What is it?

- Misnomer
  - Epiphysis/physis stays put and metaphysis displaces
- Fracture vs. pre-existing physeal abnormality
  - Physeal widening preslip
- Increase thickness of proliferative and hypertrophic zones
  - Chondrocyte clustering
Who Gets It?

This guy…
**Typical Patient**

- Males > Females—but not much (60%)
- Obese—larger get it earlier – 80% are obese
- Males—12.7-13.5 yrs
- Females—11.2-12 yrs
- Left hip slightly more than right (60%) in unilateral
- Racial differences—
  - Pacific Islanders > blacks > whites > Indonesian
- Incidence 1-10:100,000 – most common hip disorder in adolescents

**Atypical Patient**

- Endocrine disorder “HYPOS”
  - Hypogonadal
    - Low GH before rx
  - Hypothyroid
    - Low T4 before rx
- HGH treatment
- Renal osteodystrophy

**What is the cause?**

- Mechanical most likely – shear
  - Acetabular side
    - Relative increased retroversion of acetabulum
    - Deeper acetabulum – “vice”
  - Femoral side
    - Vertical femoral physis: 8-11 deg difference
- Biochemical - Disease of puberty
  - Decreased physéal strength
    - Testosterone – decreases physéal strength
    - Estrogen - increases physéal strength → SCFE rare in post menarchial females
Diagnosis

Children’s Healthcare of Atlanta
Dedicated to All Better

How do you diagnose it?

- How long has pain been present?
  - Prior injury?
- Location of pain? Hip/groin vs. knee
  - Knee pain increased time to diagnosis from 6 to 15 weeks
- Has it worsened? – chronicity
- Still walking? – stability
- Pain in the other hip – 20% bilateral

Eval of 481 patients treated at CHO, CHB, LAC for delay in treatment 10 years after AAP released recs on SCFE
- Careful evaluation of hip and knee complaints critical
- Mean time to diagnosis longer in PCP or ER eval than ortho as primary evaluator
  - Ortho – initial visit
  - Primary care provider – 4 week delay
  - ED – 6 weeks
Examination

- Gait
  - Ambulatory status
  - Foot typically held in ER
- ROM
  - External rotation during flexion
- Tender
  - Often groin
- Short
  - Worsens with progressive deformity

1. Physis widens
2. Metaphyseal blanch sign – epiphysis falling posterior

Trethowan’s sign
Temporal Classification

- **Acute**: prodrome 3 weeks or less
  - Differentiate from Salter I by age and history (50-100% AVN with Salter 1)
- **Chronic** (85%): months of aching thigh or knee pain.
- **Acute on chronic**: sudden exacerbation of pain after h/o symptoms
Classification by displacement
• Southwick method—head/shaft angle
  – Measure both sides
  – Mild <30 deg difference
  – Moderate 30-60
  – Severe >60

Classification by stability
• Walking on hip—Stable- AVN rate 0%
  – 85-95% of patients
• Not Walking—47% AVN rate
  – Follow up studies show ~25% may be more realistic
  – Recently challenged
    • Slongo JBJS 2010 – 5/18 “stable” were unstable intraop
    • Ziebarth CORR 2009 – 50% of stable were unstable

Natural History
Why do we care about residual deformity of the proximal femur?

What does the femoral deformity do?

Untreated Natural history

- **Ordeberg**—20-60 yrs f/u of untreated slips
  - few had social/work restrictions
- **Carney & Weinstein** -35 untreated chronic slips
  - 6/35 (17%) displaced further (5/6 to severe)
  - 11/35 had acute on chronic episode (progressed to severe)
  - The higher grade of slip—the decrease in the Iowa hip score

- Concluded: the natural history of SCFE is favorable if displacement is mild and remains so.
Does persistent deformity cause OA?

- Carney et al 1991 JBJS
  - 155 hips f/u @ 41 yrs
    - Mild slips – 64% had DJD
    - Mod/Severe slips – 100% had DJD
- Castaneda et al 2013 JPO
  - 121 hips f/u @ 22 years – all had signs of OA
- Larsen et al 2012 JPO
  - 176 hips f/u avg 16 years
  - 8 underwent THA
  - 33% of remaining hips had pain

AVN

- Preoperative slip angle
- Females
- More sudden onset, younger patients
  - Sankar et al – 19% with screws, 26% screw + CR, 3% with open reduction
- Early arthroplasty more related to AVN
  - Larson et al – 70%
  - 7 yrs from slip vs 23 yrs for degen

Chondrolysis

- 50% decrease cartilage space
- <3mm total cartilage space
- ? Immunologic reaction
- Hardware
AVN and Chondrolysis

- Treat both with prominent hardware removal (if physis fused)
- NSAIDS
- Rest and ROM
- Eventual total hip replacement
- Chondrolysis may improve some, AVN is forever

Treatment options

In Situ Pinning

Gold Standard
Theory of Percutaneous Screw

Theory
- Low morbidity at index surgery
- Prevent deformity from worsening
- Stop physeal growth (only grows 2mm/year)
- Minimal impact on future hip replacement

Reality
- Not all remodel – less with more severe deformity (50% mod/severe – Jones)
- Many will develop hip impingement (80% - Castaneda) and require secondary surgery
- Leg length difference may be more significant
- Rotation and lack of IR doesn’t change

Bilateral
- 20-50% - simultaneously
- 50% - sequentially
  - 82% within 18mo
- Risk factors
  - Age/skeletal maturity (girls <10, boys<12)
  - Skeletal age (modified oxford bone age)
    - Low bone age [MOBA <16] – 85% chance
So when to pin the other side

- Absolute
  - All endocrine (61%)/metabolic (90%) slips
- Relative
  - Chronologic age (girls<9 or boys<11)
  - Ethnic – polynesians, hispanic, white much higher
  - Increased posterior physeal slope
  - Lower Modified Oxford Bone Age <17

Chronic SCFE

What to do if deformity is significant
Management of Chronic SCFE

- Often end up with extension, adduction, external rotation deformity even after some remodeling.
- Treatment by Southwick osteotomy when mature.
Axis of femoral neck

Children's Healthcare of Atlanta

Dunn

Kramer/Barmada

Southwick/Imhausa
Unstable SCFE

- Inability to bear weight (even with crutches)  
  - Loder et al, JBJS 1993
- Prognostic for AVN  
  - Unstable: 14 of 30 (47%) had AVN with insitu pinning  
  - Stable: 0 of 25 had AVN
- More recent data suggests ~25% AVN rate
- Prodromal symptoms are common  
  - McPartland CORR 2013 – 88% had hip, thigh, knee pain average of 42 days before slip
When does the vascular insult occur?

- At the time of injury?
- During reduction of the SCFE?
- Intraarticular hematoma with tamponade?
Questions in unstable SCFE

- Can We Do Better?
- How to Prevent AVN?
- How to Safely Correct Deformity

Safer Acute correction? Dunn Osteotomy

- Dunn & Angel- JBJS 1978
  - 73 hips in 69 patients (25 acute, 48 chronic)
  - AVN in acute SCFE:
    - Complete: 2
    - Segmental: 3
    - Mottling: 4
  - Conclusions: In the acute SCFE, open reduction yields similar incidence of AVN, however, the deformity is corrected
Advocates of Dunn Osteotomy

Ziebarth 2009
- 40 patients (12 unstable (8/10 US pts))
- 1-3 yr follow up
- Correction slip angle from 56° → 8°
- No AVN, no chondrolysis, DVT, nerve injury

Slongo 2010
- 21 patients
- Slip angle reduced 47.6° → 4.6°
- ROM not different from unaffected hip
- 6/8 hips which were unstable intraop were stable preop
- 2 patients with AVN

Concerns with Dunn Osteotomy

Sankar 2013
- 27 patients treated by 5 surgeons
- 26% AVN rate
  - Each surgeon had at least one AVN
- 15% had broken implant (none with screws)
- Results linked to incidence of AVN

CHB experience
- 43 patients, 60% unstable
- 80% severe slip
- 37% had complications
  - 23% AVN – 2 end stage DJD
- Outcome related to experience
- Redefined indications: acute, severe slip >50 degrees, mild chronic changes, treated in less than 24 hours
Intraoperative Monitoring of Epiphyseal Perfusion in Slipped Capital Femoral Epiphysis

- Less invasive method of reorienting proximal femoral physis
- Percutaneous screw placement with perfusion monitor placed down screw cannula
- 29 hips – none developed AVN

Summary

- Common cause of hip/knee pain in preadolescent
- Knee pain = hip condition in overweight adolescent until proven otherwise
- Stability is key!
  - Unstable – cannot bear weight even with crutches = fracture
  - Stable – can ambulate +/- crutches
- You can make a difference in treatment and outcomes
- Immediate referral for all SCFE
- Outcome mostly related to prevention of complications

Thank you!!!

Nicholas.d.fletcher@emory.edu