39 Fractures

GENERAL

Generic answers for Ortho

Management

CARESF
- **C**lean, complications
- **A**nalgesia, ADT, ABx
- **R**educe, refer
- **E**levate, evaluate NV
- **S**plint, slav, stabilise
- **F**ast, fluids

Wound Managment
- Irrigate
- ***ADT***
- Antibiotics: ***ceftriaxone*** 2g or ***lincomycin***

Reasons for Admission
- NV compromise
- Inability to reduce
- # related: compound, multiple, unstable

Complications of Fracture

Early complications
- Pain
- Deformity
- Disability
- Nerves
- Vascular
- Skin/pressure necrosis
- Compartment syndrome
- Compound

Late complications
- Chronic pain
- Mal/non-union
- Osteoarthritis
- Joint instability
- Complex regional pain syndrome
- Reflex sympathetic dystrophy
- Ectopic ossification
- Osteomyelitis

UPPER LIMB

Clavicle

- Common
- Mechanism: direct or FOOSH
- Site: middle 1/3 most common
- Complications: local injury e.g. ***pleura, vessels*** (axillary, SC), brachial plexus, shoulder stiffness, lump
- Tx: analgesia, broad arm sling, early mobilisation at 2 wks
- OT: complete displacement, comminuted, outer 1/3

Scapula

- Uncommon, mechanism: high energy = 90% have other inj
- Site: blade or neck
- Tx: blade = same as clavicle, neck = surgery

Humerus

Proximal
- Elderly FOOSH
- Sites: anat neck, ***surg neck*** (most common), </> tuberosity
- Complications: brachial plexus, axillary n, axillary artery
- Mx depends on ***Neer classification***:

1 part | 2 part | 3 part | 4 part

1 part refers to no displacement 75% = conservative
2 parts = 1 part displaced > 1cm 20% = delayed OT
3 part = 2 parts displaced 5% = delayed OT
4 part = 3 parts displaced <1% = urgent OT

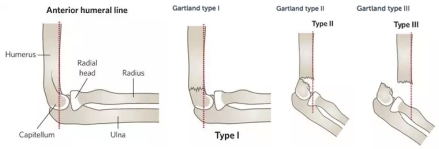
Shaft
- Usually pathological

Elbow

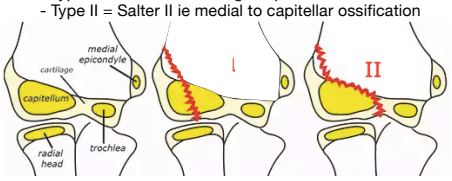
- Uncommon in adults, incl supra/condylar, radial head
- ***Post fat pad*** = supracondylar (kids), radial head (adults)

Radial Head
- Mechanism: FOOSH or direct lateral blow
- Complications: rare
- XR: post fat pad sign

Supracondylar
- most common # kids (hyper-ext during FOOSH)
- XR: post fat pad, ant sail sign
- Complications
  - 15% of all supracondylar
  - ***Median nerve*** most common
  - Volkmann's contracture (flex musc isch from brach art)
- ***Gartland classification***
  - based on ant humeral line (AHL)



Condylar
- 2nd most common # kids (lateral)
- Peak 6yo
- FOOSH with elbow bent
- ***Milch Classification***
  - Type I = Salter IV ie through capitellar ossification
  - Type II = Salter II ie medial to capitellar ossification



Terrible Triad Injury of Elbow
- ***elbow dislocation + radial head or neck # + coronoid #***
- mechanism: FOOSH (arm semi flexed & supinated)
- poor med-long term outcomes

Forearm

- Isolated shaft: radius or ulnar (night stick#)

Monteggia
- ulnar shaft # + radial head dislocation
- complications uncommon (post- io → ext forearm weak)

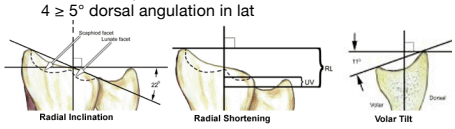
Galleazzi
- radial shaft # + distal radio-ulnar dislocation
- complications: ulnar styloid #, ulnar nerve palsy, ant IO branch of median nerve

Essex-Lopresti
- comminuted radial head + dislocated distal radioulnar jt

Wrist

- ***Colles***
- ***Smiths*** (reverse Colles)
- ***Bartons*** (Colles + intra articular extension)
- Styloid: Radial or Ulnar

Colles
- distal radial # with ***dorsal*** angulation, ↓ ulnar-carpal space
- complications: 50% ulnar styloid #, articular ext, median n
- ***Indications for reduction***
  - 1 ≥ 5° Δ in radial inclination (normally 22°)
  - 2 ≥ 5mm shortening
  - 3 ≥ 2mm step off
  - 4 ≥ 5° dorsal angulation in lat



Smiths
- Mechanism: Fall on flexed wrist
- Distal radial # with ***volar*** angulation
- Complications: articular ext (more common than colles)

Bartons & Reverse Barton's
- Intra articular extension of Colles/Smiths
- Carpal bone dislocation more common

Radial Styloid
- From direct blow
- Scapholunate injuries common (see below)

Wrist

See upper limb dislocations for more
- Scaphoid > Triquetral > Lunate
- Scaphoid & Lunate = AVN (Keinback disease)
- Often associated with dislocation (see later)
- Hamate best seen on oblique view
- Triquetrium best seen on lateral view (2nd most common #)

Scaphoid
- 30% dont show up on XR
- Additional views to AP & Lat incl ***Oblique & PA + ulnar dev***
- Site: 80% waist, 20% prox, 10% distal
- Surrogate signs: ***> 4mm gap btwn scapholunate***
  Absence of scaphoid fat pad
- Complications: ***AVN*** (prox portion)

Fingers

Bennett's
- Mechanism: forced thumb ABduction
- Base of 1st MC (intra-articular)
- ***Rolando*** = comminuted Bennett's

Gamekeepers Thumb
- Avulsion # from ulnar collateral @ MCPJ
- Sometimes just ligament without avulsion
- Mx thumb spike
- Grade 1 = pain on stressing = conservative
- Grade 2 = Pain & ↓ ROM = operative
- Grade 3 = Marked laxity = operative

Avulsion Finger Injuries

Name	Tendon	Jt
Boutonnieres[1]	extensor insertion	PIPJ
Mallet	extensor insertion	DIPJ
Jersey	flexor insertion	DIPJ

[1]Central slip

Metacarpal

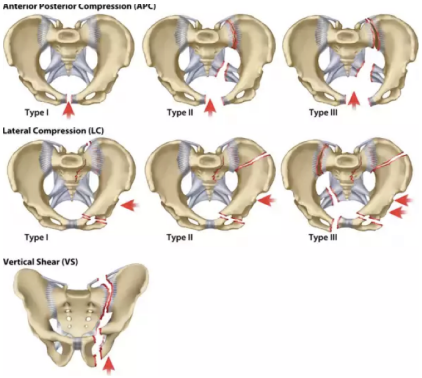
	Acceptable angulation	
Digit	**Shaft**	**Neck**
2,3	10-20	10-15
4	30	30-40
5	40	50-60

Tenosinovitis
Kanaval signs
- tendon sheath tenderness
- fusiform swelling ie sausage shaped
- flexed finger
- pain with massive movt

LOWER LIMB

Pelvic Bone

Young Classification
AP II, III & VS = high risk haemorrhage

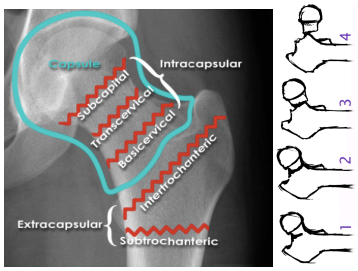


Femur

- ***Shenton's line*** = contour of sup ramus → fem head → fem neck = surrogate for fracture

Shaft
- High mechanism
- Complications: fem a&v, compound, ***fat embolism, ARDS***
- Winquist & Hansen classification (IM nail or open reduction)

Neck



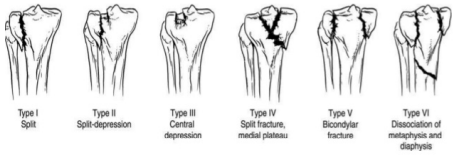
- intracapsular have ↑ risk AVN
- use ***garden classification***

Knee

- Supracondylar
- Condylar
- Patella
- Tibial Plateau
- ***Segond*** (tibial plateau avulsion)
- Skyline view useless in ED (subtle patella # but mostly patellofemoral compartment osteoarthritis

Tibial Plateau
- Mechanism: lateral force to WB knee
- Site: split (young), depress (old), lat > medial
- Complications
  - Ligament (10%)
  - Popliteal artery
  - Peroneal nerve
  - Compartment

Schatzker Classification



Segond (Avulsion of Tibial Plateau)
- Associated 75% ACL tear, 70% meniscal tear

Lower Leg

- Tibial shaft
- Fibular shaft
- ***Maisonneuve*** (prox fib + unstable ankle or medial mall #)
- Proximal 1/3 # from torsional indirect trauma
- ***Pilon/Plafond*** (distal tibia incl articular surface)
- ***Toddler's Fracture*** (distal 1/3 spiral #)
- Metaphyseal corner # (***bucket handle***, ***most spec for NAI***)

Tibial Shaft

- Direct mechanism
- most common long bone # & most common compound
- Complications: compartment ***(Deep > Ant > lat)***

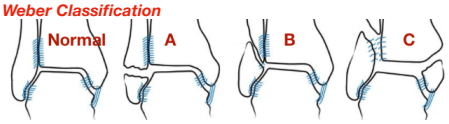
Ankle

Ottawa Ankle Rules

> 18yo, not pregnant

XR if: 1 Tenderness over post/distal 6cm tibia or fibula or
2 Unable to WB 4 steps

Weber Classification



Foot

- Talar
- Calcaneal
- Tarsals
- Lisfranc
- Metatarsal: shaft, head & neck
- Jones & Pseudojones (base of 5th MT)

Ottawa Foot Rules

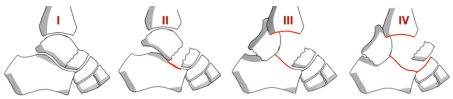
> 18yo, non-pregnant

XR if: Base of 5th tender or
Navicular tender or
Unable to WB 4 steps

Talar

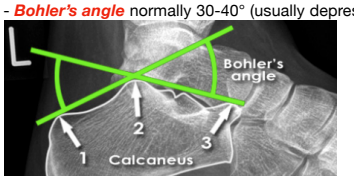
- Head: low risk AVN, due to plantar flexion with weight
- Neck: high risk AVN, due to hyperdorsiflexion
- Body: lateral more common in sports
- Hawkins classification (risk of AVN)

Grade	Dislocation	Risk of AVN
I	Non-displaced	0-13%
II	Subtalar	20-50%
III	Subtalar + Tibiotalar	20-100%
IV	Subtalar + Tibiotalar + Talonavicular	70-100%



Calcaneal

- 75% intra articular
- Associated other lower limb & 10% vertebral
- ***Bohler's angle*** normally 30-40° (usually depressed in #)



Tarsals

- Navicular most common mid foot #, VN rise
- Cuboid: part of Lisfranc, otherwise rare
- Cuneiform: rare++

Lisfranc

- LF jt = MT 1-3 → Cuneiform 1-3 + MT4-5 → cuboid
- Complications: unstable foot

Jones/Pseudojones

- Mechanism: adduction during plantar flexion
- Transverse # at level of metaphysis (~ 3cm)
- Jones = at level of 4/5 MT articular surface
- Pseudojones = distal to jones
- Avulsion = prox to jones
- ***Non-union*** common if missed

C-SPINE

1. Lines/Ligaments

- Ant vert line/ALL
- Post vert line/PLL
- Spinolaminar line/Ligamentum flavum
- Post spinal line/Supraspinous ligament

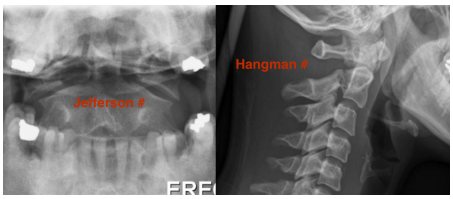
2. Prevertebral Soft Tissue

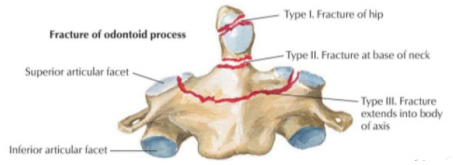
- ***≤ C4 = ≤ 1/3 body width***
- ***> C4= 100% body width***
- ***Thumbprint*** sign of epiglottis

Common Fracture Patterns

- Jefferson	C1	Axial loading
- Hangman	C2	Extension/distraction
- Odontoid fracture	C2	Flex or Ext
- Flexion Teardrop	C5/6*	Flexion
- Extension Teardrop	C2*	Extension
- Clay Shovelers	Any	Flexion
- ***Facet dislocation***	Any	Flexion/distraction
- Pillar	Any	Extension/rotation
- Uncinate	Any	?

**most common*





Jefferson

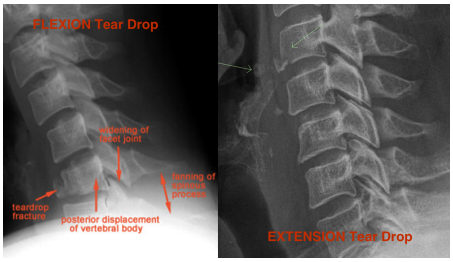
- C1 burst #: peg view best ***(> 6mm dens→lat mass)***
- Associated: 50% other c-spine injury, 33% C2#, ***vert artery***
- Tx mostly conservative unless transverse ligament involved

Hangman

- Bilateral ***C2 pedicle*** #
- Mechanism: forced hyperExtensions
- Associated: vert art if extends into transverse foramina

Odontoid

- From flexion (more common) or ext (eg fall on forehead)
- Type I & III conservative, Type 2a immobilise, 2b surgery

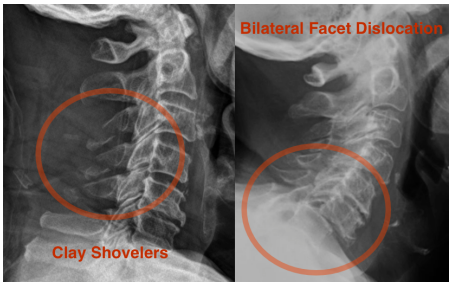


Flexion Tear Drop

- Causes ***ant cord syndrome***
- Worst prognosis of all c-spine #
- ***C5/6 most common***

Extension Tear Drop

- Differs from flexion as no vertebral body displacement
- Associated with hangman #, ***central cord syndrome***
- C2 most common
- In isolation is stable



Clay Shoveler's

- Often missed BUT conservative Mx
- Spinous process fracture from hyperflexion

Facet Dislocation

- Due to buckling force
- Flexion injury
- <25% anterolisthesis = ***unilateral facet dislocation***

XR vs CT

XR: < radiation, interpret in ED, 52% sens
CT: > radiation, time for report, 98% sens

Spinal Fractures

- Unstable if ≥ 2 columns or
> 25% compression (C3-7) or > 50% TL spine

FACE

Facial Fractures

Tripod

- ***most common*** facial fracture
- separation of zygoma
- # across 3 areas:
  - A. Zygomatico-frontal suture
  - B. Infra-orbital rim & floor
  - C. Zygomatic arch
- Complications
  - ocular muscle entrapment
  - ***infraorbital nerve*** entrapment

Blow out Fracture

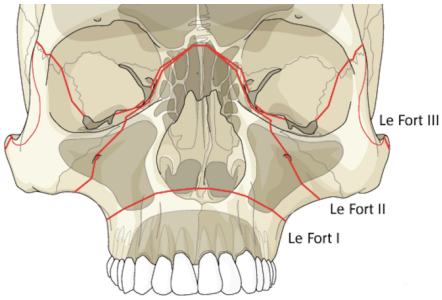
- Orbital floor fracture
- Complications
  - epistaxis
  - infraorbital nerve
  - ***retro orbital haematoma***

TMJ Dislocation

- Mandibular heads ***DL ant to*** articular surface
- Relocation is ***one side at a time, down & back***
- No yawning & small mouth opening/soft food 1wk

LeForte Fractures

- reduce if bleeding ++
- consider packing if intubated



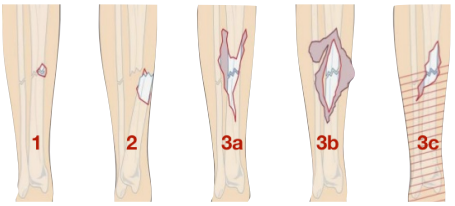
	Shape	Bones	Findings
I	Horizontal	M	Maloccl, mobile teeth
II	Pyramidal	M, IOR	Epistaxis, CSF leak
III	Transverse	M, OF, Z	Floating face
IV	+ frontal	M, OF, Z, F	Floating face

M maxilla; IOR inferior orbital rim; Z zygoma; frontal bone

COMPOUND

Gustilo Classification

Gr	Criteria
1	< 1cm
2	1-10cm + no extensive soft tissue damage, flaps
3a	Extensive + adequate coverage
3b	Extensive without adequate coverage
3c	Arterial repair needed



40 Dislocations

UPPER LIMB

Shoulder

- Y view helps differentiate

Anterior

- Most common
- XR: ant, medial, inf to glenoid fossa
- Mx: shoulder immobiliser 1 week
- Complications
    - Axillary nerve, axillary vessels (uncommon)
    - ***Hill-Sachs lesion*** boney or soft: post-lat head #
    - ***Bankart***: inf glenoid lip #
    - Recurrent DL 60%, younger > older
    - Traction neuropraxia (often transient)
    - Arthritis

Reduction techniques

Milch	Abduction, ext rotation, gentle traction ± push humeral head in with thumb
Spaso	Supine, lift arm vertically + traction → ext rotation + traction to humeral head
Modified Kochers	Traction on bent elbow, → ext rotate ± adduction → int rotation
Scapular Rotation	Prone, scapula tip pushed medial
Cunninghams	Sit upright, hold arm at 90°, ***massage deltoid***, bicep & back to deltoid
FARES	hand by side, ***oscillate*** up & down & abduct, at 90° ext rotate
Hippocratic	foot in axilla & pull arm parallel to body - high risk of NV damage
Stimpsons	***prone*** holding weight

Posterior

- Causes: electric shock, seizures, direct force (FOOSH)
- Ex: arm fixed in adduction/internal rotation
- XR: ***light bulb sign***, ↑ jt space
- Reduction: traction in 90° abduction

Inferior

- Ex: ***arm fixed in full abduction***
- Reduction: longitudinal traction in direction of arm ± cephalad pressure over humeral head

ACJ

- Ortho FU if ≥ Type 3 ***Rockwood Classification***

Type	XR AC	XR CC
I	Normal	Normal
II	Wide	<25%
III	Wider	25-100%
IV	Clavicle post	↑
V	Clavicle Sup	100-300%
VI	Clavicle inf	↓

AC Acromioclavicular; CC Coricoclavicular

Elbow

- Complications: brachial a, Ulnar/Median n, myositis ossif

Posterior

- FOOSH with arm extended
- Ex: shortened forearm held I flexion, prominent olecranon
- Reduction: axial traction & flexion ± thumb on olecranon

Anterior

- Rare, Mechanism: direct posterior blow

Pulled Elbow (Radial head subluxation)

- Age 1-3
- ***Reduction: supinate & extend elbow → flex elbow***

Radial Head Dislocation

- Usually anterior
- Diff to pulled elbow because doesn't reduce easily
- XR: ***radiocapitellar line*** (mid rad not through mid cap)
- Check for monteggia #

Wrist

Perilunate Dislocation

- ***Capitate*** dislocation (from lunate)
- Scapho-lunate preserved, ***rest of carpals not aligned***
- Complications: ***high risk median n palsy***, pressure necrosis, compartment syndrome

Lunate Dislocation

- Lunate dislocates ant: ***spilled tea cup and piece of pie***
- Complications: median n

Scapholunate Dissociation

- Torn scapholunate ligament = unstable
- XR shows "Terry Thomas" sign ie ***> 4mm*** or > 2mm with ulnar deviation
- Complications: SLAC wrist

Dorsal Intarcalated Segment Instability (DISI)

- Lunate rocked forward → capital sublimed
- Always pathological (vs VISI - sometimes normal)
- Due to radio-triquetral-scaphoid ligament

Phalanges

- Dorsal PIPJ common (volar uncommon)
- DIPJ usually open

LOWER LIMB

Hip

Complications

- sciatic nerve (10% of post) ie L5/S1 sens, Foot drop
- AVN > 6hr

Posterior

- More common
- Ex: shortened, adducted, int rotation (vs ext in #)

Reduction

1. Allis Manoeuvre: Traction on ASIS, Hip at 90° + traction, int/ext rotation to help, immobilise in slight abduction
2. Whistler Technique: flex both knees, put your arm under affected side & lever up
3. Captain Morgan: use your knee to lever up
4. Lateral traction-countertraction: Allis with lateral traction
5. Stimpson

Anterior

- Due to forced abduction
- Type I = sup/Type II = inf
- High risk of femoral artery & vein transection (esp Type I)

Knee

- Rare
- Complications: popliteal artery rupture (20%)
- Reduction: traction, splint 15° flexion

Patella

- Common, lateral
- Mechanism: ext + valgus/ext rotation
- Reduction: extend knee & pressure on patella margin

Ankle

- Associated with fractures
- Posterior: more common
- Ant: DP pulse lost
- Superior: uncommon

Foot

- Subtalar: uncommon, from fall from height
- Talar: rare, AVN high risk, closed reduction impossible
- Midtarsal
- Phalangeal

41 Testing Neurology

UPPER LIMB

Innervation

Root	Muscle	Action	Sensation
Axillary (C5)	Deltoid	Shoulder ABd	Deltoid
Musculocutaneous (C5-6)	Biceps	Elbow flex	Lat forearm

Nerve	Sign	Action
Median (IO)	OK Sign	Flex 1st IPJ + 2nd DIPJ
	Benediction sign	1/2/3 digit Flex
	Froments sign	Thumb adduction
Radial	Thumbs up sign	Thumb IPJ Ext
	Retropulsion thumb	Thumb CMCJ Ext
Ulna	Starfish	Interosseous
	Cross fingers	Interosseous
C5-8	Erb's Palsy	
L Thoracic	Winging scapula	

Reflexes

- Biceps C5,6
- Triceps C6,7
- Brachioradialis C5,6

FOOT

Innervation

Joint	Action	Root	Nerve
Hip	Flex	L1/2	Femoral
	Ext	L5/S1	Inf Gluteal
	ABd	L4/5	Femoral
	ADd	L2/3	Obturator
Knee	Flex	S1	Sciatic
	Ext	L3/4	Femoral
Ankle	Dorsiflex	L4	Peroneal: Deep
	Plantarflex	S1/2	Tibial
	Inv	L4	Peroneal: Deep
	Ev	L5/S1	Peroneal: Superficial
Hallux	Ext	L5	Peroneal: Deep

Reflexes

- Knee L3/4
- Ankle L5/S1
- Plantar S1

Foot drop

L5 compression vs Peroneal nerve

- Peroneal n: able to plantar flex & ***invert***
  dorsum numb = deep p = 1st web space
  normal ankle reflex
- L5 n root: unable to invert
  absent reflex
  numb area non-specific