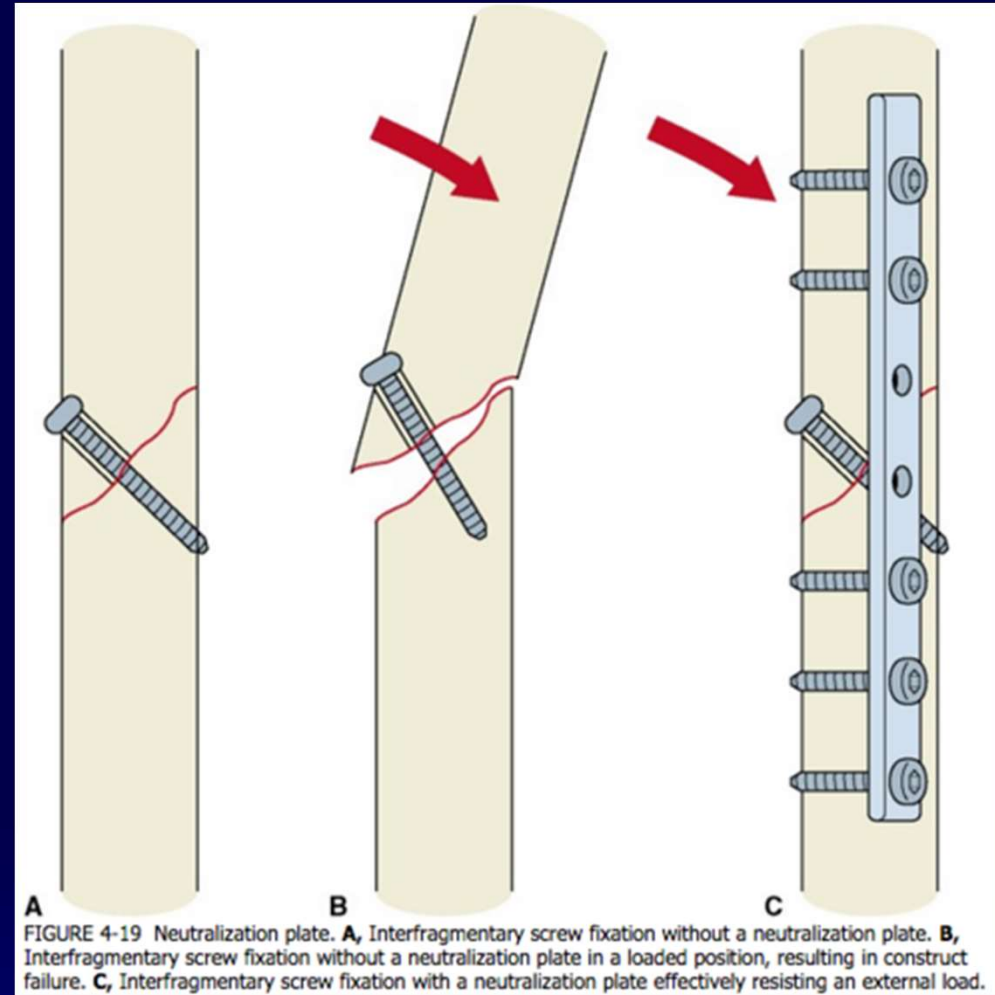
Lag Screws

- Remember to place lag screws as close to perpendicular to fracture as possible
- Maximizes compression forces



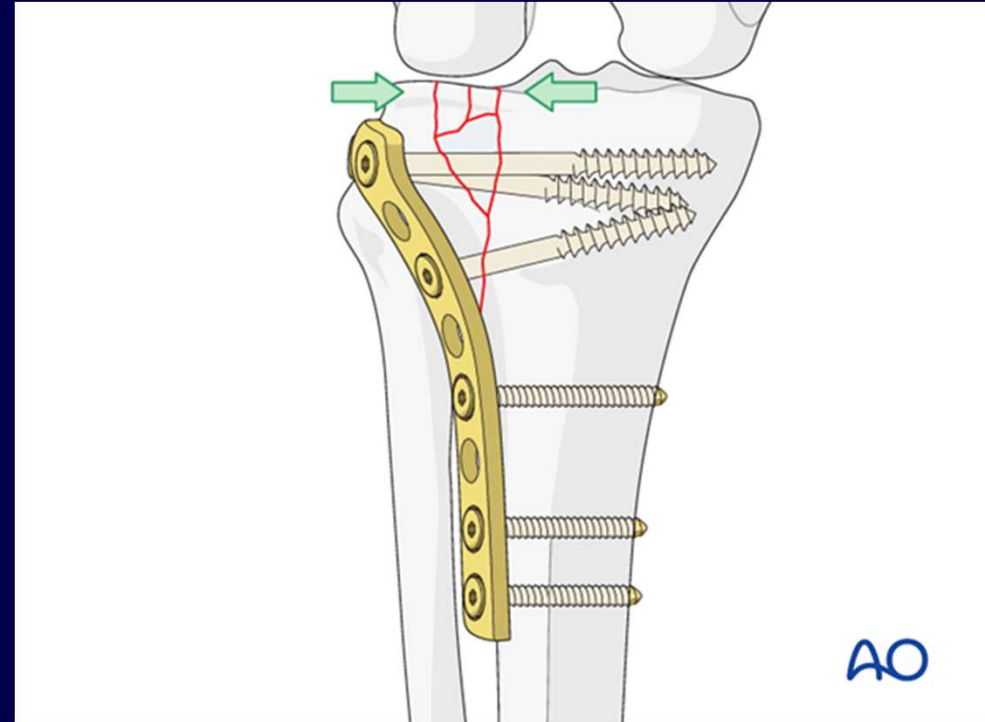
Neutralization Plating

- Neutralizes forces on lag screws
- Protects from shear, bending, and rotational forces
- Acts as a bridge



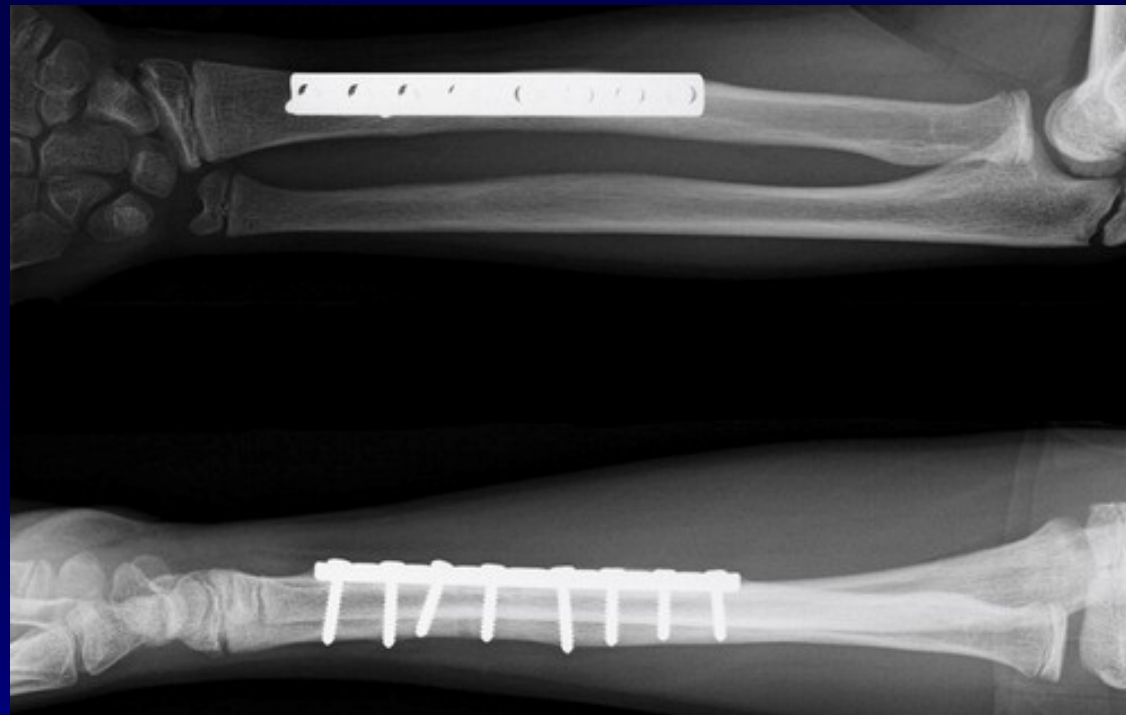
Buttress (Antiglide) Plating

- Resists shear forces during axial loading
- Protect weakened areas of cortex
- Often used in metaphyseal section for intraarticular fractures
- Reduces risk of sliding/collapse during healing



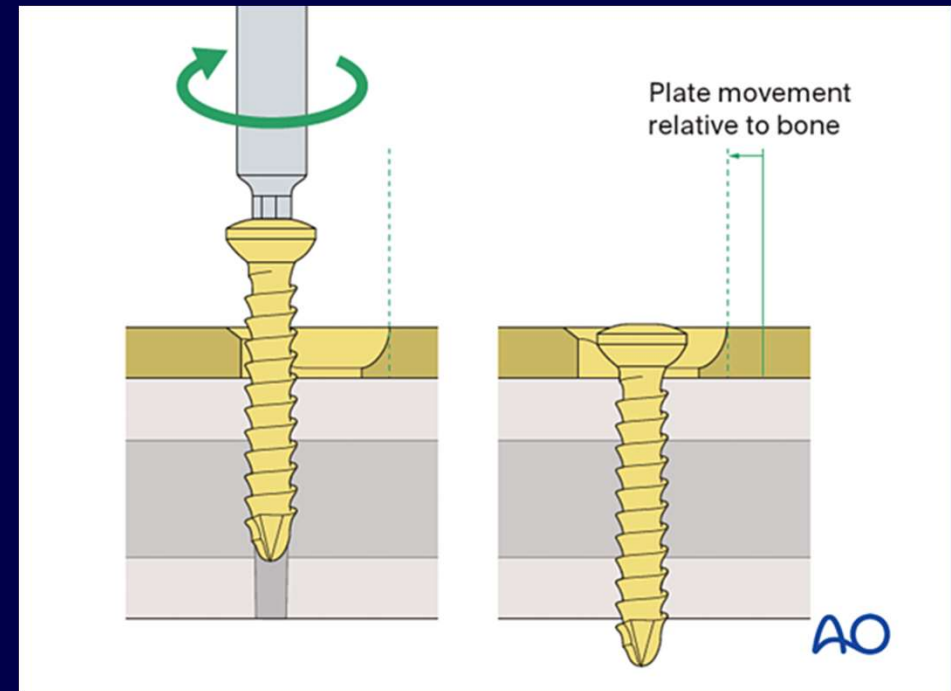
Compression Plating

- Compression is fundamental to healing
- Decreases fracture gap
- Maintains position and stability through physiologic forces

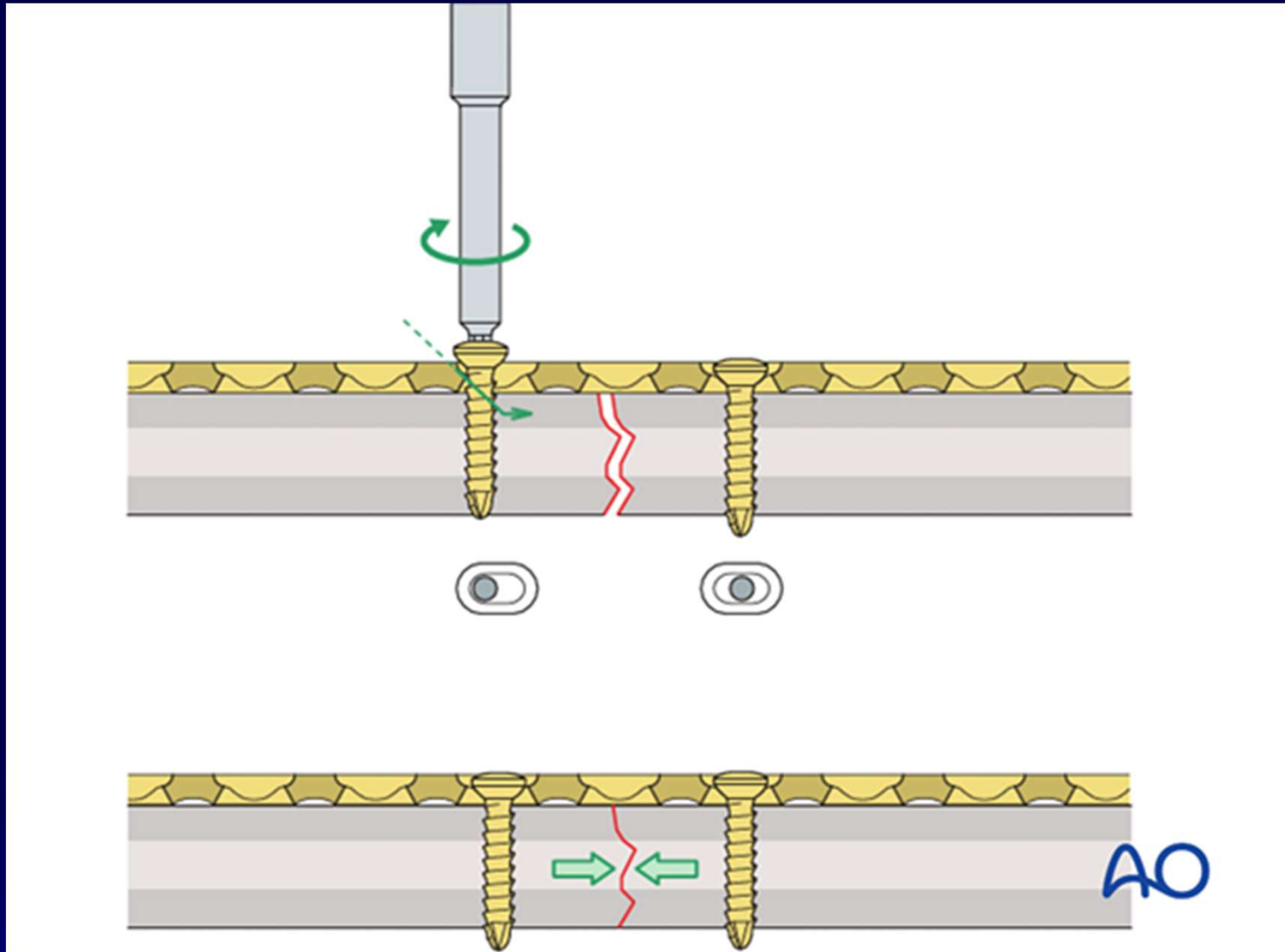


Compression Plating

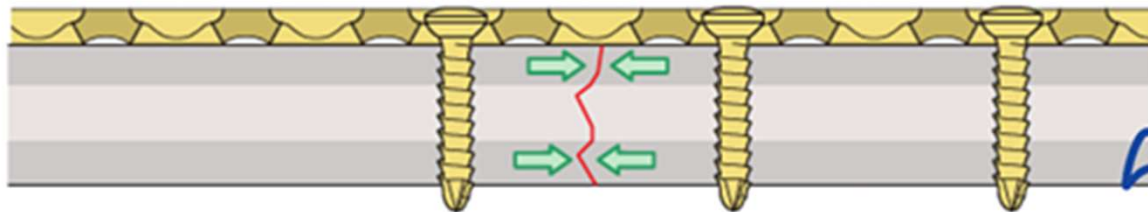
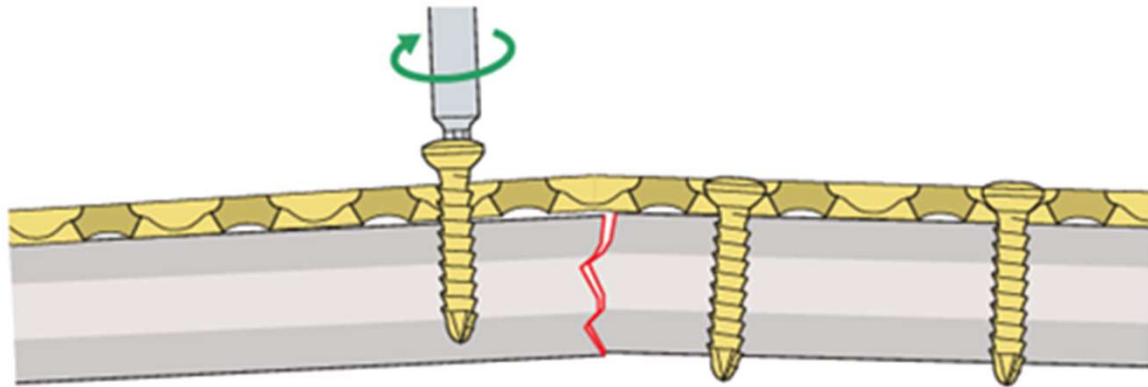
- Reduce and compress transverse or short oblique fractures
- Prebending plate converts to compressive forces
- Dynamic compression with oval holes and eccentric screw placement



Compression Plating



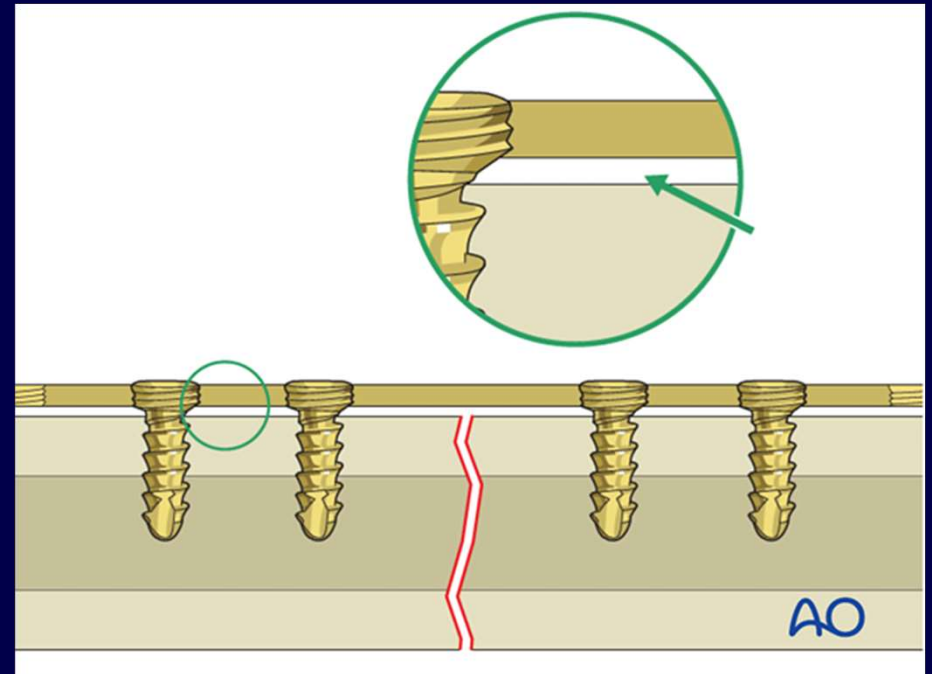
Prebending Plate



AO

Locking Plates

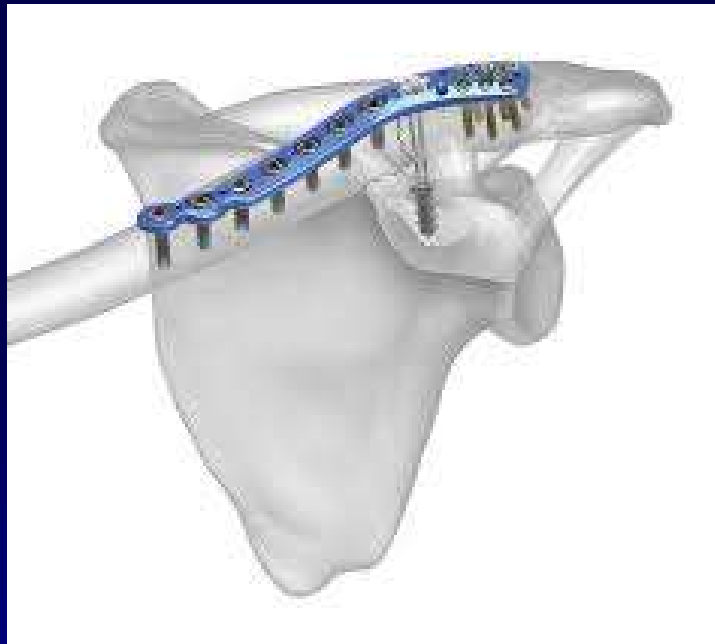
- Screw heads are threaded
- Lock into plate
- Fixed angle device
- Improves axial stability
- Reduces risk of implant failure



Combined LCDC Locking Plates



Specialty Plates



Take Home Points

- Numerous options for managing fractures
- Internal fixation offers advantages
- Many different plate/screw options available
- Advancing technology
- Understanding of basic biomechanical principles
- Improve capabilities

A scenic sunset over a body of water. The sky is filled with colorful clouds in shades of orange, yellow, and blue. The sun is low on the horizon, creating a bright glow. The water reflects the colors of the sky. In the foreground, there is a dark silhouette of a building with a balcony or deck on the right side. The overall mood is peaceful and serene.

Thank You!

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