

Management of Paediatric Skeletal Trauma- Full Clinical Paediatric Guideline – Derby only

Reference no.: CH CLIN G138

1. Introduction

Guideline for the management of Paediatric Skeletal Trauma in patients under the age of 18 under the care of the Children's Emergency Department.

2. Main body of Guidelines

A. GENERAL PRINCIPLES

- Remember to check and record the neurovascular status distal to any fracture/dislocation.

Choose analgesia appropriate to the injury. If the injury looks painful to you treat it accordingly Children have different responses to pain than adults and this often results in their pain being under-treated.

Options to consider are:

- Oral paracetamol, ibuprofen, oramorph
- Intranasal diamorphine
- Intravenous morphine titrated to response
- Digital nerve blocks
- Femoral nerve block (CED/ ED senior only)
- Splinting and Elevation

REMEMBER ALL ANALGESIA WEARS OFF, CONSIDER YOUR BACK UP PLAN – JUST GIVING IN DIAMORPHINE TO A CHILD WITH A BENDY ARM IS NOT ENOUGH. DO THEY NEED SPLINTING IN A CAST FOR COMFORT?

- Always examine the joint above and below any injury and if necessary X – ray these joints.
- **Remember to consider NAI in all children with fractures**, especially those less than 2 years of age. Mobility and developmental stage should be taken into account before you decide if the mechanism of injury is consistent with the fracture. If you have concerns seek senior ED/Paediatric advice.
- If there are any doubts about how to assess suspected #, diagnose or manage paediatric musculoskeletal injury speak to a senior ED doctor.
- Children under 2 years old usually require full lower limb POPs to avoid them coming off. If in doubt ask the ED nursing staff.

B. TIME CRITICAL CONDITIONS

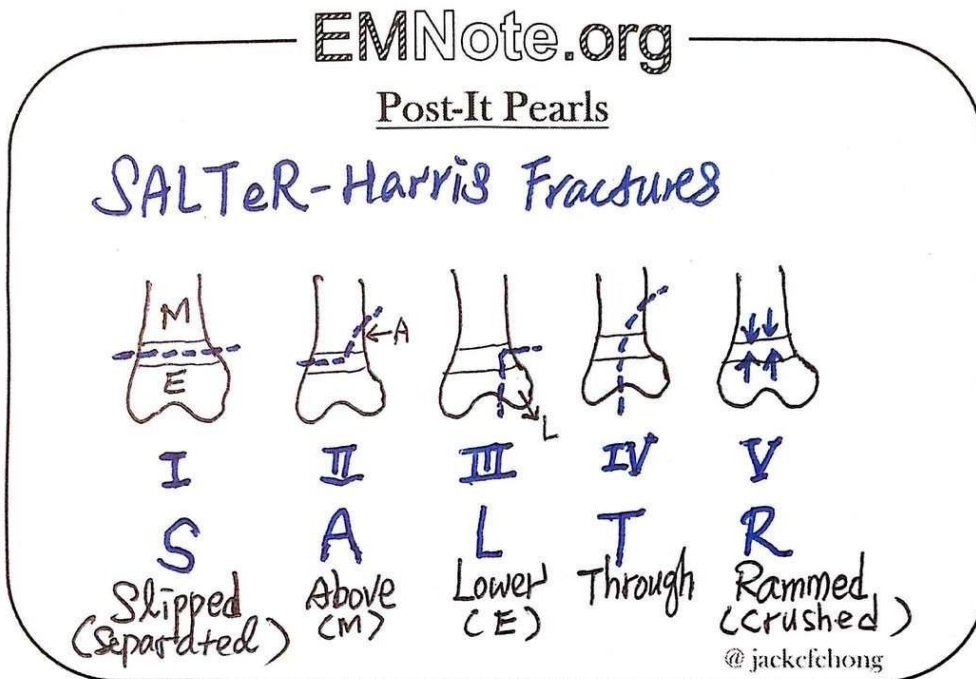
Some orthopaedic injuries must be recognised as time critical. Immediate attention to ABC and assessment of the following is required:

- Vascular compromise/lack of pulse / ischaemia of limb distal to injury (remember to document capillary refill time).
- Distal neurological deficit.
- Ischaemic skin tented over displaced or angulated fracture or a dislocated joint.
- Open fractures.

- Massive soft tissue damage.
- Dislocated joints (except fingers)

C. JUXTA-PHYSEAL FRACTURES

Salter Harris classification of juxta-physeal fractures



The Salter-Harris Classification is:

- Type I - fracture through the physis(growth plate)- possible widening of growth plate
- Type II - fracture partway through the physis extending up into metaphysis
- Type III -fracture partway through the physis extending down into the epiphysis
- Type IV -fracture through the metaphysis, physis, and epiphysis - can lead to angulation and deformities when healing.
- Type V - crush injury to the physis.

D. OPEN FRACTURES

Aim to reduce risk of infection.

- Appropriate analgesia.
- Take **photographs** with digital camera if possible.
- Apply a saline soaked gauze, and plaster slab if possible
- Start IV antibiotics for open fracture antibiotics. Please see link: [Adult Orthopaedic Surgical Antibioitc Porphyllaxis Guideline \(koha-ptfs.co.uk\)](#)
- Check tetanus status – refer to BNFC guidance.

E. UPPER LIMB FRACTURES

SHOULDER GIRDLE			
SITE	NOTES	TREATMENT	REFERRAL/FU
Sterno-clavicular dislocation	<ul style="list-style-type: none"> • Required significant force if posterior • May be associated with 	<ol style="list-style-type: none"> 1. Urgent CED senior advice 2. Analgesia 3. BAS if isolated injury 	Fracture clinic

	major injuries If anterior need a broad arm sling and FU		
Acromio-clavicular dislocation		1. Analgesia 2. BAS	Fracture clinic
Clavicular fracture	<ul style="list-style-type: none"> <12 years, uncomplicated fracture, middle third? See also CH Clin C40 for full clinical guideline 	1. No need for XR 2. Clavicle advice sheet 3. No FU	None
	<ul style="list-style-type: none"> >12 years and uncomplicated fracture 	1. XR 2. BAS 3. Analgesia	Fracture clinic
	<ul style="list-style-type: none"> Complicated: skin tenting, NV compromise 	1. Analgesia 2. Broad arm sling 3. Urgent senior CED or ortho input	Ortho SpR
Scapular fracture	<ul style="list-style-type: none"> Unusual injury requiring significant force – other injuries likely 	1. Analgesia 2. BAS if isolated	Ortho SpR
Anterior Shoulder Dislocation	<ul style="list-style-type: none"> Check axillary (loss of sensation over deltoid – regimental badge sign) 	1. Analgesia 2. Urgent CED senior review 3. Manipulation under sedation	Fracture clinic Ortho Spr if unable to reduce or unlikely to tolerate (eg high risk for sedation or deemed unlikely to succeed)
Posterior Shoulder Dislocation	<ul style="list-style-type: none"> Rare in children Easily missed Light bulb sign on XR 	1. Analgesia 2. BAS	Ortho reg and CED senior – consider Procedural sedation and reduction in CED
Shoulder dislocation with fracture		1. Analgesia 2. BAS	Ortho SpR for admission/ reduction
HUMERUS			
Fractured neck of humerus	<ul style="list-style-type: none"> Check axillary nerve function (loss of sensation over deltoid – regimental badge sign) 	Minimally displaced: 1. Analgesia 2. Collar and cuff	Fracture clinic
		Displaced Fracture Collar and cuff	ED senior
Fractured shaft of humerus	<ul style="list-style-type: none"> Check radial nerve function (wrist drop, sensation over back of hand) 	Minimally displaced: 1. Collar and cuff 2. Analgesia <i>May need U slab for comfort</i>	Fracture clinic
		Displaced fracture: May need manipulation and fixation	Ortho SpR

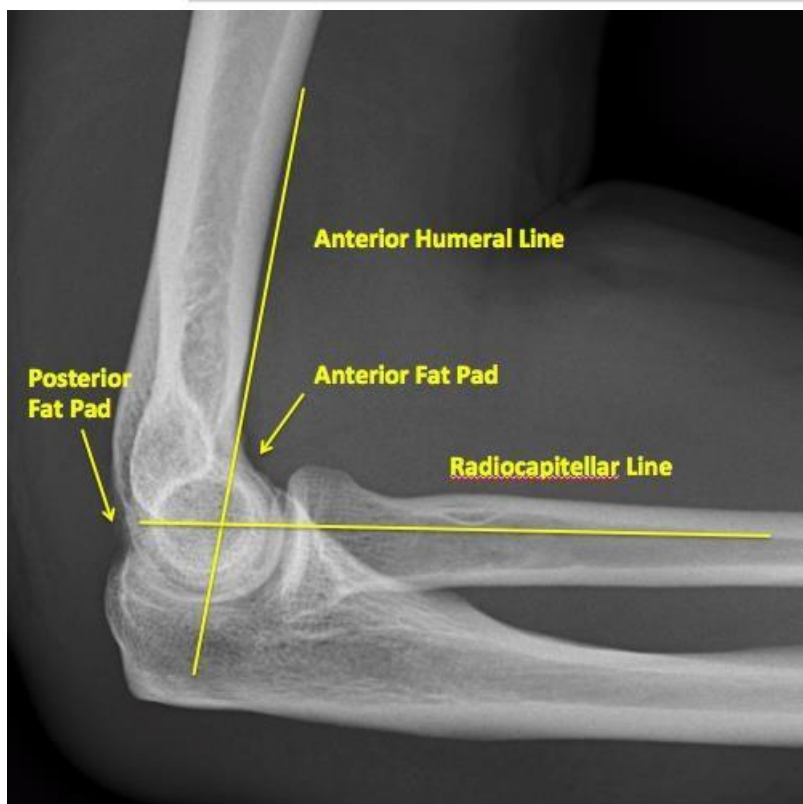
ELBOW INJURIES

Elbow Xrays are difficult to interpret in children due to ossification centre which appear at different ages, These appear as small pieces of bone and depending on age may be normal or represent AN ossification centre. **IF IN DOUBT ASK THE CED SENIOR**

Ossification centers



1	C	Capitulum
3	R	Radial Head
5	I	Internal Epicondyle
7	T	Trochlea
9	O	Olecranon
11	L	Lateral Epicondyle



ELBOW			
SITE	NOTES	TREATMENT	REFERRAL
Supracondylar fracture	<ul style="list-style-type: none"> • Check radial and ulnar and median nerve function (sensation thenar eminence) • High risk of NV damage if displaced 	Undisplaced fracture: 1. Analgesia 2. Above elbow backslab	Fracture clinic
		Displaced fracture: 1. Analgesia 2. Support and splint if required for pain relief	Ortho SpR
No fracture but obvious anterior and posterior fatpad	<ul style="list-style-type: none"> • Suspect occult bony injury • Anterior fat pad can be normal 	1. Analgesia 2. BAS	Obs ward for up 10/7
Lateral epicondyle	Check it isn't an ossification centre!	1. Analgesia 2. Collar and Cuff	Fracture clinic
Medial epicondyle	<ul style="list-style-type: none"> • Risk of ulnar nerve damage (loss of sensation ring and little finger) • Fragment can be displaced – LOOK for it 	1. Analgesia 2. Collar and Cuff	Ortho reg
Olecranon	Unusual	Undisplaced: 1. Analgesia 2. Above elbow backslab	Fracture clinic
		Displaced fractures: 1. Analgesia 2. BAS	Ortho reg
Radial head or neck		1. Analgesia 2. BAS	Ortho reg
Pulled Elbow	<ul style="list-style-type: none"> • Clear history of pull to arm • Does not need XR if clear history 	Manipulate (ask ENP!) observe till moving arm. If not then analgesia and obs ward review in 48 hrs	No FU

WRIST			
SITE	NOTES	TREATMENT	REFERRAL
Distal Radius	The following fractures can be managed in a Futura splint according to buckle fracture pathway full guideline at CH Clin C36: Dorsal buckle Minor buckle Dorsal green stick-volar cortex intact	Analgesia Futura Splint 3/52 No PE 5/52	Buckle fracture advice sheet
	Angulated/displaced fractures.	May be suitable for manip with procedural sedation in department discuss with CED senior/Ortho reg Analgesia Below elbow backslab	Ortho reg
	Undisplaced greenstick fractures involving both cortices	Below elbow backslab	Fracture clinic
Scaphoid injuries	Rare in under 10 yrs Assess for compression test, and scaphoid tubercle pain Request full scaphoid series	Normal X-ray (but clinical suspicion): Analgesia Futura splint with Thumb extension	>10 year Hand clinic FU <10 year discharge with sprain advice.
		Positive XR: Scaphoid cast	Hand clinic FU
Other carpal bones	Unusual injuries	Avulsion or any fracture: Futura splint	Hand clinic FU
Carpal dislocation	Wrist will usually be very swollen VVV rare in children High index of suspicion required Assess median nerve.	Analgesia Senior ED input may need urgent reduction if median nerve entrapment Below elbow backslab	Hand Fellow

HAND – always state which is dominant hand			
SITE	NOTES	TREATMENT	REFERRAL
Thumb metacarpophalangeal joint dislocation	Closed reduction can fail due to button holing of the MCP head in the capsule	Attempt closed reduction – key is good analgesia and slow traction.	Hand fellow if cant reduce Hand clinic for FU
Thumb metacarpal head	At risk of gamekeepers thumb – check for ulnar collateral ligament laxity	Analgesia Minimally displaced fracture or ulnar collateral ligament laxity – futura with thumb extension	Hand clinic FU
		Analgesia Displaced fracture	Refer Hand fellow for manipulation
Thumb – metacarpal base	Look for fracture dislocation at Carpo-metacarpal joint (Bennett's)	Analgesia Attempt reduction with CED senior (if not fracture) If reduced – plaster thumb spica	Hand clinic if reduced, hand fellow if not reduced or fracture dislocation.
Other metacarpal neck fractures And Other Metacarpal base fractures	Always assess for rotational deformity and <i>explicitly</i> state if present or not. Assess for extension lag. Remember hand oedema is very bad for the tendons and compartment syndrome can occur. Consider a fight injury may be an open fracture and damage to the extensor tendon is a possibility – also consider it is a human bite, easily involves the joint and there may be tooth fragments left behind.	Minimal displaced fracture/ buckle Analgesia Ulnar gutter slab	Hand clinic
		Rotational deformity or significant displacement. Likely need open reduction and internal fixation	Hand fellow
		Multiple metacarpal fractures At risk of compartment syndrome High arm sling Discuss further management with hand fellow	Hand fellow
Proximal and middle phalanges	Always assess for: Rotational deformity Extension lag FDS and FDP function and DOCUMENT. Even a small flake	Minimally displaced fractures : Neighbourstrap HAS	Hand clinic FU
		Displaced fractures – discuss with ED senior re manipulating with	Hand clinic FU

	can be significant on XR and a sign of a volar plate injury – DW CED senior if unsure	local block and Entonox. Neighbourstrap HAS	
Fingertip injuries	<p>Even the most awful looking injuries have really good results under the hand team Consider if a nail bed repair is needed</p> <p>Isolated Pulp lacerations do not need closure these heal well – consider steri strips and no FU</p>	Refer to hand fellow	

LOWER LIMB INJURIES

FEMUR			
SITE	NOTES	MANAGEMENT	FOLLOW UP
Slipped Upper Femoral Epiphysis (SUFE)	Can present with isolated knee pain in classic age group (10-17) 50% of adolescents are >95 th Centile in weight. Always XR both hips (bilateral in 18-50%)	Analgesia Admit Refer Ortho	Ortho SpR
Femoral shaft	See separate clinical guideline CH Clin C45 – Femoral fracture management guideline.	Consider other injuries dependent on mechanism. Check distal neurovascular status Prompt analgesia is key – IN diamorphine, followed by Femoral Nerve block often prior to XR if clinically obvious DW CED senior urgently re splint	Ortho SpR
Femoral condyle and femoral supracondylar fracture	If displaced at high risk of NV problems.	Analgesia Consider long length backslab for comfort	Ortho SpR

**XR interpretation in SUFE**

- Klein's lines
- A line drawn tangential to the superior aspect of the femoral neck should intersect the epiphysis on the AP view. If it doesn't it's a slip.

KNEE			
Hints: Lipohaemarthrosis implies a fracture and is indicated by immediate swelling Locking is suggestive of meniscal tear or loose body Giving way – suggestive of ligamentous/ meniscal tear or patellar instability Always assess the joint above and below (referred pain) If NWB despite normal XR bring back for obs ward review 10 days. Consider hip XR to rule out possible SUFE			
Site	Notes	Treatment	Referral
Patellar fractures	Can they SLR? (patellar tendon integrity)	If small avulsion: Analgesia Thackery Splint Crutches If large – refer Ortho	Fracture clinic
Patellar dislocation	Usually dislocates laterally Usually easily reducible with entonox if not spontaneously reduced pre CED	Analgesia Reduce Thackery splint	Fracture clinic
Tibial spine fractures	Associated with significant swelling Lipohaemarthrosis on XR Cruciate ligament tears	Analgesia Thackery	Ortho Reg
Meniscal Injuries	Common footballing injury – knee flexed and twisted whilst falling	Analgesia Thackery if can get knee fully extended Ortho reg if locked	Ortho reg
Osgood Schlatter's	Traction apophysitis of proximal tibia Clinical diagnosis – Do not need XR	Analgesia RICE Cut back of sport till settling Advice sheet	GP follow up

Lipohemarthrosis

Blood and fat do not mix, with the fat (radiolucent) layering on top of the blood (radiodense)



XR appearance of
Lipohaemarthrosis

LOWER LEG			
SITE	NOTES	TREATMENT	REFERRAL
Tibial Shaft	High risk of compartment syndrome – consider admission for monitoring and elevation	Minor Buckles – above knee backslab (consider doing in flexion if young child to avoid POP falling off)	Fracture clinic
		Undisplaced fracture Analgesia Above knee backslab	Fracture clinic
		Displaced fracture Analgesia Above knee backslab Admit for compartment syndrome obs	Ortho reg
Toddler Fracture (fracture lower third of tibial shaft)	Often with minor trauma eg slip or trip May not recall the trauma Initial XR may be normal – high index of suspicion. If NWB and pain on tibial torsion even if normal XR suspect #	Normal XR but NWB DW family re risk benefit of plaster vs no plaster. Allow parents to decide	Obs ward review 10-14 days for rpt XR
		Abnormal XR – Above knee back slab (in flexion) or Scotchcast if able	Fracture clinic
Fibular fractures	Proximal injuries are associated with ankle injury (Maisonneuve fracture) Look for ankle diastasis (separation of the tibia and fibula at ankle) Check for common peroneal nerve injury (foot drop)	Distal injury – below knee backslab Proximal injury – above knee backslab If diastasis or peroneal nerve injury urgent Ortho review.	Fracture clinic

ANKLE**Ottawa Imaging rule to determine if need an XR****Apply to:**

School age children - as need to have been able to walk prior to their injury and localise pain effectively with verbal communication.

What is it?:

Ankle XR needed if:

Pain near malleoli (see diagram) **AND**

Inability to WB immediately and in the ED (limping is STILL WB!) **OR**

Tenderness at posterior edge or tip of lateral malleolus **OR**

Tenderness at posterior edge or tip of medial malleolus.

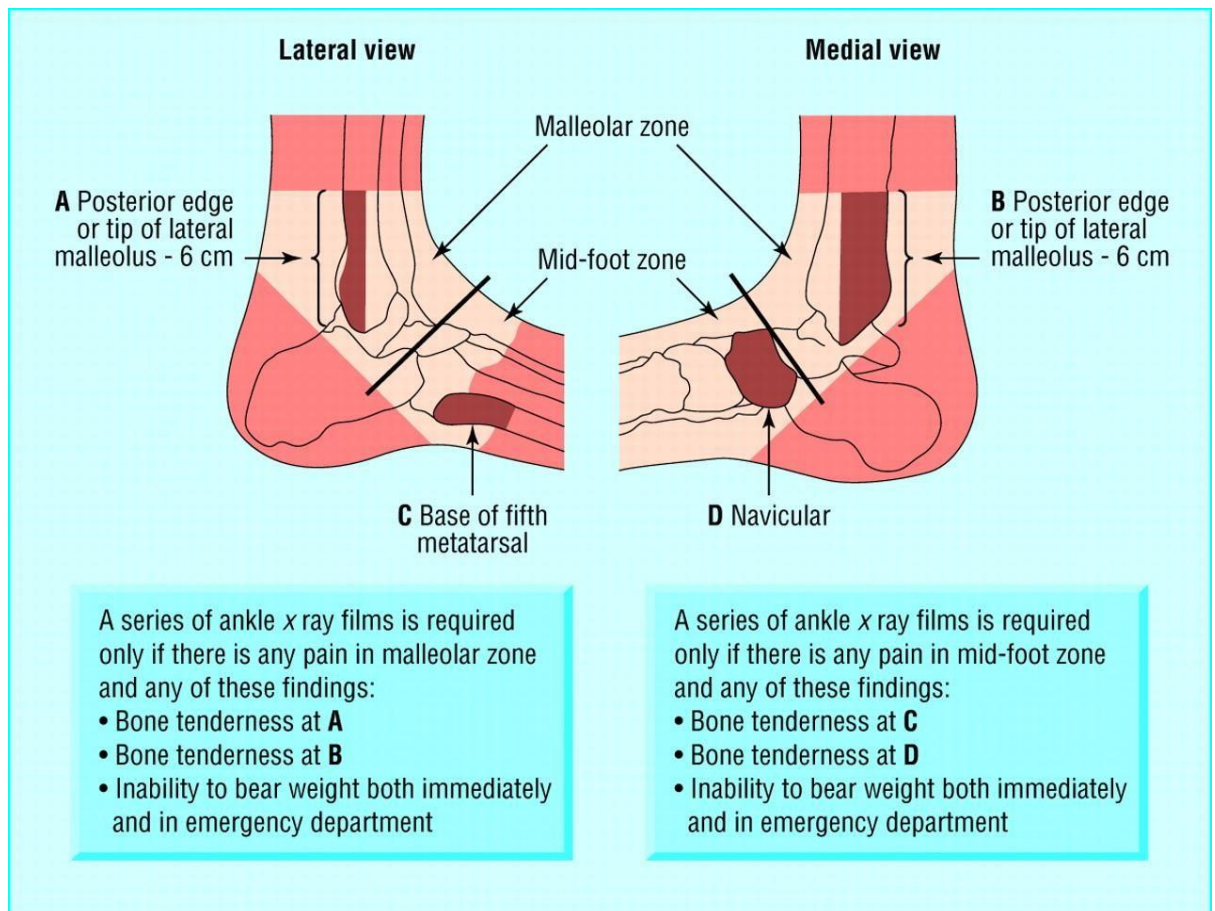
Foot XR needed if:

Pain in the midfoot **AND**

Inability to WB immediately and in the ED (limping is STILL WB!) **OR**

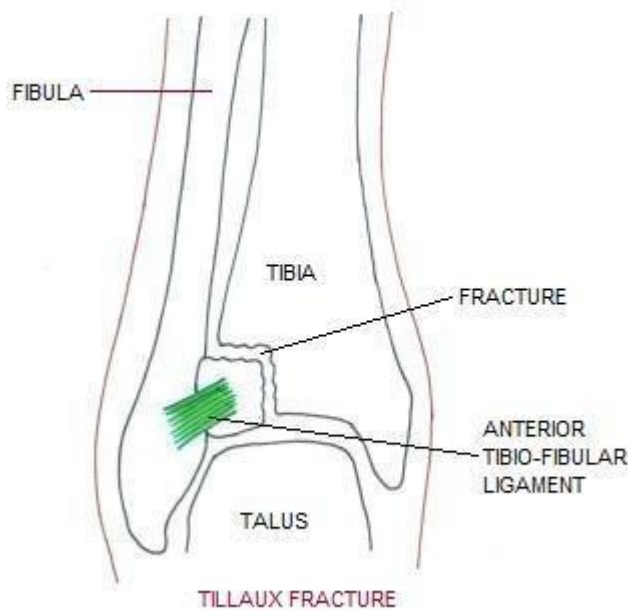
Tenderness at the navicular

Tenderness at the base of the 5th Metatarsal



ANKLE			
SITE	NOTES	TREATMENT	REFERRAL
Ankle sprain	Aim to mobilise early	Analgesia RICE advice	Discharge If they really wont

		Ankle advice sheet	WB bring back to obs ward 10-
Lateral malleolus avulsion fracture		Analgesia Equaliser Boot	Fracture clinic
Malleolar fractures	<p>Look for talar shift</p> <p>Tillaux fracture – avulsion of anterolateral epiphysis of lower end of tibia by the tibio fibular ligaments.</p> <p>Triplane fracture – caused by twisting injuries in adolescents.</p>	<p>Undisplaced fracture</p> <p>Analgesia</p> <p>Below knee backslab</p> <p>Crutches</p>	Fracture clinic
		<p>Displaced fracture</p> <p>Look for NV compromise</p>	Ortho reg



FOOT			
SITE	NOTES	TREATMENT	REFERRAL
Calcaneal fractures	<p>Rare (and painful –they won't be WB)</p> <p>Usually a fall from a height</p>	<p>Analgesia</p> <p>Below knee Backlab (BKBS)</p> <p>Crutches</p>	Fracture clinic

	Check for associated hip, knee and spinal injury Request specific calcaneal views	If displaced or intra-articular for urgent referral to Ortho reg	
1 st Metatarsal fracture		Buckle fracture – equaliser boot	Fracture clinic
		Undisplaced or displaced fracture for BKBS	Fracture clinic
Other Metatarsals	Look for intermetatarsal joint disruption – Lisfranc’s fracture A crush injury eg car driving over foot may not cause fracture but can cause compartment syndrome – elevation and analgesia is key	Buckle fracture – equaliser boot If they have greenstick fractures and they are walking they may not need any treatment	Fracture clinic
		Minimally displaced fracture Equaliser	Fracture clinic
		Displaced or multiple fractures – analgesia and elevation	Ortho reg
Phalanges	Only XR if suspect there is MTPJ involvement/ rotational deformity or IP joint dislocation	Neighbour strap Reduction if appropriate	No FU 3 weeks off PE

Proximal 5th MT fractures

3 types - see Fig 1:

Avulsion fracture – pink area

Acute Jones fracture – green area

Stress fracture – blue area

Differentiated by their position in relation to the 4/5th MT articulation at the green region

Management of each one is different, hence the importance of determining the type of fracture, with a high incidence of mal-union and non-healing in the acute Jones and stress fractures.

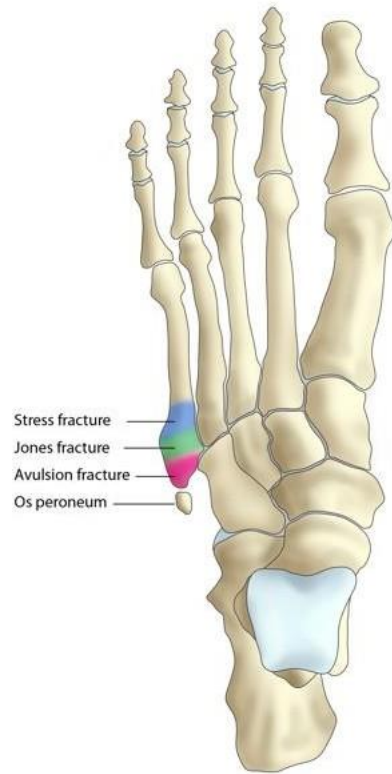






Fig 1

F. Gaillard 2009
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	Avulsion (tuberosity) fracture	Acute (Jones) fracture	Stress fracture
Mechanism	<p>Foot and ankle are in plantar flexion and forced inversion – attachment of peroneus brevis.</p> <p>Children 5 years or Younger:</p> <ul style="list-style-type: none"> • More likely (>50% of cases) to be injured by fall from height. [Singer, 2008] 	<p>Foot and ankle are in plantar flexion with lateral force eg. Football</p>	<p>Overuse – pain for days to weeks in younger patients and athletes</p>

	<ul style="list-style-type: none"> • More likely to fracture 1st metatarsal! <p>Children older than 5 years of age:</p> <ul style="list-style-type: none"> • More likely (> 50% of cases) to be injured by “fall” from standing. [Singer, 2008] • Greater likelihood of being related to sport activities. [Singer, 2008] • More likely to fracture 5th metatarsal! 		
Examination findings	<p>Physical examination reveals tenderness at the base of the fifth metatarsal, often with bruising and swelling at the site.</p> <p>Full evaluation of the distal fibula and lateral ligamentous structures must be included in the assessment</p>	As for avulsion fracture	Pain at the base of the fifth metatarsal and may have bruising and swelling at the site
Site of fracture	Proximal to the 4/5 th MT articulation, and is perpendicular to the shaft of the 5 th MT	Fracture at the metaphyseo-diaphyseal junction at the 4/5 th MT articulation (or within 1.5cm of the tuberosity (lateral aspect of the 5 th MT). Jones first described his own fracture as within 0.75cm from the base of	Distal to the 4/5 th articulation

			
<p>Differential</p>	<p>Secondary ossification center (apophysis) seen as a fleck of calcification parallel to the shaft, seen in 9 -11 year old girls and 11-14 year old boys</p> <p>When 2nd, 3rd, or 4th metatarsals are fractured, they are frequently associated with another metatarsal fracture, while 1st and 5th metatarsal fractures can be isolated. [<i>Singer, 2008</i>]</p>		

			
Complications	None	High incidence of non-union	High incidence of non-union
Management	<p>Conservative – low profile Ortho walking boot with weight bearing as tolerated for 4 weeks, or until symptoms abate (3-6/52)</p> <p>Refer displaced or comminuted fractures to fracture clinic</p>	Displacement of the fracture can be increased with persistent weight bearing - non-weight bearing cast for 6-8 weeks.	Walking boot and fracture clinic follow-up
Follow up	None if non-displaced	Paediatric fracture clinic	Paediatric fracture clinic

3. References (including any links to NICE Guidance etc.)

<http://www.bmj.com/content/bmj/326/7386/417/F1.large.jpg>

Skeletal trauma guideline – C Dieppe (2017). Nottingham University Hospitals NHS trust

References:

Singer G1, Cichocki M, Schalamon J, Eberl R, Höllwarth ME. A study of metatarsal fractures in children. J Bone Joint Surg Am. 2008 Apr;90(4):772-6

<https://dontforgetthebubbles.com/foot-x-rays/>

EM in 5: 5th Metatarsal Fractures - <https://youtu.be/4k1dvPdpW4E>

4. Documentation Controls

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	1.1.0	Jun 2020	Dr G Robinson	Review in consultation with Paediatric CED Consultants, Miss Arrowsmith & Mr Tafazal
	2	Nov 2023		
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Development of Guideline: Dr G Robinson Job Title: Consultant Paediatrician				
In Consultation with: (Relevant peer review) Mr S Tafazal, Trauma and Orthopaedic Surgeon				
Linked Documents: State the name(s) of any other relevant documents				
Keywords: Skeletal Trauma				
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Contact for Review			Dr G Robinson	