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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- No corporate affiliation, interests, or royalties
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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

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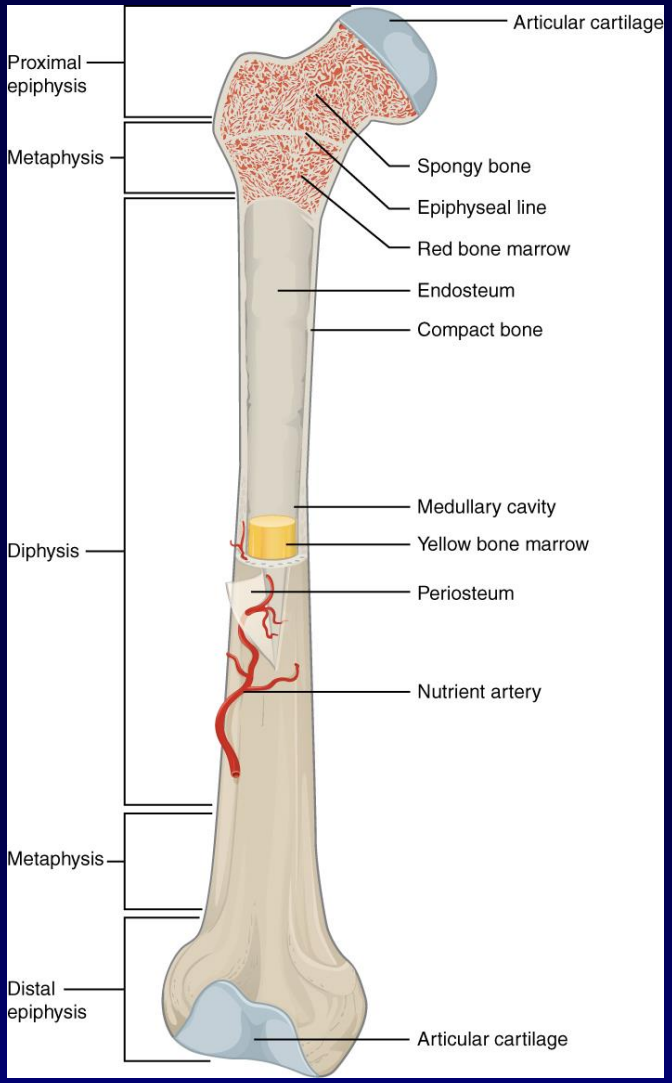
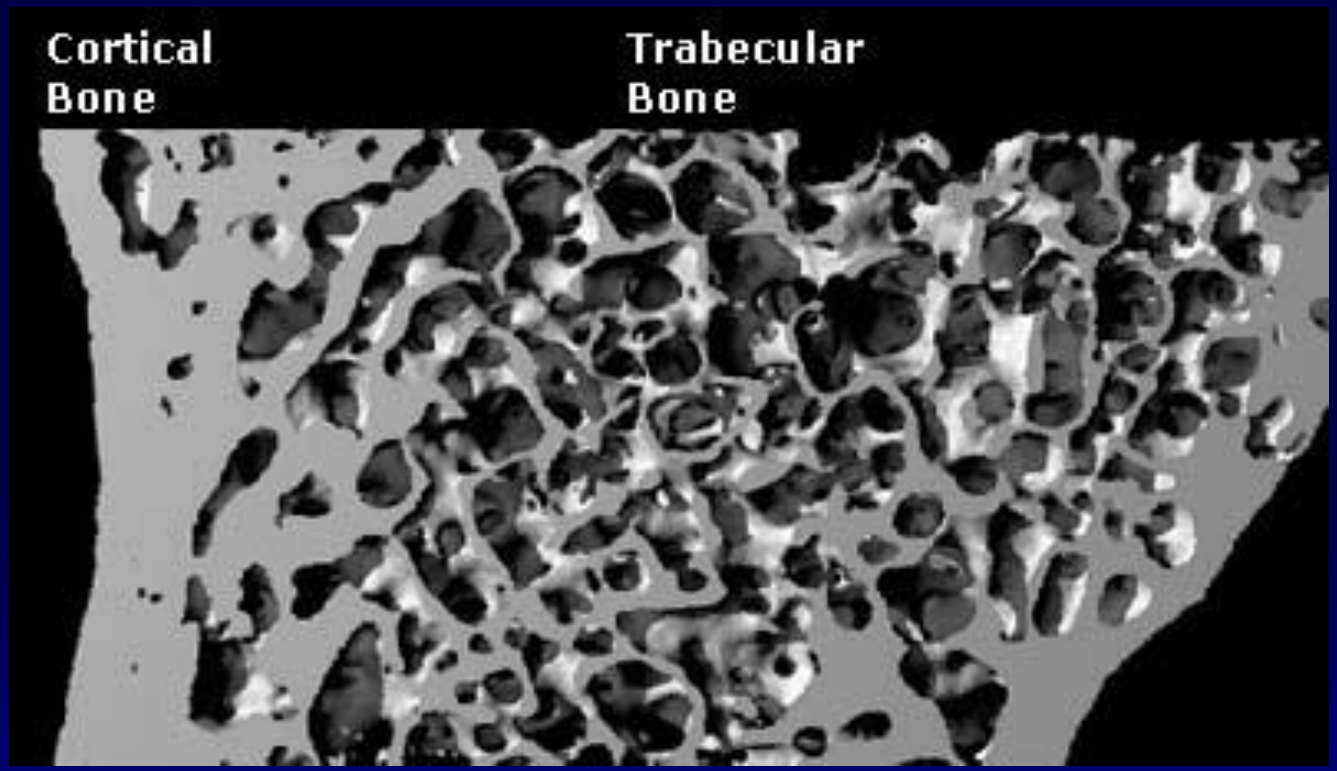
Bony Anatomy

- Long Bones
  - Epiphysis
  - Metaphysis
  - Diaphysis



Bony Anatomy

- Cortical Bone
- Cancellous (Spongy) bone



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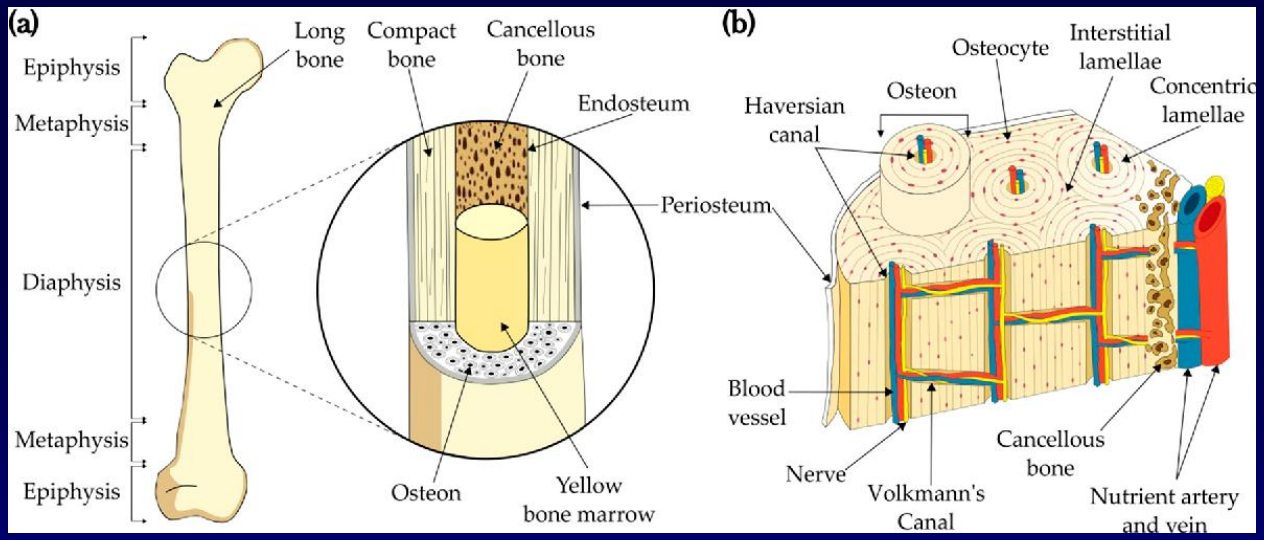
Cortical Bone

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



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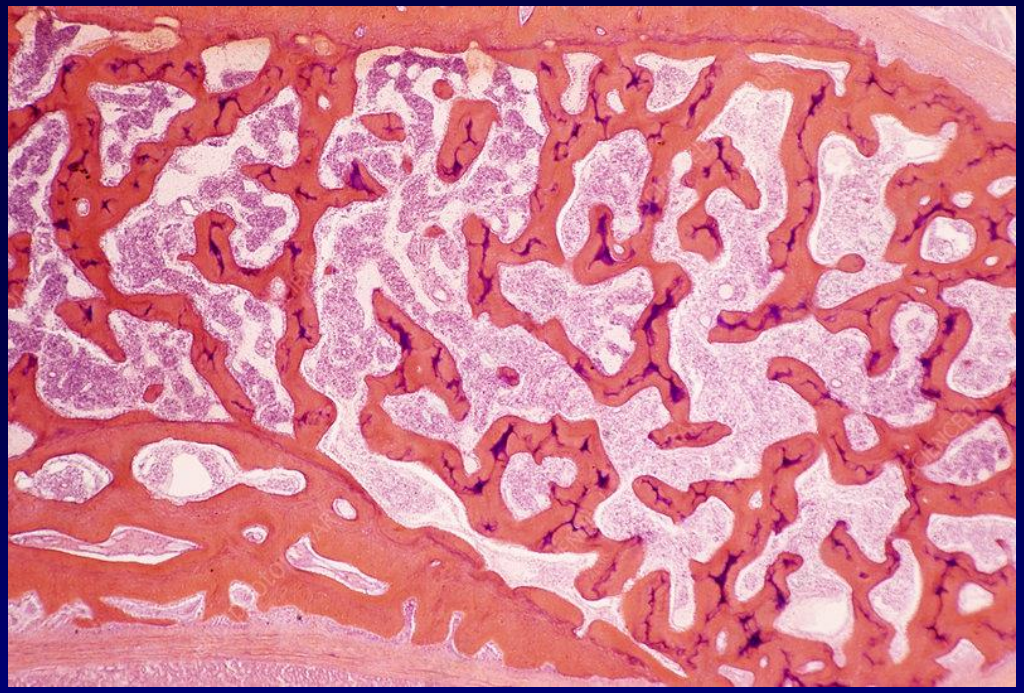
Cancellous Bone

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



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 fur Osteosynthesfragen (AO)
- “Working group for bone fusion issues”
- Association for the Study of Internal Fixation (ASIF)

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Principles of Internal Fixation

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

Fractures

- Overload of force greater than bone can withstand
- 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

Bone Healing

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

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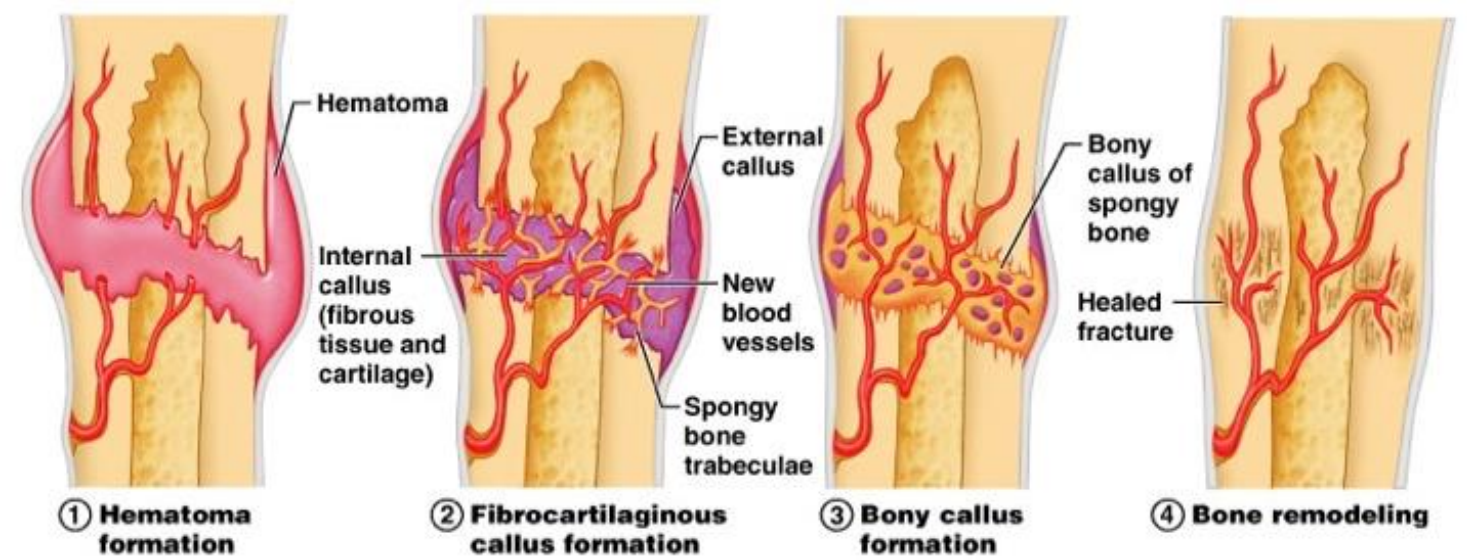
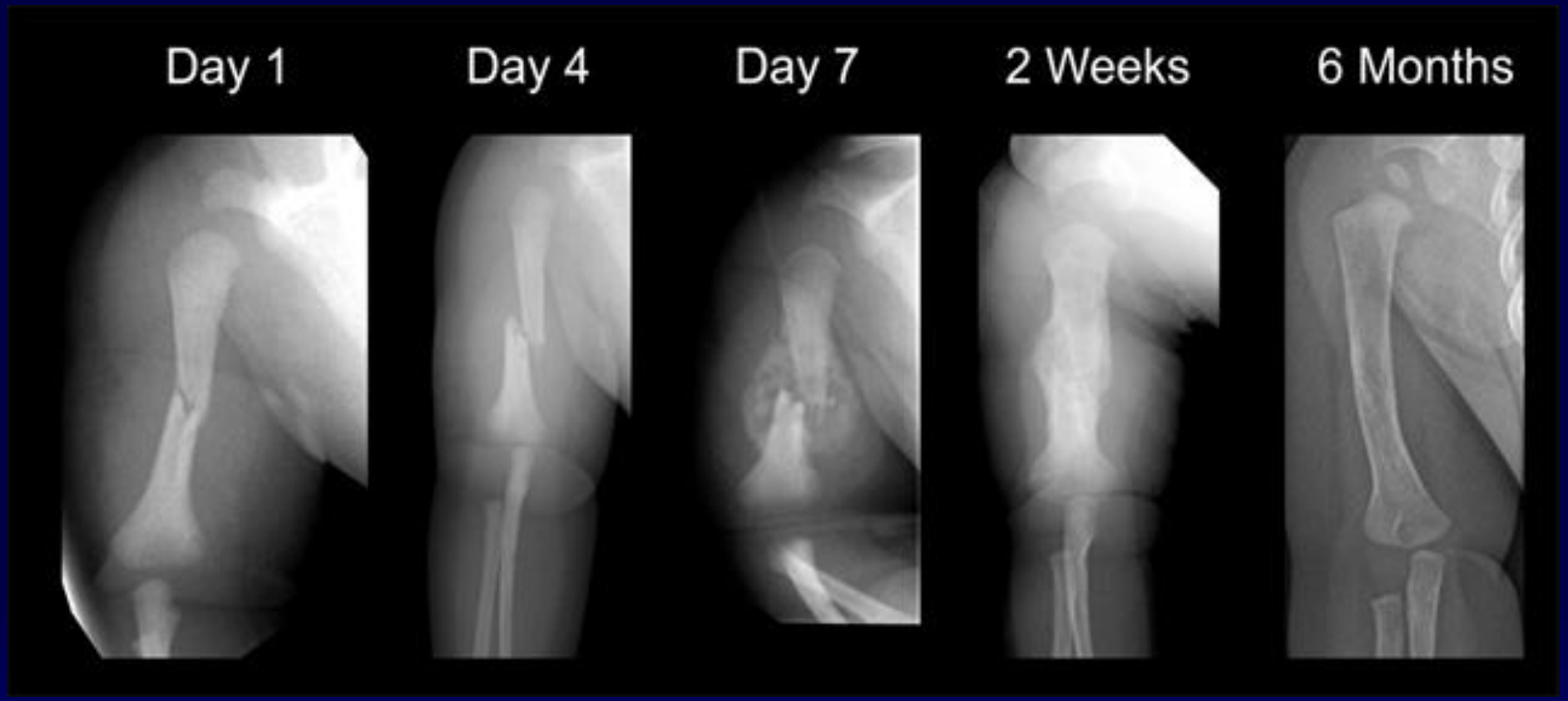
Indirect Bone Healing

- Relative stability
- Some motion between fragments
- Callus formation

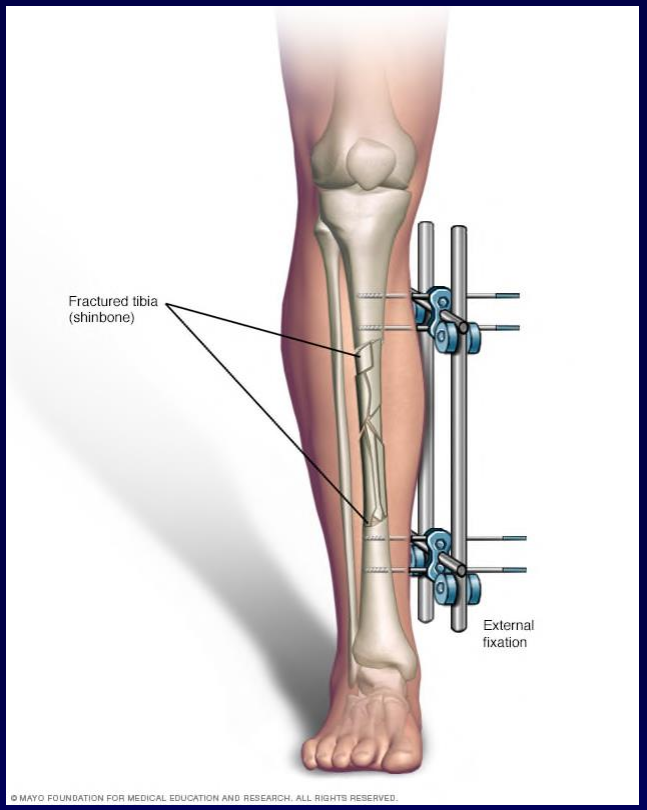


Fracture Callus



Indirect Bone Healing

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



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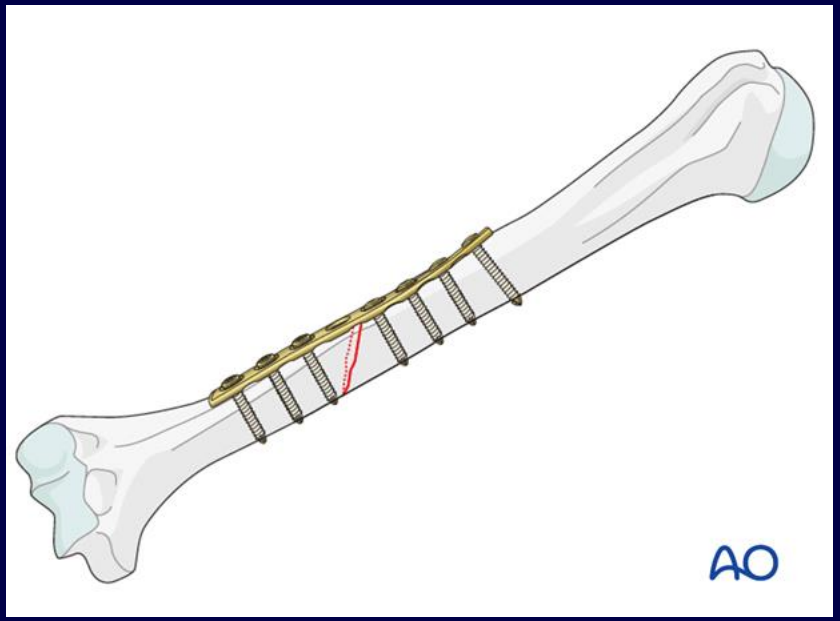
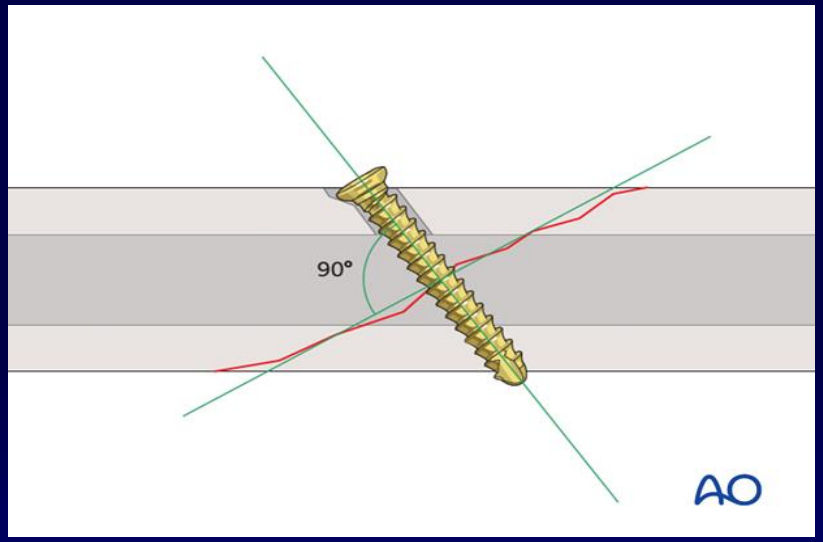
Direct Bone Healing

- 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 implants

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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

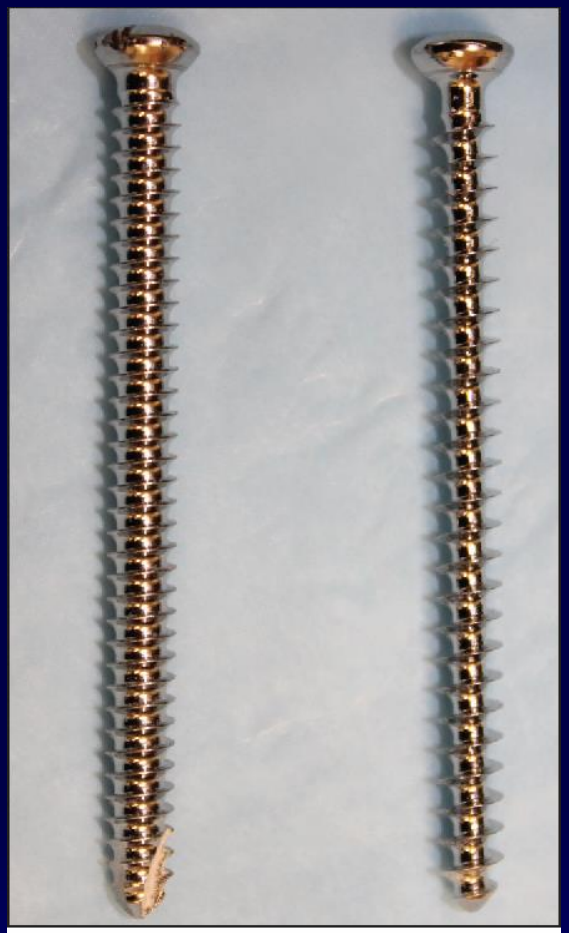

Figure 1: Four-mm outer-diameter cortical (left)

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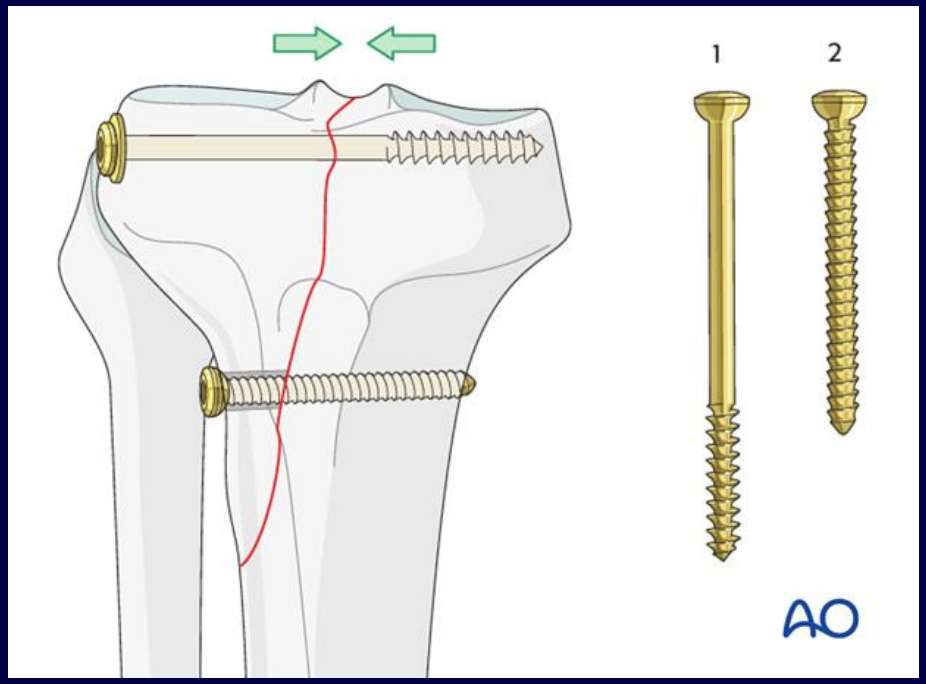
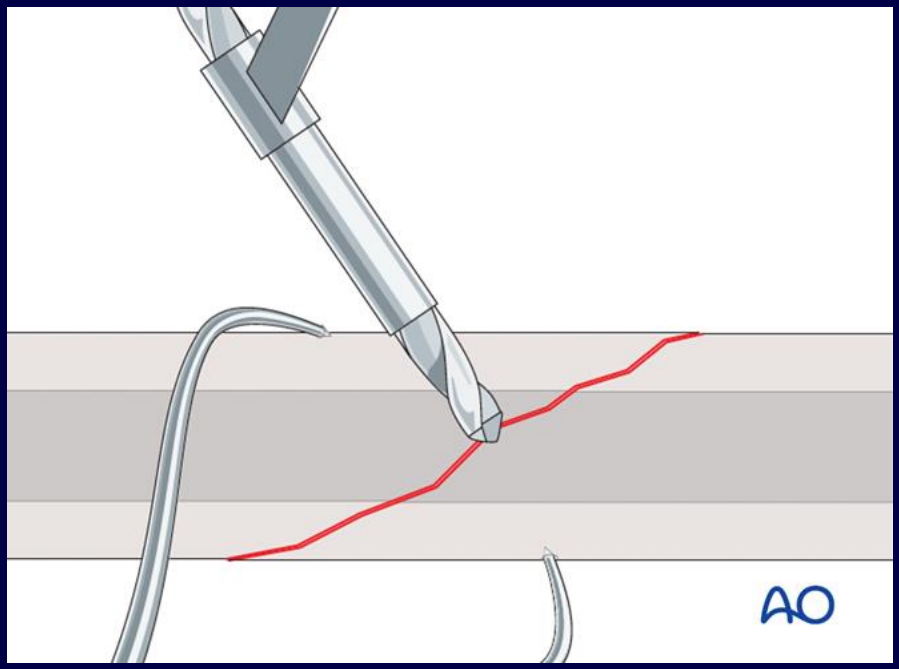
Lag Screws

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



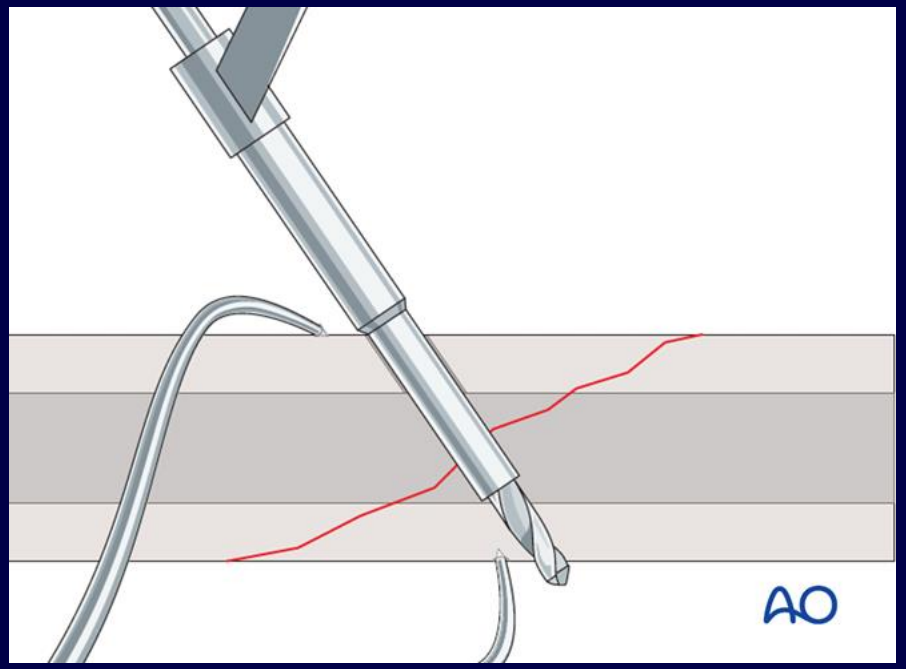
Lag Screws

- 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



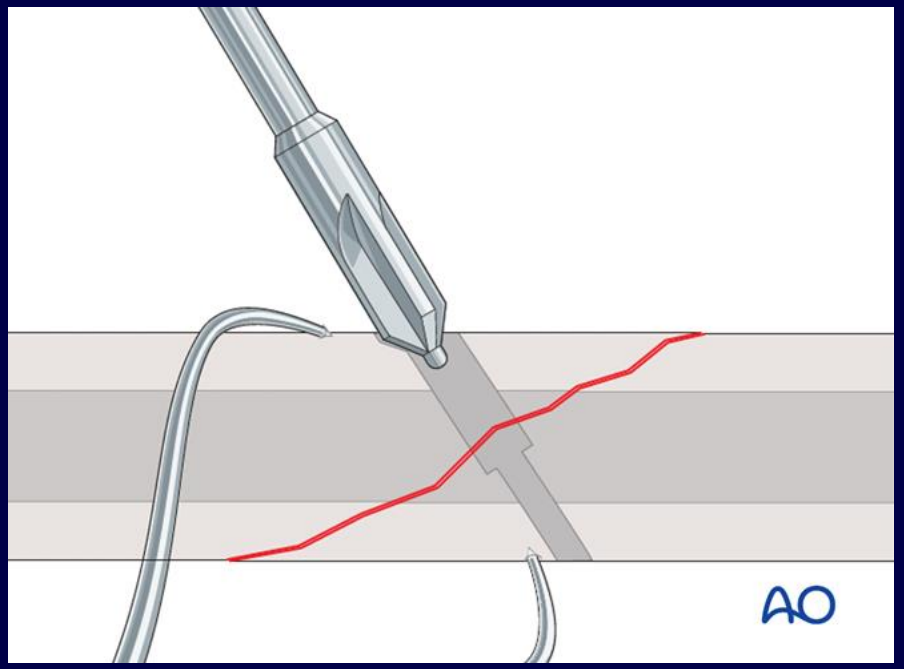
Lag Screws

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



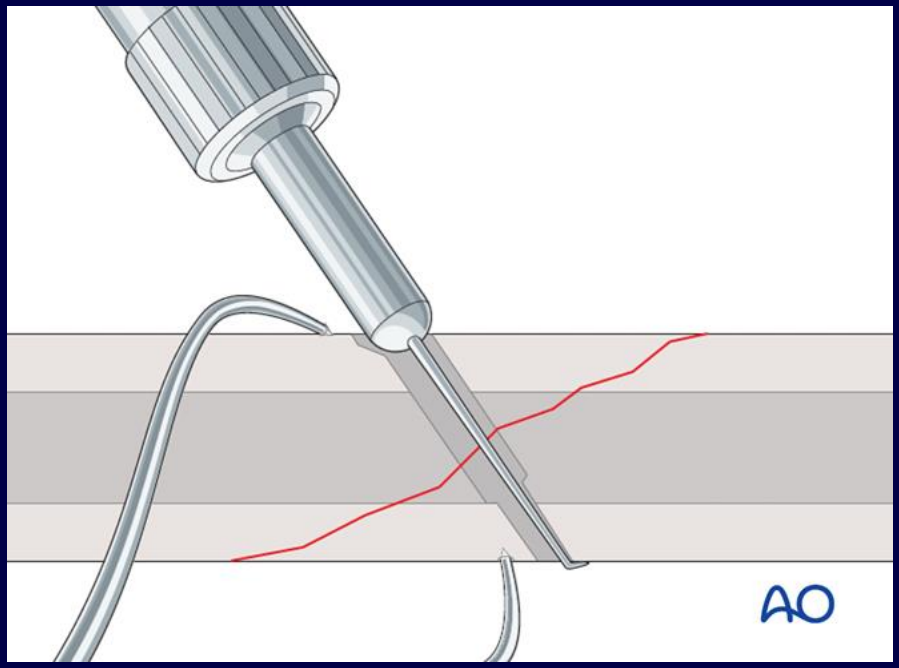
Lag Screws

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



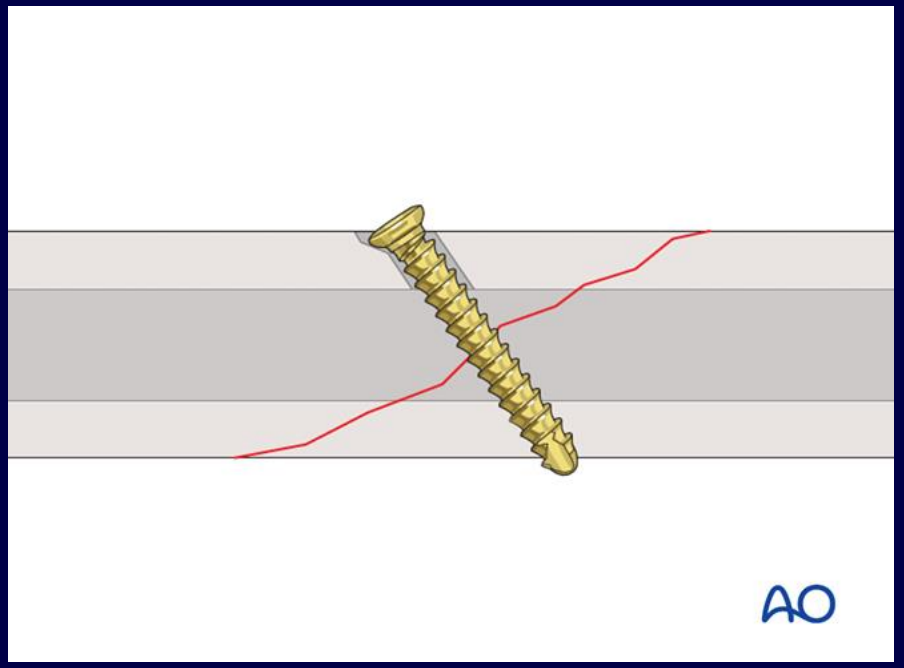
Lag Screws

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



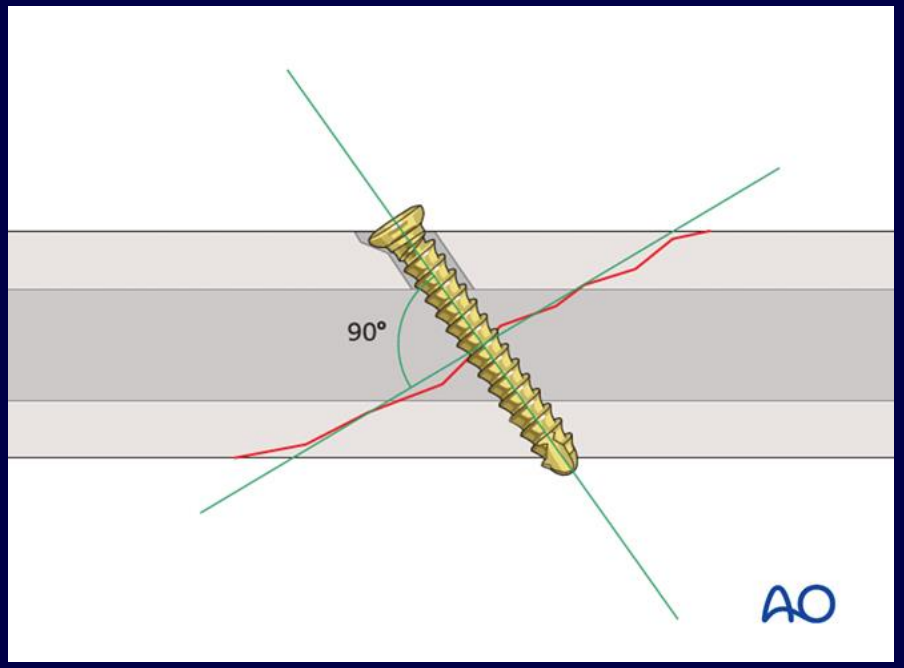
Lag Screws

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



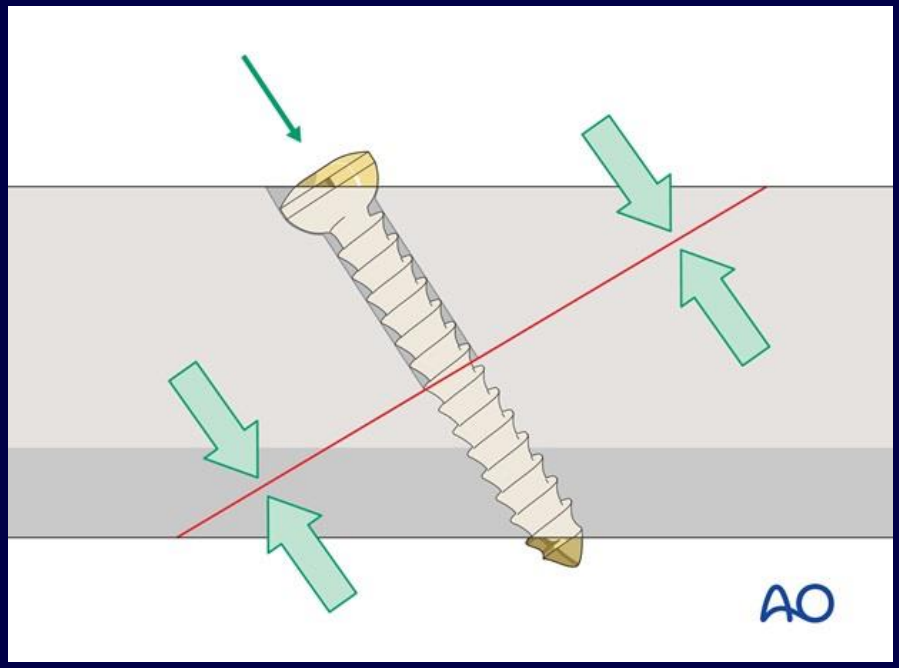
Lag Screws

- 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



Questions?

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Neutralization Plating

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

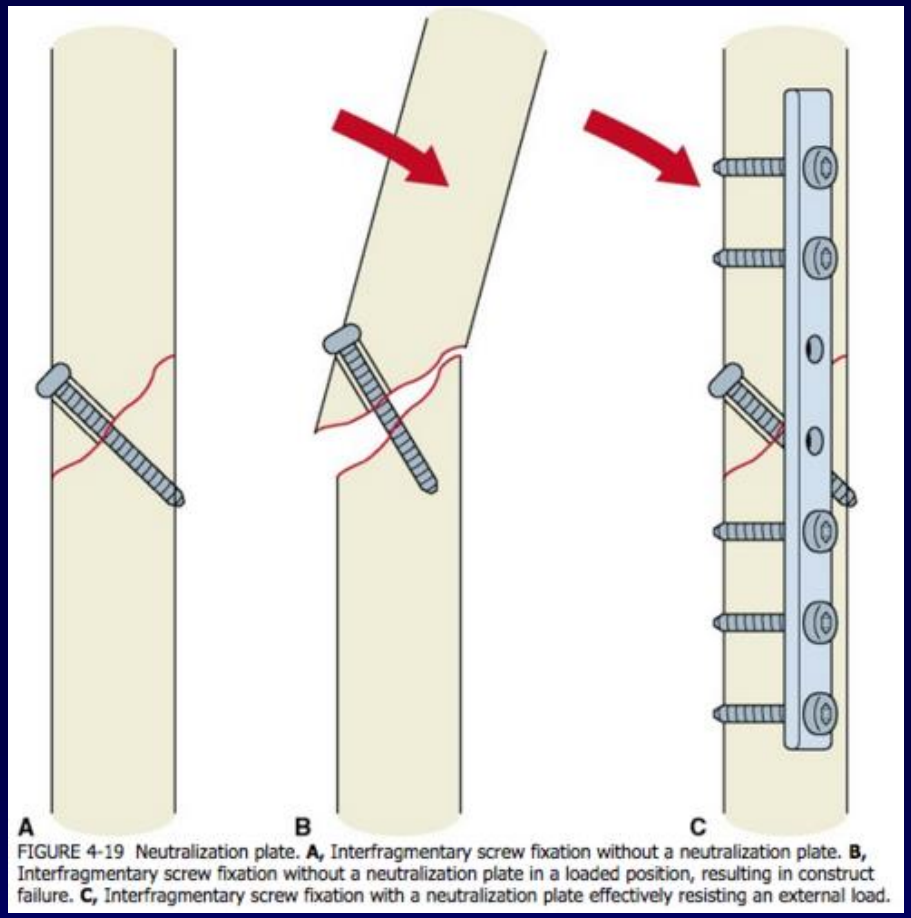
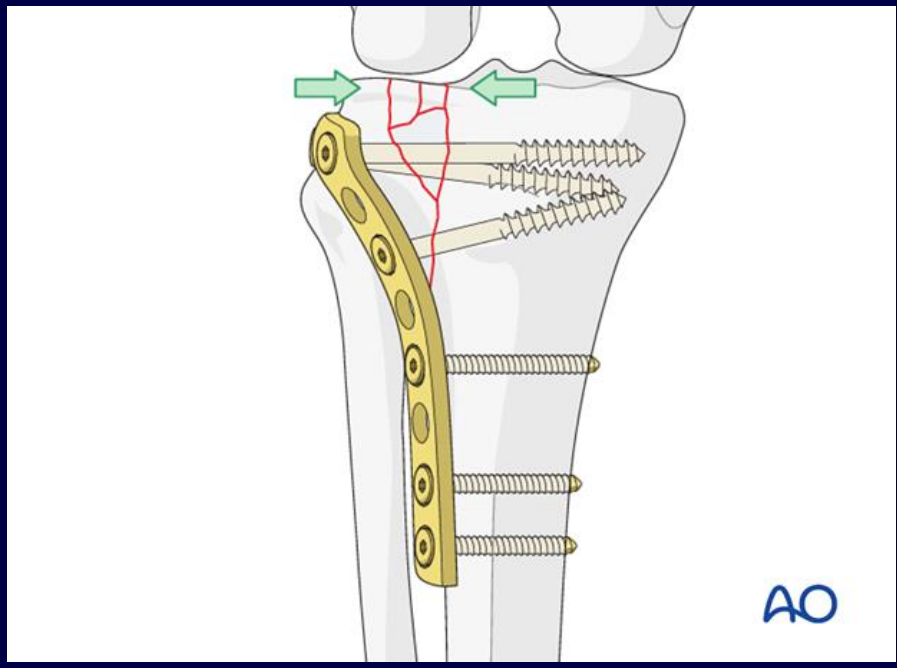


FIGURE 4-19 Neutralization plate. **A,** Interfragmentary screw fixation without a neutralization plate. **B,** Interfragmentary screw fixation without a neutralization plate in a loaded position, resulting in construct failure. **C,** Interfragmentary screw fixation with a neutralization plate effectively resisting an external load.

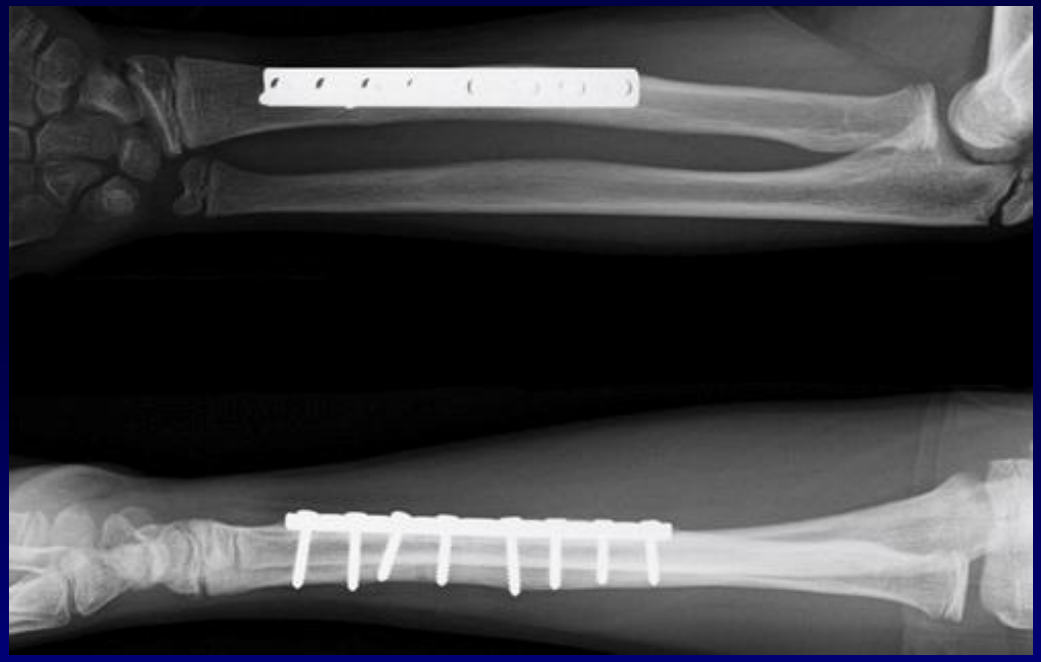
Buttress (Antiglide) Plating

- 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



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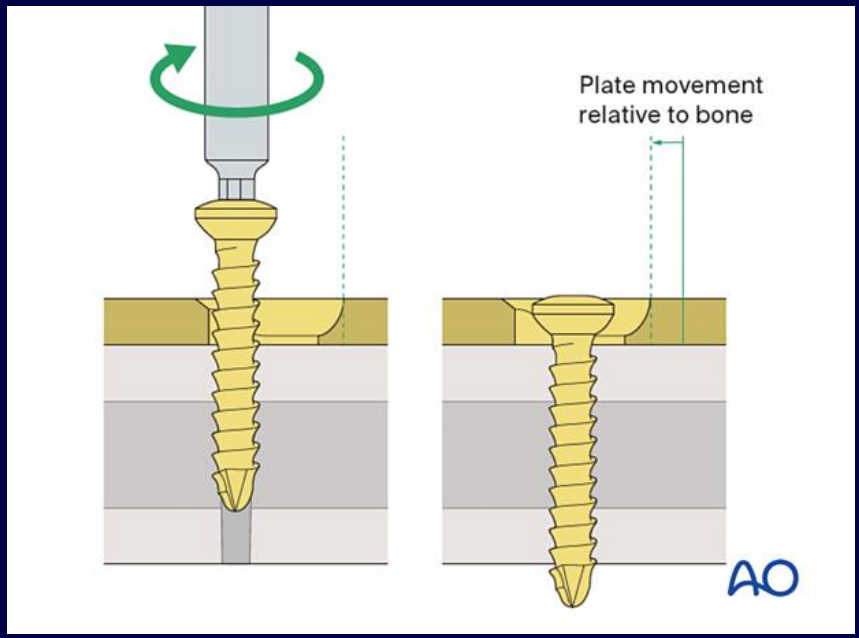
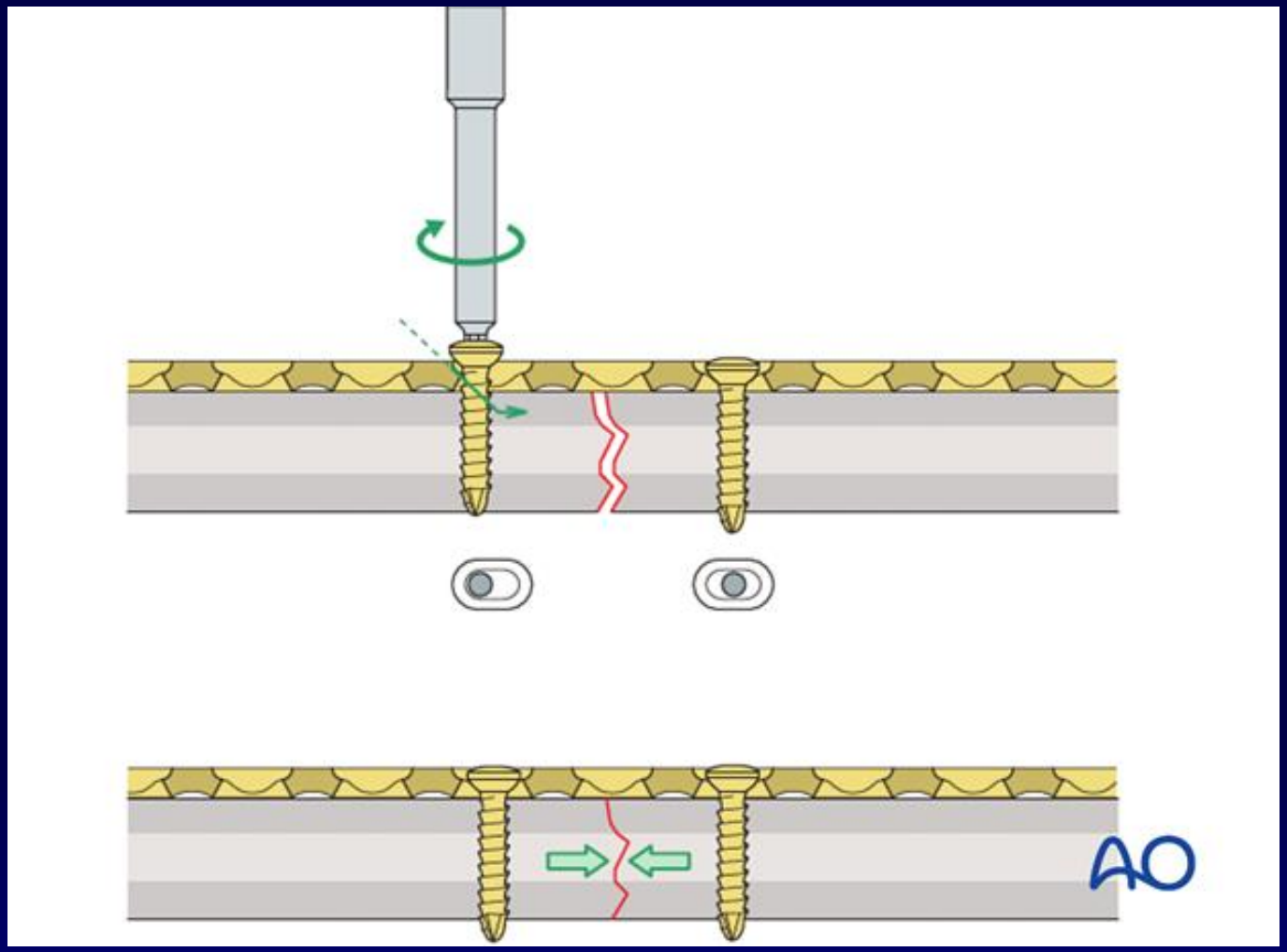
Compression Plating

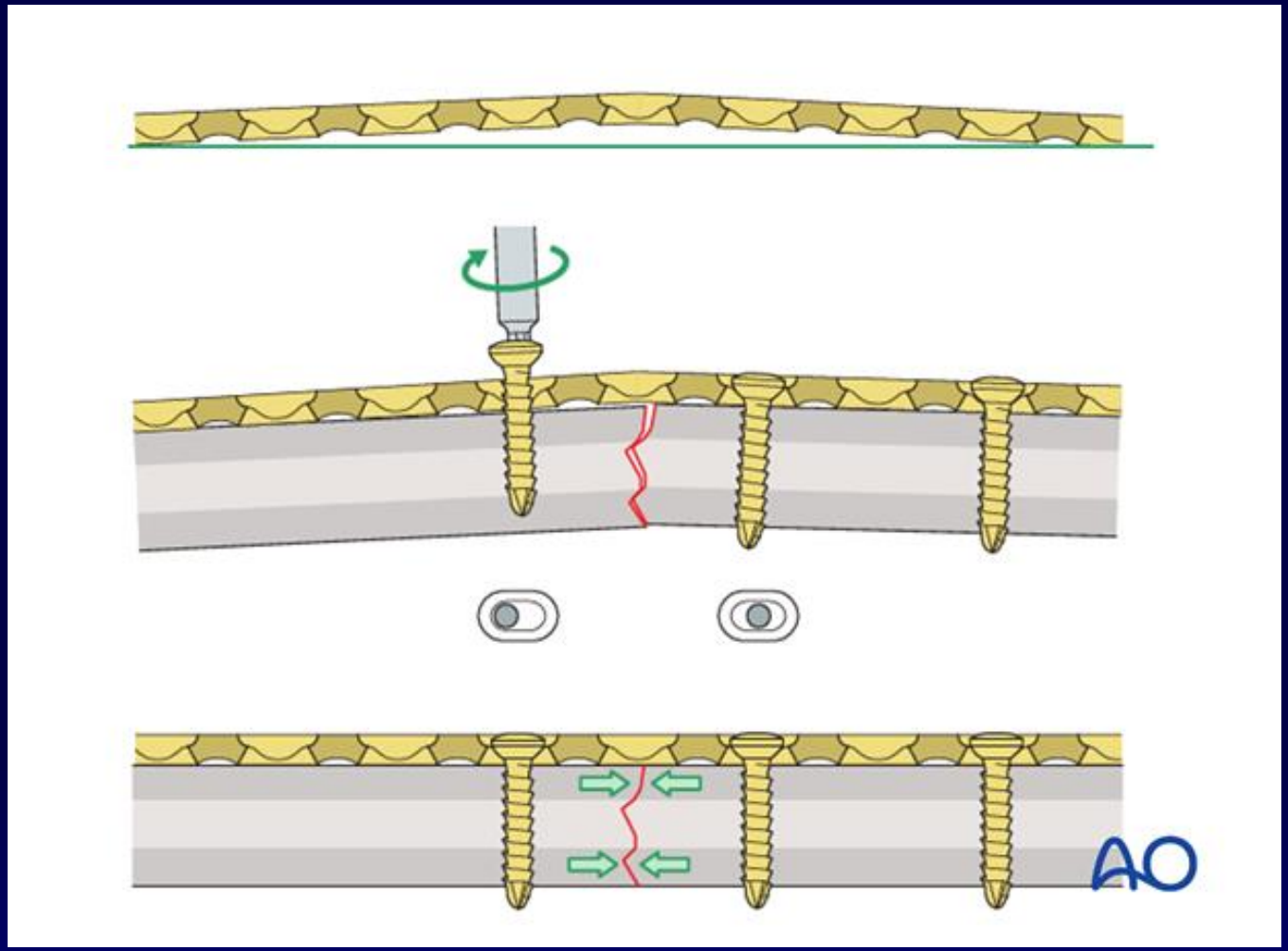
- Reduce and compress transverse or short oblique fractures
- Prebending plate converts to compressive forces
- Dynamic compression with oval holes and eccentric screw placement



Compression Plating

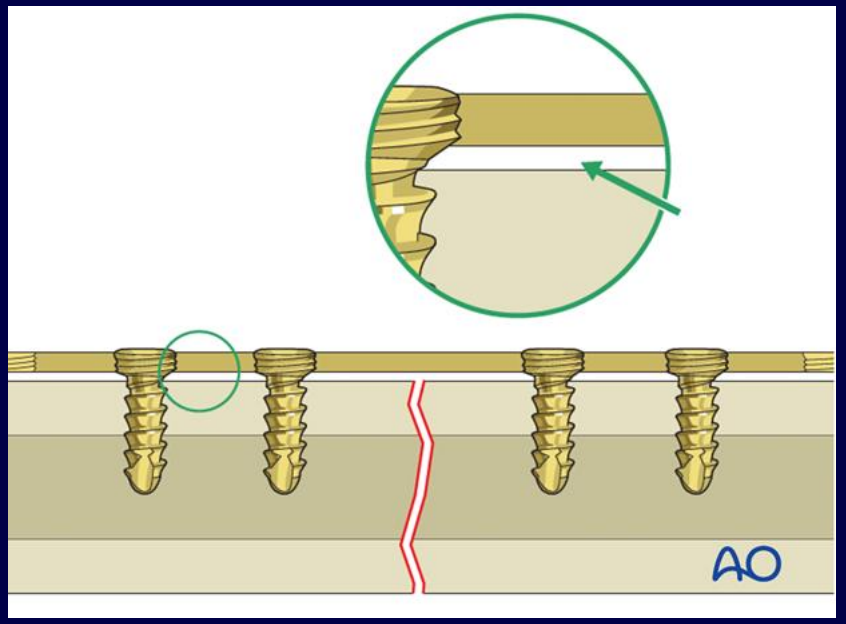


Prebending Plate



Locking Plates

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



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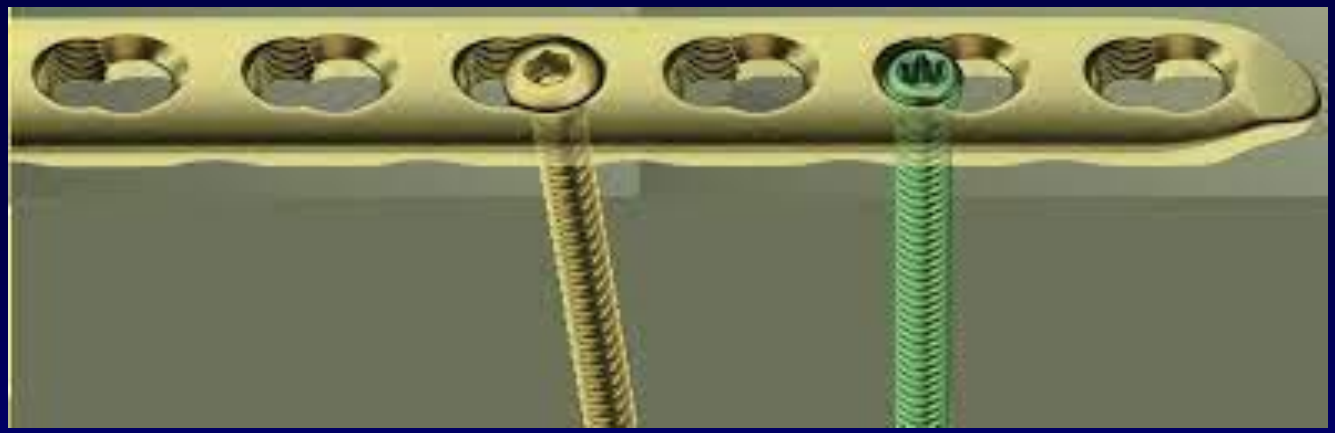
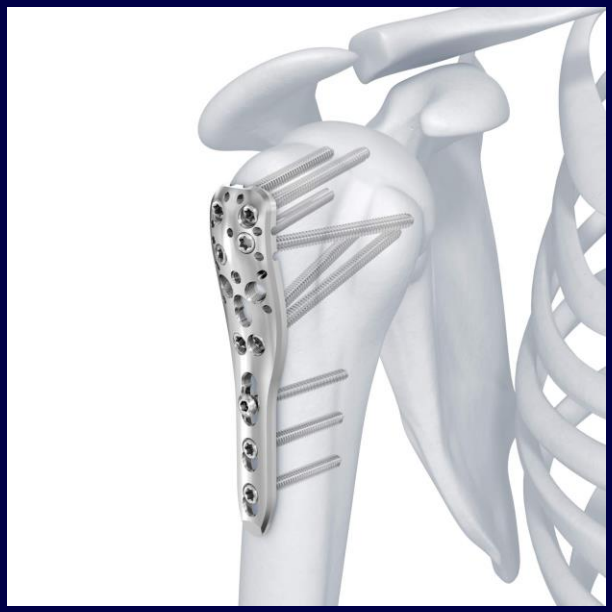
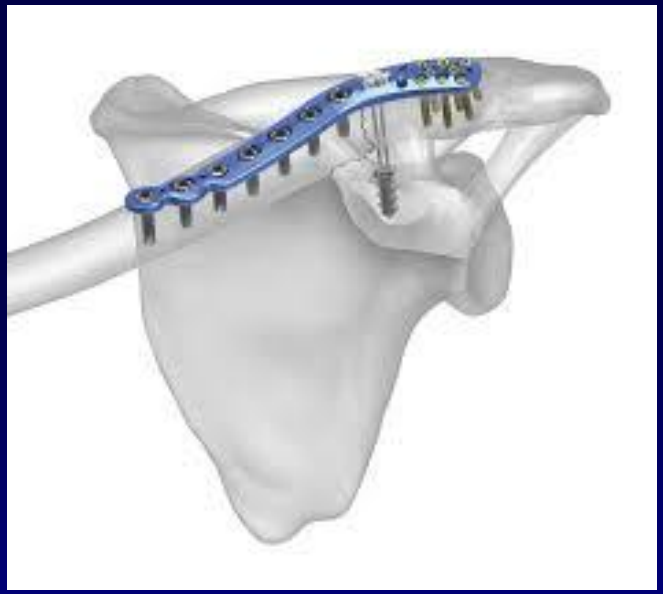
Combined LCDC Locking Plates



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

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