The Growing Pains of a Growing Child

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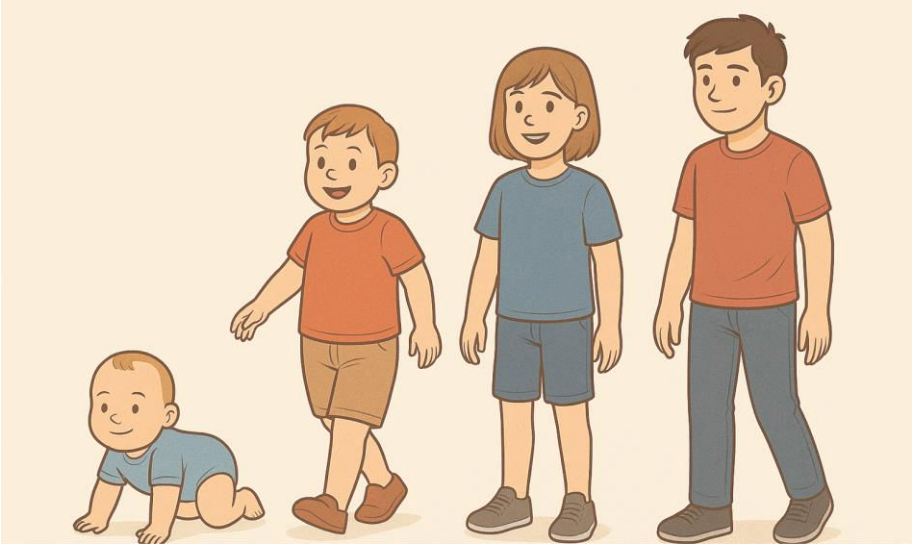
Learning Objectives



1. Discuss age-appropriate musculoskeletal screening techniques during routine well-child visits from newborn through adolescence.
2. Integrate historical and physical examination to assess for atraumatic musculoskeletal conditions in the pediatric population.
3. Determine when musculoskeletal findings warrant specialty referral versus primary care monitoring.
4. Review management of common pediatric musculoskeletal conditions in both the pediatric and pediatric orthopaedic settings.
5. Develop appropriate follow-up and monitoring plans for common pediatric musculoskeletal conditions presenting to primary care.


Newborn/Infant

Assessment of a Newborn

- Head/Neck
- Clavicle
- Upper Extremities
- Chest/Spine
- Hips
- Lower Extremities

Congenital Muscular Torticollis

Definition: Unilateral sternocleidomastoid muscle contracture causing head tilt

Clinical presentation: Head tilted toward affected side, chin rotated to opposite side

Associated findings: May have palpable "pseudotumor" in SCM muscle

Congenital Muscular Torticollis

Physical examination: Assess for plagiocephaly, facial asymmetry

Treatment: Stretching exercises, positioning strategies

Referral: Physical therapy, orthopedic consultation if persistent beyond 6-12 months

Prognosis: Most cases resolve with conservative management

Plagiocephaly

Nonsynostotic

- Deformational (positional) plagiocephaly:
  - Flattening due to persistent pressure to one part of the head
  - Intrauterine positioning and postnatal “Back to Sleep”
  - Associated with congenital torticollis

Synostotic

- Unilateral craniosynostosis
  - Sagittal, Coronal, Metopic, Lambdoid
- Palpable suture ridge
- Early referral to craniofacial center recommended

Typically, a clinical diagnosis: best viewed from above

AAP

Plagiocephaly

- Imaging
  - 4-view radiographic series
  - CT may be needed

- Treatment
  - Patient education is key: Repositioning
  - Nonsurgical: PT (mild-moderate) or helmet orthosis (severe/craniosynostosis)
    - Stretching/PT particularly beneficial with underlying torticollis

Hips

Developmental Dysplasia of the Hip (DDH)

- Commonly referred to as hip dysplasia
- Disease spectrum: Laxity, subluxation, dislocation
- Most common orthopaedic disorder in newborns
- Epidemiology: Left hip most commonly affected (bilateral 20%)

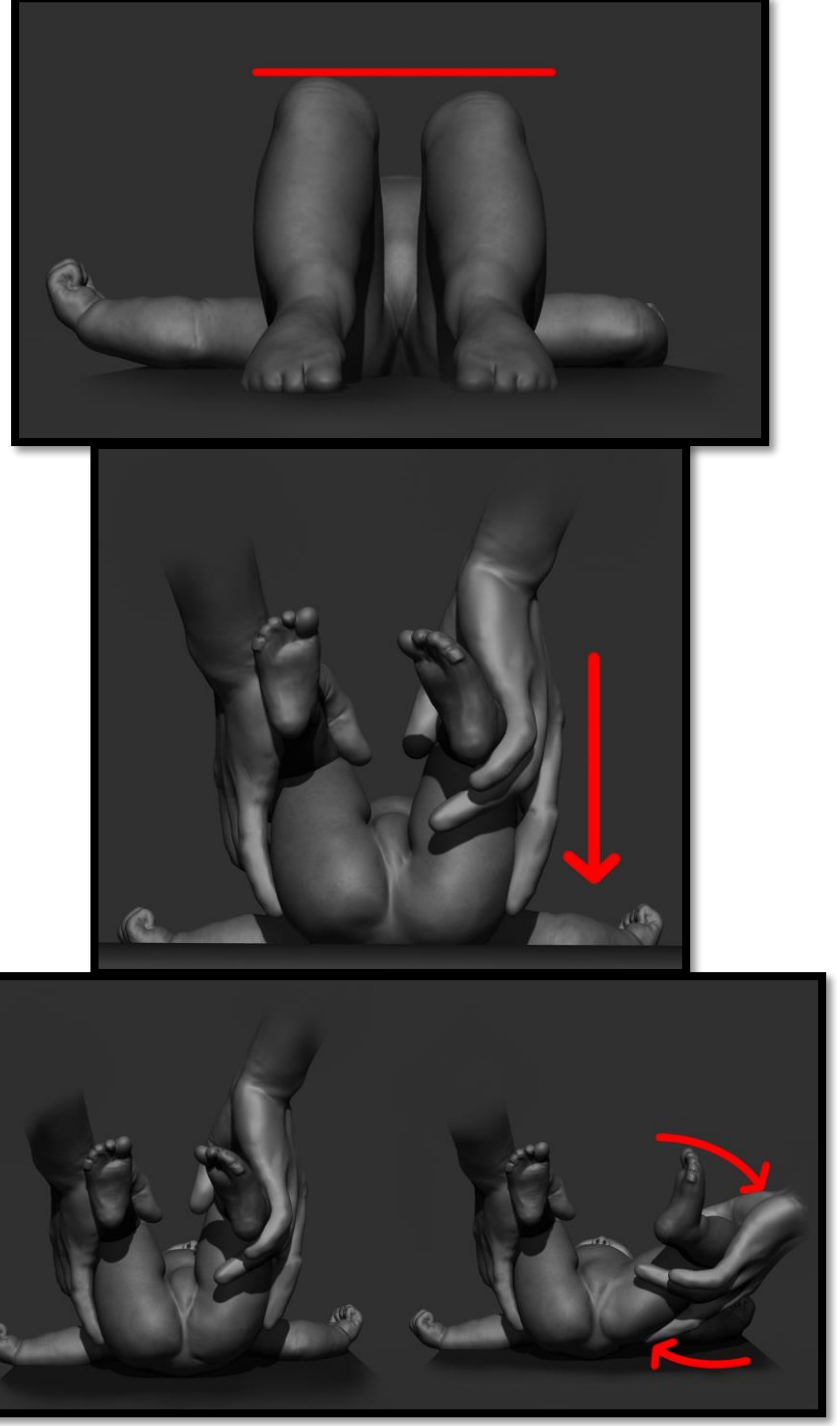
Risk: BFFF

- **B**reech
- **F**irst born
- **F**emale
- + **F**amily hx

- Associated conditions: congenital muscular torticollis and metatarsus adductus

DDH: Physical Exam

- Galeazzi:
  - Apparent limb length discrepancy while supine and knees flexed at 90 degrees
  - May be consistent with unilateral dislocated hip
- Barlow:
  - Provocative maneuver
  - Flexion, adduction, and provide posterior pressure to the joint
- Ortolani:
  - Reductive maneuver
  - Flexion, abduction, and place posterior pressure to lift the greater trochanter



DDH: Physical Exam Tips

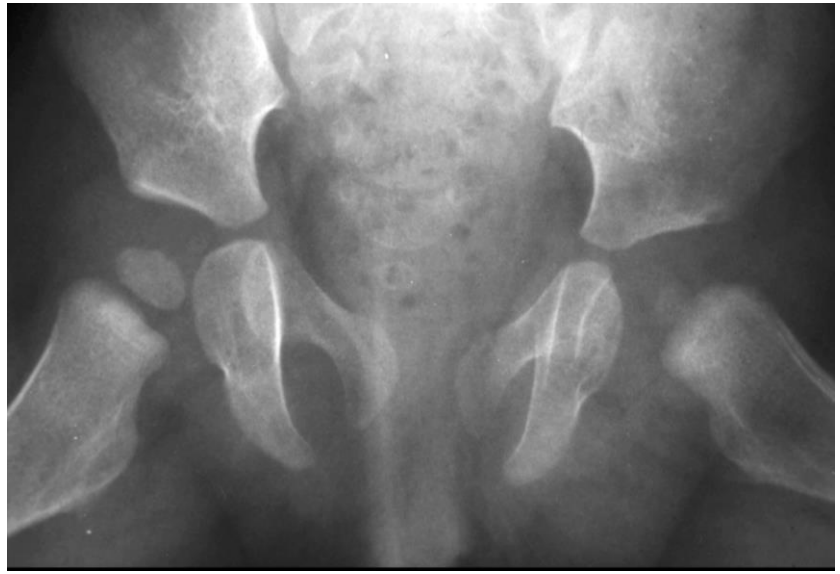
- Remove diaper for exam
- Evaluate one hip at a time while stabilizing the contralateral hip
- Findings are often better felt than heard
  - A click is not a clunk

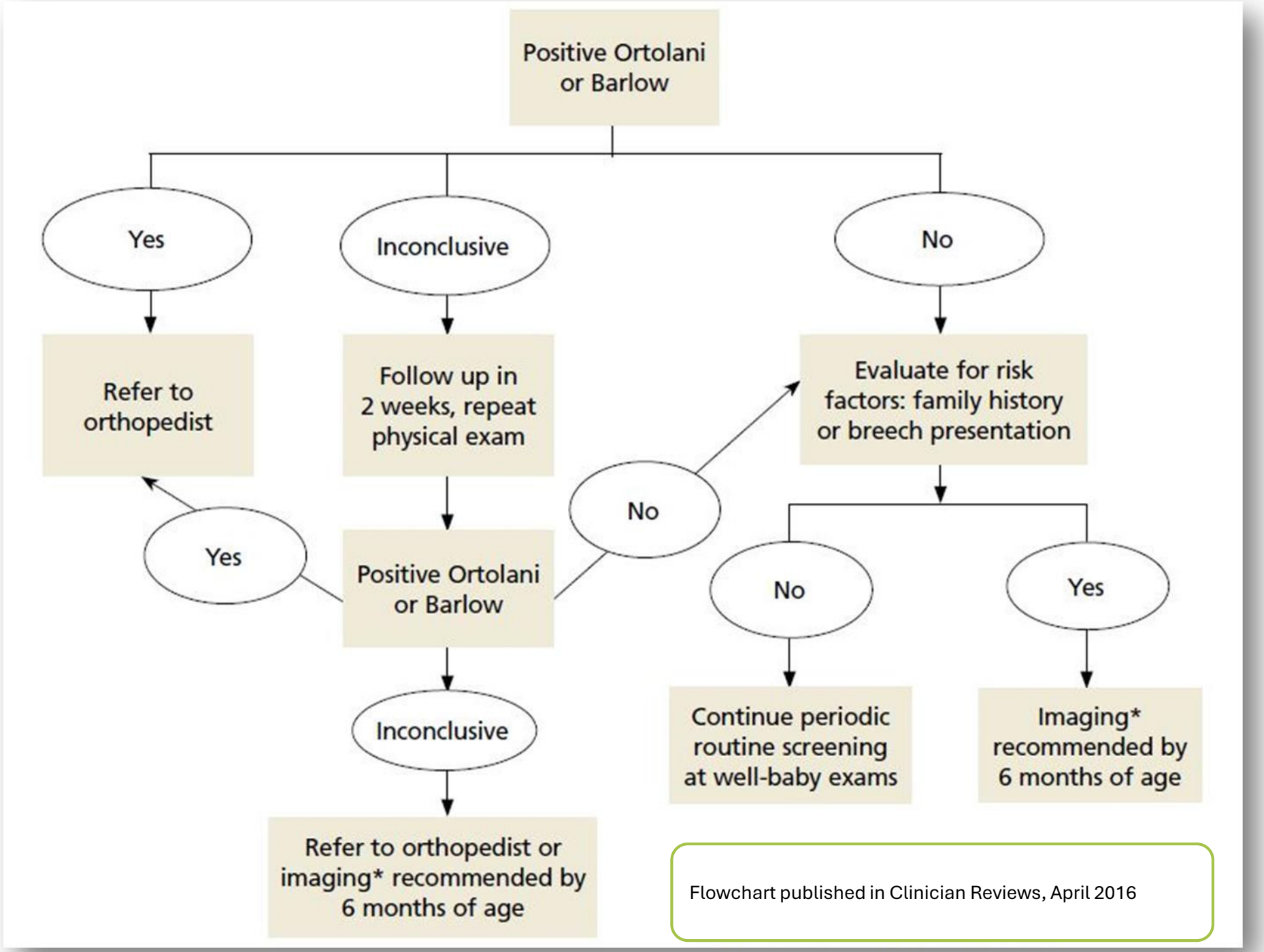
- After 8 weeks: Limited hip abduction becomes most sensitive finding

- Later signs: Leg length discrepancy, asymmetric thigh folds, Galeazzi sign

DDH: Imaging

- Ultrasound is diagnostic test of choice for infants
  - Requires dynamic stress testing by skilled provider
  - Recommended after 3-4 weeks
- Radiography preferred after 4-6 months
- Referral indications
  - Overtly dislocated/dislocatable hips: immediate orthopedic referral
  - Infants with significant risk factors: imaging before 6 months





Flowchart published in Clinician Reviews, April 2016

Photo Courtesy of Trent Tipton

DDH

Management

- Early diagnosis (before 3 months): Abduction bracing effective in 90% of cases
  - Treatment should be implemented before 6 weeks
- Delayed diagnosis (after 4-6 months): Often requires surgery and spica casting for up to 6 months

- Long-term consequences: Early hip osteoarthritis if untreated

DDH

Patient Education

- Patient compliance is essential
  - Frequent appointments to ensure harness fit and evaluate femoral nerve function
- Discuss appropriate baby carriers
- Educate on proper position and methods for diaper changes to avoid stress on the hips
- Safe swaddling technique should be recommended for all patients with DDH or at risk for developing DDH

INTERNATIONAL HIP DYSPLASIA INSTITUTE

Metatarsus Adductus

- Most common congenital foot deformity
- Medial deviation of forefoot
  - Deep medial crease
- Risk factors: first-born, family history, multiple gestation
- Imaging not required unless deformity persists as a toddler
- Treatment not required in 90% of cases

AAFP

Clubfoot:
Congenital Talipes Equinovarus

- Rigid foot deformity
- Risks: FHx, maternal smoking
- Bilateral vs Unilateral
  - Affected limb will have smaller foot and calf with shortened tibia

Clubfoot: Congenital Talipes Equinovarus

- Refer early!
- Nonsurgical Treatment: Ponseti Method (Manipulation and Casting)


Toddlers/Preschool

Gait Variations

History: Age of onset, progression, family history, functional impact

Physical examination:

- Rotational profile
  - Hip internal/external rotation in prone position
- Foot progression angle
- Thigh-foot angle (normal: -5° to +30°)
- Assess for asymmetry and joint laxity

Gait Variations: In-toeing

Three primary causes:

- Metatarsus adductus (infancy): Medial deviation of forefoot
- Internal tibial torsion (1-3 years): Measured by thigh-foot angle
- Femoral anteversion (3-8 years): Assessed by internal/external hip rotation

- Natural history: Most resolve spontaneously by age 8-10 years

- Physiologic Bowing accentuates in-toeing and vice-versa!

Out-Toeing: Femoral Retroversion

Gait Variations

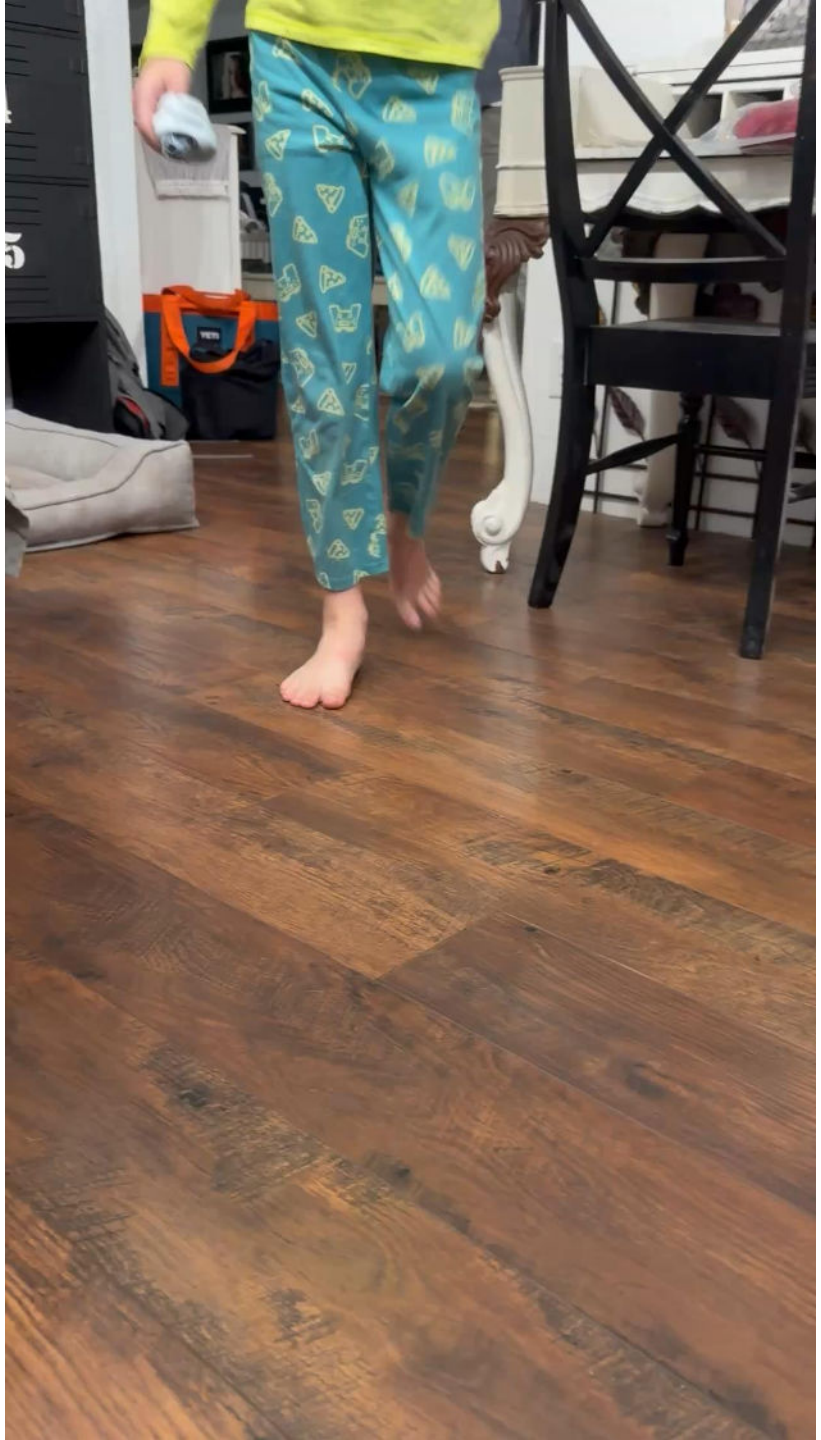
- Reassurance: Most are normal developmental variants
- No strong evidence supporting orthotics or braces

- Referral indications
  - Measurements >2 standard deviations outside normal
  - Pain or functional impairment
  - Asymmetric findings
  - Persistence beyond expected age of resolution
  - Other underlying concerns

Toe Walking

- Idiopathic toe walking: diagnosis of exclusion
- Differential diagnosis: Cerebral palsy, muscular dystrophy, Achilles contracture, autism spectrum disorder
- Evaluation: Neurologic examination, assess ankle dorsiflexion with knee flexed and extended
- Management: Observation for mild cases
  - Physical therapy, serial casting, or surgery for persistent contractures

Toe Walking



Bowlegs (Genu Varum)

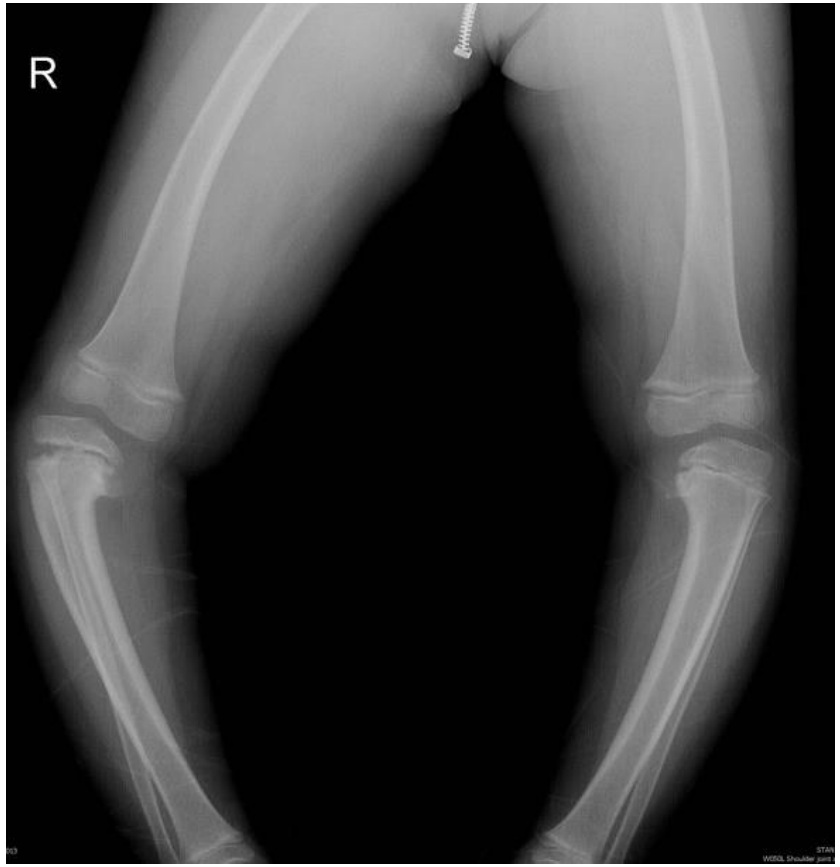
- Physiologic genu varum
  - Normal from birth, peaks at 12-18 months
  - Typically resolves by age 2-3 years
  - Bilateral and symmetric

- Pathologic causes: Blount disease, rickets, skeletal dysplasias

- Measurement: Intercondylar distance with ankles together

Bowlegs: Blount Disease

- Definition: Progressive pathologic genu varum centered at proximal tibia
- Types: Infantile (1-3 years), juvenile (4-10 years), adolescent (>11 years)
- Radiographic findings: Medial tibial metaphyseal beaking, fragmentation
- Management: Bracing for infantile form if diagnosed early but often requires surgery



Case courtesy of Fakhry Mahmoud Ebouda, Radiopaedia.org, rID: 38684

A Few Traumatic Considerations in the Age Group...

Case courtesy of Dr Jeremy Jones, Radiopaedia.org, rID: 23981

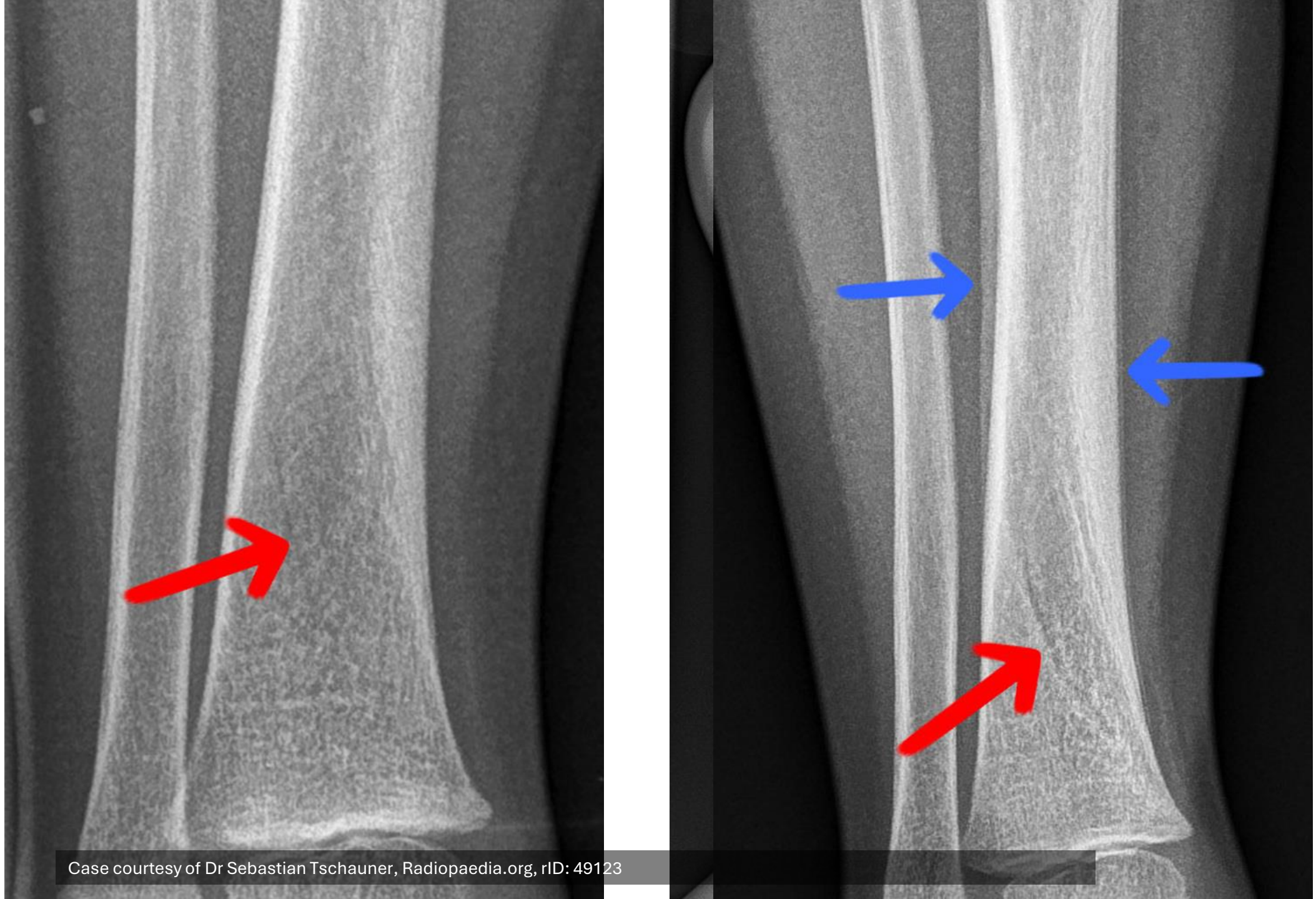
Toddler with a Limp
Think Toddler Fracture

Minimal or nondisplaced tibia spiral fracture

Most common in
9 months - 3 years

Slides are common MOI

OCCULT TODDLER FRACTURE



Case courtesy of Dr Sebastian Tschauner, Radiopaedia.org, rID: 49123

Tips for Toddler Fracture

- Often subtle Treat based on clinical presentation
  - Limp or refusal to weight bear (often mista for a foot injury)
  - Pain with palpation along tibia and with attempts at dorsiflexion

- Recommendation to have removable boot
  - Parents are able to adjust and minimize prolonged pressure and skin breakdown

- Educate on safe use of slides

Radial Head Subluxation

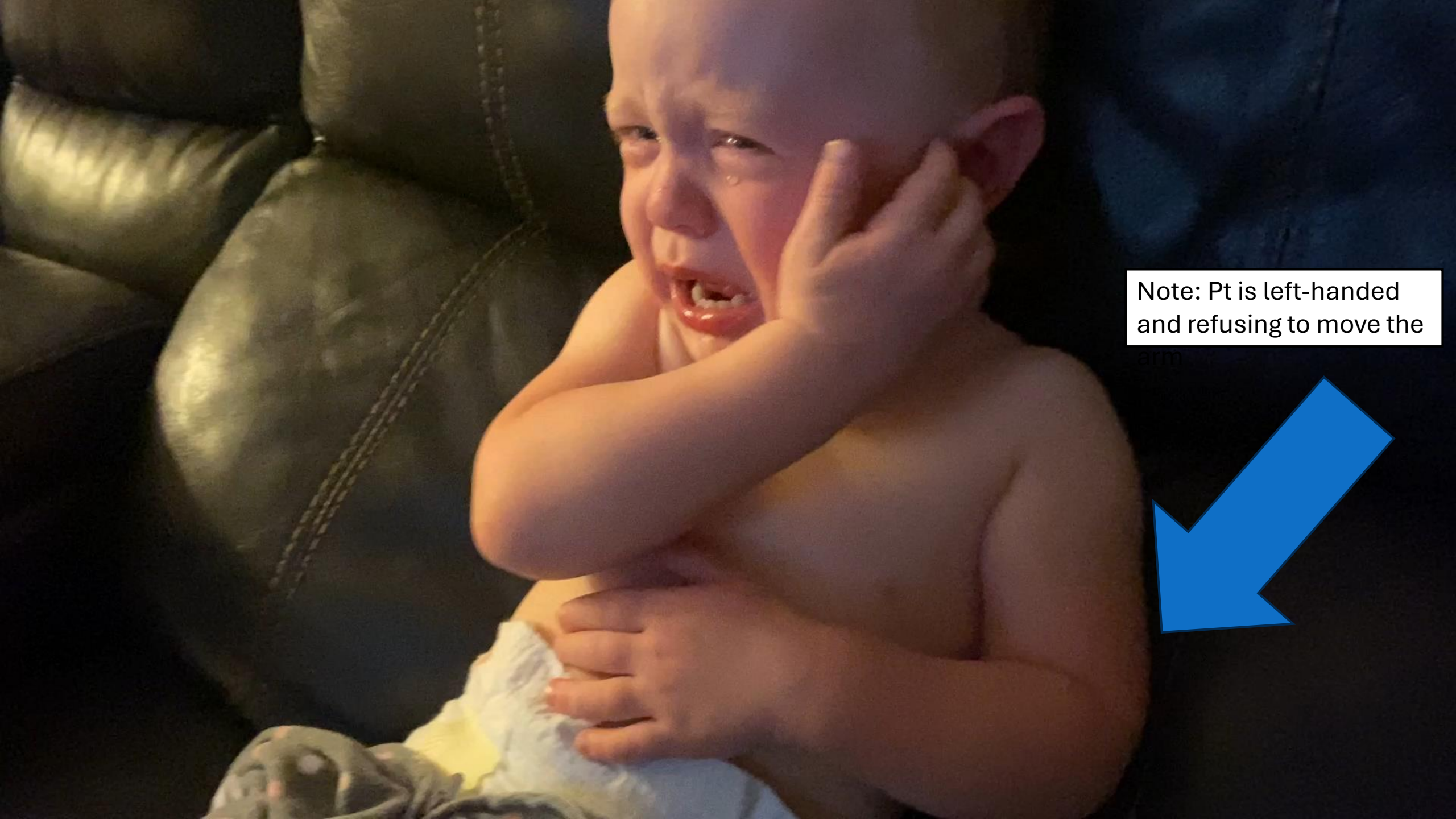
"Nursemaid's elbow"/ "pulled elbow"

- >80% occur between 1-3 years of age
- MOI: Sudden pull of pronated arm

Clinical Presentation:

- Pain increases with attempts to supinate
- Arm either fully extended or slightly flexed and pronated
- Overall refusal to use arm but may use fingers

*Young children may complain of **wrist pain with radial head trauma**


Note: Pt is left-handed and refusing to move the arm

Nursemaid's Elbow


Motion returns following successful reduction

School-Aged

Knocked Knees (Genu Valgum)

- Physiologic genu valgum:
  - Peaks at age 3-4 years
  - Gradually improves with adult alignment by age 7-8 years
  - Bilateral and symmetric
- Observation for physiologic variants within normal range
- No role for bracing or orthotics

- Referral indications:
  - Difficulty for ambulation
  - Underlying concerns: Rickets
  - Unilateral/Asymmetric

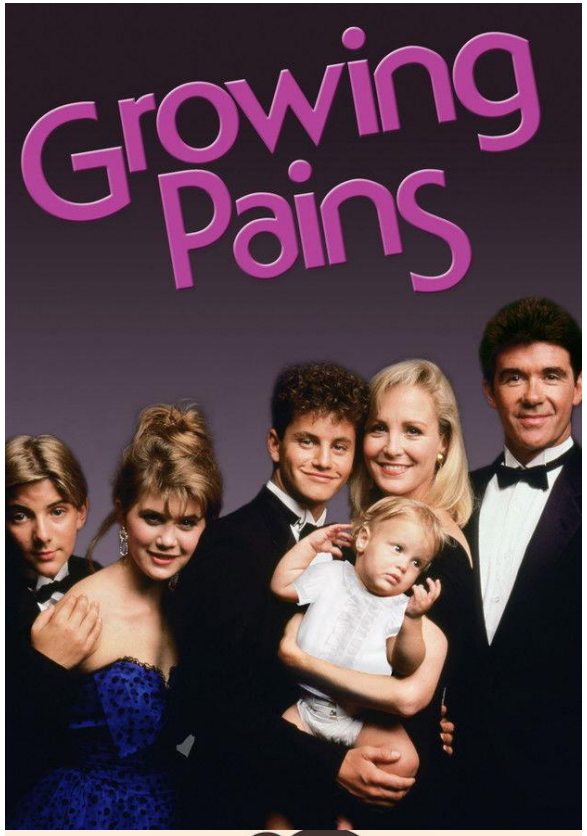
Case courtesy of Ian Bickle, Radiopaedia.org, rID: 51638

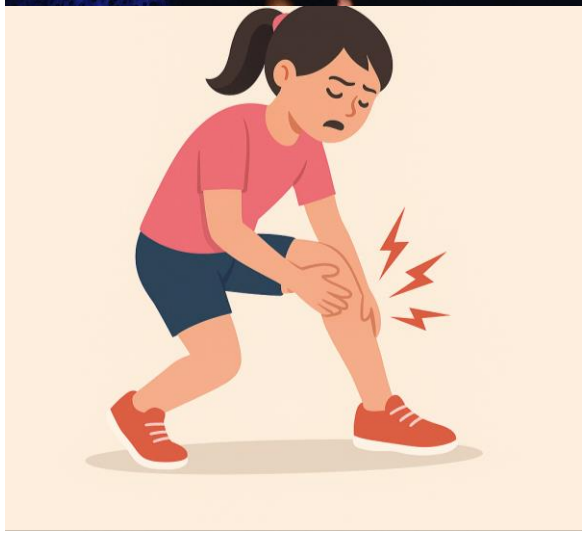
Growing Pains

- Definition: Benign limb pain of childhood
  - Diagnosis of exclusion

- Epidemiology: Affects 10-20% of school-aged children

- Clinical presentation:
  - **Bilateral**, intermittent leg pain (thighs, calves, behind knees)
  - Occurs in late afternoon/evening or awakens child from sleep
  - Normal physical examination with no objective findings
  - Pain resolves by morning and does not limit daytime activities





Growing Pains

- Diagnostic criteria:
  - Bilateral leg pain without joint involvement
  - Normal physical examination and gait
  - No systemic symptoms (fever, weight loss, fatigue)
  - Pain does not persist into daytime
- Red flags requiring further evaluation: Unilateral pain, joint swelling, limp, systemic symptoms, abnormal examination
- Management: Reassurance, massage, stretching, heat application; acetaminophen or ibuprofen for severe episodes

Pediatric Hip

Legg-Calvé-Perthes Disease

- Definition: Idiopathic avascular necrosis of the femoral head
- Epidemiology: Peak age 4-8 years. Male-to-female ratio 4:1
- Clinical presentation:
  - Often a painless limp
  - Insidious onset of hip or knee pain with painless or antalgic limp
  - Limited hip abduction and internal rotation
  - Pain worsened by activity

Perthes

Imaging

- Radiographs (AP pelvis and frog laterals)
  - ‘Plain radiographs are often initially normal
  - Mainstay for diagnosis and monitoring condition

- MRI: More sensitive for early detection
  - Perfusion MRI shows promise for prognostication

Case courtesy of Dr Mohammad Taghi Niknejad, Radiopaedia.org, rID: 54156

Gradual Course of Perthes

Stages

- Initial Phase (necrosis)
- Fragmentation
- Re-ossification
- Healed (remodeling)

Perthes

Management

- Age of onset best prognostic factor
  - Younger age at presentation = better outcome
- Goal: Symptomatic control and preserve hip function
- Referral: All suspected cases require orthopedic consultation
  - Treatment recommendations are controversial
    - Nonsurgical Options: Observation, activity restrictions, PT
    - Surgical intervention early vs late

Emergent Hips (more to come…)

- Septic Hip
- Slipped Capital Femoral Epiphysis (SCFE)


Adolescent

Scoliosis

- Lateral curve of the spine > 10º
- Rotational component
- Idiopathic, W>M
  - Congenital/Infantile: 0-3 years
  - Juvenile: 4-9 years
  - **Adolescent: ≥10 years**
  - *Neuromuscular

Scoliosis

- Clinical presentation
  - Often asymptomatic and detected on routine examination
  - Shoulder height and pelvic asymmetry
  - Scapular prominence, rib hump with forward bending
  - Need to assess for limb length discrepency

- Adams forward bend test
  - Patient bends forward at waist with arms hanging
  - Observe for asymmetric rib or paraspinal prominence

- Neurologic examination: rule out underlying neuromuscular causes

Scoliosis

- Radiographic evaluation:
  - Standing posteroanterior and lateral spine radiographs
  - Cobb angle
  - Risser sign: Assesses skeletal maturity (grade 0-5 based on iliac apophysis ossification)

- Additional imaging:
  - MRI indicated for: Atypical curves (left thoracic), rapid progression, neurologic findings, early onset (<10 years)

Scoliosis

Management

- TLSO Brace: Boston, Milwaukee, Charleston Bending
  - 25 degrees
- Surgery
  - 45 degrees
  - Internal rod fixation

Risk factors for progression

- Female sex (7-10 times higher risk for progression)
- Younger age at diagnosis
- Skeletal immaturity (Risser grade 0-2), premenarchal status in girls
- Larger curve magnitude at presentation


Traction Apophysitis

Tractional Apophysitis

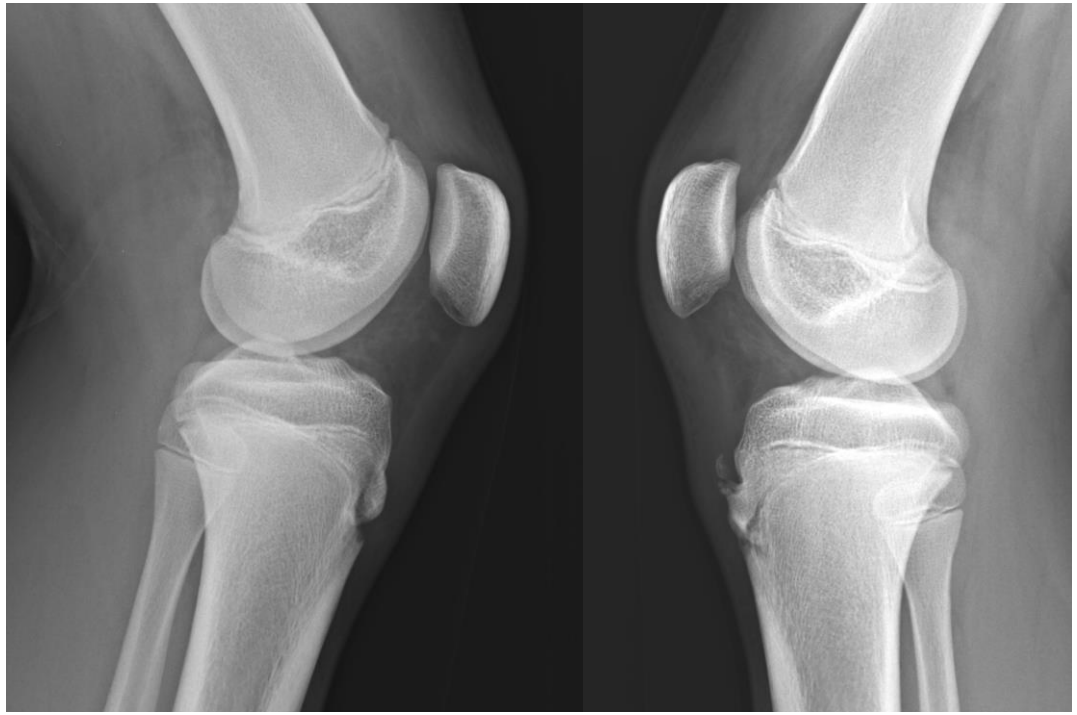
- Definition: Traction injury to cartilage and bony attachment of tendons at apophyses
- Pathophysiology: Repetitive stress during growth when apophysis is weaker than surrounding structures and imbalance between training loads and recovery
- Risk factors: Rapid growth, tight/inflexible muscle-tendon units, overuse, high-impact sports, cleats!

- Common locations: Tibial tubercle (Osgood-Schlatter), calcaneus (Sever's), patella (Sinding-Larsen-Johansson),
  - Others: medial epicondyle, anterior inferior iliac spine

Osgood-Schlatter's Disease

- Definition: Apophysitis of the tibial tubercle at patellar tendon insertion
- Epidemiology:
  - Peak age 12-15 years in boys, 10-13 years in girls
  - Point prevalence 10% in general population ages 12-15 years
  - Lifetime incidence 13%; significantly higher in athletes
- Clinical presentation: Anterior knee pain worsened by running, jumping, kneeling; tender, prominent tibial tubercle

Osgood-Schlatter's Disease



Asymptomatic Symptomatic

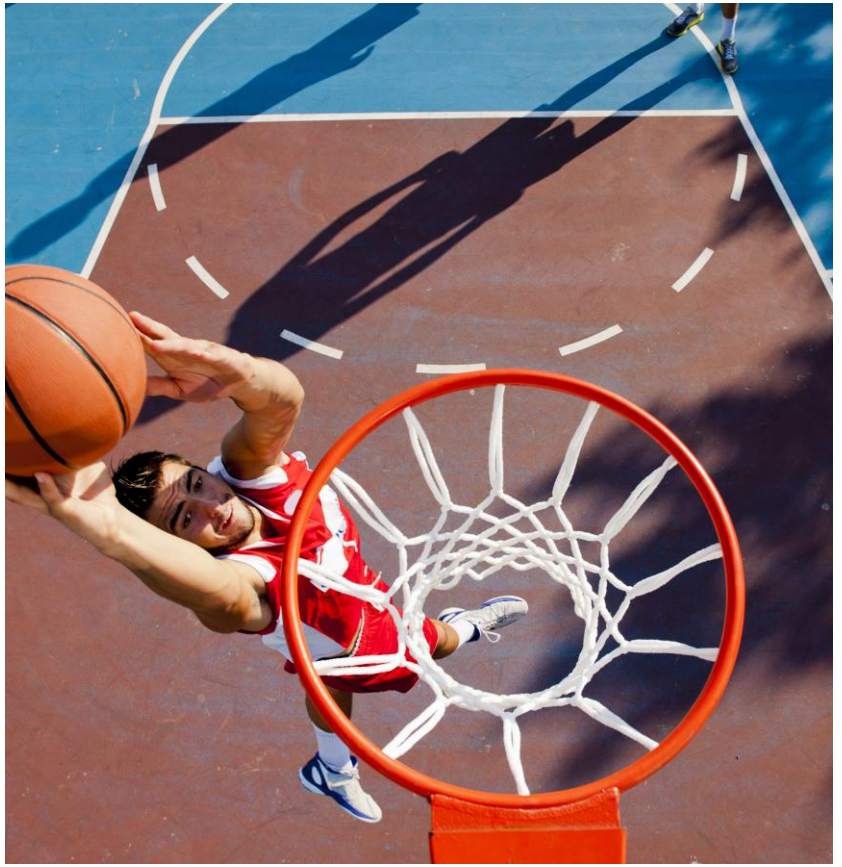
Case courtesy of Dr Maulik S Patel, Radiopaedia.org, rID: 10135

- Diagnosis: Clinical diagnosis
- Radiographs PRN
  - Lateral x-rays used to r/o avulsion
- Conservative treatment (successful in >90% of cases)
  - Relative rest and activity modification
  - Quadriceps and hamstring stretching (key preventive measure)
  - Ice after activity
  - NSAIDs for pain (limited use)
  - Patellar tendon strap or knee pad for symptom relief
- Prognosis: Self-limiting.
  - Resolves with physeal closure.

Sinding-Larsen-Johansson (SLJ) Syndrome

- Commonly referred to as pediatric jumper's knee
- ~10-14 years of age
- Caused by repetitive traction of apophysis at the inferior pole of patella (vs patellar tendonitis in jumper's knee)

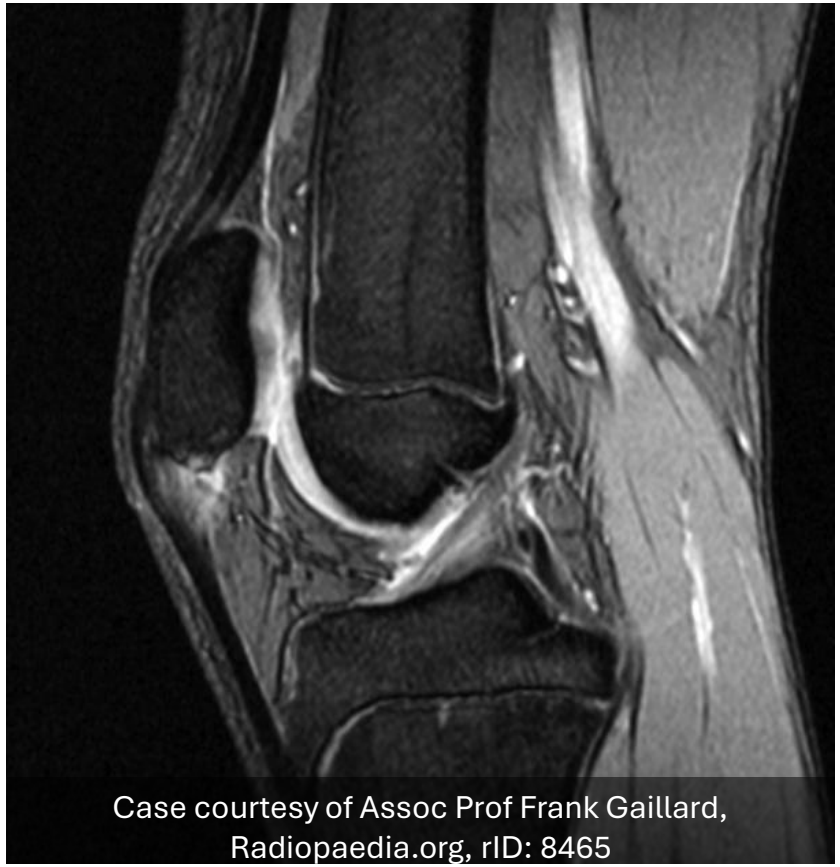
- Clinical Presentation:
  - Focal tenderness inferior pole of patella
  - Enlargement or bony protrusion of tibial tubercle



Sinding-Larsen-Johansson (SLJ) Syndrome

- Diagnostics:
  - Radiographs: typically normal, spurring?
  - MRI: indicated if dx unclear

- Management: Usually, self limited
  - Activity modifications, ice, NSAIDs
  - PT



Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 8465

Calcaneal Apophysitis (Sever's Disease)

Irritation, inflammation of calcaneal apophysis

- Overuse syndrome

Typically seen in ages 6-12

- Common in soccer players and gymnasts

Clinical Presentation:

- Most common cause of heel pain in kids
- Limp after activity and pain at calcaneal apophysis (may extend up achilles)

Calcaneal Apophysitis (Sever's Disease)

DX: Squeeze test

Mediolateral compression

Imaging: typically, not needed for diagnosis

Management:

- Achilles/Hamstring stretches, PT
- Ice, NSAIDs
- +/- Heel cups, X braces
- Boot or cast if unresponsive

Case courtesy of Dr Fateme Hosseinabadi, Radiopaedia.org, rID: 69971

Patellofemoral Pain Syndrome (PFPS)

- Definition: Anterior knee pain without structural pathology.
  - Pain originates from patellofemoral joint
- Epidemiology: Most common cause of anterior knee pain in later adolescence after tibial tubercle maturation

- Clinical presentation:
  - Anterior knee pain worsened by running, stairs (especially descending), prolonged sitting
  - Pain with squatting or kneeling
  - May have crepitus but no effusion

PFPS

- Imaging not routinely required
  - Consider if no response to treatment
- First-line treatment
  - PT: quadriceps and hip abductors, gait retraining
- Adjunctive therapies for short-term pain relief
  - Patellar taping combined with exercise
  - Braces/sleeves
  - Short course of NSAIDs


Questions?

Resources

- AAOS: http://www.aaos.org/
- POSNA: https://posna.org/
- AAFP: http://www.aafp.org/
- International Hip Dysplasia Institute: http://hipdysplasia.org/
- Radiopaedia: http://radiopaedia.org/
- Radiology Assistant: http://www.radiologyassistant.nl
- OrthoBullets: https://www.orthobullets.com
- Stanford Newborn Physical Exam Images: https://med.stanford.edu/newborns/professional-education/photo-gallery.htm
- BonePit: normal xrays based on age and sex

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