SCALPEL
MANCHESTER MEDICS SURGICAL SOCIETY

Introduction to Fractures:

Radiology & Management

Scalpel Surgical Teaching Series

Trauma & Orthopaedics: Session 2

31 July 2020

Vasudev Zaver

What Will Be Provided

- Assessment – Pre-Module
- Recap
- Physiology
- Clinical Signs
- Open fractures
- Closed fractures
- Long term follow-up and complications
- Assessment – Post-Module

What You Will Need

Pen/keyboard

Paper/word document

Thinking cap

Session Info

- Q&A poll
- Post questions throughout
- Slides will be available
- Recording will be available
- Use MCQs for active recall
- Traffic light system for level
- Photos of fractures

Types of Fractures

Open	Closed
Complete/Partial	
Displaced/Undisplaced	
Comminuted	
Linear/Transverse	
Spiral	
Oblique	
Greenstick	
Impacted	
Depressed	

Describe This Fracture…

1	Open	Closed
2	Complete/Partial	
3	Displaced/Undisplaced	
4	Comminuted	
	Linear/Transverse	
	Spiral	
	Oblique	
	Greenstick	
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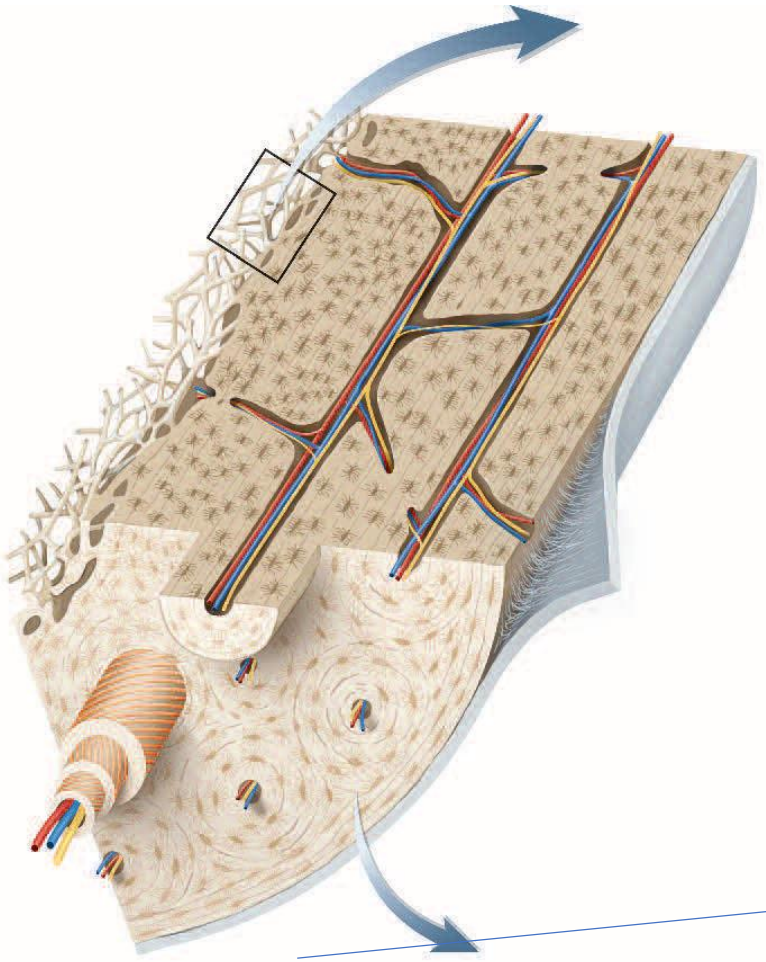
1. What radiograph (who, what, why, when)
2. Type of fracture?
3. Location of fracture
4. Displacement
5. Anything else?

Image courtesy of Dr Ian Bickle and Assoc Prof Craig Hacking et al., Radipaedia.org.

Anatomy of the Bone



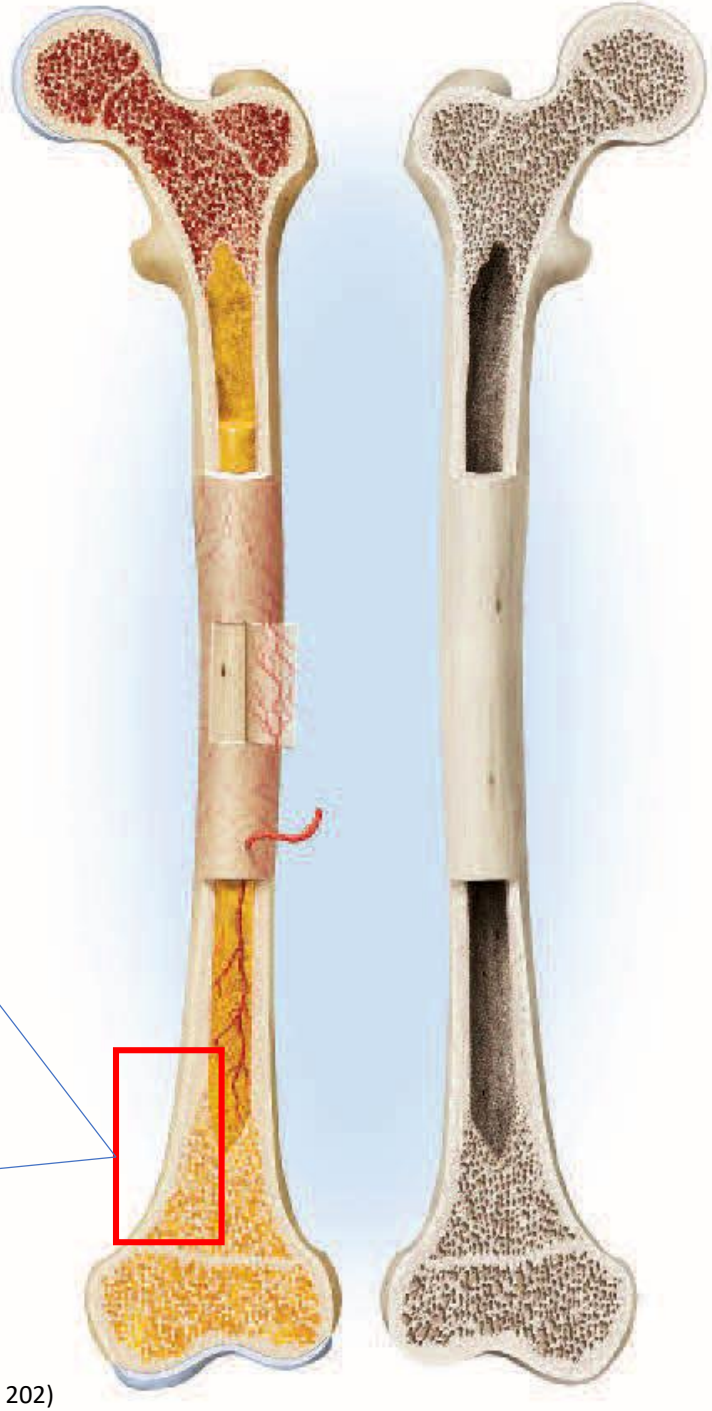


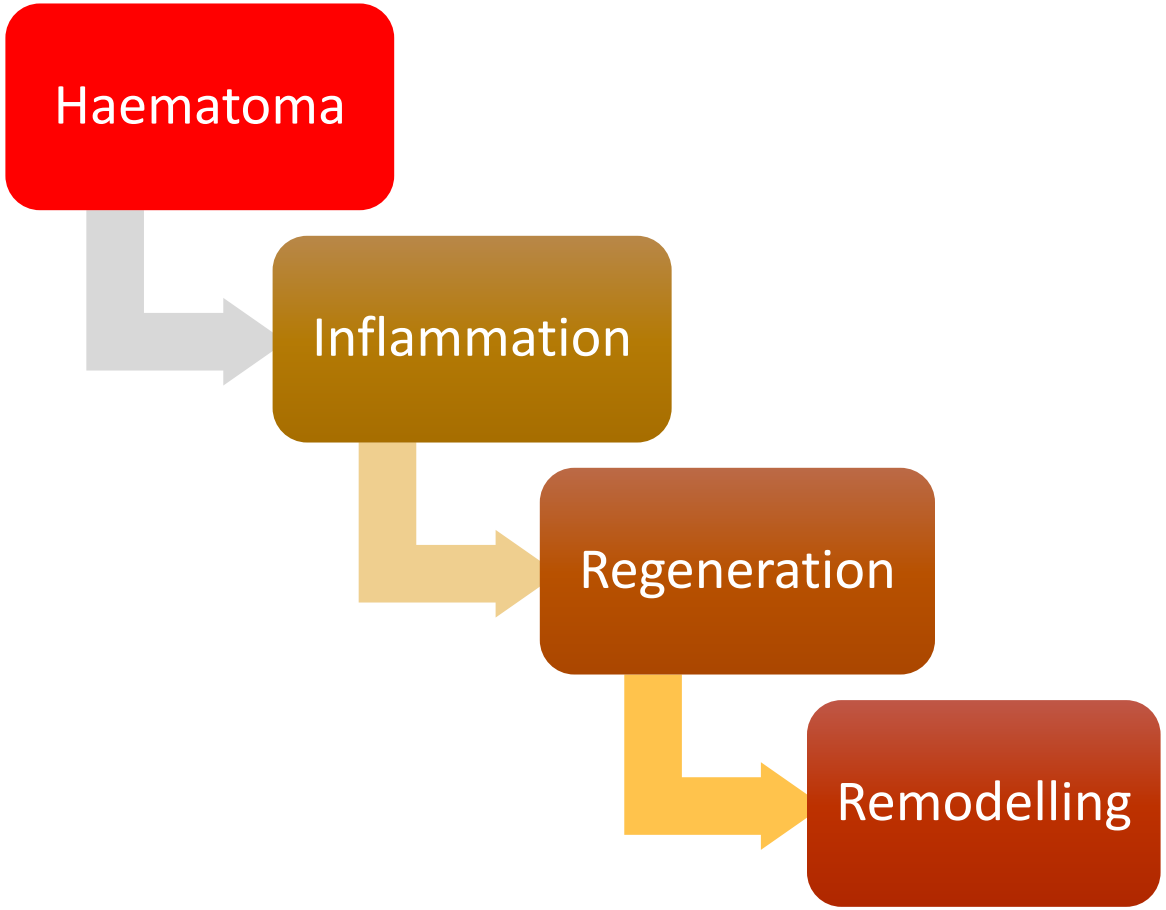
Image adapted from: Saladin: Anatomy & Physiology: The Unity of Form and Function, Fifth Edition; Chapter 7 Bone Tissue (Pages 215, 202)

Why Do We Reduce Fractures?

- Bone heals no matter the position
- If the fracture is not reduced appropriately then the bone can heal in a deformed position.
- Bone heals best with contact:

- Primary healing – < 0.01mm gap + <2% interfragmentary strain
- Secondary healing – gap + 2% - 10% interfragmentary strain

Physiology of Secondary Fracture Healing | Overview



Physiology of Secondary Fracture Healing | Detailed View

Haematoma

- Blood flow from capillaries
- Clot → Haematoma
- Encapsulates fracture site

6-8 hours post fracture

Inflammation

- Influx of growth factors + neutrophils
- Proliferation of fibroblasts + osteoblasts + macrophages → stimulate matrix regeneration
- Clot transforms into granuloma

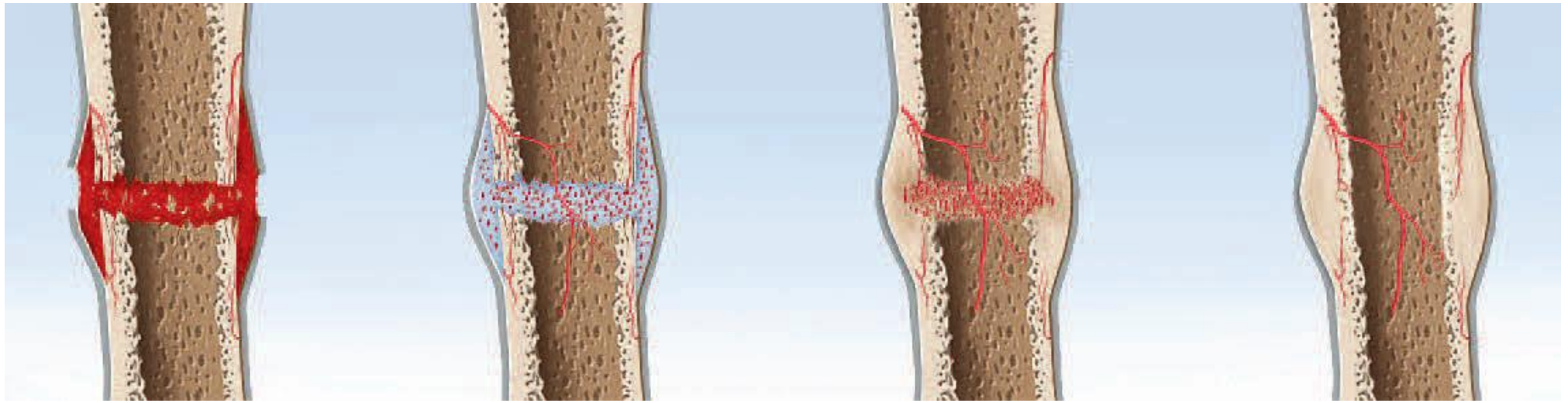
Regeneration

- Primary callus formation — 2 weeks
- Soft callus if bone ends not touching
- Soft callus converted into hard callus — 4 – 6 weeks

Remodelling

- Longest phase — 3 – 4 months
- Involves calcification
- Osteoblast vs osteoclast

Physiology of Secondary Fracture Healing | Detailed View



1. Haematoma formation

Haematoma encapsulates the fracture site.

2. Soft callus formation

Vascular invasion, cartilaginous mass.

3. Hard callus formation

Enchondral ossification.

4. Bone remodelling

Calcification of cartilaginous material and remodelling of newly formed bone.

Image adapted from: Saladin: Anatomy & Physiology: The Unity of Form and Function, Fifth Edition; Chapter 7 Bone Tissue (Figure 7.20, Page 234)

Clinical Signs & Symptoms

- Pain (on or off movement)
- Inability to weight bear/function 
- Visible deformity/swelling (closed/open)
- Bleed/haematoma 
- Fever
- Compartment syndrome - watch out!

Fracture Management | Open Fractures

- Trauma call → **ATLS principles!**
- Immobilise fracture (C-spine collar, pelvic binder, traction, brace, splint)
- Assess soft-tissue damage (classification system)
- Neurovascular status (ABPI should be >0.9)
- X-rays, CT trauma series

1. **Immediate IV antibiotics + tetanus**
2. **Washout and debridement**
3. **Definitive fracture fixation**

Fracture Management | Open Fractures

- Gustillo & Anderson classification:

Grade	Injury
1	Low energy wound
2	>1cm wound with moderate soft tissue damage
3	High energy >10cm wound with extensive soft tissue damage
3A	Adequate soft tissue coverage
3B	Inadequate soft tissue coverage
3C	Associated arterial injury

Ilizarov external fixator

Image courtesy of: *Ilizarov external applicator*, Wikipedia. Accessed 29 Jul 2020: https://commons.wikimedia.org/wiki/File:Ilizarov_Apparatus_External_Fixator.JPG#filelinks

Fracture Management | Open Fractures

Open tibia and fibula fracture case image
courtesy of Dr Shailaja Muniraj, Radipaedia.org.

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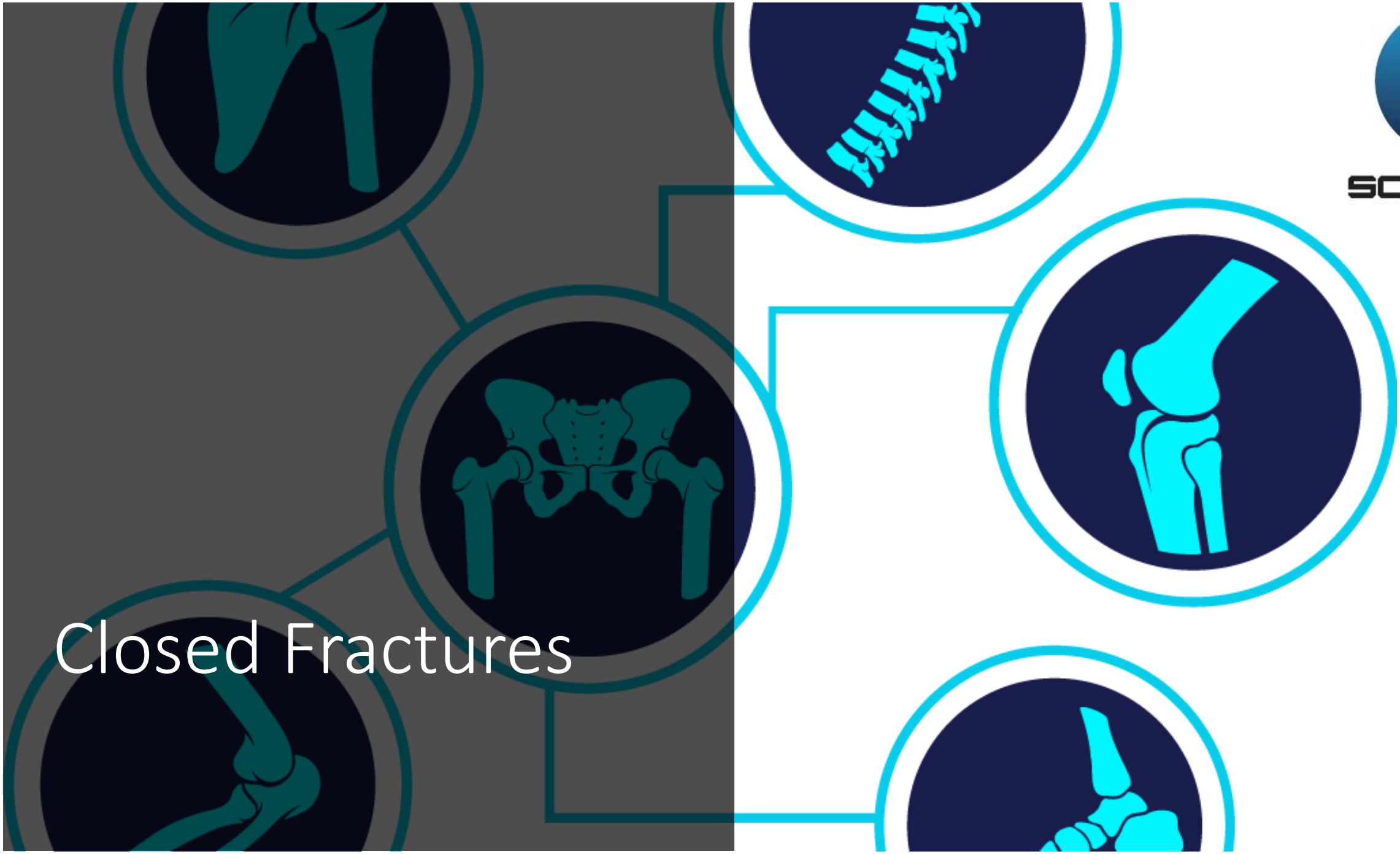
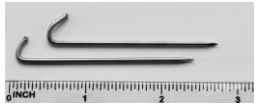


Closed Fractures

Closed Fractures | Scaphoid

- Suspect if FOOSH and pain in anatomical snuff box
- Radiographs:
- Difficult to see on XR (5-20% missed)
- Neutral AP, semi-pronated (45°) oblique, **Ziter (scaphoid) view** (30° wrist extension, 20° ulnar deviation)
- MRI most sensitive for occult # <24 hours and AVN
- Non-displaced = cast immobilisation with good outcomes
- Displaced = percutaneous screw fixation (often **K-wire** ) or open reduction and fixation (**ORIF**)
- Comps = AVN secondary to vascular damage and malunion

Closed Fractures | Scaphoid

Images courtesy of Dr Daniel J Bell and R Bronson et al., Radiopaedia.org

Kirschner Wire

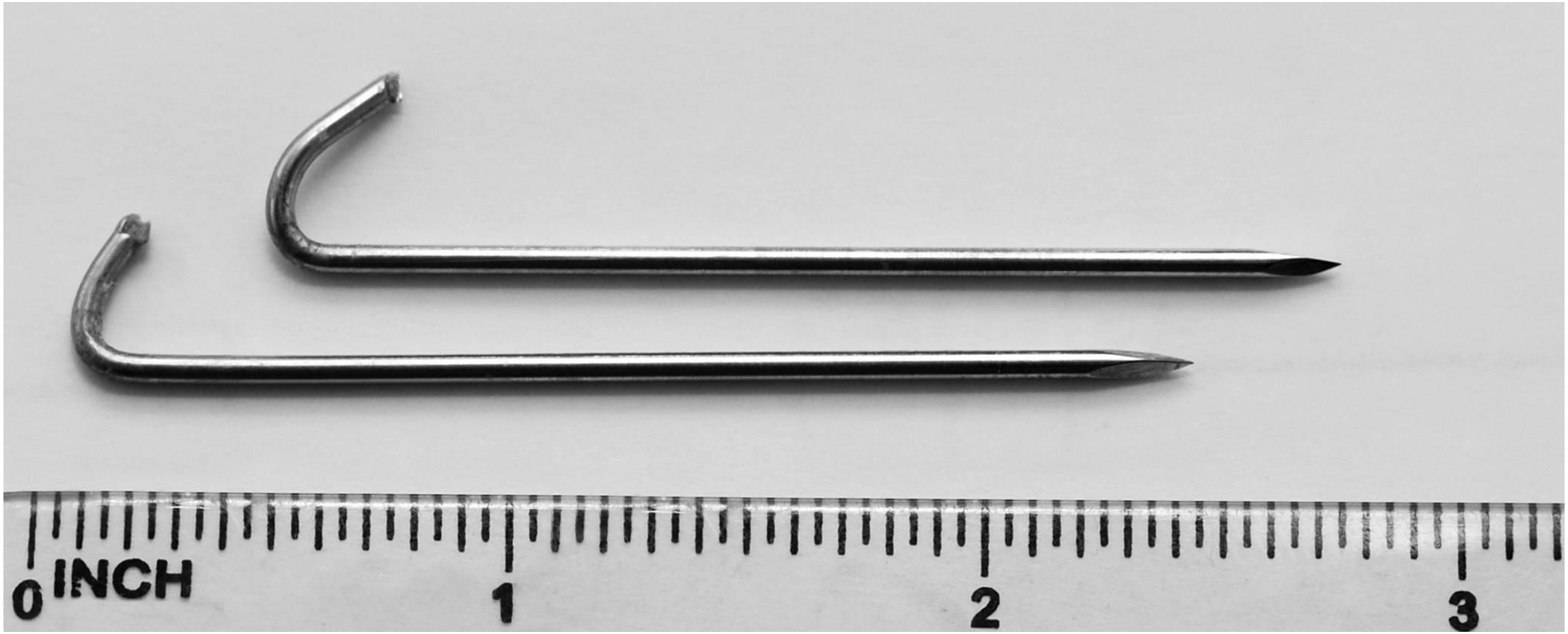


Image courtesy of: *Kirschner Wires,* Wikipedia. Accessed 29 Jul 2020: https://en.wikipedia.org/wiki/Kirschner_wire#/media/File:Wrist_Kirschner_Wires.jpg

Closed Fractures | Distal Radius

- Suspect if FOOSH and pain/wrist deformity with bruising
- Smith's/Colles'/Barton's
- Radiographs:
- XR Wrist: AP, lateral and oblique
- MRI/CT for soft tissue evaluation
- Conservative (splint/cast immobilisation) = <5mm radial shortening, <5° angulation or within 20° of other side
- Closed reduction percutaneous pinning (CRPP) (usually with K-wire to help reduce #) or ORIF (plating) = stable with increased radial shortening +/- increased angulation or unstable

Closed Fractures | The Hip

- If trauma call → **ATLS principles!**
- Radiology
- Normal neck-shaft angle 130° and 10° of anteversion
- Shenton's line
- XR is sufficient
- If inconclusive XR then MRI
- Best practice = surgery within 36 hours.

Images courtesy of Dr Ayla Al Kabbani and Assoc Prof Frank Gaillard et al., Radiopaedia.org

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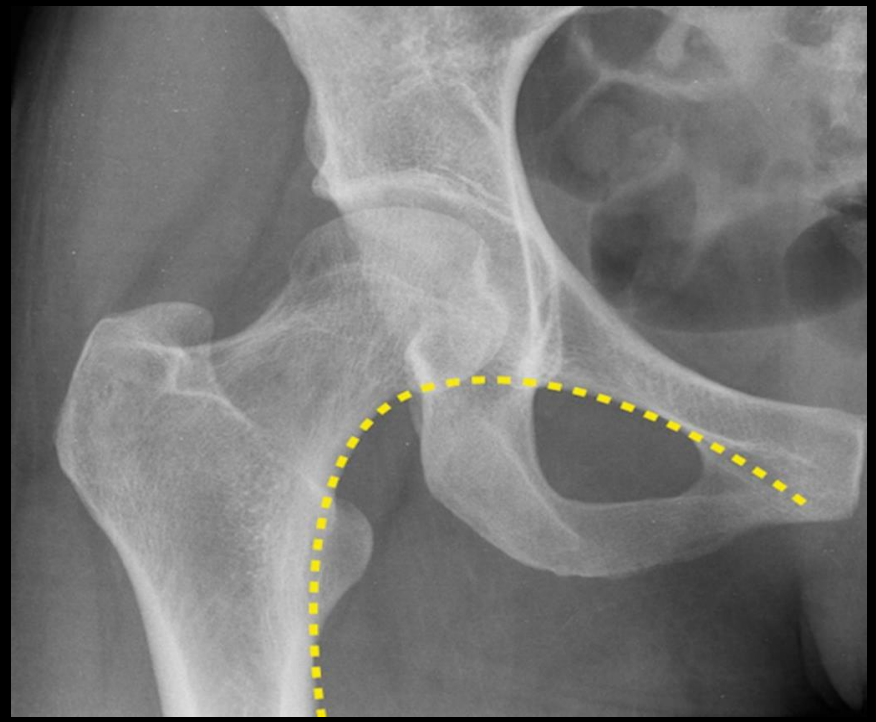


Images courtesy of Dr Ayla Al Kabbani and Assoc Prof Frank Gaillard et al., Radiopaedia.org

Closed Fractures | The Hip
Imaging

Images courtesy of Dr Francis Deng and Assoc Prof Frank Gaillard et al., Radiopaedia.org

Closed Fractures | The Hip

Intracapsular

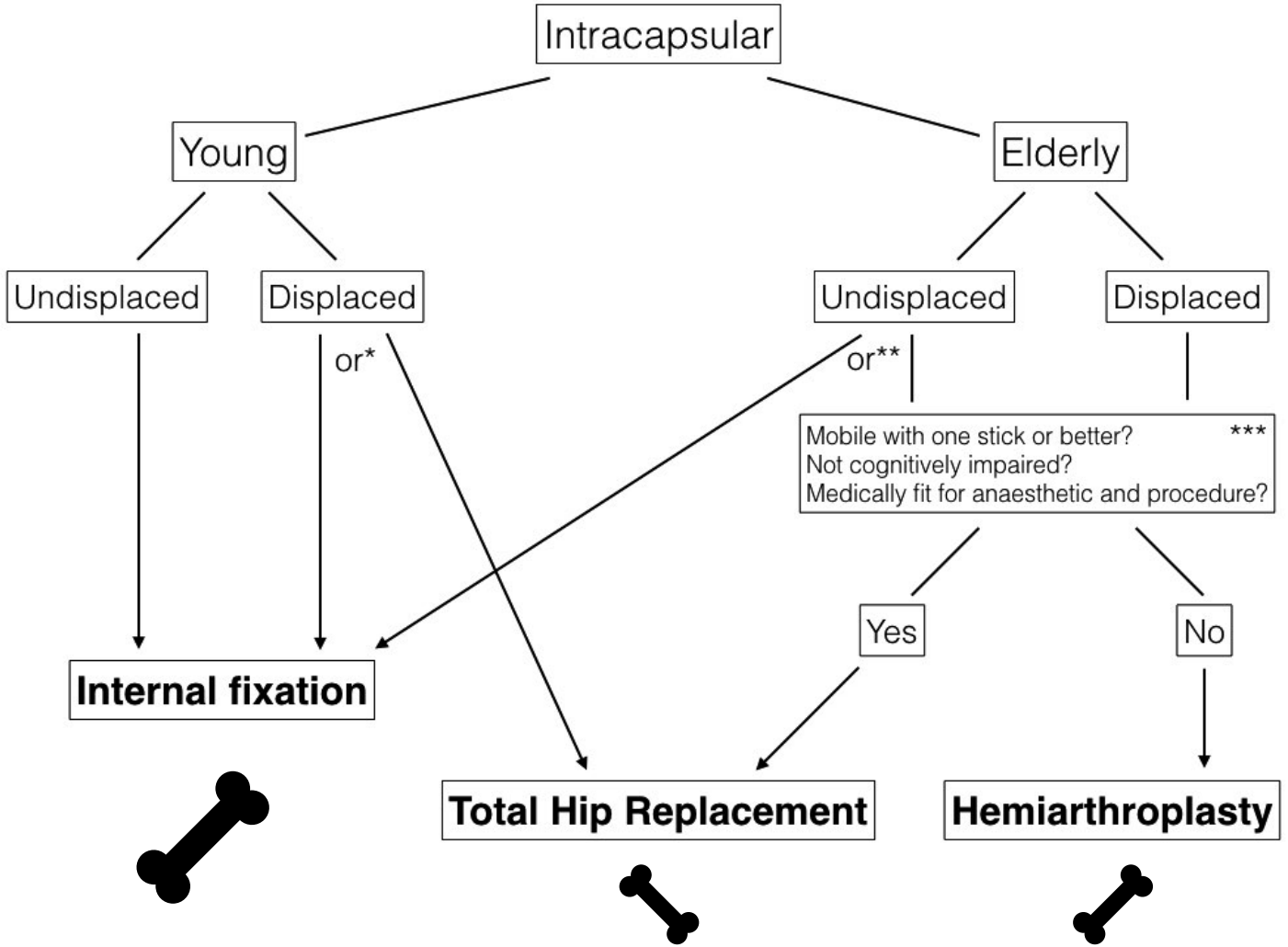


Image courtesy of Wikipedia via eMRCS

Cannulated screw (CS)

In some femoral neck fractures, the bones may not move apart and the blood supply remains intact. In this instance the Surgeon may recommend CS. Three screws are used to hold the bone together whilst it heals.

Image adapted from: *Your fractured hip explained: A patient and carer's guide*; Whittington Health NHS Trust (page 6). Accessed 30 Jul 2020: https://www.whittington.nhs.uk/document.ashx?id=3045

Total hip replacement

When the fracture involves both the head of the femur and the acetabulum, or if the joint is likely to be affected by osteoarthritis and wear-and –tear in the near future, a total hip replacement is considered. This operation requires careful consideration by the Surgeon due to the precautions in the post-operative phase.

Image adapted from: *Your fractured hip explained: A patient and carer's guide*; Whittington Health NHS Trust (page 5). Accessed 30 Jul 2020: https://www.whittington.nhs.uk/document.ashx?id=3045

Hemiarthroplasty (half joint replacement):

A fracture of the neck of femur bone can damage blood supply to the head of the femur (hip joint). If this blood supply is damaged the bone will not heal. This operation involves removing the head and neck section of the bone above the fracture and replacing it with a metal ball and stem which fits into the top end of the thigh bone.

Image adapted from: *Your fractured hip explained: A patient and carer's guide*; Whittington Health NHS Trust (page 4). Accessed 30 Jul 2020: https://www.whittington.nhs.uk/document.ashx?id=3045

Closed Fractures | The Hip

Extracapsular

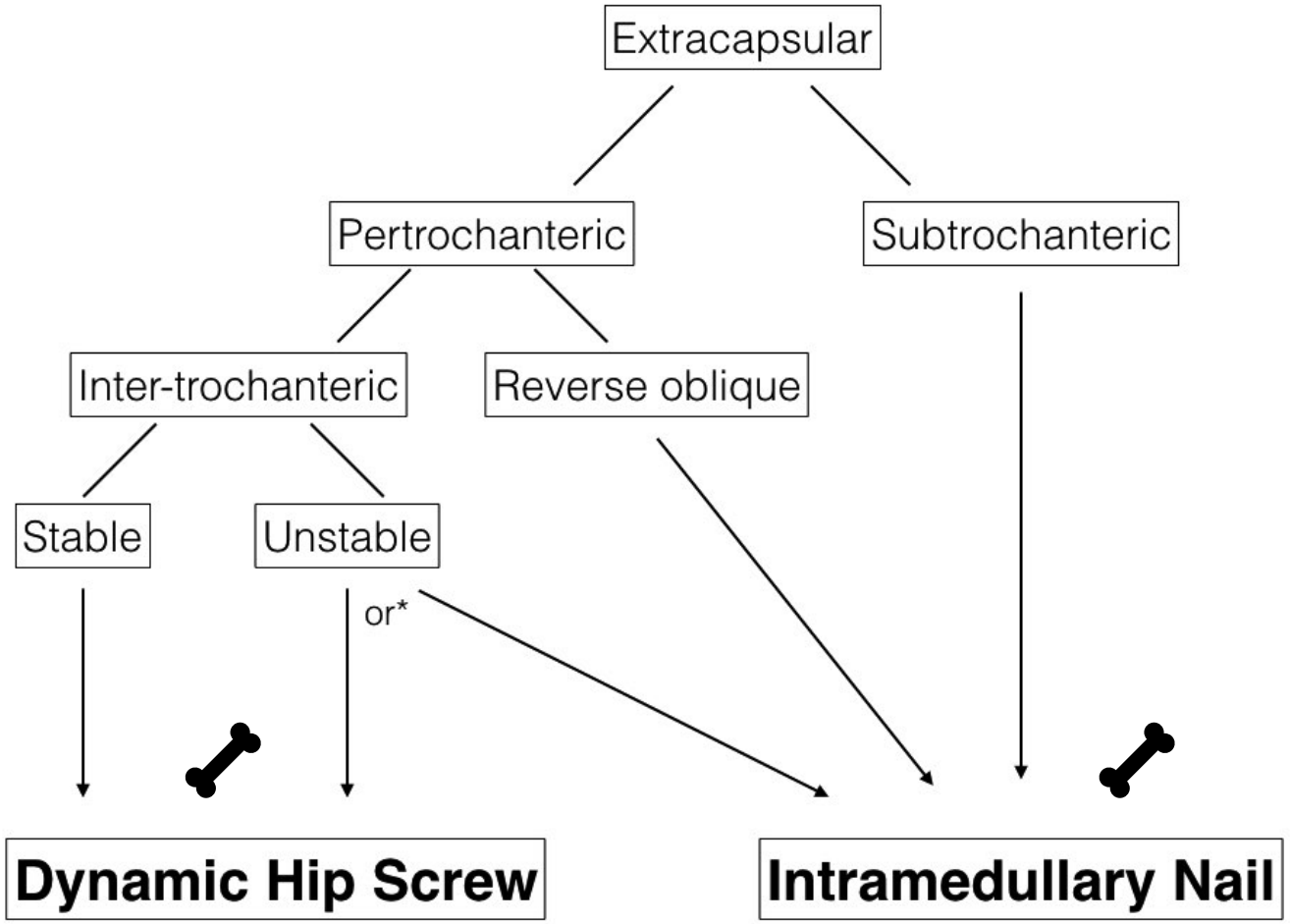


Image courtesy of Wikipedia via eMRCS

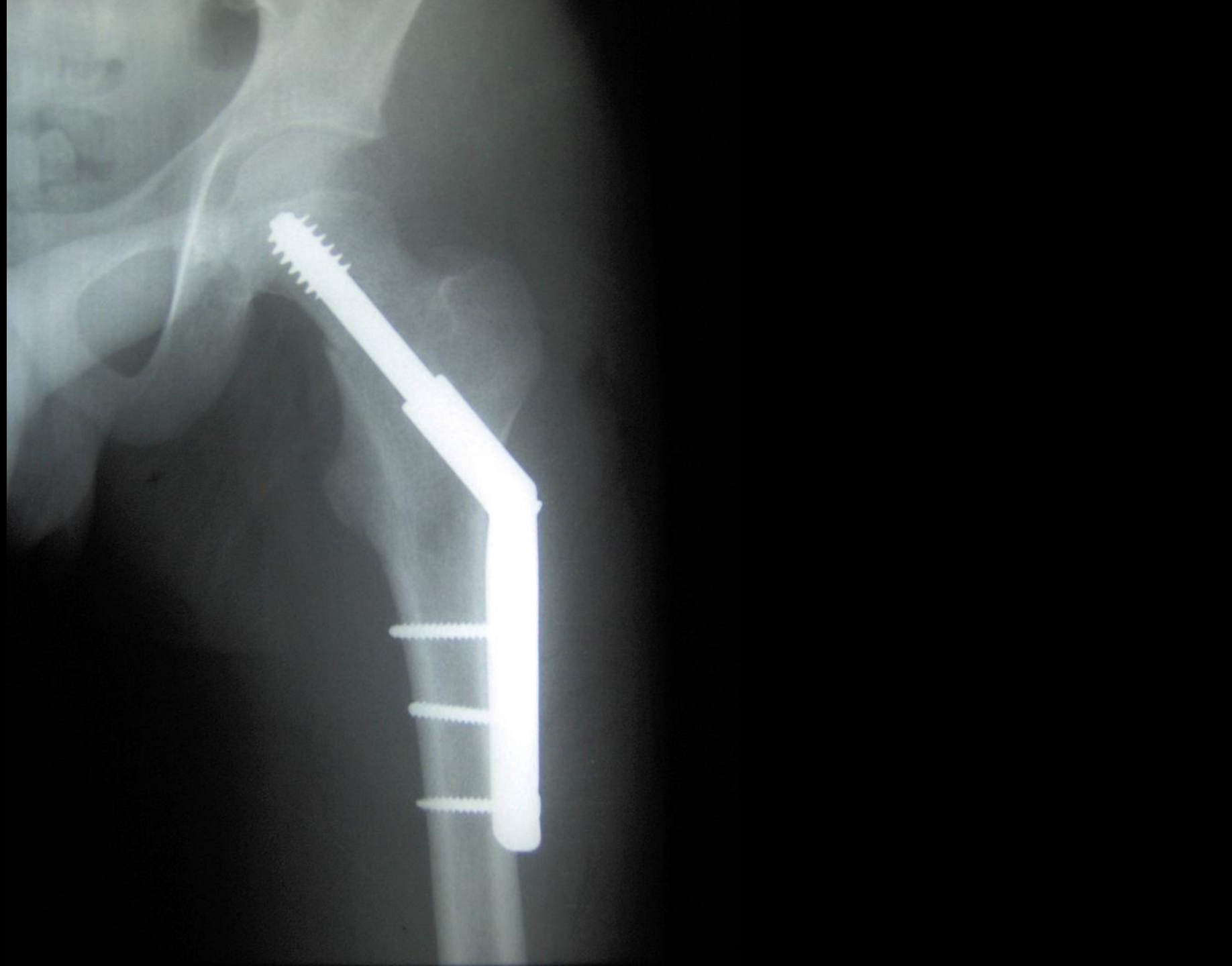


Image adapted from: *Dynamic Hip Screw*, Wikipedia. Accessed 29 Jul 2020: https://en.wikipedia.org/wiki/Dynamic_hip_screw#/media/File:Cdm_hip_implant_348.jpg

Intramedullary nail / Gamma nail

Fractures which extend down the femur need to be fixed with a metal rod passed down the middle of the bone.

Image adapted from: *Your fractured hip explained: A patient and carer's guide*; Whittington Health NHS Trust (page 6). Accessed 30 Jul 2020: https://www.whittington.nhs.uk/document.ashx?id=3045

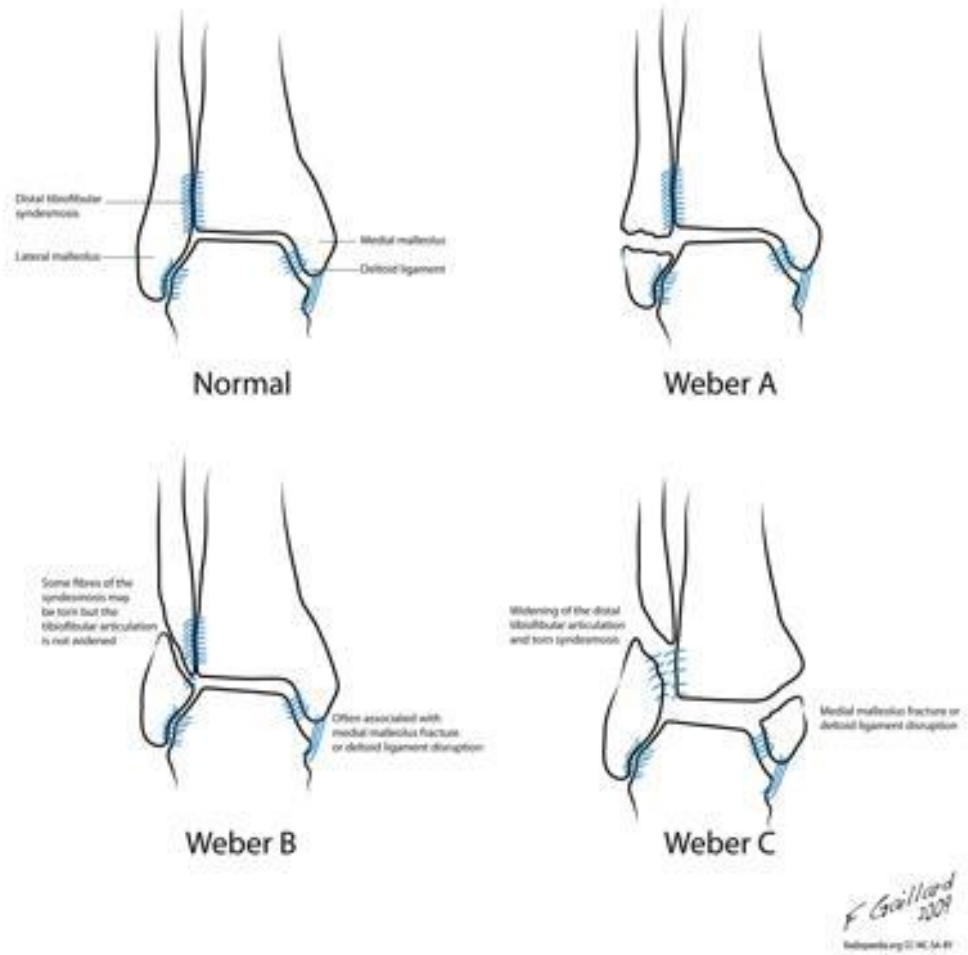
Closed Fractures | The Ankle

- Suspect if pain, swelling, inability to weight bear.
- If trauma call → **ATLS principles!**
- Assess neurovascular status and reduce any obvious deformity ASAP
- Radiographs:

- XR Ankle: AP, lateral and Mortise views (20° internal rotation)
- Danis-Weber or Lauge-Hansen classification

Lower Limb Fractures | The Ankle

Classification



Closed Fractures | The Ankle
Imaging

AP view

Lateral view

Mortise view (20° internal rotation)

Images courtesy of Dr Ayla Al Kabbani and Dr Louise Hartley et al., Radiopaedia.org.

Closed Fractures | The Ankle

- Treatment depends on stability of fracture.
- Usually carried out a week post injury to let soft tissue swelling reduce.
- **Weber A** = relatively stable so can mobilise in ankle boot.
- **Weber C** = **syndesmotic disruption** + **bimalleolar** so needs **ORIF.**
- **Weber B** = variable and relies on XR. If **trimalleolar** injury then **ORIF**. If unimalleolar injury then mobilise in ankle boot.
- Risks to consider – post-traumatic arthritis in young patients.

Monteggia’s Fracture

- Often in children, rare in adults
- Fracture of proximal 1/3 ulna with radial head dislocation

Monteggia’s Fracture

- Often in children, rare in adults

Monteggia's Fracture

- Often in children, rare in adults
- Fracture of proximal 1/3 ulna with radial head dislocation
- Trauma call → ATLS principles!
- Assess neurovascular status
- Associated with terrible triad of elbow
- Can be treated with closed reduction or ORIF

Galeazzi Fracture

- Often in children, rare in adults
- FOOSH + pronation
- Fracture of distal 1/3 radius with distal radioulnar joint injury (DRUJ)

Galeazzi Fracture

Galeazzi Fracture

- Children + adults
- FOOSH + pronation
- Fracture of distal 1/3 radius with distal radioulnar joint injury (DRUJ)
- Trauma call → ATLS principles!
- Assess neurovascular status
- ORIF only + DRUJ stabilisation

Compartment Syndrome!

- Always look out for this in closed fractures or post internal fixation.
- Raised pressure in closed anatomical space = >40mmHg
- Suspect if extreme, refractory pain on movement (inc. passive).
- Assess neurovascular status for compromise.
- Emergency theatre for fasciotomy.

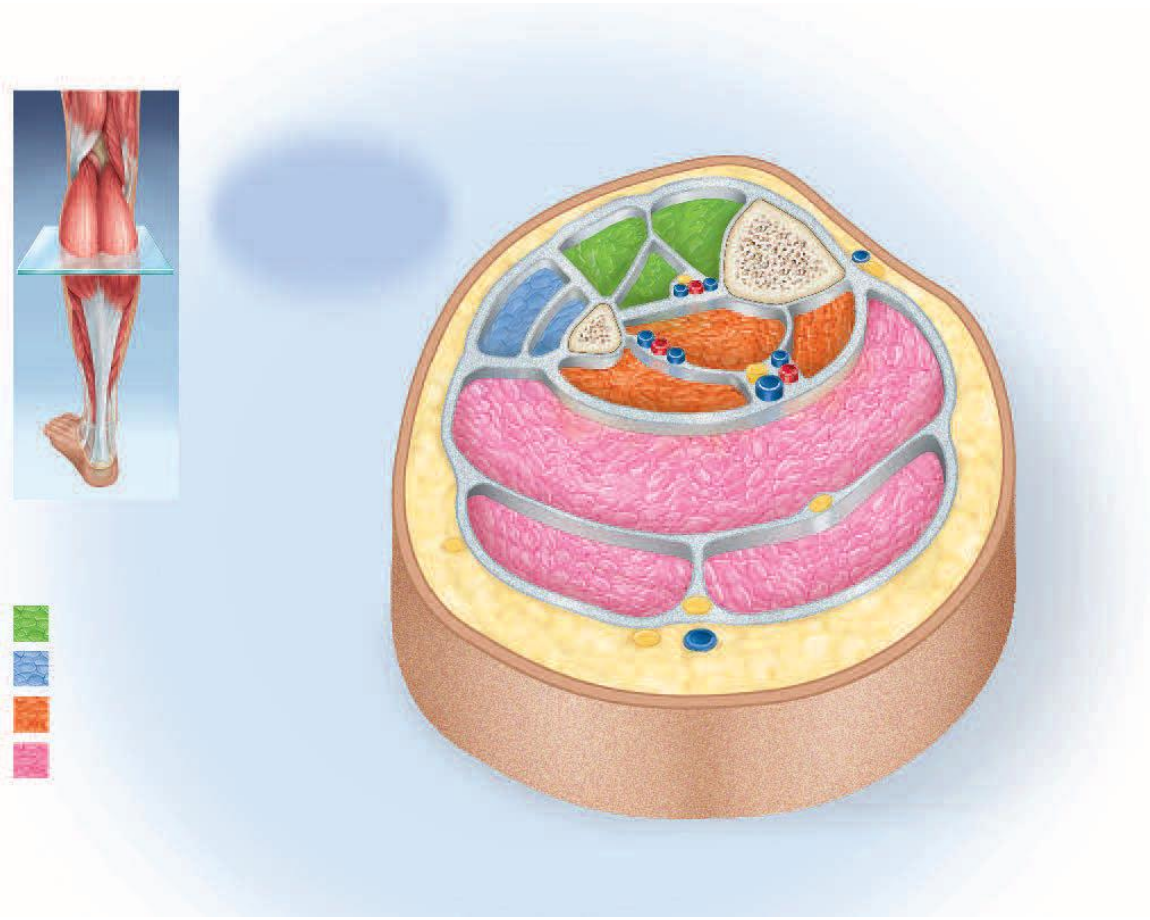


Image adapted from: Saladin: Anatomy & Physiology: The Unity of Form and Function, Fifth Edition; Chapter 10 The Muscular System (Page 350)

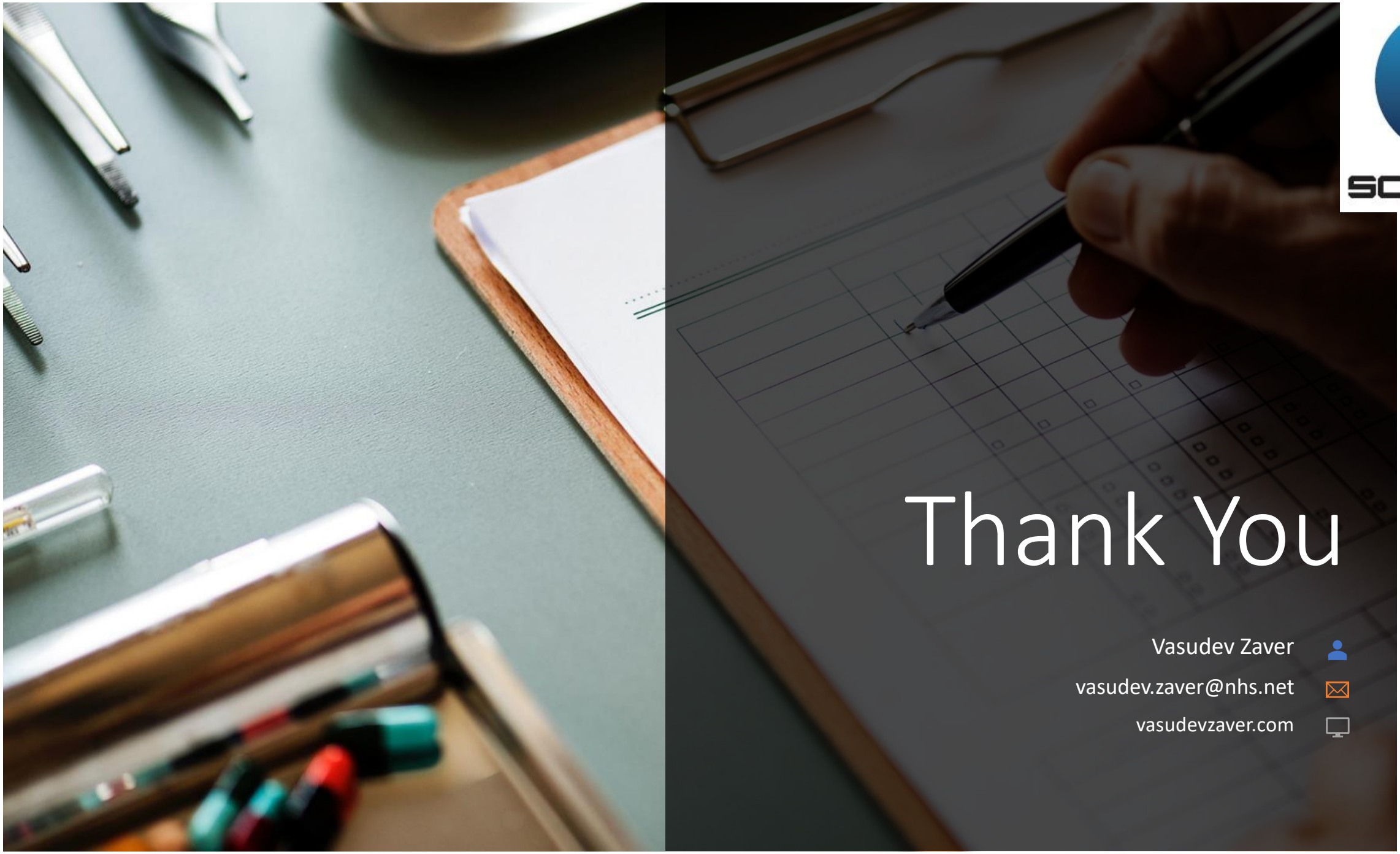
Long Term Follow Up & Complications

- 6-8 weeks follow-up in fracture clinic
- Longer term = ED
- Complications:

- AKI
- Infection
- Failure/malunion
- Recurrence/peri-prosthetic fracture

Summary & Key Principles

- Bone heals through primary or secondary process
- If trauma → **ATLS!**
- Scaphoid/distal radius fracture = conservative (immobilisation) if stable, surgical fixation if unstable (usually k-wire, sometimes ORIF)
- Intracapsular NOF = total/hemi/internal fix
- Extracapsular NOF = DHS/IM nail
- Ankle = depends on Weber classification but Weber A = conservative (moon boot) and Weber C = ORIF
- Beware of compartment syndrome → emergency fasciotomy



Thank You

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