# Paediatric Femoral Fractures

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# Outline

- Femoral Diaphyseal Fractures
  - Introduction & Epidemiology
  - Mechanisms of Injury
  - Classification of Fractures
  - Treatment Modalities
- Proximal Femoral Fractures
  - Anatomy
  - Classification
  - Treatment options

# Epidemiology

- Relatively common paediatric fracture
- Around 1.5% of all paediatric fractures
- Most due to trauma
- Consider NAI as cause
  - Up to 30% in <4yrs old
  - Most common cause of femoral # in non-walkers

# Mechanism

- Low or high energy injury
- Direct blow causes transverse #
- Torsion causes oblique/spiral #
- Injuries usually more stable in young patients
  - Thick periosteum
  - Low energy injury

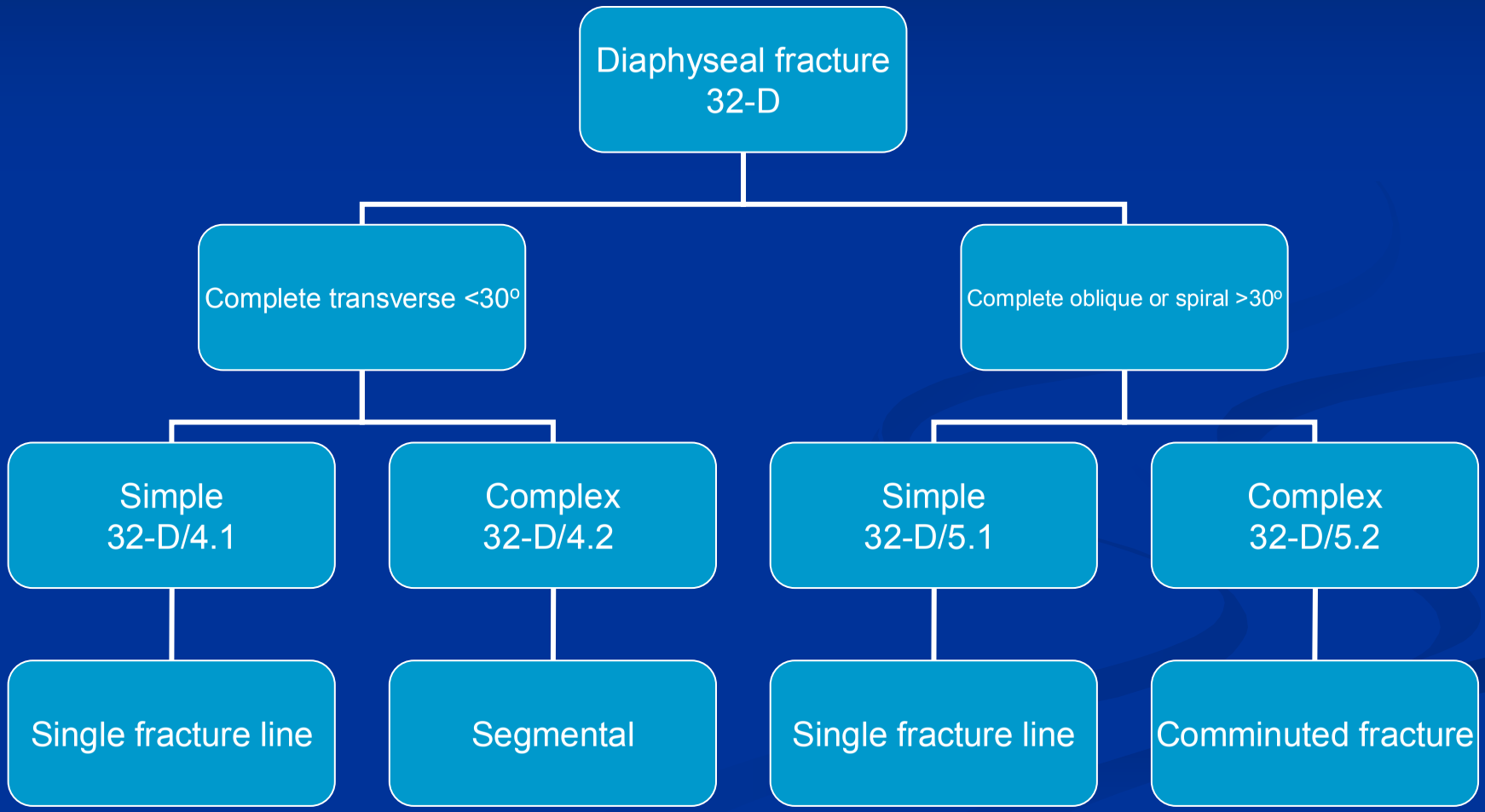
# Anatomy

- Displacement in proximal diaphyseal fractures is due to;
  - Psoas (flexion of prox. fragment)
  - Gluteus medius/minimis (abduction)
  - Short rotators (ex.rotation)
  - Weight of lower limb (external rotation of distal fragment)

# Classification

- Anatomical location
- Fracture pattern
- Degree of comminution
- Open or closed injury
- AO classification

# AO classification



# Treatment principles

- ***Varies by age of patient***

- Fracture pattern
- ?other injuries

# Traction

- Horizontal (Buck 1860's)
- Vertical or Gallows traction (Sir Thomas Bryant, 1870's)
- ?skeletal traction for older children unsuitable for gallows traction (distal femoral pin)

# Bryant's (Gallows) Traction

- Child under 2 yrs
- Body mass under 12kg
- May be used instead of or before hip spica
- Both legs
- Well padded around ankles
- Bottom just off bed

# Bryant's (Gallows) traction

- Accept up to 1.5cm shortening & 30$^{o}$ of saggital angulation
- Union usually occurs in around 2 weeks
- Watch for loss of position & overdistraction in gallows
  - Skin problems
  - ischaemia

# Hip spica

- Not in obese, open #'s or polytrauma
- Apply immediately to fractures in good position or after a period of traction
- Useful in patients between ages of 1 & 10
- Limb position depends on fracture level

# Hip spica technique

- GA preferable
- II to reduce fracture (± skeletal traction)
- 3 man team
- Padding (Abdomen & edges
- Window for perineal hygeine
- Cross support (broomstick)

# Hip spica technique

- II in cast to check fracture reduction
- Ideal position for mid-diaphyseal #
  - Hip flexion 45°
  - Hip abducted 30°
  - Hip externally rotated 20°
- Position of limb depends on level of fracture

# Acceptable position in spica

- Up to 25° of saggital angulation
- Up to 15° of frontal plane angulation
- Less than 2cm shortening
- Ideally side-side apposition in cast with ≈ 1-1.5cm
- Overgrowth corrects most discrepancies
- May be resulting leg length discrepancy

# Intramedullary fixation

- Rigid or flexible
- Rigid in pts. older than 11-12
- Risk of AVN (post. retinacular vessels)
- Flexible nails now common & reproducible $R_x$ method
- Indicated in;
  - Failure of conservative Rx
  - Obese patient
  - Patients between ages of 5-12/13 yrs

# Flexible IM nails

- Retrograde through distal metaphysis
- Both nails brace cortex at 3 points
- Flexural, axial, rotational & translational stability
- Able to weight bear post-operatively
- Removed electively at 3-9 months

# External fixation

- May be used in diaphyseal fractures
- Useful in polytrauma & open injuries
- Complications include;
  - Pin site infection
  - Fracture at pin site
  - Re-fracture

# Plate osteosynthesis

- Familiar technique
- Traditionally high infection rates (Ziv & Rang 1983)
- Better results in more recent years (0% infection; Ward 1992)
- Recent development of sub-muscular technique
- Sink et al report series of 27 cases with sub-vastus bridge plating
- 0% complications & stable union at 12 weeks

Sink, Ernest L. MD; Hedequist, Daniel MD; Morgan, Steven J. MD; Hresko, Timothy MD. Results and Technique of Unstable Pediatric Femoral Fractures Treated With Submuscular Bridge Plating. Journal of Pediatric Orthopaedics: March/April 2006 - Volume 26 - Issue 2 - pp 177-181

# Evidence for treatment

- Clinkscales et al, Mayo Clinic
  - 30 pts over 7 years
  - Spica vs. IM nail vs. ex-fix vs. skeletal traction
  - Spica gave quickest time to union & discharge, but highest rate of malunion & LLD
  - Skeletal traction gave longest stays & no cheaper than nail or ex-fix
  - IM nail gave fewest complications

Clinkscales C.M, Peterson H.A. Isolated closed diaphyseal fractures of the femur in children: comparison of effectiveness and cost of several treatment methods. Orthopaedics 1997 Dec;20(12):1131-6

# Evidence for treatment

- Bar-On et al, Jerusalem
  - Prospective study
  - IM nail vs. Ex-Fix; 19 patients 5 to 13 yrs
  - 20 #'s; 10 in each group
  - IM nail gave quicker time to callus formation, weight bearing, & return to school
  - Ex-fix had higher rate of mal-union & complications in general

Bar-On E, Sagiv S, Porat S (1997) External fixation or flexible intramedullary nailing for femoral shaft fractures in children. A prospective, randomised study. J Bone Joint Surg Br 79:975–978

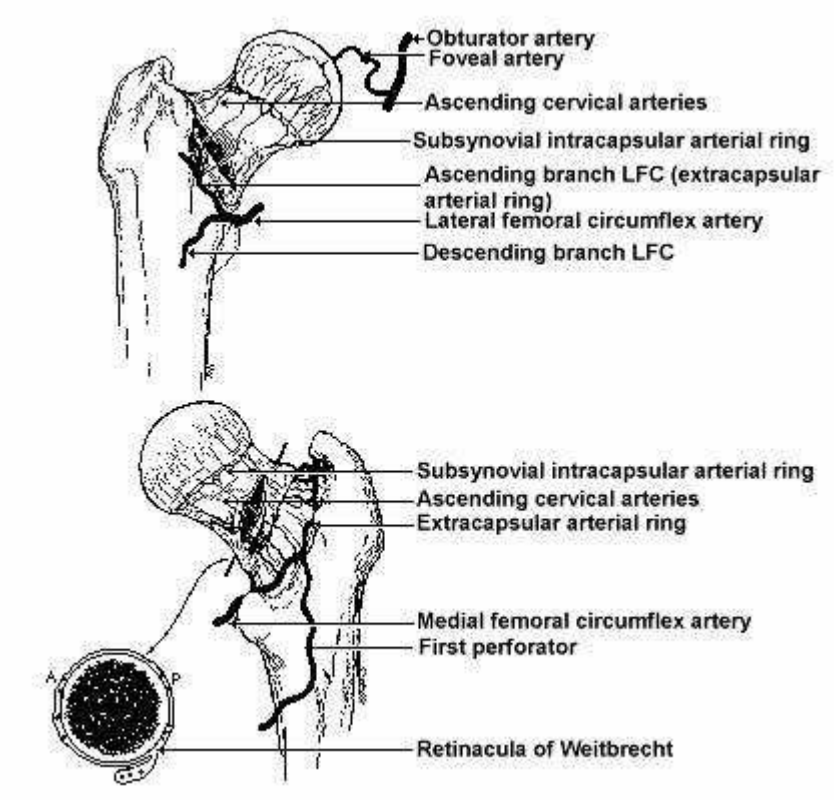
# Femoral Neck Fractures

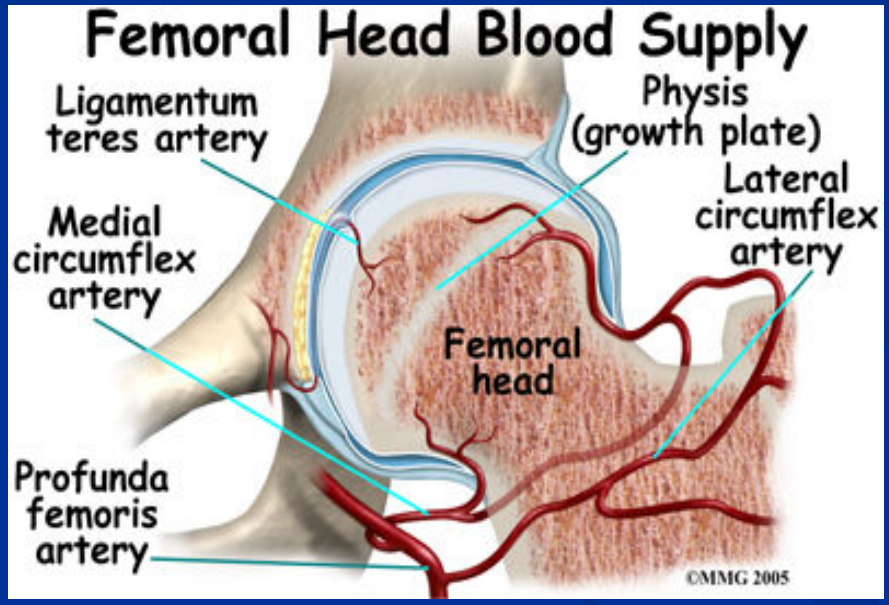
- Usually as a result of high energy trauma
- May be part of a series of other injuries
- Vascularity of femoral head may be compromised
- Risk of AVN high in most of these fractures

# Femoral head Vascularity

- Extracapsular & intracapsular anastamotic rings
- Extracapsular from acsending branches of med. & lat. femoral circumflex
- Head, neck & trochanter supplied by lateral ascending arteries of the extracapsular ring
- Subsynovial ring made of 4 branches of the 2 circumflex arteries
- Subsynovial ring supplies metaphysis adjacent to the growth plate & the ossification centre
- These vessels prone to obstruction or compression

# Proximal femoral blood supply

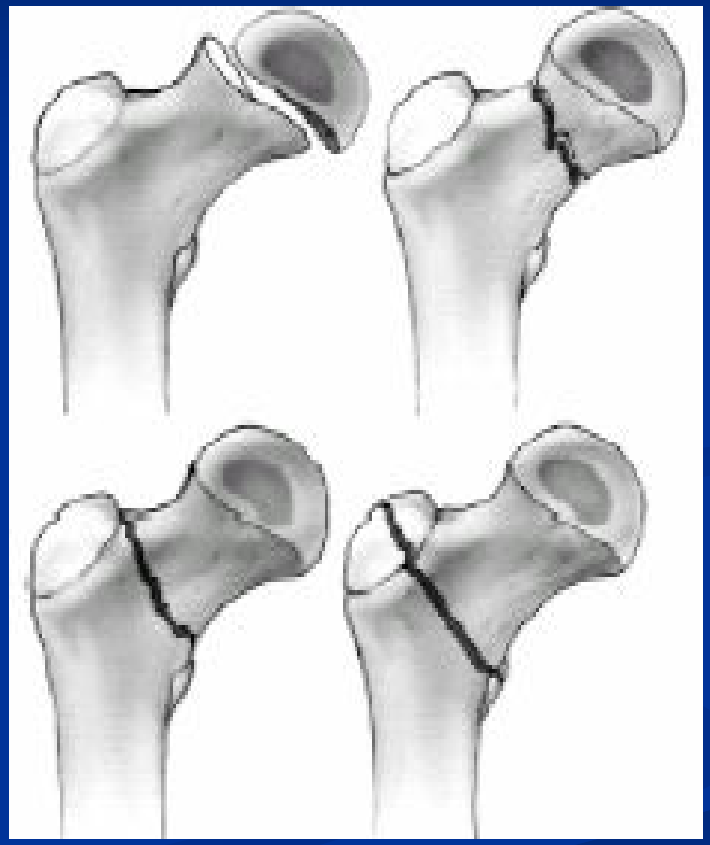


# Classification

- Delbet's Classification

- 4 types of fracture
  1. trans-epiphyseal (subtypes a & b)
  2. Trans-cervical
  3. Cervical-trochanteric (subtypes a & b)
  4. intertrochanteric



# Treatment

- ***Treatment is as an emergency***
- Type 1
  - If undisplaced/undislocated → hip spica
  - If displaced → closed ± open reduction
  - Stabilise with smooth pins / can. Screws
- Type 2
  - closed ± open reduction
  - Stabilise with 2/3 can screws in lag mode

# Treatment

- Type 3
  - Hip spica if undisplaced
  - X ray to ensure reduction is maintained
  - ORIF with can. screws in most
  - Screws stop short of physis (unless closed)
- Type 4
  - Traction ± hip spica in young/undisplaced #s
  - closed ± open reduction
  - Threaded pins / lag screws in under 12's
  - Sliding hip screw / angled blade plate in over 12's

# Results

- AVN rates up to 100% reported in type 1 #'s (Hughes et al 1994)
- Lower rates if no dislocation
- Type 2 #'s undergo AVN in up to 60% of cases (Canale 1977)
- AVN in up to 30% of type 3 #'s
- AVN rare in type 4 #'s

# Complications

- AVN
  - Fracture type & displacement important
  - Type 1 with dislocation of the femoral head most at risk

- Non-union
  - Mostly in types 2 & 3
  - Up to 15% (Canale 1977)

# Complications

- Coxa Vara
  - Internal fixation reduces incidence
  - Up to 32% in MUA & hip spica (Lam 1971)

- Premature proximal physeal closure
  - Highest risk in type 2
  - Proximal physis responsible for 30% of femoral growth

# Questions?

# Summary (1)

- Diaphyseal fractures
  - Counsel for LLD, limp for up to a year
  - Consider NAI
  - Follow standards for alignment

# Summary (2)

- Hip fractures
  - Counsel patients re AVN, coxa vara, growth arrest
  - Early anatomic reduction
  - Use screws, not k wires or spica alone
  - Spica for younger children
  - Follow for at least 2 years

# Other tips

- Don't put excess strain in popliteal fossa (spica)
- Elastic nails need symmetry
- Don't bend at the exit point or distract/rotate
- 1 leg spica or ex-fix in unstable fractures
- Caution in >11/12 yrs / over 50kg
- Ex-fixes need good pin site care
- Rigid IM nails through trochanteric entry

Thank You!