

JOHNS HOPKINS ALL CHILDREN'S HOSPITAL

# Care of Extremity Fractures Clinical Pathway

Johns Hopkins All Children's Hospital

# Care of Extremity Fractures

## Clinical Pathway

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Owners: Orthopedics

*This pathway is intended as a guide for physicians, physician assistants, nurse practitioners and other healthcare providers. It should be adapted to the care of specific patient based on the patient's individualized circumstances and the practitioner's professional judgment.*

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# Care of Extremity Fractures Clinical Pathway

## Rationale

This clinical pathway was developed by a consensus group of JHACH physicians, advanced practice providers, and nurses to standardize the management of children with extremity fractures. Fracture in children is a common injury and understanding what x-rays to order coupled with comprehensive assessment for nerve and vascular injury is imperative to ensure correct treatment and best long term outcome for the patient.

This clinical guideline will:

1. Define the major orthopedic injuries that will be seen in trauma patients.
2. Provide a list of some radiographic studies that may be used to define specific injuries.
3. Enumerate immobilization and reduction techniques that can be applied in the trauma room until definitive treatment can be undertaken.
4. Provide a list of potential definitive orthopedic procedures that will be considered for each injury.

## Background

Extremity fractures are a very common occurrence in children. Although complications are rare, it is imperative that children undergo a comprehensive assessment to determine if there are other unseen injuries and to determine the extent of the injured extremity. Neurovascular complication can be a devastating complication of extremity fractures.

## Diagnosis

Diagnosis of extremity injuries will be based on clinical presentation and diagnostic testing.

Radiologic studies: X-rays, CT scans, MRI

Diagnostics

1. Image affected limb – 2 orthogonal views (AP and lateral)
2. Consider imaging joints above and below the injury site
3. Consult orthopedics of abnormality noted on imaging or concern for compartment syndrome.
4. Consider CTA, angiogram, and/or trauma consult if vascular injury suspected

## Clinical Management

Interventions:

1. Remove jewelry and/or constrictive clothing as soon as possible.

2. RICE – rest, ice, compression, elevation.
3. Dress open wounds – give Td as indicated.
4. Splint injured site to prevent further injury or allow patient to hold extremity in position of comfort
5. Reevaluate neurovascular status after interventions provided to injured part.

**Emergency Center Management**

Assessment

- Obtain time and mechanism of injury and any associated injuries.
- Note obvious swelling, deformity, tissue integrity, dislocation, or inability to bear weight or move affected extremity. Compare to uninjured extremity.
- Assess the five P’s of compartment syndrome (see guideline); document quality and severity pain.

- Pain**
- Pulses**
- Paresthesia**
- Paralysis**
- Pallor**

- Assess potential for compartment syndrome.
  - Taut, firm extremity
  - Pain unrelieved by narcotics
  - Extreme pain elicited by passive stretch
  - Paresthesia
  - Anxiety
  - Agitation
- Determine past history, including previous fracture or injury; if female – possible pregnancy status; tetanus immunization status; last meal; etc.
- Document treatment PTA – self-treatment, at outlying facility, or pre-hospital personnel.

**HAND:**

<b>INJURY</b>	<b>X-RAYS</b>	<b>REDUCTION IMMOBILIZATION</b>	<b>TREATMENT</b>
<b>DIP or PIP dislocation</b>	AP/Lat finger	Dorsal splint in extension, or Buddy tape	Closed reduction
Metacarpal fracture	AP/Lat hand	Dorsal-volar splint	Closed reduction, wires

**ARM:**

<b>INJURY</b>	<b>X-RAYS</b>	<b>REDUCTION/ IMMOBILZATION</b>	<b>TREATMENT</b>
Wrist	AP/Lat wrist	Dorsal-volar splint	Closed reduction
Distal radius	AP/Lat forearm	Sugar tong splint	Closed reduction, or ORIF
Forearm, radius and/or ulna	AP/Lat forearm	Sugar tong splint	Closed reduction, or plates
Radial head	AP/Lat Elbow AP/Lat forearm	Posterior elbow splint	Closed reduction, or ORIF
Olecranon	AP/Lat elbow AP/Lat forearm	Posterior elbow splint	ORIF
Distal humerus	AP/Lat elbow AP/Lat humerus	Posterior elbow splint <b>Beware of vascular compromise</b>	ORIF
Humeral shaft	AP/Lat humerus	Coaptation splint <b>Beware of radial nerve compromise</b>	Conservative ORIF
Proximal humerus (surgical and anatomic neck)	AP/axillary shoulder AP/Lat humerus	Coaptation splint Sling	Conservative ORIF

**SHOULDER:**

<b>INJURY</b>	<b>X-RAYS</b>	<b>REDUCTION/ IMMOBILIZATION</b>	<b>TREATMENT</b>
Scapula	AP/axillary/ scapular shoulder	Sling	Conservative ORIF
Clavicle	AP/ axillary	Sling	Conservative

**PELVIS:**

<b>INJURY</b>	<b>X-RAYS</b>	<b>REDUCTION/ IMMOBILIZATION</b>	<b>TREATMENT</b>
Anterior ring, pubic symphysis, rami	AP, inlet and outlet pelvis, CT scan	Initial bedrest	Non-operative or ORIF
Posterior ring, sacrum, SI fracture/ dislocation, iliac wing	AP, inlet and outlet pelvis, CT scan	Initial bedrest. If hemodynamically unstable consider T-POD, angioembolization or external fixation	ORIF
Acetabulum	AP pelvis, Judet views, thin cut (3mm) CT scan	Distal femoral traction, Buck's traction, tibial traction, or nothing	ORIF

**FEMUR:**

<b>INJURY</b>	<b>X-RAYS</b>	<b>REDUCTION/ IMMOBILIZATION</b>	<b>TREATMENT</b>
Femoral head	AP pelvis, AP/lat hip	Distal femoral traction, or nothing	ORIF

Femoral neck	AP pelvis, AP/lat both hips (uninjured side)	Buck's traction, or nothing	ORIF
Intratrochanteric femur	AP pelvis, AP/lat hip	Buck's traction, or nothing	ORIF
Subtrochanteric femur	AP pelvis, AP/lat femur	Distal femoral traction, tibial traction	ORIF
Femoral shaft	AP/lat femur, AP/lat knee, AP pelvis	Hare traction splint, or Speed Splint	ORIF
Supracondylar femur	AP/lat femur, AP/lat knee, AP pelvis	Knee immobilizer, or tibial traction	ORIF

**LOWER LEG:**

INJURY	X-RAYS	REDUCTION/ IMMOBILIZATION	TREATMENT
Patella	AP/lat knee	Knee immobilizer	ORIF
Tibial plateau	AP/lat knee, CT scan (after spanning ex-fix)	Knee immobilizer	ORIF, or spanning ex-fix
Tibial shaft	AP/lat tibia	Posterior sugar tong splint	ORIF

**ANKLE:**

INJURY	X-RAYS	REDUCTION/ IMMOBILIZATION	TREATMENT
Pilon	AP/lat ankle, mortise view, AP/lat tibia, or CT	Posterior sugar tong splint, calcaneal traction	ORIF
Malleolus (medial, lateral, posterior)	AP/lat ankle, mortise view	Posterior sugar tong splint	ORIF

**FOOT:**

INJURY	X-RAYS	REDUCTION/ IMMOBILIZATION	TREATMENT
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Calcaneus	Lat foot, oblique foot, Harris heel view, thin cut CT (3mm)	Posterior sugar toe splint with toe plate	ORIF
Talus	Lat foot, oblique foot	Posterior sugar toe splint with toe plate	ORIF
Metatarsals and phalanx	AP/lat and oblique foot	Posterior sugar toe splint with toe plate	ORIF



## Open Long Bone Extremity Fractures

Open long bone extremity fractures are associated with significant trauma. The expedient management of these injuries ensures the best possible fracture treatment outcome. The determination of the grade of open fracture is the responsibility of the orthopedic trauma service. The extent of the grade of open fractures often requires intra-operative evaluation.

### OBJECTIVE:

1. Define the types of open fractures and prioritize injury management based on them.

### *Gustilo Open Fracture Classification*

<b>Grade</b>	<b>Definition</b>
I	Open fracture, clean wound, wound <1 cm in length
II	Open fracture, wound > 1 cm in length without extensive soft-tissue damage, flaps, avulsions
III	Open fracture with extensive soft-tissue laceration, damage, or loss or an open segmental fracture. This type also includes open fractures caused by farm injuries, fractures requiring vascular repair, or fractures that have been open for 8 hr prior to treatment
IIIA	Type III fracture with adequate periosteal coverage of the fracture bone despite the extensive soft-tissue laceration or damage
IIIB	Type III fracture with extensive soft-tissue loss and periosteal stripping and bone damage. Usually associated with massive contamination. Will often need further soft-tissue coverage procedure (i.e. free or rotational flap)
IIIC	Type III fracture associated with an arterial injury requiring repair, irrespective of degree of soft-tissue injury.

### GUIDELINES:

1. Follow ABC's. Extremity fractures assume low priority in the multiply injured patient unless there is significant bleeding. Suspect open fracture if there is any bleeding or any wounds in the injured extremity.
2. When patient is stable, examine the fracture and document distal neurovascular status of limb. Wounds must be inspected/ explored for communication with the fracture site.
3. Remove all gross contamination using sterile saline and cover all wounds with sterile dressing soaked in saline only.
4. Grossly align limb or reduce dislocation.
  - a. Splint femur fractures with Speedsplint femoral traction (see guideline)

- b. Splint other fractures with aluminum gutter or plaster, including joint above and below the fracture.
5. Radiographs in two planes, including joints above and below fracture.
6. Antibiotics: (see EAST Guidelines) :
- a. Clean or Grade I or II wounds: cefazolin for 24hrs.
  - b. Contaminated or Grade III wound: add additional Gram negative coverage (aminoglycoside NOT fluoroquinolones) for 72hrs or till flap coverage in place
  - c. Soil contamination or barnyard wounds: add penicillin G 4-5 million units every 4 hours.

Antimicrobial Treatment for Open Fractures Depending on Grade		
Open Fracture Grade	Antibiotic Treatment	Antibiotic Treatment if PCN Allergic
Grade I	Kefzol 25 mg/kg IV q8h x 24h	Clindamycin 10 mg/kg IV q6 x 24h
Grade II	Kefzol 25 mg/kg IV q8h x 24h	Clindamycin 10 mg/kg IV q6 x 24h
Grade III	Kefzol 25 mg/kg IV q8h x 24h + Gentamicin 2.5 mg/kg/d x 48h	Clindamycin 10 mg/kg IV q6 x 48 + Gentamicin 2.5 4mg/kg/d x 48h

If patient exposed to barn or farm wound contamination then add high dose PCN x 24 hours (Grade I and II) or 48 hours in Grade III.

Open fracture management and evaluation, including antibiotics should be initiated as soon as possible from the time of injury, not based on arrival to ER.

If a patient gets an operation on this open fracture after completion of the above duration of antibiotics is given they should get only a perioperative dose.

7. Tetanus prophylaxis if indicated.
8. Consult orthopedics.
- a. Surgical irrigation and debridement within 6-24 hours of injury. Early fixation according to orthopedic protocols.
  - b. Repeat surgical debridements every 24-36 hours until wound clean or all devitalized tissue removed.
  - c. Formal wound closure when wound is stable by whatever method necessary (delayed primary closure, STSG, rotational or free tissue transfer).
  - d. For Grade IIIC injuries with pulseless distal part, perform emergent surgical intervention with intra-op angiogram if limb salvage is planned. Use of the MESS

Score may help in these decisions. Scores >7 have a greater than 95% predictive value of amputation.

<http://www.mdcalc.com/mangled-extremity-severity-score-mess-score/>

Mandatory documentation of neurovascular exam is required in all extremity injuries pre and post extremity fracture care. Frequent neurovascular examinations are required before and after fracture management to detect extremity compartment syndrome. The LAST clinical finding lost in developing compartment syndrome is the pulse. The body has evolved to perfuse cells until the very end so it makes sense that the pulse is the last clinical finding to be lost in developing compartment syndrome.

\*\* All open fractures must be evaluated by the Orthopaedic Service for proper management (stabilization, wound management, further fracture grading, and definitive fracture management).

### **Discharge from the Emergency Center**

Under the guidance of the orthopedic team, patients with isolated extremity fractures that do not require operative intervention can be discharged from the emergency center.

### **Admission**

Patients with isolated orthopedic injuries can be admitted to the orthopedic service. Patients with multisystem injury will be admitted to the trauma service with orthopedics providing care and guidance for all orthopedic injuries. Operative interventions and care will be collaborative and coordinated under the leadership of the trauma attending. Patients will receive orders for a rehabilitation screen on admission to assist with discharge planning.

### **Inpatient Management**

All patient with orthopedic injuries will have the appropriate rehabilitation teams evaluate and assist with safe discharge needs.

### **Outcome Measures:**

- Team compliance with guidelines
- Unexpected mortality and morbidity

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