The Annual General Pediatric Review & Self Assessment

ORTHOPEDICS/ SPORTS MEDICINE

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Disclosure of Relevant Relationship

Dr. Baitner has not had (in the past 24 months) any relevant conflicts of interest or relevant financial relationship with the manufacturers of products or services that will be discussed in this CME activity or in his presentation.

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“Suggested Topics To Be Covered in the Orthopaedic Section:”

- Sprains/Strains (Sports Injuries)
- Fractures (Greenstick, Clavicle, Spiral, Distal Humerus) & Fracture Complications
- Radial Head Subluxation
- Developmental Dysplasia of the Hips
- SCFE, Legg-Calve-Perthes, Osteo Dessicans
- Scoliosis, Back Pain

Orthopaedic Problems

- 20 % pediatric visits for musculoskeletal complaints
- PCP participates in management
  - Know pitfalls
  - Avoid over/under referral
  - Avoid unnecessary tests/treatments

Diagnosis

- History – Mom knows (best)
- Physical examination
  - Think of existing normal anatomy
  - Normal – Wide range, age related
  - Signs of disease
    - Swelling vs effusion
    - Tenderness – local/diffuse
    - Errythema
    - Heat

Diagnosis

- Lab – Simple tests (CBC, ESR, CRP)
- X-ray
  - Before “high tech”
  - Two orthogonal views
  - Growing bones have “extra” bones

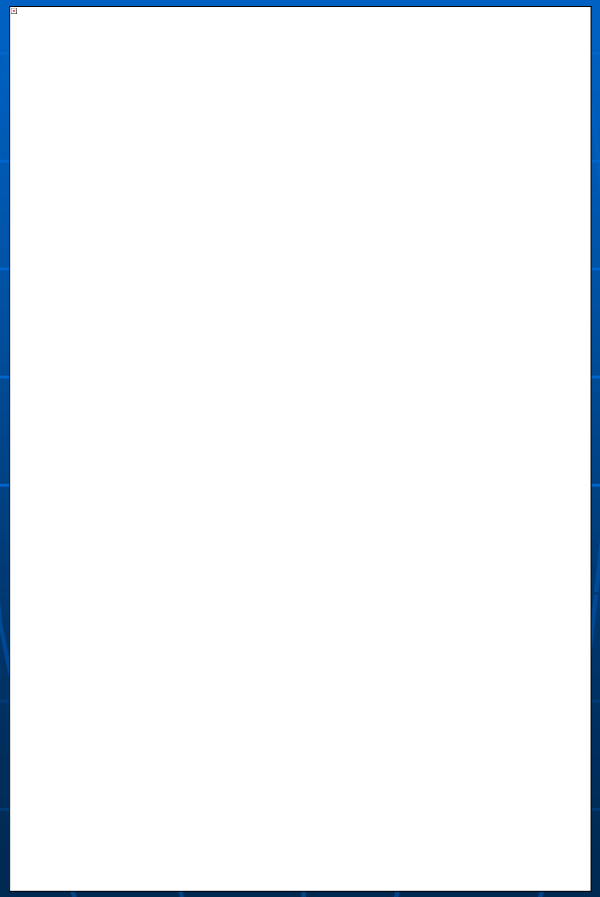
Diagnosis

- Bone scan
  - Non-specific – bone turn over
  - Increase blood flow
  - Inflammation
  - Fracture, infection, growth

Diagnosis

- Ultrasound
  - Shows interfaces
  - Fluid
  - Cartilage surfaces
  - Bone hides all below
- MRI
  - Can imply inflammation/tumor
  - Soft tissue definition/bone marrow edema
  - Is predictive
  - Interpreter prejudice

How some parents seem to see their children



Intoeing

- Foot: Metatarsus adductus, clubfoot
- Leg: Internal tibial Torsion
- Hip: Femoral anteversion/external rotation contracture of hip

Assessing Intoeing

- Constant or intermittent
- Improving or remaining same
- Family history of same
- Foot Progression Angle
  - Angle foot makes w/ line of progression
  - Normal about 0 to 30º external rotation

Intoeing by age

- Metatarsus Adductus
- INTERNAL Tibial Torsion
- Femoral ANTEversion

Metatarsus Adductus (MTA)

- Medial deviation of the forefoot
- Measure "heel bisector line (HBL)"
  - Normal = 2nd toe
- Begin Serial casting before 9 months
- Surgery rarely necessary

Classification of MTA

- Rigid Vs Flexible
  - HBL — Web Space
  - Normal — 2-3
  - Mild — 3-4
  - Moderate — 4-5
  - Severe — >5

Treatment of MTA

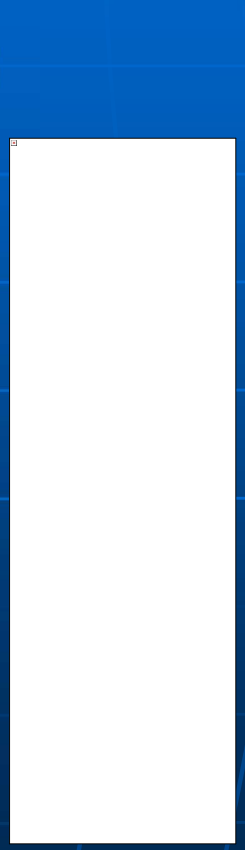
- Treat rigid, ≥ moderate
- Beware heel valgus!
- Serial casting prior to age 9 months
- Maintain w/ straight-last shoes
  - Avoid
    - Denis-Browne bars
    - Reverse-last shoes

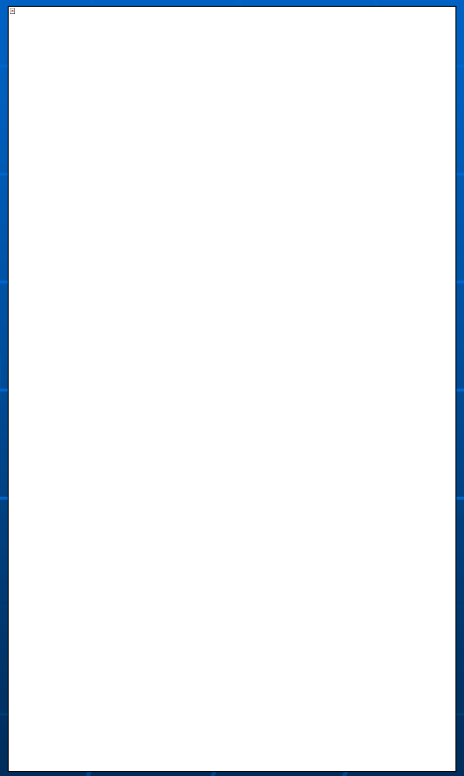
MTA Surgery

- Age Procedure
- 1-3 Medial soft-tissue release
- 4-6 Cuboid osteotomy
- >7 Medial cuneiform osteotomy
- **Not me!** MT base osteotomies
- MT base capsulotomies

Internal Tibial Torsion (ITT)

- Common before age 3
- May walk w/ knees externally rotated
- Diagnose by Thigh-foot-angle
  - Normal 0 to 30º external
- X-rays not helpful unless Blount's disease suspected





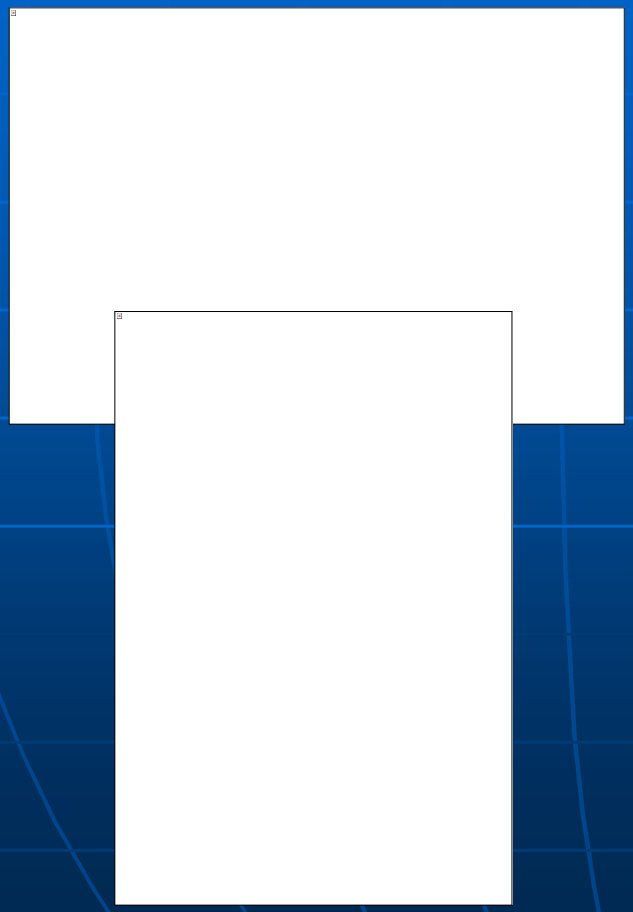
Treatment of ITT

- >90% spontaneously correct by age 5 yrs
- Braces are unproven-expensive
  - Internal tibial torsion brace
  - Dennis-Browne Bar
  - Occasionally used for TFA >- 20º
- Surgical intervention (tibial osteotomy)
  - >-15º TFA after age 5 and symptomatic

Femoral Anteversion

- Normal anatomical development
- Axis of head and neck of femur compared to transverse axis of femoral condyles
  - 40º at birth
  - 15º at maturity
- Radiographs not helpful

Excessive Femoral Anteversion



- Intermittent intoeing
  - Fatigue
  - Running
- W-sitting common
- Diagnosed clinically
  - Hip internal rotation > 70º
  - Hip external rotation < 30º

Excessive Femoral Anteversion

- Intoeing resolves in 90% by age 8
- No brace or shoe modifications changes spontaneous resolution
  - Twister cables prevent tripping ?
    - Expensive
    - Ugly
    - Tear up clothing

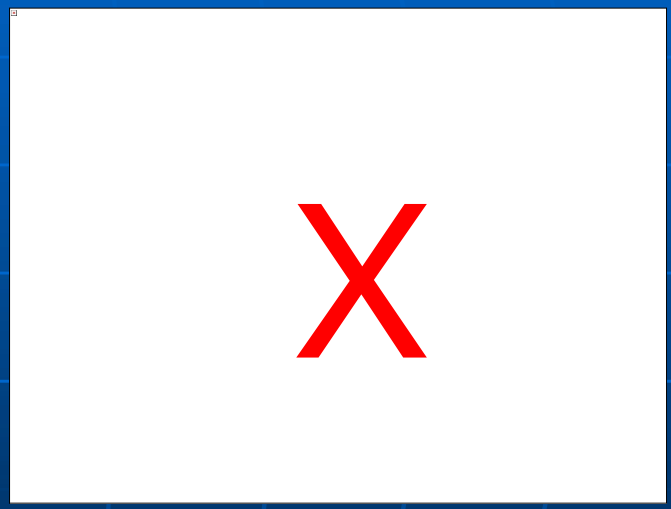
Excessive Femoral Anteversion

- Surgery intervention
  - Proximal femoral osteotomy
  - Indications: Severe persistent intoeing w/ frequent tripping
  - Patello-femoral malalignment/tracking
  - Acetabular dysplasia

Intoeing – Bottom Line

- Observation
- Observation
- Observation

- Bracing is RARELY necessary



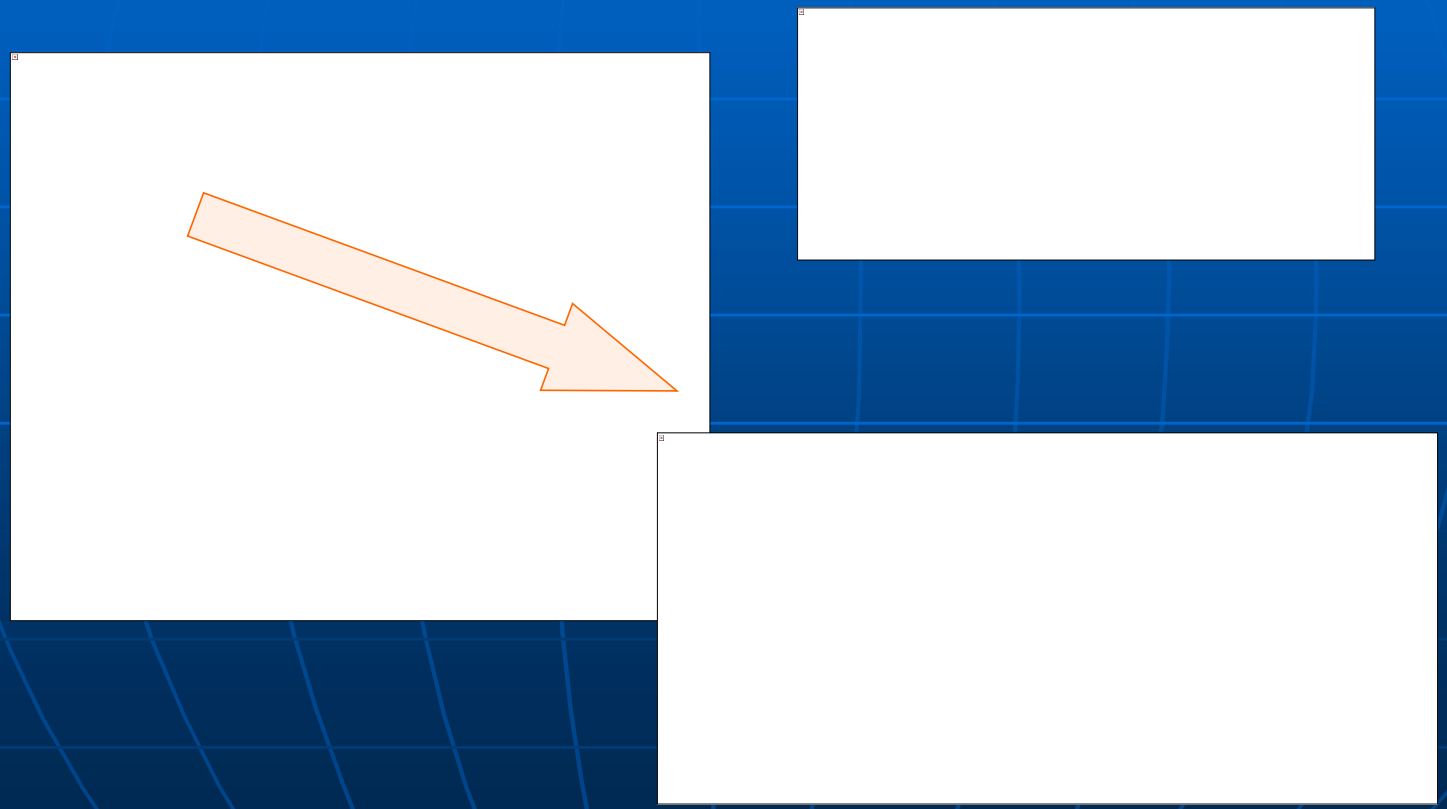
Clubfoot

- Congenital talipes equinovarus
- "CAVE"
  - Cavus
  - Adductus
  - Varus Heel
  - Equinus

Clubfoot - Treatment

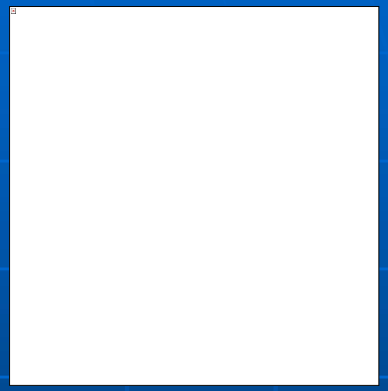
- Serial casting up to 3 months
- Surgical release commonly
- Multiple operations later possible

Pes Planus



Flat Feet

- Flexible Vs Rigid
- Asymptomatic Vs Painful
- Heelcord contracture
- Neurologic abnormality



Flatfoot - orthotics

Flat Feet - Asymptomatic

- "Orthopaedic shoes" do not create arches
- Arch supports do not support the arch
- Reassurance/education is helpful
- Growth is facilitated with activity
- "Support" induces weakness/alters mechanics

Flat Feet - Symptomatic

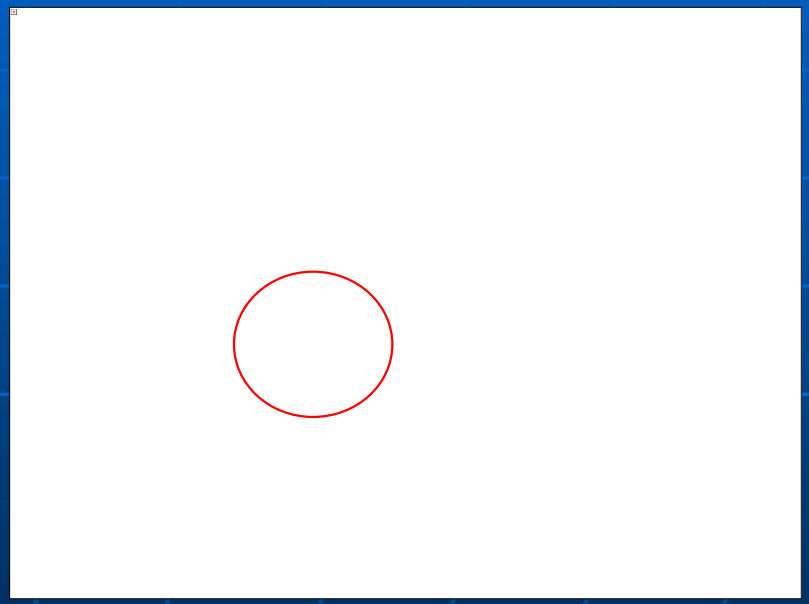
- Tight heelcord: Stretching exercises
- Look for signs of rigid flatfoot
- Prominent navicular bone
- Peroneal spasm
- Plantar fascia
- Sever's disease
- Stress fractures

Rigid Flatfoot

- Not passively correctable
- Often unilateral
- Stiff subtalar joint
- Painful by adolescence
- Refer to Pedi Ortho specialist
- Usually require surgical treatment

Rigid Flatfoot - Causes

- Congenital vertical talus
- Tarsal coalition
- Fibular hemimelia
- Spastic peroneals
  - Subtalar arthritis
  - Neurological condition



Developmental Dysplasia of Hip

- Nomenclature
  - DDH vs CDH
  - Dislocated (+Ortoloni, Allis)
  - Dislocatable (+Barlow)
  - Subluxated/Subluxable (Ultrasound)
- Etiology: Intra-uterine positioning (?)
- Incidence: 2 per 1000 live births

Developmental Dysplasia of the Hip

- Occurs in neonatal period
- More common in first-borns and breech position deliveries
- Association with congenital muscular torticollis and metatarsus adductus

DDH – Risk Factors

- Family history (10% unstable)
- Breech presentation 3rd trimester (5%)
- Large birth weight
- Torticollis or metatarsus adductus
- 1st born, female

DDH

- Detection
  - At birth: Ortoloni/Barlow tests
  - After 6 wks: Limited Abduction
  - After 3 months: Allis (Galeazzi), LLD
- Left hip 60%, Bilateral 20%

Clinical Features: Your First Clue

- Asymmetric hip creases
- Positive Barlow and/or Ortolani maneuver
- Limited abduction of hip

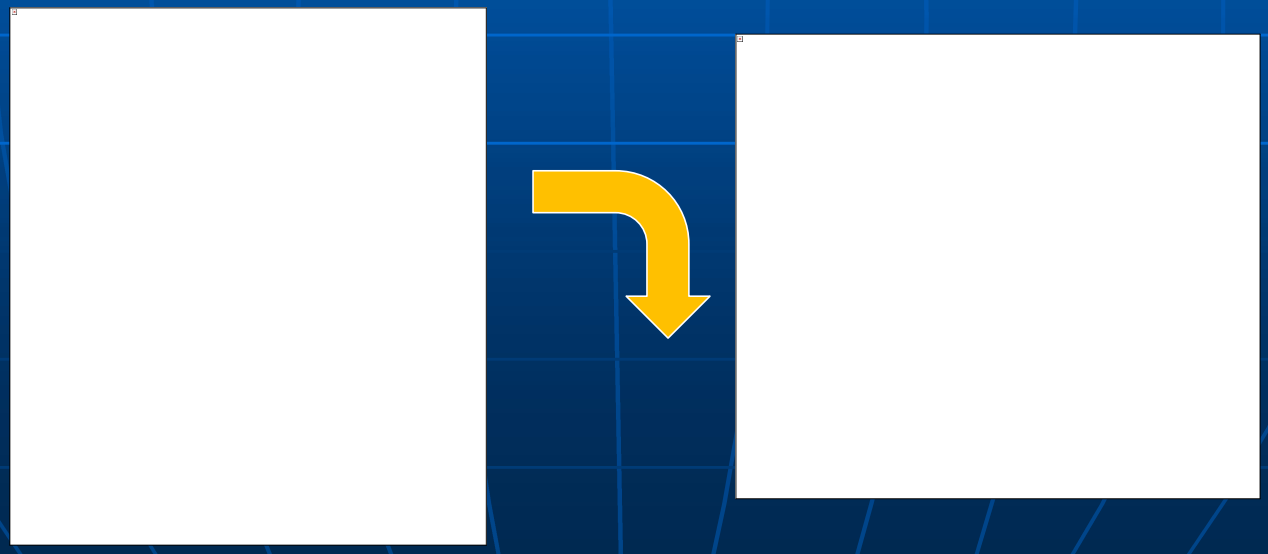
DDH

- X-rays in first 6 weeks unreliable
- Ultrasound - reliable, assess suspect hip
- Pavlik harness successful 95%
- Surgical treatment of failed Pavlik/late Dx
- Reduction prior to 1st birthday critical

Ortolani and Barlow Maneuvers

Diagnostic Studies

- Dynamic ultrasonography in neonates and young infants
- Plain AP pelvis and frog-leg views in older infants and children



Radiology (1 of 2)

Radiology (2 of 2)

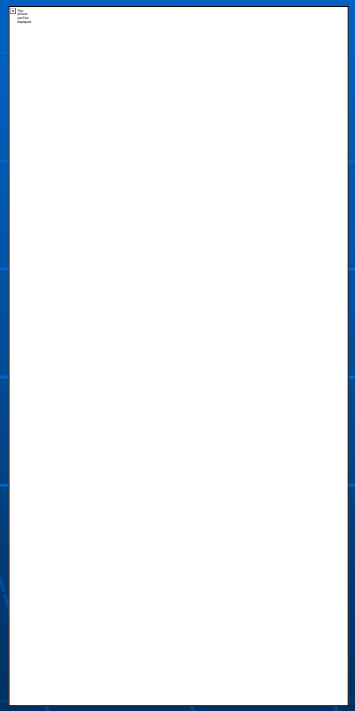
Bowlegs (Genu Varum)

- Physiologic genu varum
- Infantile tibia vara (Blount's Disease)
- Bone dystrophy (Rickets)
- Bone dysplasia (achondroplasia)
- Physeal abnormality (trauma)

Physiologic Genu Varum

- Usually corrects by 20 - 24 months
- Treatment: Reassurance only
- Worrisome: Progressive or unilateral
  - Blount's disease most likely
- X-ray: Measure metaphyseal-diaphyseal angle (MDA) - 11º or more

MDA parameters



MDA	Probable etiology
≤ 9º	Physiologic genu varum
10-15º	Gray zone-close observation
≥ 16º	Blount's disease

Infantile Tibia Vara (Blount's)

- Usually bilateral and progressive
- Obesity and ITT common
- Early bracing may help
- Surgical treatment often required
- Morbidity fairly common
  - Recurrence, joint incongruity, arthritis
- Pedi Ortho referral always indicated

Perthe's Disease

- Idiopathic osteonecrosis femoral head
- Etiology unknown
  - Old theories
    - Trauma
    - Transient synovitis
  - New theories:
    - Abnormal clotting factors
    - Second hand cigarette smoke

Perthe's Disease

- Typical age 4-8 years
- Limping +/- Pain
- Limited hip abduction/IR
- 12% bilateral
- Onset after age 6 = worse prognosis
- Femoral head small, flattened

Perthe's Pitfalls

- Referred pain to knees
- Early x-rays may be normal
- Radiographic appearance variable
- Include frog lateral views both hips
- Epiphyseal dysplasia my mimic AVN
- **MRI unnecessary**

Perthe's Charades

- Epiphyseal dysplasia
- Spondyloepiphyseal dysplasia
- Hypothyroidism
- Sickle cell disease
- TB of hip

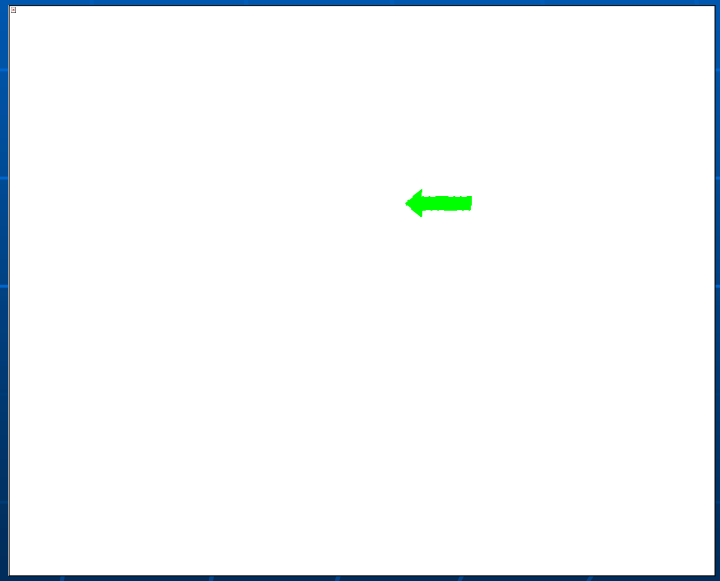
Perthe's Treatment

- Not an emergency
- 2 to 4 year process
- Activity reduction
- NSAID's
- Gentle hip ROM exercises

Perthe's Treatment

- Older age (>7-8 yrs)
- Total head involvement
- Prolonged regeneration stage
- Hip containment
  - Abduction traction or Petrie casting
  - Ambulator abduction bracing
  - Proximal femoral osteotomy
  - Salter pelvic osteotomy

Radiograph: LCP



Legg-Calvé-Perthes Disease

- Avascular necrosis leading to collapse, fragmentation, and then reossification
- Most frequent between 4 and9 years
- Boys more often than girls
- Bilateral in 10% of cases

Clinical Features: Your First Clue

- Knee or hip pain
- Limp
- Shortened limb
- Limited range of motion of hip

Diagnostic Studies

- Radiology
  - AP and frog-leg pelvis radiographs
- Findings
  - Femoral head smaller and cartilage space appears wider
  - Crescent sign
  - Fragmented femoral head—less radiopaque
- MRI

Management

- Disease is self-limited – limp can last 2 to 4 years
- Nonsteroidal anti-inflammatory agents
- Limit activities
- Crutches/braces occasionally needed
  - May help maintain spherical femoral head
- Better outcomes in younger children

Slipped Capital Femoral Epiphysis (SCFE)

- 65% obese males
- Peak adolescent growth spurt
- Limping with external rotation LE
- X-rays diagnostic
- Urgent surgical treatment required
- High morbidity

SCFE Classification

- Stable
  - Able to bear weight on limb
  - Good prognosis
- Unstable
  - Unable to bear weight
  - Poor prognosis
- "Head-Shaft angle" measures deformity

SCFE Treatment

- Percutaneous pinning of hip
  - Stabilization of epiphysis
  - Closure of physis
- Prophylactic pinning opposite hip?
  - 40% bilateral occurance
- Spica cast immobilization x 3 months

SCFE Pitfalls

- Referred pain to the knee
- Bedrest/crutches not protective
- Slip more visible on lateral hip x-ray
- Endocrinopathy-early, bilateral SCFE
- 40-50% develop SCFE other hip
- No sports until both hip physis fused

SCFE Pitfalls

- Osteonecrosis femoral head
- Chondrolysis
- Restricted hip motion
- Leg length discrepancy
- Premature hip arthrosis

SCFE: Background

- Incidence: 1-3/100,000
- Occurs during early adolescence
- Increased forces during growth spurt
- Males 2 times as frequent as females
- Obese in 2/3 of cases
- *Can* become bilateral in up to 40% of children

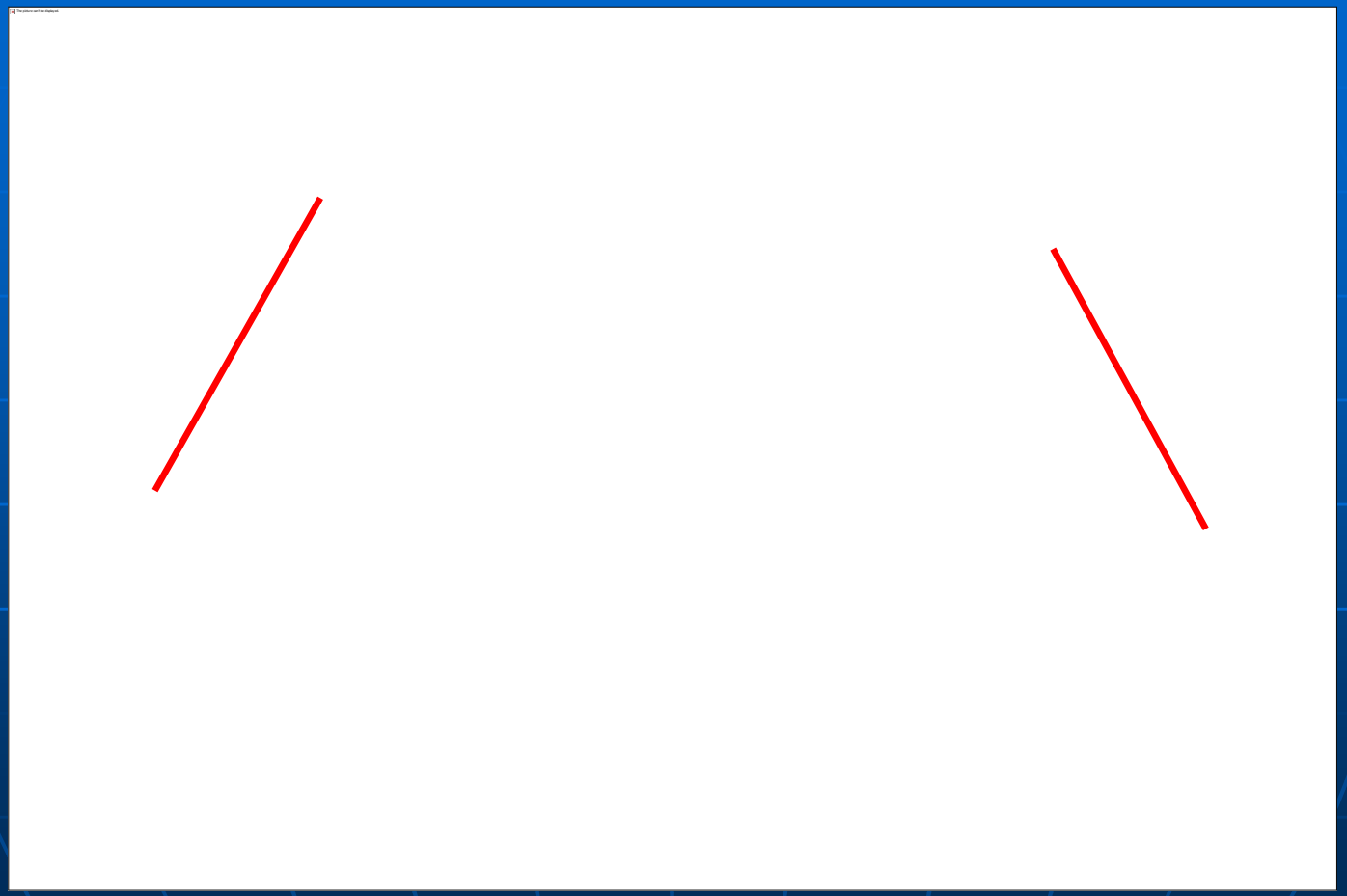
Clinical Features: Your First Clue

- Obese preadolescent or adolescent
- Often weeks to months of discomfort
  - Acute visit precipitated by trauma
- Limp
- Hip, thigh, groin, or knee pain
- Decreased range of motion of hip

Diagnostic Studies

- Radiology
  - AP pelvis and frog-leg of hips
- Signs
  - Physeal widening
  - Klein line
  - Epiphysis inferior and posterior
  - Disruption of Shenton line

Klein Line



Management

- Bed rest
- Pain management
- Relief of muscle spasms
- Definitive treatment is surgical.
  - Screw placed through femoral neck

Hip Pain by Age

- Transient Synovitis
- Perthes Disease
- SCFE

Infection

- Osteomyelitis
- Septic Arthritis
  - Hematogenous
  - Direct extension
  - Sub acute
  - Chronic

- Agents
  - Bacterial: Staph aureus
  - TB
  - Fungal

Septic Arthritis: Background

- Occurs in all age groups
  - More common in younger children
- Majority of cases in lower extremity
- Mechanism of entry
  - Hematogenous seeding
  - Local spread
  - Traumatic or surgical introduction of bacteria

Septic Arthritis

- History
  - Onset-rapid
  - Limp/refusal to walk
  - Fever (>102)
  - Swelling (knee/ankle)
- Physical
  - Pain w/ motion - Severe
  - Pseudoparalysis
  - Effusion
  - Increase warmth
  - Cellulitis confuses

Septic Arthritis

- Prognosis
  - Early diagnosis: Good
  - Hip, late dx: ON
  - Serial aspiration: Usually adequate
  - Surgical drainage: Morbidity

Clinical Features: Your First Clue

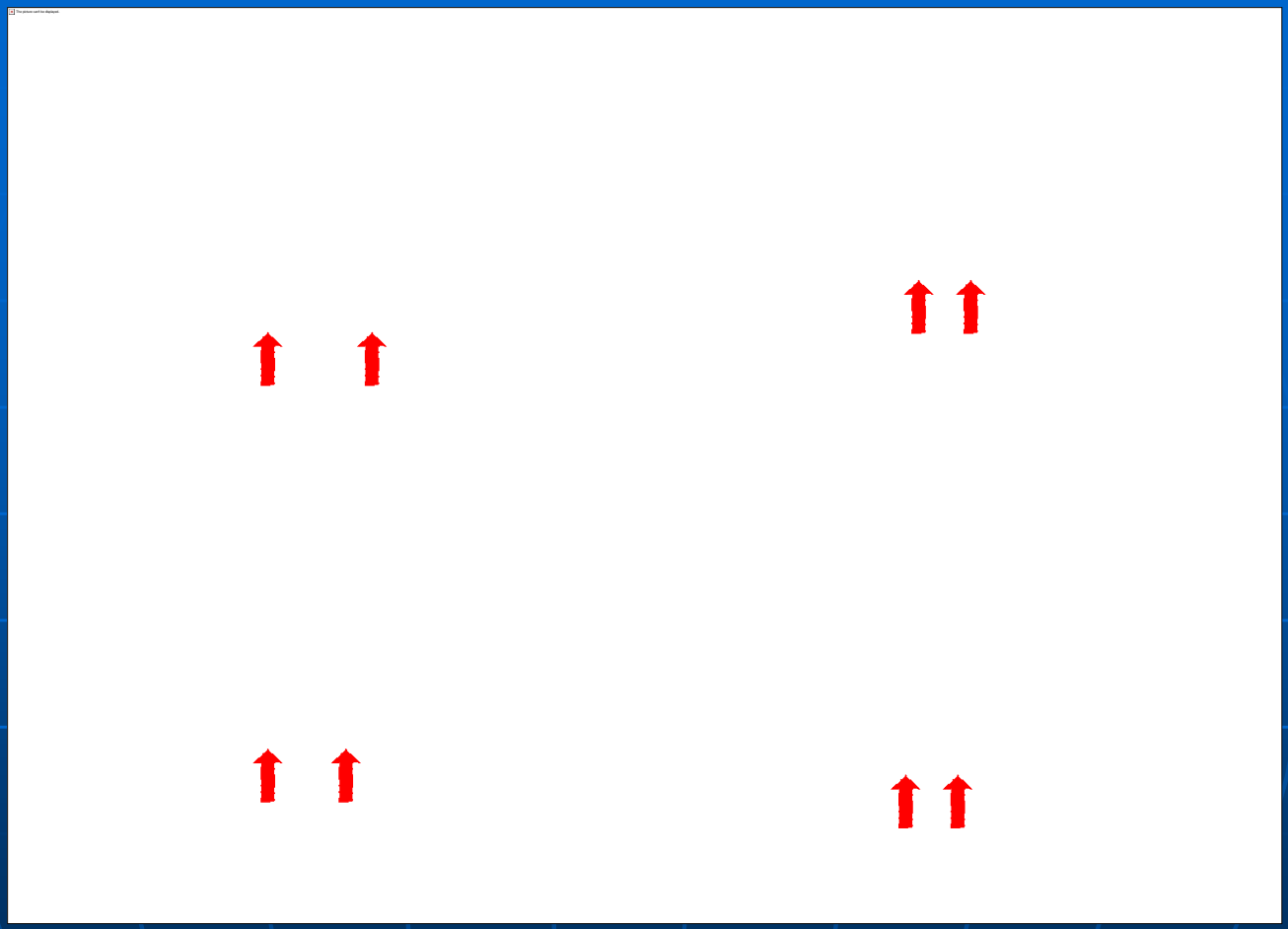
- Irritability
- Fever
- Erythema
- Limp/refusal to walk
- Decreased range of motion of limb

Position of Comfort With Hip Effusion

Which hip is affected?

Diagnostic Studies

- Radiology
  - Radiograph may be nondiagnostic
  - Ultrasonography helpful in detecting fluid
- Laboratory
  - CBC
  - CRP (more helpful than ESR)

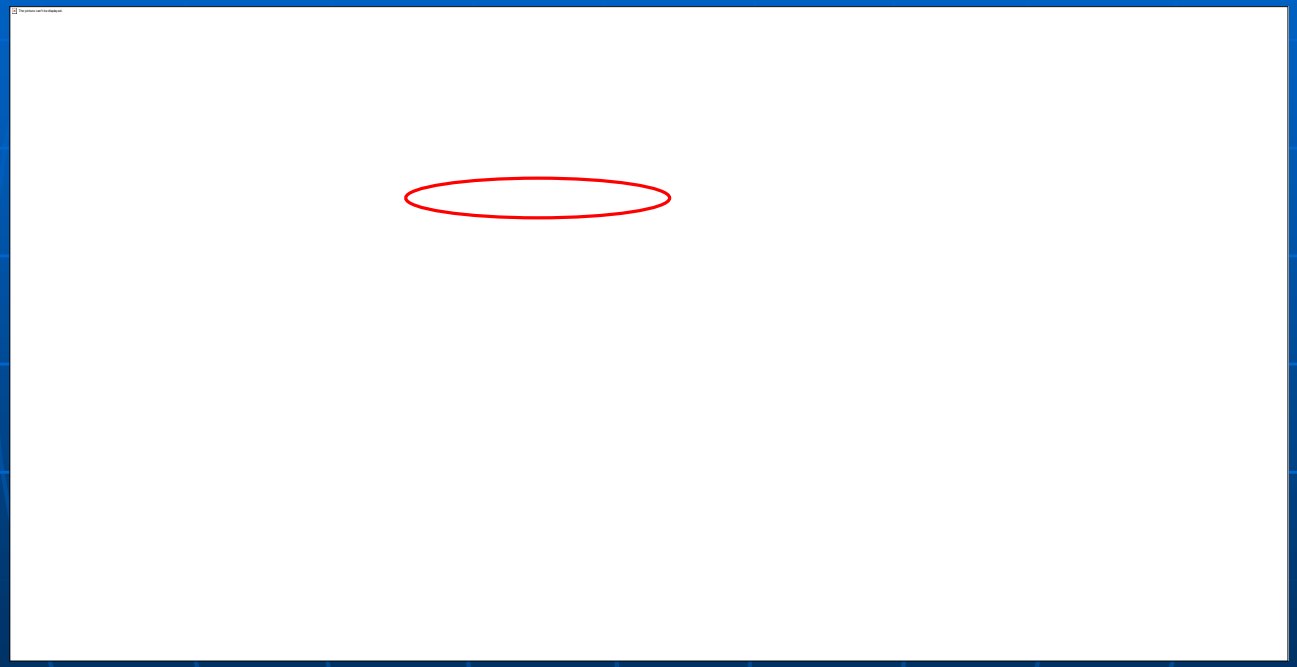


Management

- Once the diagnosis of septic joint is made, surgical intervention should proceed ASAP.
  - Needle aspiration or open surgical drainage required

Synovial Fluid Findings

Septic Arthritis Treatment by Age



Bottom Line
"Kocher Criteria"

1. Inability to bear weight
2. Fever
3. Elevated WBC (>12,000)
4. Elevated ESR (>40)

4/4 – 99% Septic Arthritis

3/4 – 93%

2/4 – 40%

Transient Synovitis

- Common in 2-8 year group
  - Afebrile or low grade
  - Limp/gait ceases
  - Pain at extremes of motion
  - Small effusion
- Aspiration (if done)
  - Small amount
  - 5-15,000 WBC
  - 75% poly's
  - Glucose 60 or higher

Osteomyelitis

- History
  - Rapid to insidious onset
  - Limp/refusal to walk
  - Fever (>102)
  - Swelling near joint
- Physical
  - Local tenderness
  - Swelling +/- effusion
  - Loss of motion not prominant
  - Errythema, heat common
- Sub-acute or chronic
  - Symptoms/signs subtle

Osteomyelitis

- Lab
  - WBC, ESR, CRP inc. sig.
- Imaging
  - X-ray: normal early (< 10D)
  - US: Periosteal abscess
  - MRI: Bone and soft tissue edema
- Culture
  - Staph aureus
  - Neonate: Strep B, E. coli
  - Infant to 4: Pneumo, Strep A, H. flu
  - 4 and up: Staph aureus
- Sub-acute or chronic
  - Variable, often normal

Osteomyelitis

- Treatment: Medical/Surgical
  - Neonate: Ox/Gent or Cefotaxime
  - Infant to age 4: Ox, Cef 1, Clinda
  - 4 and up: Ox, Cef 1, Clinda
  - 6 weeks IV, variable oral

Osteomyelitis

- Prognosis
  - Low incidence of Chronic osteo
  - Growth arrest in late diagnosis
  - Overgrowth of extremity can occur
  - Medical complications not benign

Subacute Osteomyelitis

- Subtle, chronic symptoms
- Muscular atrophy, limp
- No fever
- Radiograph: diaphyseal lesion
- Tumor must be ruled out

Chronic Recurrent Multifocal Osteomyelitis

- Insidious onset
  - Localized bone pain
  - Palmoplantar pustulosis/psoriasis
  - Fever not common
  - Can be single or or multiple
  - Culture negative usually

Chronic Recurrent Multifocal Osteomyelitis

- X-ray: suggestive of osteo
- Bone scan: other locations
- Biopsy: r/o tumor, histiocytosis

Diskitis

- Inflammation of IVD
- Etiology uncertain
- Self limited?
- Bx/Asp only in resistant cases
- Staph aureus virtually all
- Antibiotic treatment generally recommended

Diskitis

- Symptoms vary per age group
- < 3: Hip irritability in extension
- 3 to 9: Abdominal pain, some back
- > 9: Back pain, “walk on eggs”
- Fever uncommon
- WBC nl, ESR elevated
- X-ray: Narrow disc space
- Bone scan: sensitive, not infallable

Sacroiliitis

- Back pain
- FABER +
- Same Labs as septic arthritis
- No aspiration
- Medically treated
- Prognosis good

Tropical Myositis

- Staph aureus in muscle
  - Fever
  - WBC, ESR, CRP increased
  - Joint/Bone studies negative
  - MRI can be most helpful
- Prolonged illness
- Multiple absesses common
- Surgical, medical treatment needed

Appendicitis

- Can be mistaken for hip/SI infection
- Index of suspicion
- Sympathetic hip joint effusion
- Aspirate: Negative for infection
- Abdominal CT

TB Spine

- Onset insidious
- Collapse of vertebral body first
- Multiple levels common
- Treatment usually medical
- Surgery for neurological symptoms

TB Hip/Other joints

- Insidious onset
- Painless limp
- Fevers variable
- Destruction of both sides of joint

Scoliosis

- Idiopathic
- Congenital
- Paralytic
- Functional
- Hysterical
- Discogenic
- Traumatic
- Tumor

Idiopathic Scoliosis

- Cause unknown
- Structural curve > 10º
- Screening: Adam's forward bend test
- Scoliometer
- Common Curves: R thoracic/ L lumbar
- Not painful

Scoliosis Progression

- Associated with:
  - Size of Curve
  - Rate of growth
  - Growth remaining (Risser Sign)

Scoliosis Pitfalls

- Failure to examine back!
- Over -referral
  - Leg length discrepancy
  - Scoliometer $\geq$ 7º suggests curve > 20º
- Unusual curve pattern (left thoracic)
  - Refer to Pedi Ortho specialist
  - Neuro exam (abdominal reflex)
  - MRI spinal cord

Scoliosis Surgery

- Curves >40 degrees
- Segmental fixation
- Autologous blood
- 5 to 6 days hospital
- Skeletally immature-Ant/Post
- Superior mesenteric syndrome
  - Early, day 3
  - Late (typical), day 5-7

Congenital Scoliosis

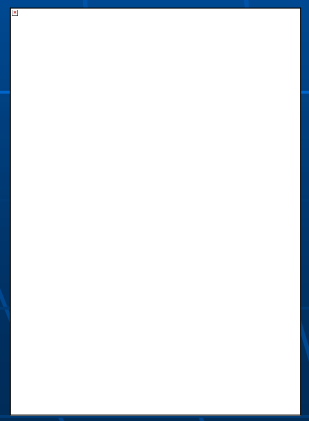
- Errors in vertebral development during embryogenesis
  - Failure of Formation
  - Failure of Segmentation
- Associated anomalies:
  - 20% urinary tract
  - 25% cardiac

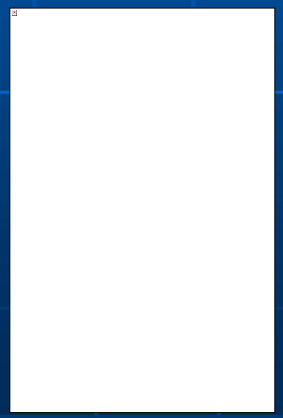
Radial Head Dislocation

- Idiopathic vs Syndrome
- Prominence lateral elbow
- ROM restricted to some degree
- Observation +/- surgery at maturity

Tibial Bowing

- Posteromedial (wait till the PM)
  - Idiopathic
  - Limb Length Inequality
  - Observation
  - Equalization procedures
- Anterolateral
  - Congenital pseudoarthosis
  - Neurofibromatosis
  - Protect
  - Multiple operations



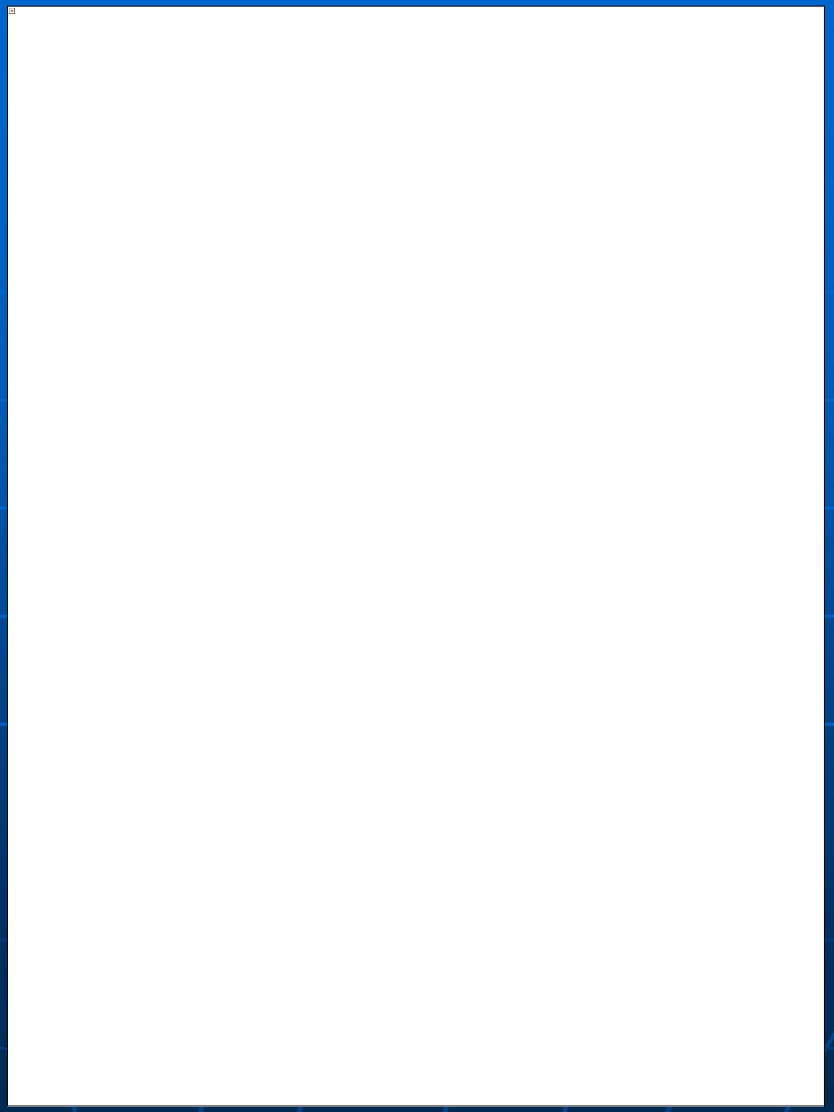


Skeletally Immature

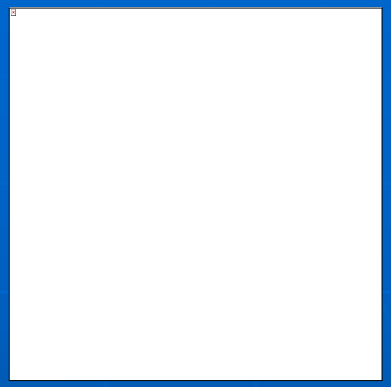
Apophysitis

- Sever's Disease
- Iselin's
- Sinding-Larsen-Johansson
- Osgood-Schlatter

“Osteochondrosis”







Fractures…

…or “children are NOT just small adults”

-Mercer Rang

Fractures

- Stronger in tension
- Periosteum thick
- Elastic physiology
- Growth plates weak link
- Growth arrest
- Remodeling

Salter Harris Classification

- I Physis only
- II Physis + Metaphysis
- III Physis + Epiphysis
- IV Physis+Metaphysis+Epiphysis
- V Physis Crushed
- (VI) Peripheral physis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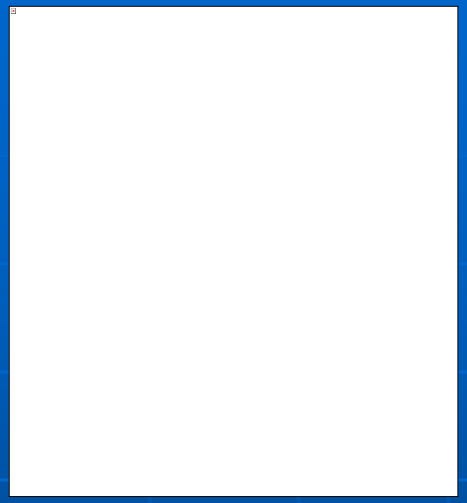


“Trivial” Fractures

- Nurse Maid Elbow
- Clavicle
- Humerus
- Toddler fx: tibia

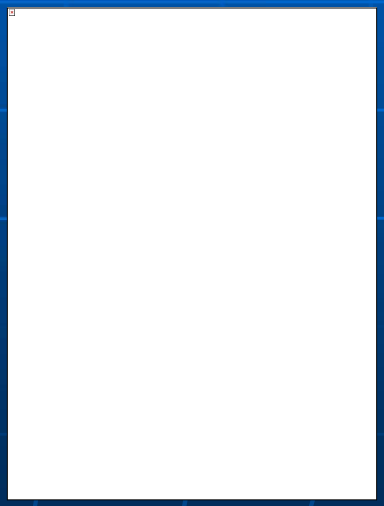
- Torus
  - Bone fails in compression
  - Deformity usually minimal
  - Heal in 3 to 4 weeks
  - Growth arrest very rare

Birth fractures

- Clavicle
- Humerus

Dangerous Fractures

- Humeral supracondylar
- Lateral condyle fracture of elbow
- Peri-articular
- Femoral neck
- Knee
- Ankle



Compartment syndrome

How many “P’s” ?

1. Pain
2. Pallor
3. Paresthesia
4. Paralysis
5. Poikilothermia
6. Pulselessness

Compartment syndrome

- Elbow, knee, tibia, ankle
  - Pain out of proportion
  - Pain w/ passive motion
  - Motor loss
  - Sensory +/- loss
- Pulses - often normal
- Capillary refill - often normal
- Index of suspicion - HIGH

Amputations

- Amniotic bands
- Failure of formation
  - Transverse (amputation)
  - Longitudinal (Hemimelia)
  - Intercalary (Phocomelia)

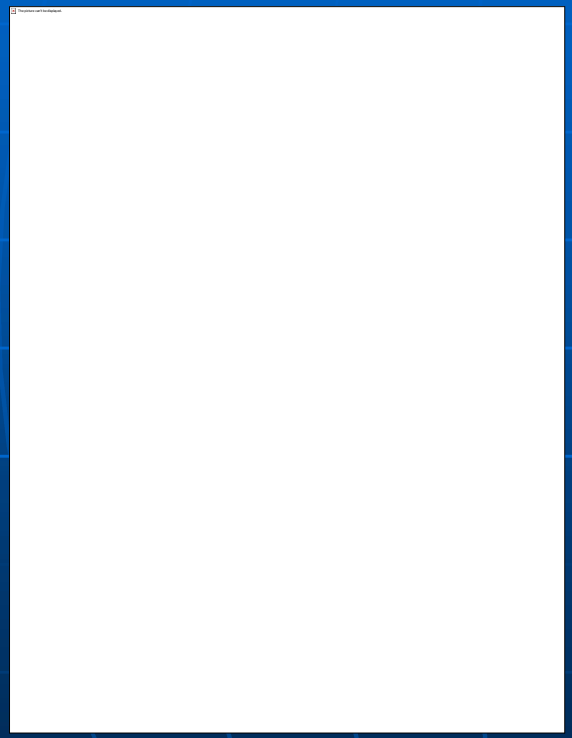
Systemic

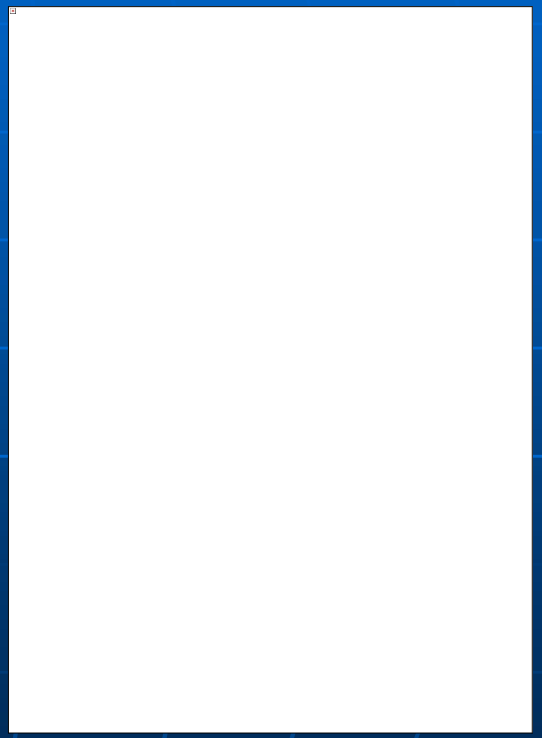
- Bone dysplasias
  - Muccopolysaccharidosis
  - Achondroplasia
  - Diastrophic
  - MED
  - OI
  - Vitamin D dependent rickets
- Osteochondromatosis
- Enchondromatosis
  - Ollier's disease
  - Maffuci's disease

Neoplasia

- Benign
  - Borders well defined
  - No periosteal reaction
  - No endosteal reaction
  - Deformity of bone sharp/defined
- Malignant
  - Vague borders
  - Periosteal reaction new
  - Endosteal destruction permeative
  - Matrix mottled, irregular

Osteochondroma





Neoplasia

- Caffey's
  - Onion skinning
  - Diaphyseal, total
  - Mimics infection/Ewings

Neoplasia

- Eosinophyllic Granuloma
  - Sclerotic border
  - Lytic center
  - Faded border
  - Periosteal elevation possible
  - Verbra Plana unique to this
- Mimics
  - Infection
  - Tumor (Ewings, neuroblastoma,
  - Ewings, neruoblast., lymphoma

Neoplasia

- Ewings
  - Diaphyseal
  - Permeative destruction
  - Periosteal elevation
- Mimics
  - Infection
  - Caffey's
  - EG

Neoplasia

- Osteoid osteoma
  - Sclerotic border
  - Lytic center (Target)
  - Faded border
  - Periosteal rxn rare
  - Mimics
  - infection
  - EG

Leukemia

- Periphyseal lysis
- Multiple bones
- Vertebral compression

Neuromuscular

- Cerebral palsy
  - Quadriplegic
  - Hemiplegic
  - Diplegic
  - Spastic/Athetoid
- Myelomeningocoele
- Tethered Cord

Neuromuscular

- Prader-Willi
- Down's

Neuromuscular

- Muscular dystrophy
- Charcot-Marie-Toothe
- Myotonic Dystrophy
- Arthrogryposis
- Benign congenital hypotonia
- Guillian-Barre Syndrome

Nutritional

- Rickets
- Vitamin D Toxicity
- Scurvy
- Diffuse Periostitis
  - Prostaglandin E infusion
  - Syphilis
  - Vit D Toxicity
  - Caffey's

Pharmacology

- Steroids — Osteopenia, ON
- Dilantin — Osteomalacia
- Ciprofoxacin — Arthropathy
- Chloramphenocol — Aplastic Anemia

Shoes, Braces and Things

- Orthopaedic shoes
  - Straight last
  - Reverse last
  - Thomas heel
  - MLA support
  - Cookies
  - Metatarsal pads
- Orthotics (custom/commercial)
- UCB – University of California - Berkley

Shoes, Braces and Things

- AFO, KAFO, etc
  - Named for joint controlled
  - Custom or off “the shelf”
  - Solid or hinged, plastic or metal
  - Functional, retentive or corrective
- Twister cables
- Internal Tibial Torsion Brace
- Dennis - Browne Bar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Thank You !

A word about NAT…

Battered Child (NAT)

- History
  - Delay in eval
  - Vague, inconsistent history
  - Unobserved injury
  - Repeated visits
- Fracture: none pathognomonic
  - Humerus/tibia fx in < 1 year old
  - Femur fracture, transverse esp.
  - "Corner fracture"

Myth

- Easy to recognize child with NAT

Recognition of NAT Important

- Unrecognized and return to home - 25% risk of serious injury, 5% risk of death
- Recognize and get child into safe environment
- Abuse second leading cause of mortality in infants and children

How Widespread a Problem?

- 1 - 1.5% of children are abused per year
- 70,000 - 2,000,000 children are abused annually in US.

“Quoted” Risk Factors for NAT

- Young
- First born children
- Premature infants
- Disabled children
- Stepchildren
- Single-parent homes
- Drug - abusing parents
- Families with low income
- Children of parents who were abused

Signs of NAT

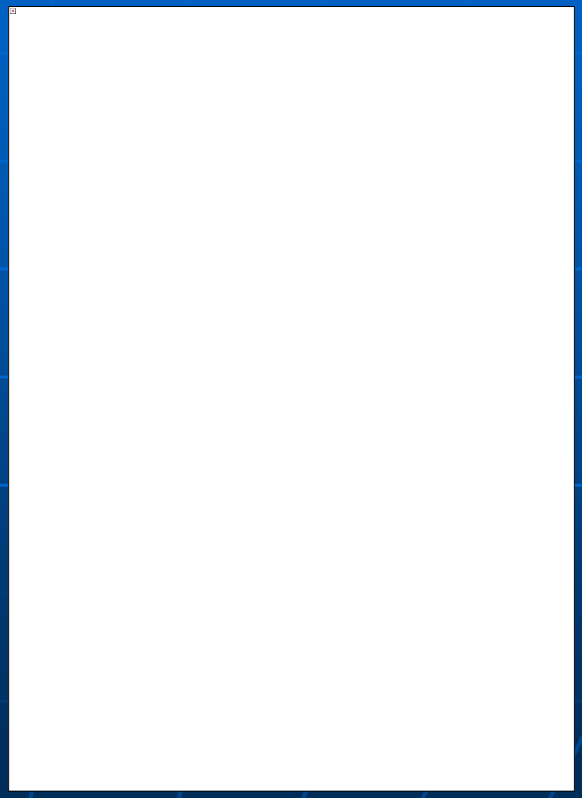
- Inconsistent history of injury
- Delay in presentation
- Reported mechanism of injury insufficient to explain injury
- Parents/caregivers may be hostile or indifferent

Evaluation

- Team approach helpful - pediatrician, medical social worker, subspecialties, law enforcement, government child protection agencies
- Orthopaedic surgeon may be alone in recognition and documentation

Risk Factors

- Children of all ages, socioeconomic backgrounds, family types may be subjects of abuse
- Up to 65% may have only isolated long bone fracture



Child Abuse - Epidemiology

- >1 million children/year are victims of abuse and/or neglect
- >1,200 deaths/year
- Fractures are 2nd most common presentation of physical abuse
- 1/3 of abused children eventually seen by orthopaedic surgeon

Fractures in Abused Children

- 25-50% of children with documented NAT will have fx's
- 31% of child NAT victims had fx's

Isolated Long Bone Fracture

Loder, JPO 1991

- Most common orthopaedic presentation of children with NAT - 65% of children with fx's
- Only 13% of children with fractures presented with multiple fractures in different stages of healing

NAT Fx Pattern

- Most are similar to accidental trauma fracture patterns
- Must rely on other factors, history, physical examination, etc...
- *Age of child with specific fx's*

Associated Features of NAT

- Multiple fractures in different stages of healing
- Soft tissue injuries - bruising, burns
- Intraabdominal injuries
- Intracranial injuries

Flags for NAT

- AGE of Patient
- History
- Social Situation
- Other injuries (current and past)
- Specific injuries/ fractures

Age of Battered Children

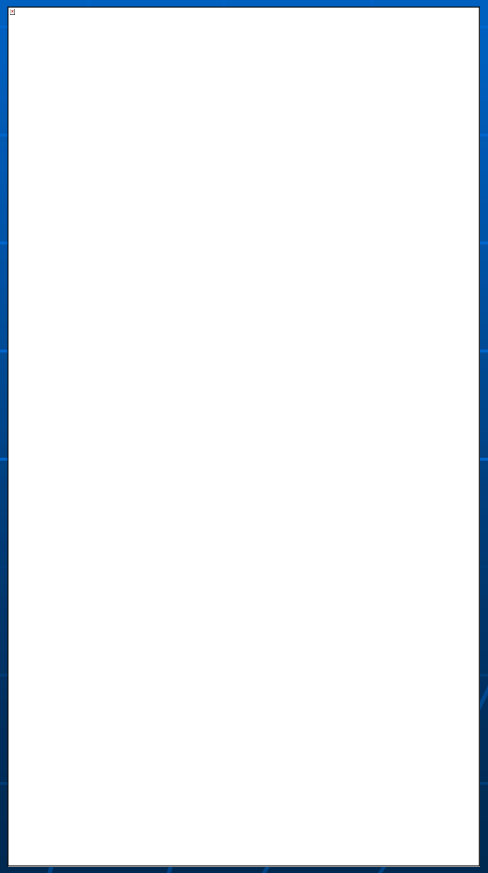
Who is at Risk?

- Most children with NAT fractures -

age of < 3 years

Who's at Risk?

- Most femur fx's in children who are < 1 yo of age are from NAT (60-70%)
- Most femur fx's in children > 1 yo accidental



Features that Increase Chance of NAT

- Inappropriate clinical hx
- Failure to seek medical attention
- Discovery of fx in healing state

History

- Is the injury consistent with the explanation given?
- Is the explanation consistent with the child's level of development?
- Does the story change between caregivers? between child and caregiver?

History

- Has there been a delay in seeking medical treatment?
- Is the parent reluctant to give an explanation?
- Drug or alcohol abuse?
- Parents in abusive relationships?

History

- Is the affect inappropriate between the child and the parents? (lack of concern, overly concerned)
- Poor compliance with past medical treatment
- Adults were victims of child abuse
- Families under stress (loss of job, etc..)

History - Associated Risks

- Children born to adolescent parents
- Children who suffer from colic
- The abused child may be overly compliant and passive or extremely aggressive
- Role reversal

Physical Examination

- *Undress the child*
- Look for areas of bruising
  - Bruises at different stages of healing

Physical Examination

- Careful search for signs of acute or chronic trauma
- Sign - bruises, abrasions, burns
- Head - examine for skull trauma, palpate fontanelles if open, consider funduscopic exam for retinal hemorrhage
- Trunk - palpate rib cage, abdomen
- Extremities - careful palpation
- Genitalia – consider exam for sexual abuse

Fractures Commonly seen in NAT - High Specificity

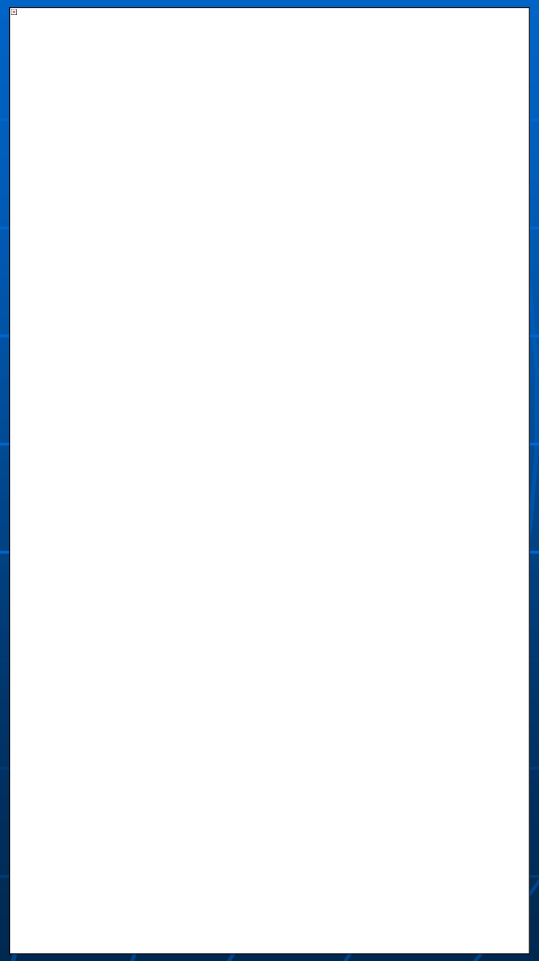
- Femur fracture in child < 1 year old
- Humeral shaft fracture in < 3 year old
- Sternal fractures
- Metaphyseal corner (bucket-handle) fractures
- Posterior rib fxs
- Digit fractures in nonambulatory children

Radiographic W/U

- Skeletal survey for children with suspicion of NAT
- "Babygram" not sufficient as does not provide necessary detail to identify fractures

Myths

- Spiral Fractures have a high association with NAT
- Actually commonly seen accidental fx pattern



Humerus Fx's

- Diaphyseal fx's in children < 3 yo are very suggestive of NAT!!!!!!!

Management - NAT Suspected

- Professional, tactful, nonjudgmental approach in initial encounter and workup
- Explain workup to parents as standard approach to specific ages/injury patterns
- Early involvement of child protection team if available
- Early contact/involvement of child's primary care physician

Management - Documentation

- Many cases result in medical records becoming part of legal record
- Carefully document history, physical exam and radiographic findings
- Document evidence supporting physical abuse
- Document statement regarding level of certainty of abuse

Legal Aspects of NAT

- All states require reporting of suspected cases of abuse by medical professionals
- Need only reasonable suspicion to report suspected maltreatment
- Law affords immunity from civil or criminal liability for reporting in good faith

Differential Diagnosis - NAT Fractures

- Accidental trauma
- Osteogenesis Imperfecta
- Metabolic Bone Disease (rickets, etc.)
- Birth trauma
- Physiologic periostitis

Summary

- Isolated diaphyseal fx's common in NAT and accidental trauma
- Remember other factors, history, physical examination

NAT Summary

- Humerus diaphyseal fx's < 3 yo are almost always associated with NAT
- Femur fx's < 1 yo are usually due to NAT

The Bottom Line

- Causes of nontraumatic orthopedic emergencies vary with age.
- Always examine the hips in patients with knee pain.
- Radiographs are often needed to establish the diagnosis.
- Not all elbow fractures are the same
- Prompt orthopedic referral for specific conditions
- Always keep NAT in the back of your mind…

Acknowledgments

- www. (almost anything you can imagine!)
- APLS Pediatric Emergency Medicine Resource
- OTA

Thank You !