Paediatric Knee Injuries

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Postgraduate Teaching

29th October 2012

Overview

- Acute injuries
  - Extra-articular
  - Intra-articular
- Overuse trauma

Acute Injuries

Extra-articular

Important Points

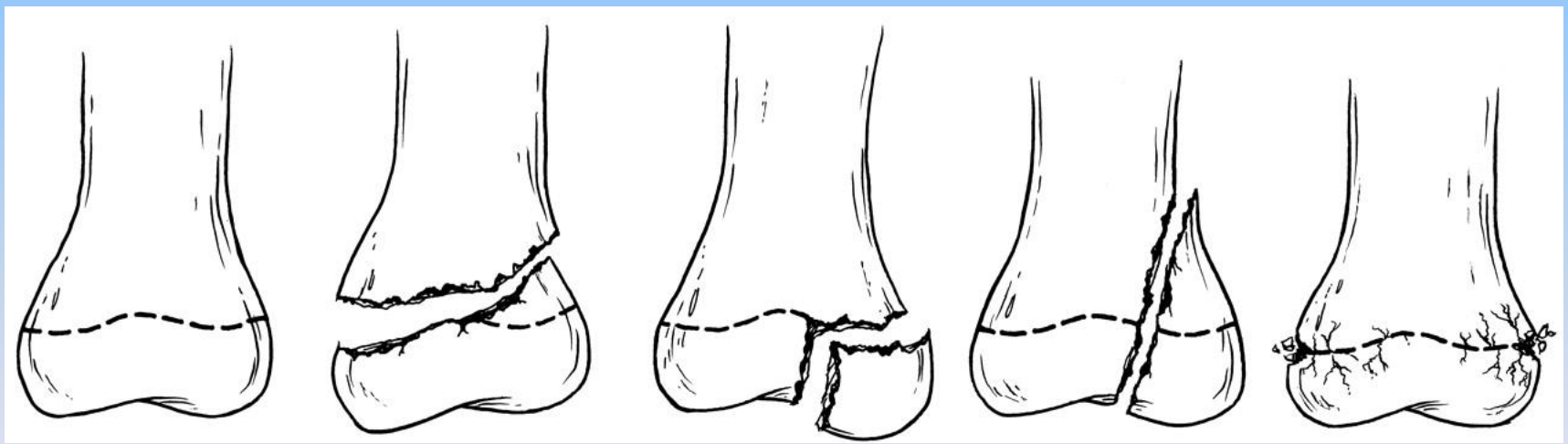
- Contribution of distal femur & proximal tibia to growth in terms of leg length
  - Distal femur 10mm/year
  - Proximal tibia 6mm/year

2.2% physeal fractures BUT **51%** partial growth arrest

- Tibial tubercle growth arrest
  - Can lead to recurvatum

Peterson HA, et al. JPO 1994;14(4):423

Salter Harris Classification



Distal femoral epiphysis

- 70% of femoral growth
- 37% of leg length
- Popliteal artery and geniculates lie posterior to capsule and metaphysis
- Rare injuries: <1% of all paediatric fractures
  - High energy: pedestrian (<11 years old) or fall from height
  - Sporting injuries in teenagers
    - Valgus/varus force
    - Hyperextension
- DO NOT MISS
  - Vascular injury
  - Tibial or peroneal nerve injury
  - Compartment syndrome

Riseborough RJ et al. JBJS(Am) 1983;65:885.

Distal Femoral Fractures

incomplete

Distal Femoral Fractures

complete

Distal Femoral Fractures

Beware of NAI- in patients <12 months of age

Banaszkiewicz P, et al. JPO 2002;22(6):740-4.

Anterior displacement

- Associated with vascular injury
  - Inform vascular team
  - Low threshold for angiography
- Clear documentation of any neurological deficit
  - Persistent deficits: EMG after 3 months

Management

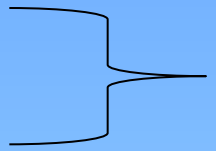
- Cast for minimal displacement SH I & II
- ORIF for severe displacement or SH III & IV
  - Crossed wires
  - Screws into metaphyseal

Salter Harris IV

Open Distal Femoral Fracture

Open fracture

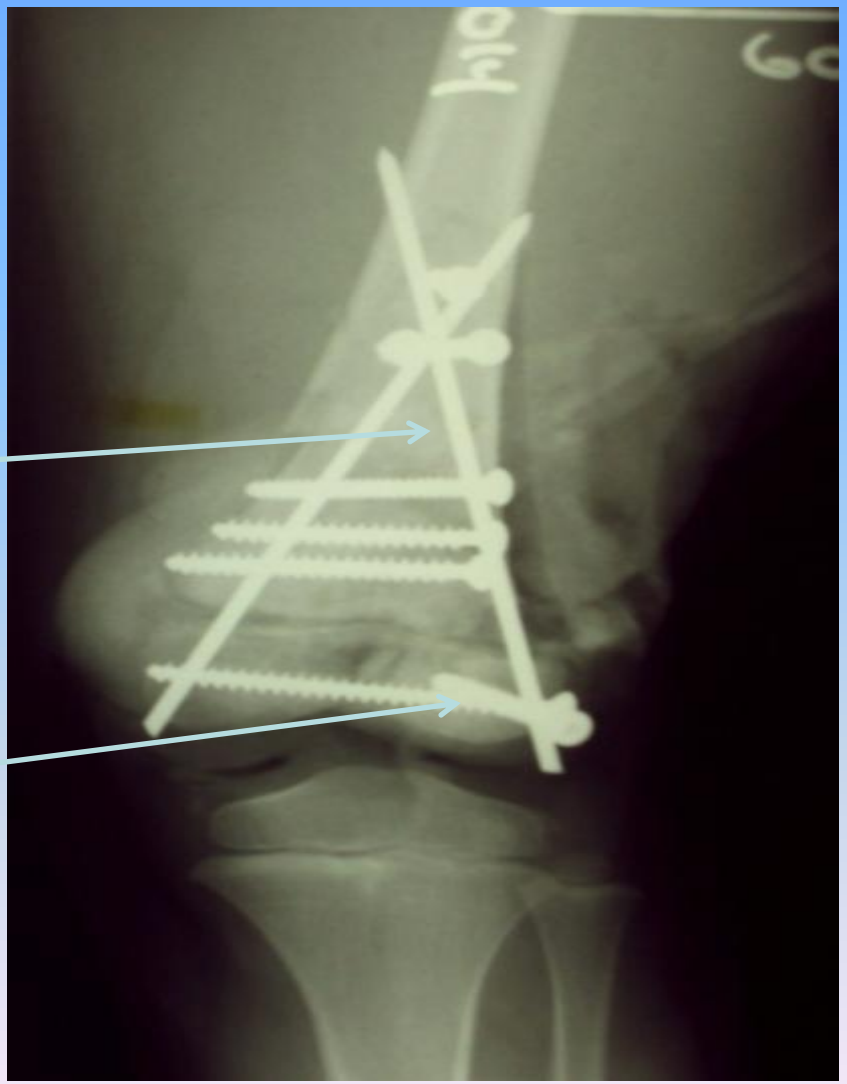
- Assess neurovascular status
- Cover the wound and splint the limb
- Administer iv antibiotics
- Theatre when practicable
- Excise, extend & explore the wound
  - Remove dead and devitalised tissue
  - Remove contaminants
- Stabilise fracture
  - External fixator
  - Definitive ORIF
- Reconstruct the soft tissue envelope
  - Plastic surgery input



ORIF

Metaphyseal/diaphyseal component reduced under direct vision and relative stability achieved with inter-fragmentary screws and the crosed wires

Anatomical reduction of intra-articular component under direct vision
and fixation with absolute stability using an inter-fragmentary screw



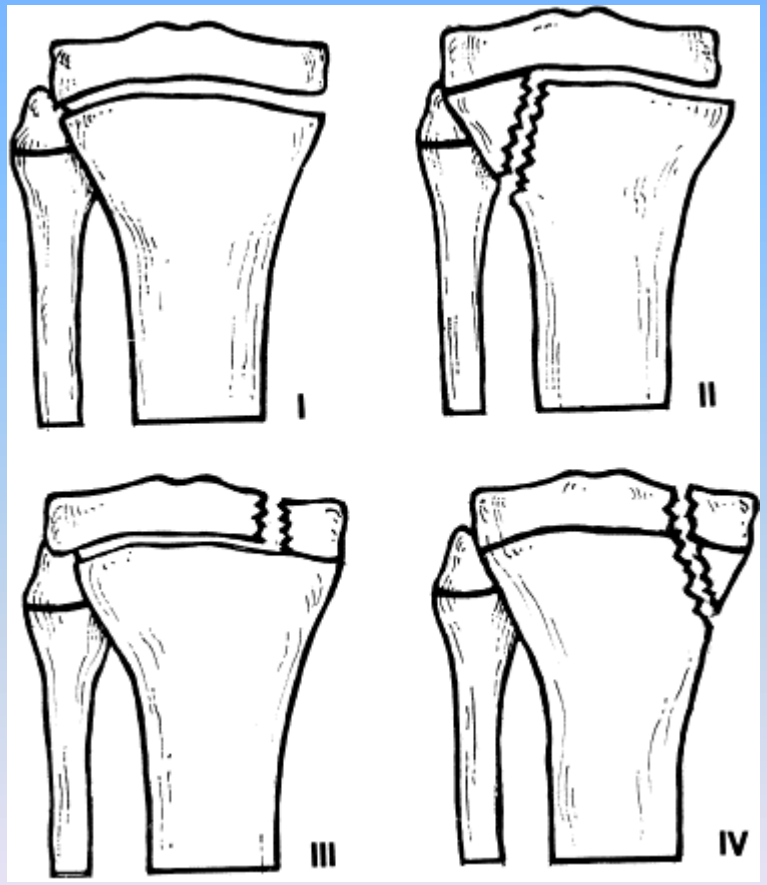
Proximal Tibial Fractures

- Rare: <1% of all paediatric fractures
- Often high energy trauma
  - RTA
  - Fall from height
  - Varus/valgus force
  - Hyperextension
- DO NOT MISS
  - Vascular injury
  - Tibial or peroneal nerve injury
  - Compartment syndrome
- Look out for occult knee ligament injuries during follow-up

Management

- Closed reduction and cast if undisplaced
- Usually SH I & II
- Monitor for iatrogenic common pernoeal injury post reduction
- Closed reduction and percutaneous fixation for unstable SH I & II
- ORIF
  - Failed closed reduction
  - Displaced SH III & IV
  - Soft tissue interposition often present

Salter Harris Classification



Proximal Tibial Fractures

Proximal Tibial Fractures


RAFE|010Y|M
L
0Y|M
Fluo
L

Radiology report

- No fracture.

3 days later


L

Radiology report

- There is slippage of the proximal tibial epiphysis, which has been manipulated and immobilised in a cast. Position as shown. No associated fracture.

4 weeks cast off

Complications

- Compartment syndrome
- Loss of reduction
- Growth disturbance
- Ligamentous instability

Tibial tubercle

- Cartilagenous stage up to 10 years
- Apophyseal stage: ossification centre appears 8-14 years
- Epiphyseal stage: ossification centres of tubercle and proximal tibial epiphysis merge 10-17 years
- Bony stage merged tubercle and metaphysis

Tibial tubercle fractures

- Jumping activities
- 98% male
- Tender tubercle with palpable fragment
- Patella alta may be present
- Associated injuries
  - Ligament injuries
  - Meniscal tears
  - Extensor mechanism disruption
  - Tibial plateau fracture

Classification – Watson Jones

Tubercle only
A- Undisplaced
B- Displaced

Tubercle & extra-articular tibial epiphysis
A- Non comminution
B- Comminution

Tubercle & intra-articular tibial epiphysis
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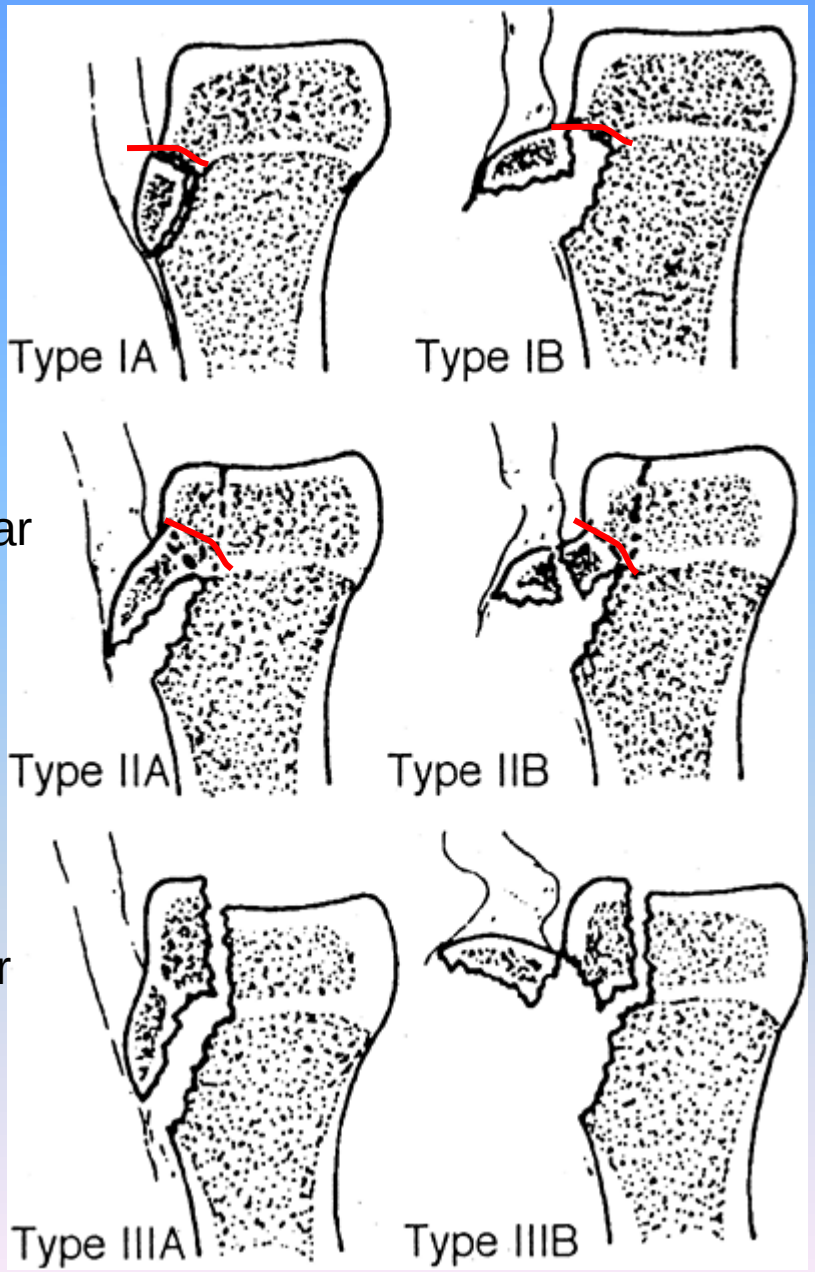


Management

- Undisplaced type I= cast moulded aound the patella
- All others are displaced so need ORIF

Tibial Tubercle Fractures Type I

Tibial Tubercle Fractures

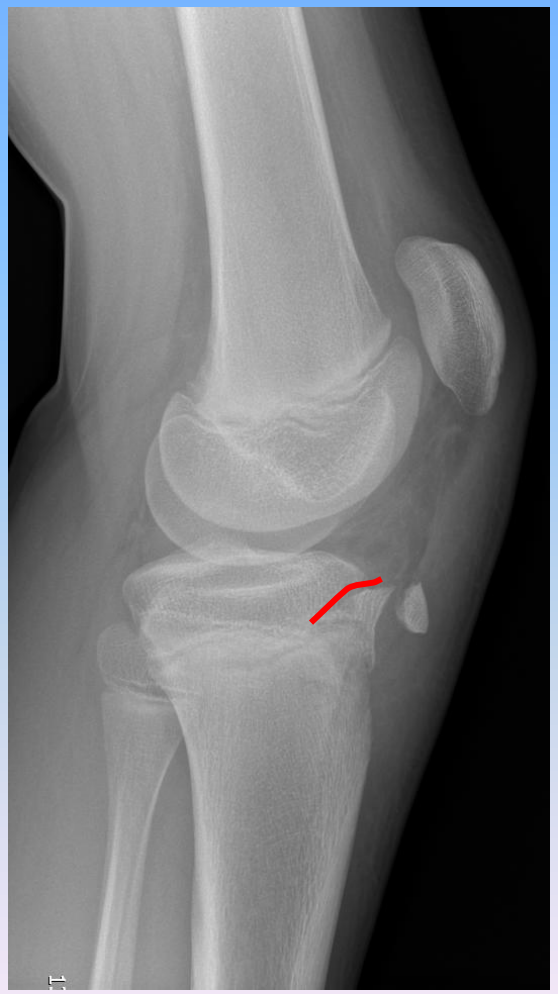
Tibial Tubercle Fractures Type IIA

Tibial Tubercle Fractures

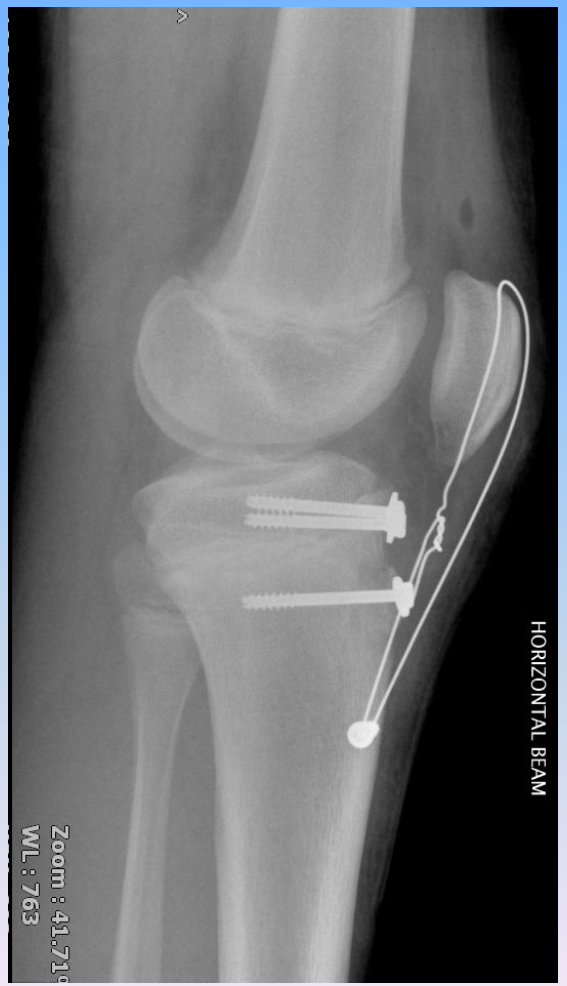
Tibial Tubercle Fractures

Tibial Tubercle Fractures

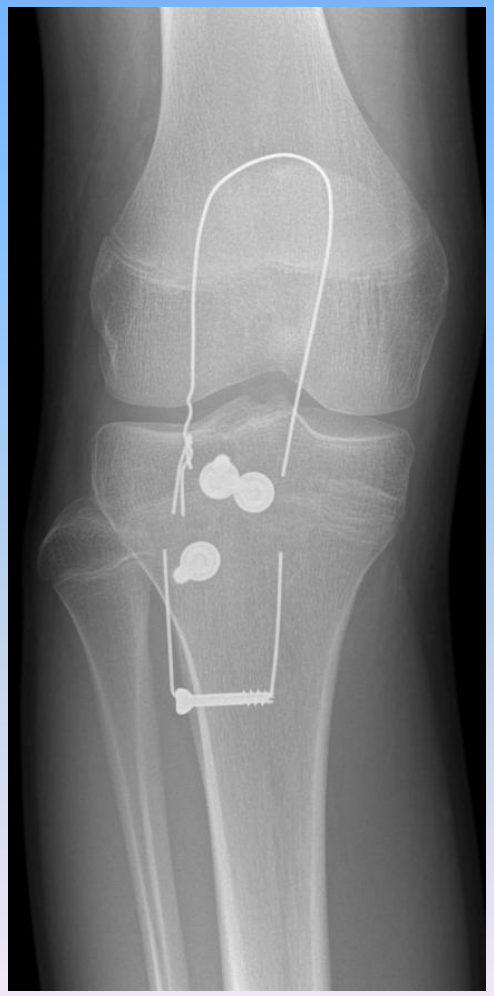
Tibial Tubercle Fractures Type IIB



Tibial Tubercle Fractures

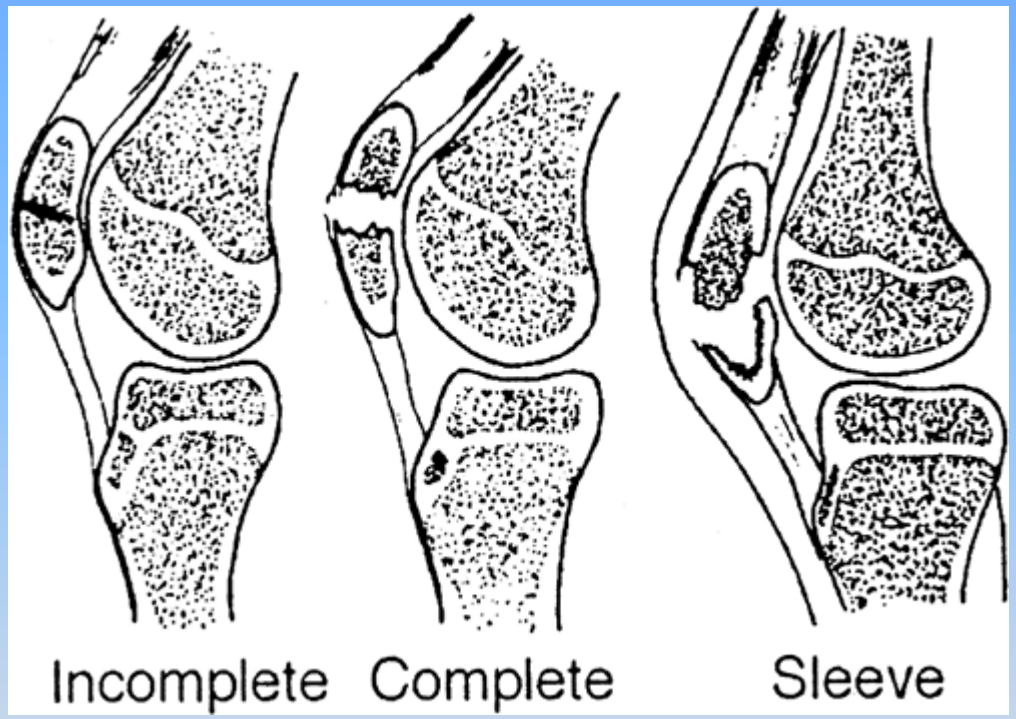


Tibial Tubercle Fractures



Tibial Tubercle Fractures Type IIIA

Patella Fractures



Commoner in children than adults
Eccentric contraction
Direct blow

Examination

- Inability to weight bear
- Inability to straight leg raise
- High riding patella
- Radiographs
  - Small flake of bone may be the only sign of a sleeve fracture
  - Comparison views with normal knee very useful

Management

- Cast only
  - Extensor mechanism intact
  - <2mm displacement at fracture site
- ORIF
  - Sutures
  - Tension band wiring
  - Screws
  - Bone anchors

Distal sleeve

Proximal sleeve

6 year old female


R
AB

Knee Dislocation

- Very rare BUT extremely severe associated injuries
- Series of 3 patients from trampoline injuries
  - Aged 11, 13 and 17
  - All had vascular injury: 1 transection & 2 intimal tears with thrombosis

Kwolek CJ, et al. Am Surg 1998;64(12):1183-7

Intra-articular injuries

- Acute haemarthrosis
  - ACL 50%
  - Meniscal tear 40%
  - Fracture 10%

Intra-articular injuries without obvious fracture

- Acute haemarthrosis
  - ACL tear
  - Meniscal tear
  - Patellar dislocation +/- osteochondral fracture

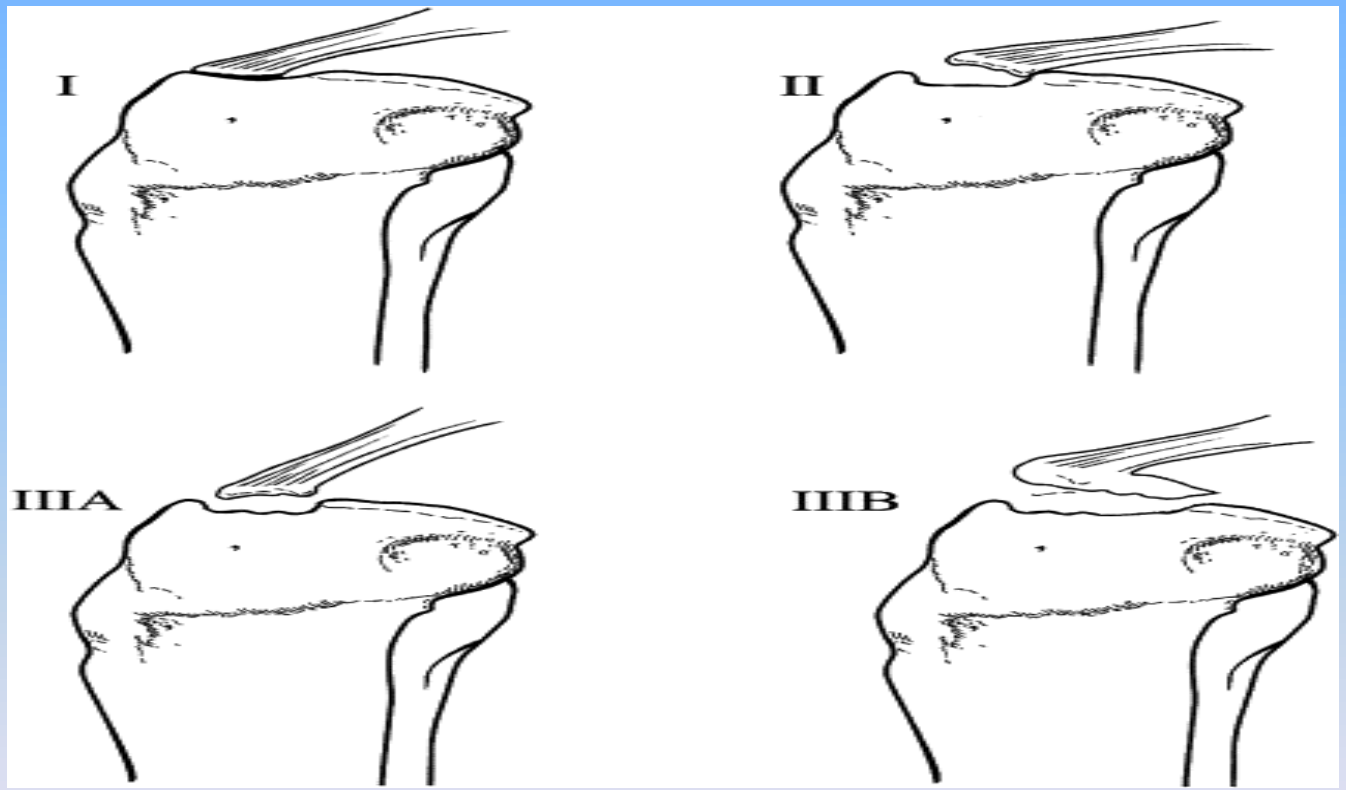
Tibial spine fractures

- Usually 8-14 years old
  - Hyperextension
  - Direct blow to flexed knee
  - Often sporting or fall from bicycle

Myers & McKeever classification

I- Undisplaced

II- Displaced anteriorly with ‘hinge’ contact posteriorly



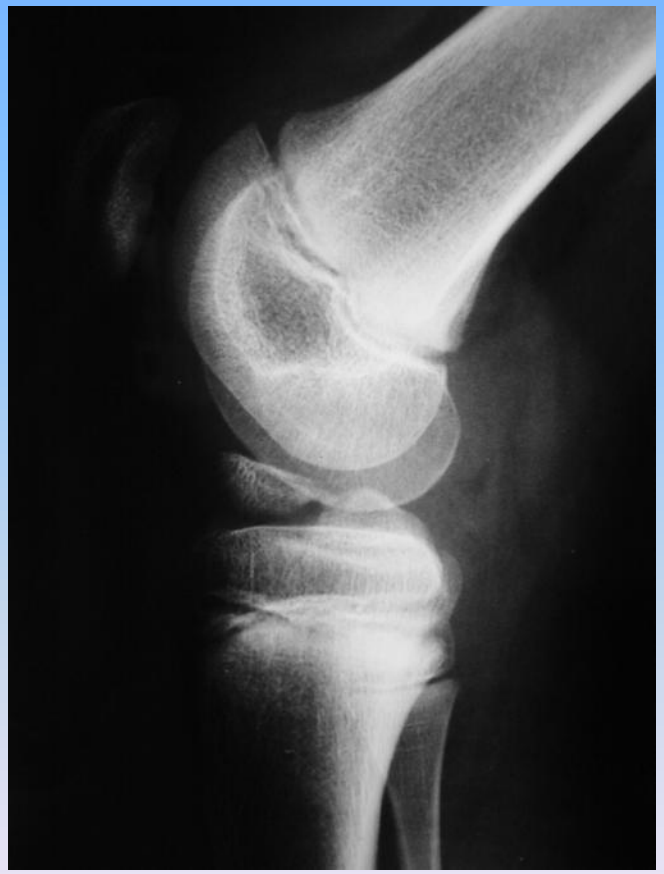
IIIA- Displaced- small fragment

IIIB- Displaced- large fragment

Management

- Non-operative
  - Undisplaced
  - Type 2 after closed reduction
  - Cast in extension
  - Frequent radiographs to monitor
- Operative
  - Arthrotomy and screw fixation
  - Athroscopic with sutures

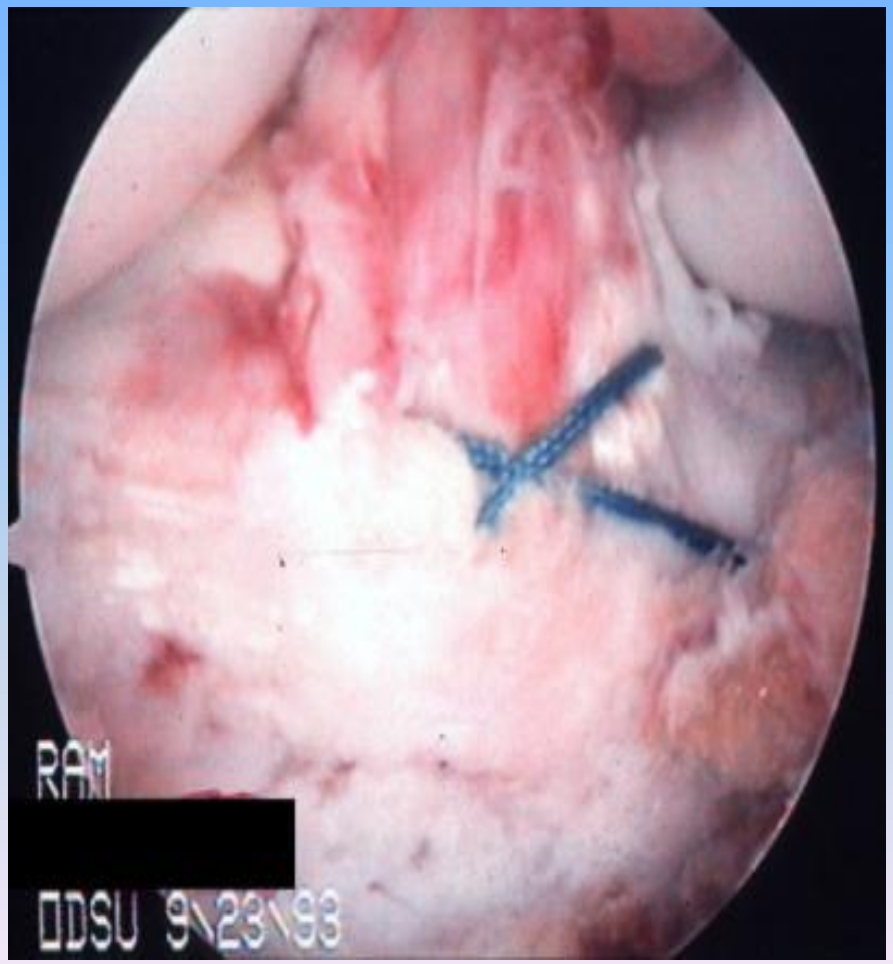
Closed reduction



14 year old male

13 year old male

Arthroscopic



Outcomes

- Generally good
  - Must intervene if not reduced/ loss of reduction occurs
  - Ensure the patient can clinically obtain full extension post reduction

Osteochondral fractures

- Usually due to patellar disclocation
  - Medial patellar facet
  - Lateral femoral condyle
- Often larger than appearance on plain radiographs
- Arthroscopic assessment
  - Excise small fragments
  - Repair large fragments

Meniscal injuries

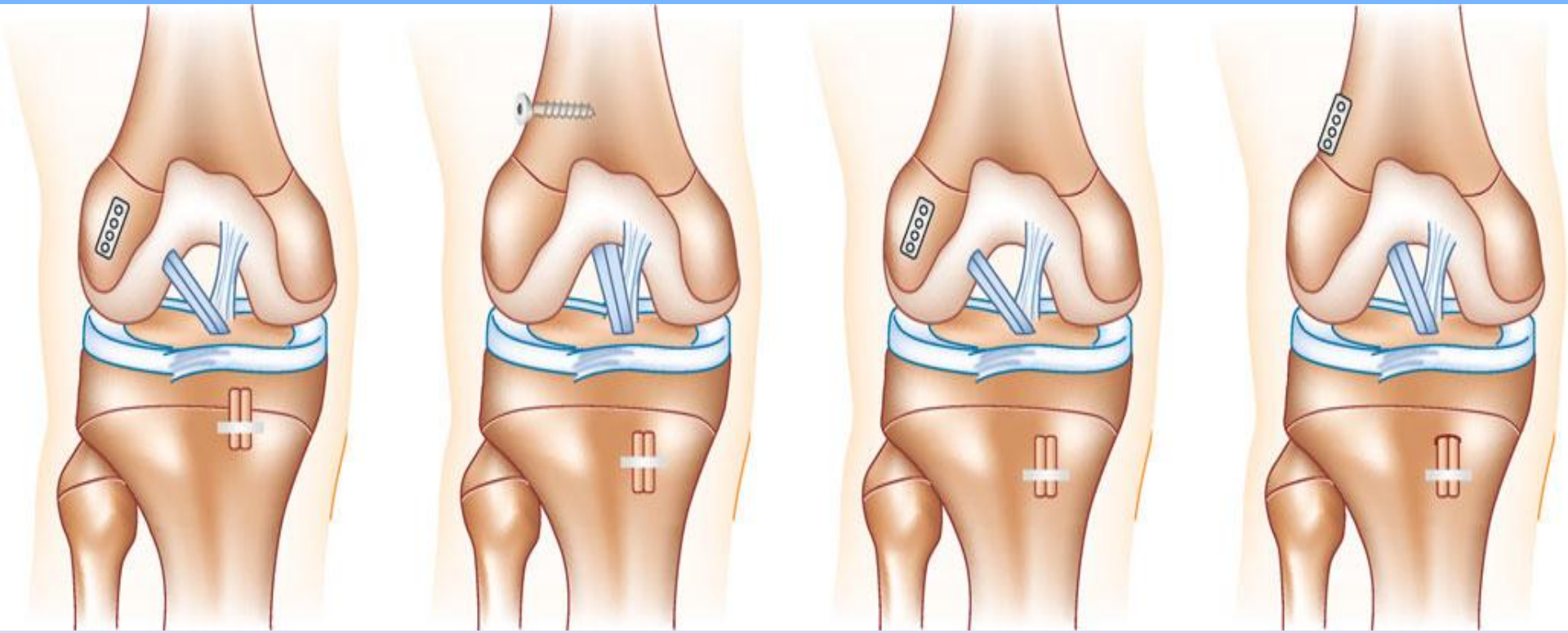
- Increasing incidence
  - Sporting activities
- Longitudinal and bucket handle tears common
- Often associated with ACL tear
- Repair meniscus wherever possible

ACL injuries

- Increasing incidence
- ACL tear present in 47-65% of paediatric knee haemarthrosis*
- Most occur within 6-12 months of skeletal maturity
- Lateral blow to flexed knee
- Reconstruct wherever possible
  - Debate surrounds physeal sparing versus transphyseal techniques

*Stanitski CL, et al. Observations on acute knee hemarthrosis in children and adolescents. JPO 1993;13:506-10.

Paediatric ACL reconstruction



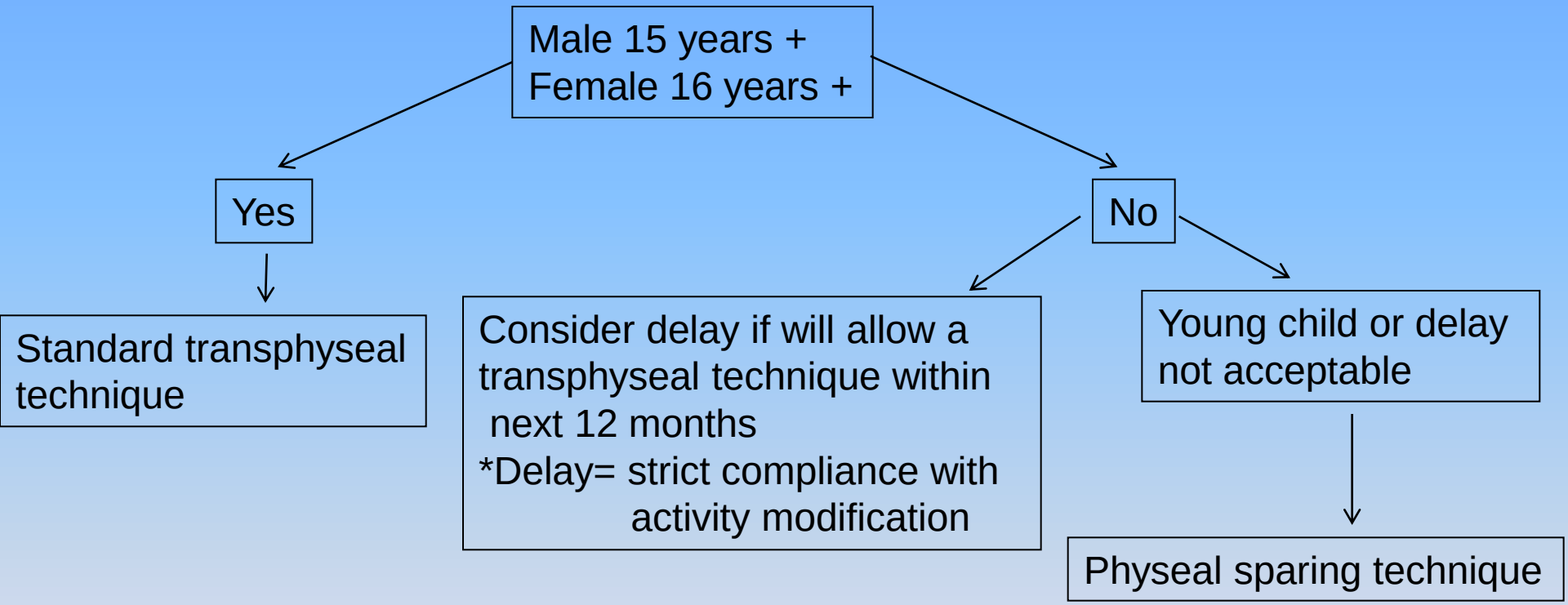
Physeal sparing

Partial transphyseal (over the top)

Partial transphyseal

Complete transphyseal

ACL reconstruction algorithm



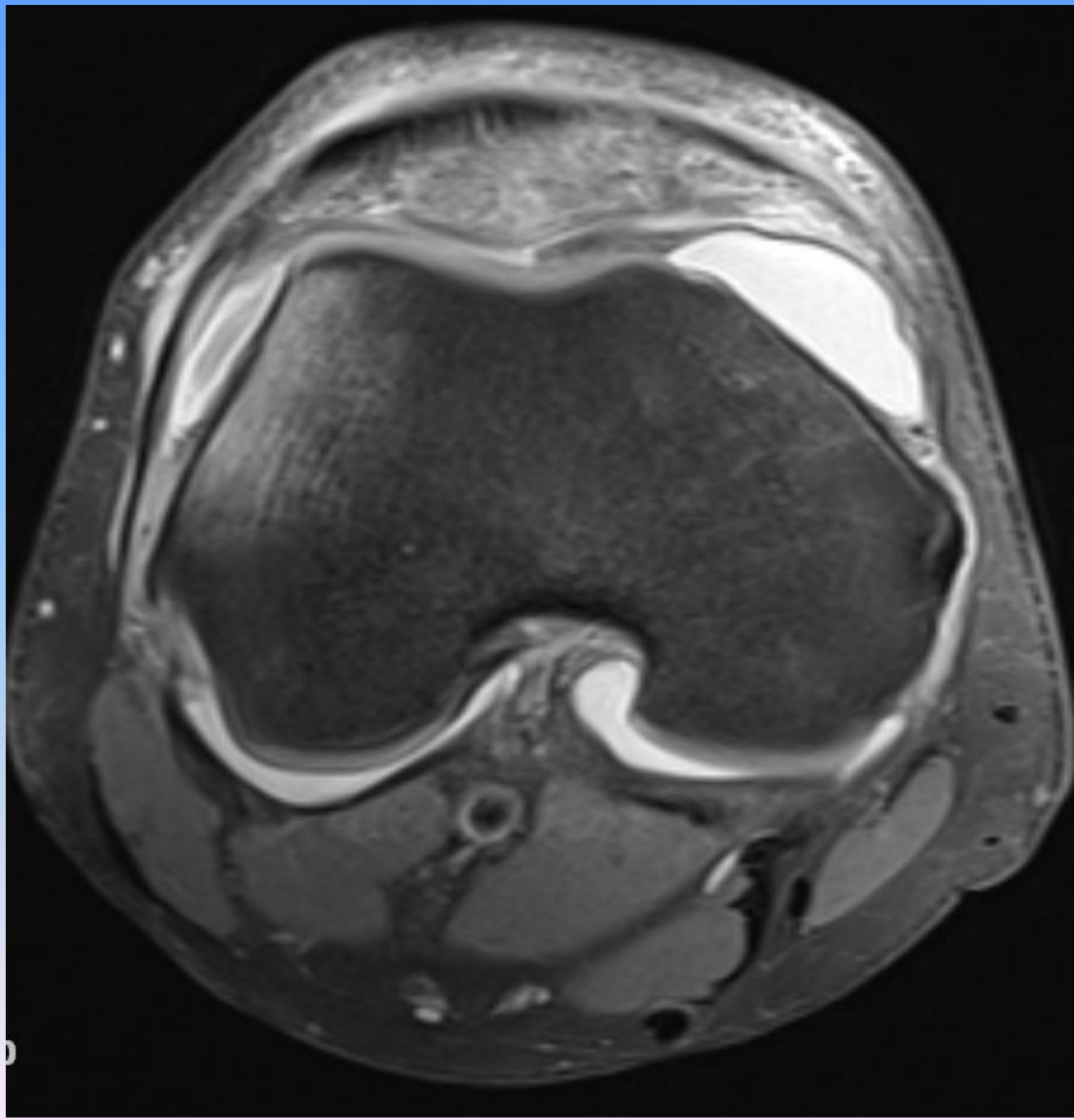
McConkey MO, et al. Curr Rev Musculoskel Med 2011;4:37-44

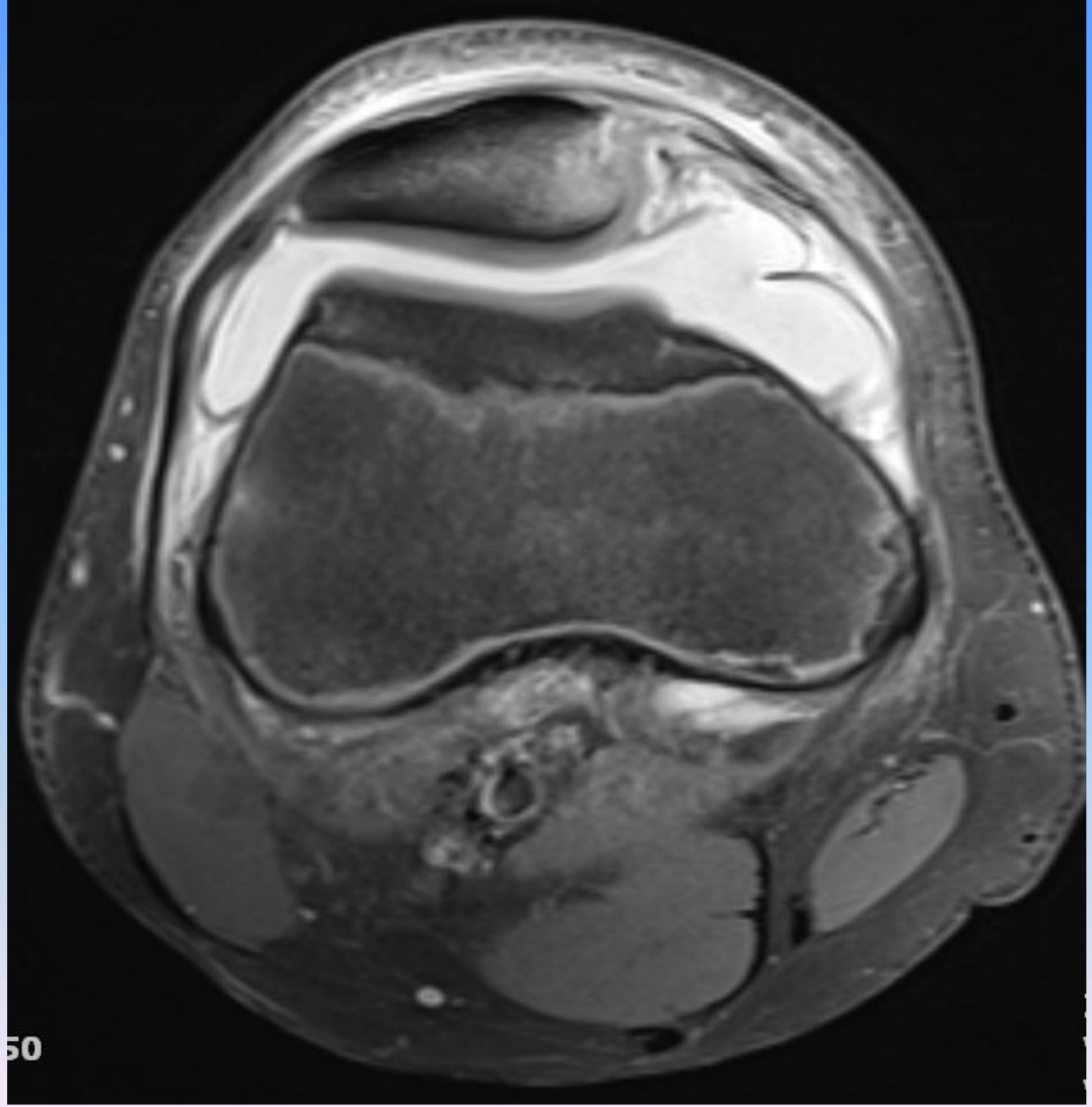
Patella dislocation

- Almost always lateral
- Often reduce spontaneously and present with haemarthrosis
- Immobilise in extension 4 weeks


R
TSB

14 YEAR OLD MALE
F0000708691
MRI- medial retinaculum partial tear only

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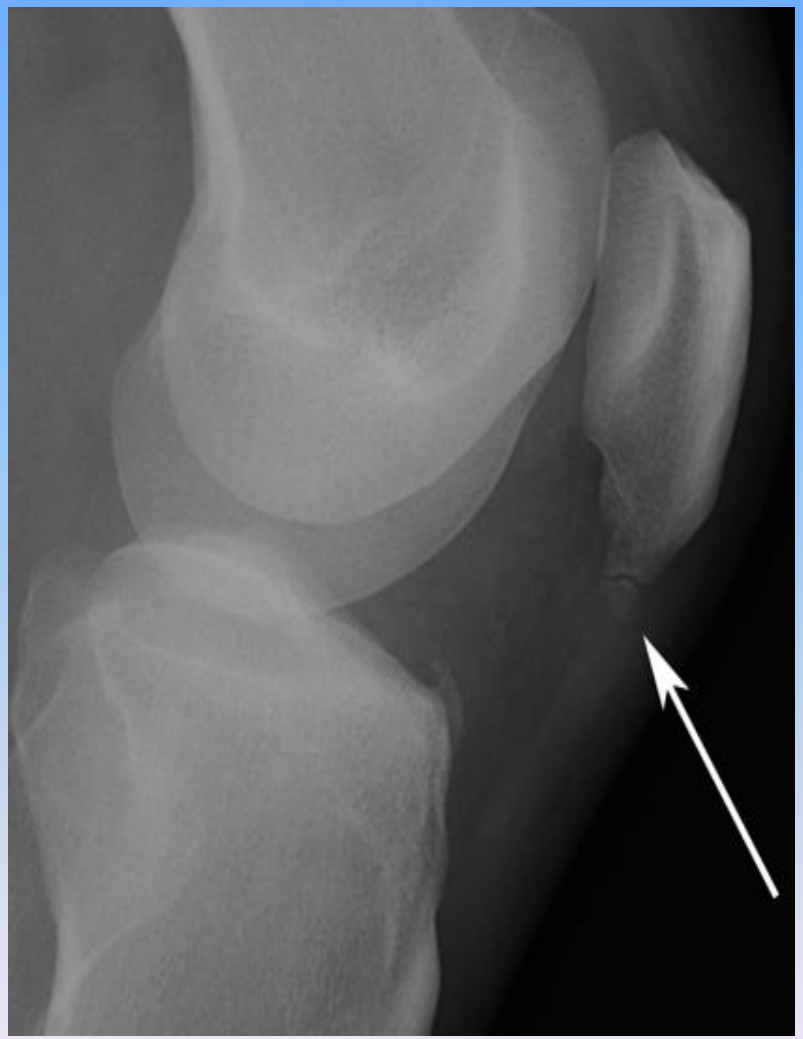
‘Overuse’ conditions

Osgood-Schlatter’s



Sinding-Larsen-Johannsen

Summary

- Paediatric knee injuries are common
- Wide variety of extra- & intra-articular injuries
- Careful neuro-vascular assessment of extra-articular injuries
- Specialist intervention may be required for intra-articular ACL/meniscal tears

Thanks to
Mr Henman & Mr De Gheldhere
for cases

Questions?