ORTHOPAEDICS

FOR PRIMARY HEALTH CARE

UNIVERSITY OF CAPE TOWN'S ORTHOPAEDIC DEPARTMENT

Editor: Michael Held
Introduction
Fractures make up about 10 to 25% of all injuries in the paediatric population. Of these lower limb fractures make up approximately 15.9% and the prevalence increases with age. These are mostly as a result of high-energy trauma from motor vehicle accident (MVA), sport injuries, falls from heights, non-accidental injuries (NAI) among others. In a study conducted in Red Cross War Memorial Hospital, falls from height was the major cause of femur fractures in the toddler group (peaking at 2 to 3 years) 39%, the next was MVA peaking at 4 to 5 years (33.7%), then struck by foreign objects (11%), NAI, pathological fractures and sporting injuries followed in descending order. This chapter will focus on highlighting lower limb fractures in a child and various protocols for their management. Generally, patients initially need to be assessed and stabilized according to ATLS principles.

Specific injuries
Hip fracture
Overview
Hip fractures are rare in children. They usually occur from high-energy trauma, particularly MVA. A high index of suspicion is needed to diagnose this. X-ray (AP and lateral views) are essential to make the diagnosis and a CT scan maybe indicated for occult fractures. Below is a table summarising how hip fractures are classified.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Transepiphyseal fracture, with or without dislocation of the femoral head.</td>
</tr>
<tr>
<td>Type II</td>
<td>Transcervical. Usually displaced.</td>
</tr>
<tr>
<td>Type III</td>
<td>Cervicotrochanteric</td>
</tr>
<tr>
<td>Type IV</td>
<td>Intertrochanteric</td>
</tr>
</tbody>
</table>

Treatment
- Acutely immobilise in traction
- Type I:
  - Closed reduction with smooth pin fixation in the younger child or cannulated screws or threaded pins in the older child.
  - If closed reduction is not possible
• then open reduction is indicated
• **Type II and III**
  • Undisplaced: spica cast
  • Displaced: closed reduction and cannulated screws. In the younger child avoid crossing the physis with screws, and if closed reduction fails, open reduction is indicated.
• **Type IV**: Traction in abduction, or open reduction and internal fixation if irreducible or unstable.

**Hip dislocation**

**Overview**

80% of traumatic hip dislocations are posterior. Low energy injuries account for traumatic hip dislocations in the younger child (2-5 years) due to an associated ligamentous laxity. In older children (11–15 years), dislocated hips are caused by higher energy injuries and have a higher association with acetabular fractures though rare. Dislocations are more common than fractures in the paediatric population.

![Figure 1.8.3.3B: Right hip dislocation](image)

**Clinically**

• **Posterior dislocation**: Typically flexed, adducted, internally rotated hip.
• **Anterior dislocation**: Typically extended, abducted, externally rotated hip.

Conduct a careful neurovascular evaluation with particular attention to the sciatic nerve. Ipsilateral femoral shaft fracture should be excluded prior to manipulation.

**Investigations**

If an acetabular fracture is identified on the pre or post-reduction x-Rays, Judet (45° obturator and iliac oblique) views should be obtained as well. If an intra-articular fragment or incongruent reduction is present, a CT scan is indicated.

**Treatment**

Exclude an ipsilateral femur fracture prior to reduction. Assess neurovascular status (especially sciatic nerve function) both before and after reduction. Acutely, attempt closed reduction under procedural sedation, as this is usually successful. In delayed/neglected cases, traction for 3–6 days should be attempted prior to open reduction if an initial attempt of closed reduction was unsuccessful. Once hip is reduced, immobilise in traction for 4–6 weeks.

Open reduction is rarely necessary, surgical intervention is indicated in:

• Failed closed reduction
• Nonconcentric reduction
• Displaced acetabular fractures
• Intra-articular fragments
• Sciatic nerve palsy occurring post-reduction where it was normal prior to
• reduction.
Complications
• Avascular Necrosis (3-15%) decreased incidence under age 5
• Nerve injury - Sciatic or Gluteal Nerve
• Coxa Magna - not associated with functional limitation
• Redislocation

**Femoral shaft fractures**

**Overview**
Femoral shaft fractures present with a bimodal distribution peaking at 2–4 years and mid-adolescence. Males predominate. In the neonate, the fractures are predominantly due to birth trauma and non-accidental injury. In children under 1 year, 50% are due to non-accidental injury. In adolescence most are due to MVA

**Classification**

<table>
<thead>
<tr>
<th>Descriptive</th>
<th>Anatomical</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Open/compound</td>
<td>• Subtrochanteric</td>
</tr>
<tr>
<td>• <strong>Pattern:</strong> spiral, transverse, short oblique, long oblique, butterfly fragment, comminuted</td>
<td>• Shaft</td>
</tr>
<tr>
<td>• Displacement</td>
<td>• Proximal 1/3</td>
</tr>
<tr>
<td>• Angulation</td>
<td>• Midshaft</td>
</tr>
<tr>
<td></td>
<td>• Distal 1/3</td>
</tr>
<tr>
<td></td>
<td>• Suprachondylar (metaphyseal)</td>
</tr>
</tbody>
</table>

**Treatment**
The table below summarises the accepted angulation in femur fracture.

<table>
<thead>
<tr>
<th>Age</th>
<th>Varus/valgus</th>
<th>Anterior/posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 years</td>
<td>30°</td>
<td>30°</td>
</tr>
<tr>
<td>2-5 years</td>
<td>15°</td>
<td>20°</td>
</tr>
<tr>
<td>6-10 years</td>
<td>10°</td>
<td>15°</td>
</tr>
<tr>
<td>&gt;11 years</td>
<td>5°</td>
<td>10°</td>
</tr>
</tbody>
</table>

Below are guidelines to management of femur shaft fractures, however these may vary among facilities depending on surgeons preference and expertise.

<table>
<thead>
<tr>
<th>Age</th>
<th>Treatment</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonates</td>
<td>Pavlik harness</td>
<td>3 weeks</td>
<td></td>
</tr>
<tr>
<td>&lt;2yr/ &lt;12kg</td>
<td>Gallows traction</td>
<td>3-6 weeks</td>
<td>Compartment syndrome risk</td>
</tr>
<tr>
<td>2-8 years</td>
<td>Early spica cast</td>
<td>4-8 weeks</td>
<td></td>
</tr>
<tr>
<td>8-12 years</td>
<td>Traction</td>
<td>6-8 weeks</td>
<td>Partially weight bearing to full as pain</td>
</tr>
<tr>
<td>&gt;12 years</td>
<td>Prograde IM nails</td>
<td>Trochanteric entry point, Locked nail</td>
<td></td>
</tr>
</tbody>
</table>

**Special circumstances**
- Compound fractures: External fixator/plate with preliminary debride-ment, antibiotics
- Severe head injury: ORIF (done once patients condition stabilised)

IM nails = intramedullary nails

**Figure 1.8.3.3C:** X-rays of A) Retrograde IM nail and B) Prograde IM nail

**Figure 1.8.3.3D:** Gallows traction
Complications

• **Mal-union:** Remodelling will not correct any rotational deformity. Younger patients remodel better than older patients and sagittal plane deformities remodel better than coronal plane deformities.

• **Non-union** is rare. Should it occur, bone graft and plate or IM nail fixation

• **Limb length discrepancy:** As a result of either shortening or overgrowth. 1 cm of overgrowth can usually be expected and early shortening of 1-2 cm is therefore acceptable. Up to 2 cm of leg length discrepancy is well tolerated.

• **Avascular necrosis of the femoral head:** may occur with antegrade nailing of femoral fractures through the piriforms fossa. For this reason, before skeletal maturity, a trochanteric approach is recommended

Knee injuries

Overview

In the immature skeleton, physes fail before ligaments under tensile load. Ligamentous injuries are therefore uncommon before skeletal maturity. Two thirds of the longitudinal growth of the lower limb occurs in the distal femur (10 mm/year) and the proximal tibia (6 mm/year). Injuries to the physes may lead to premature growth arrest or angular deformity

Distal femur fracture

Ligamentous and tendinous structures insert on the epiphysis, leaving the physis unprotected. Injury is usually due to indirect forces: varus/valgus hyperextension/hyperflexion, usually resulting in a Salter-Harris II type injury.

Radiological evaluation

AP and lateral films should be ordered. Oblique views are needed when in doubt or to better visualise the fracture. Stress views may be needed to identify undisplaced fractures. In infants separation of the distal femoral physis may be missed. The ossified centre of the epiphysis should always be in the line of the femoral anatomic axis on AP and lateral.

Classification

<table>
<thead>
<tr>
<th>Salter Harris</th>
<th>Displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type I:</strong> Easily missed. Stress views may be necessary</td>
<td>Hyperextension injury – anterior</td>
</tr>
<tr>
<td><strong>Type II:</strong> Most common type. Usually varus or valgus injury</td>
<td>Hyperflexion injury – posterior</td>
</tr>
<tr>
<td><strong>Type III:</strong> Intra-articular. Often best seen on AP x-Rays as the physeal component is in the sagittal plane</td>
<td>Varus injury – medial</td>
</tr>
<tr>
<td><strong>Type IV:</strong> Rare injury but high incidence of linear physeal bar formation</td>
<td>Valgus injury – lateral</td>
</tr>
<tr>
<td><strong>Type V:</strong> Diagnosis usually made retrospectively</td>
<td></td>
</tr>
</tbody>
</table>

**Treatment**

- **Undisplaced fractures:** Above knee POP with knee in extension
- **Hyperflexion injuries:** MUA and maintain position with above knee POP with knee in extension
- **Hyperextension injuries:** MUA impractical to maintain reduction by keeping knee in flexion and therefore cross pin using smooth k-wires or Steinmann pins from the epicondyles to the metaphysis.
- **Varus/valgus injuries:** MUA and cross pins
- **With Salter-Harris III and IV injuries** open reduction is necessary to restore the articular congruity unless the fracture is undisplaced.

In the older child with a large metaphyseal spike (Thurston-Holland fragment) this fragment may be used to maintain reduction with cannulated lag screws.

**Complications**

**Early**
- **Vascular injury:** Usually with hyperextension injury. The cool, pulseless foot pre-reduction requires urgent reduction. If it resolves, it requires observation for 48–72 hours to exclude intimal tears. The cool pulseless foot post-reduction requires urgent angiography.
- **Peroneal injury:** This is usually associated with varus injuries. Patient should be put in an ankle foot orthosis till nerve recovers, so to prevent an equinuous foot deformity. Persistent nerve palsy at 3 months should be evaluated with electromyography and possibly exploration.

**Late**
- **Physeal closure:** 50% of physeal injuries in the distal femur will result in arrest. This is due to the interdigitating nature of the distal femoral physis. The physeal injury will present with a bar manifesting as angular deformity or limb length discrepancy.

**Distal femur fracture:** a) Salter Harris type I fracture of distal femur; b) Stress view with valgus force; c) Stress view with varus force
Resources

Modified images:

1. Dislocated hip. Available from:
   https://commons.wikimedia.org/wiki/
   File:Dislocated_hip.jpg
About the book

Informed by experts: Most patients with orthopaedic pathology in low to middle-income countries are treated by non-specialists. This book was based on a modified Delphi consensus study with experts from Africa, Europe, and North America to provide guidance to these health care workers. Knowledge topics, skills, and cases concerning orthopaedic trauma and infection were prioritized. Acute primary care for fractures and dislocations ranked high. Furthermore, the diagnosis and the treatment of conditions not requiring specialist referral were prioritized.

The LION: The Learning Innovation via orthopaedic Network (LION) aims to improve learning and teaching in orthopaedics in Southern Africa and around the world. These authors have contributed the individual chapters and are mostly orthopaedic surgeons and trainees in Southern Africa who have experience with local orthopaedic pathology and treatment modalities but also in medical education of undergraduate students and primary care physicians. To centre this book around our students, iterative rounds of revising and updating the individual chapters are ongoing, to eliminate expert blind spots and create transformation of knowledge.

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The information in this book is meant to supplement, not replace, Orthopaedic primary care training. The authors, editor and publisher advise readers to take full responsibility for their safety and know their limits. Before practicing the skills described in this book, be sure that your equipment is well maintained, and do not take risks beyond your level of experience, aptitude, training, and comfort level.

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