Slipped Capital Femoral Epiphysis
SCFE

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MUMC
Epidemiology

- Incidence 2 per 100,000 in the general population
  - 0.2 per 100,000 in the eastern half of Japan (Minomiya et al)
  - 10.08 per 100,000 in certain regions of the United States (Kelsey et al)

- Seasonal predilection for SCFE during the summer months (Loder 1996)
78% of cases of SCFE occurring during the adolescent growth phase
  – Boys: 10-16 yr (13.5)
  – Girls: 9-15 yr (12.1)

Boys:Girls = 1.4:1

Bilateral Symptomatic: 25% during adolescent (21-37%), ½ simultaneous, ½ sequential

When a patient presents outside this range, think of underlying condition, e.g., endocrinopathy
High Risk Group

- Obese
- African-American, Polynesian
- Endocrinopathy: 7-8% of SCFE
  - Short stature (<10th percentile) as a screening test for endocrinopathy (Burrow 2001)
Etiology (Theories)

1. Body Habitus:
   - Obesity

2. Hormonal Factors:
   - Puberty: estrogen ↑ & GH ↓ growth plate strength
   - Endocrinopathy: hypothyroidism, panhypopituitarism, hyperparathyroidism, hypogonadism
Etiology (Theories)

3. Mechanical Factors:
   – Trauma, minor

4. Heredity:
   – ? Significance of 2-5% incidence in immediate family members (Rennie 1974)

5. Immunology:
   – IC in synovial fluid & histology
Pathology

- Widening & disruption of the physis
- Decreased numbers & disorganized clumping of cartilage cells
- Synovium infiltrated with round cells (++ plasma cells)
Pathoanatomy of the common posterior slip

- Femoral head in contact with acetabulum →
- Femoral shaft and neck rotates externally →
- Head moves posteriorly →
- Neck moves cephalad
Pathoanatomy
of the common posterior slip

- There is no varus deformity.
- It is due to radiographic parallax.

Internal Rotation  Neutral  External Rotation
Posterosuperior epiphyseal vessels

Artery of ligament of the femoral head

Postero inferior epiphyseal vessels

Medial femoral circumflex artery

Lateral femoral circumflex artery
Clinical History

- **Pain:**
  - Hip, **THIGH**, or **KNEE**
  - 46% of patients: knee or distal thigh pain as initial presentation (Carney 1991)
  - Usually attributed to pulled muscle by family or family Dr. → delayed presentation

- **Limp**
Physical Examination

General: overweight, early puberty
Gait: abductor lurch or antalgic gait
Hip:
  – Externally rotated, ? Shortened
  – *Obligatory external fixation with hip flexion*
  – Limitation of Internal Rotation, abduction, flexion (severity of slip)
  – Pain on extreme of motion
Imaging

- X-rays
- Ultrasound
- CT
- MRI
- Bone Scan
X-rays

- **AP & True Lateral (BOTH HIPS)**

- **Early Mild SCFE:**
  - Widening & irregularity at the physeal plate
  - **Trethowan’s sign:** failure of Klein’s line to intersect with the femoral head
  - **Blanch sign of Steel:** area of increased bone density in the proximal femoral neck

- **Chronic SCFE:**
  - Rounding of superior portion of femoral neck
  - Callus at epiphys-metaphyseal junction
Other Imaging

- U/S (Kallio 1993):
  - Hip effusion → acute event
  - Metaphyseal remodeling → chronic

- CT:
  - 3 D imaging of epiphysis in unclear cases
  - Status of growth plate

- Bone Scan:
  - Cold scan before treatment → 80-100% risk of osteonecrosis (Rhoad 1999)
Classification

- Duration of Symptoms
- Stability of the Femoral Head
- Anatomic Displacement:
  - Linear
  - Angular
1. Pre-slip (prodromal stage)

2. Acute: <3 weeks
   • 10% of SCFE

3. Chronic: >3 weeks
   • 85% of SCFE

4. Acute-on-Chronic: chronic with sudden exacerbation

   Problems:
   o Recall
   o Poor correlation with osteonecrosis
Stability Classification
Loder et al. 1993

1. **Stable:**
   - If able to walk with or without crutches

2. **Unstable:**
   - Unable to bear weight
   - 47% incidence of ON

😄 Not all acute are unstable.
😄 Not all chronic are stable.
Anatomic Classification
Linear Displacement

1. Minimal Slip: epiphyseal displacement < 1/3 of femoral neck width
2. Moderate Slip: displacement of 1/3 to 1/2
3. Severe Slip: displacement > 1/2
Anatomic Classification
Angular Displacement

The maximum difference of Southwick angles between the involved and uninvolved hip.
Anatomic Classification
Angular Displacement

1. Mild Slip: <30° difference
2. Moderate Slip: 30°-50° difference
3. Severe Slip: >50° difference
Bilateral SCFE

- Old reports, 10-15% at initial presentation
- Recent reports, 35-40% bilateral
- 57-61% of patients evaluated as adults have evidence of bilateral SCFE (Hagglund 1988 & 1996, Jerre 1994)
Prophylactic Pinning of Contralateral Hip

- Controversial

- Close observation & family education of symptoms

- Prophylactic pinning in: endocrinopathy, difficult follow-up or awareness of symptoms
**Conclusions:** The decision model shows that, when pooled data are used to predict probabilities of sequential slip, treatment of the contralateral hip with prophylactic pinning is beneficial to the long-term outcome for that hip. When considering prophylactic pinning of the contralateral hip, the clinician should use sound clinical judgment with respect to the age, sex, and endocrine status of the patient. Long-term follow-up studies are needed to establish the efficacy of prophylactic pinning, but the predictions in the present study, which are based on findings in the literature, support the safety of this procedure.
Goal of Treatment

To prevent additional slippage while avoiding the major complications of osteonecrosis and chondrolysis.
Treatment

1. Treatment to prevent further slippage

2. Treatment to reduce the degree of slippage: corrective osteotomies

3. Salvage procedures
Stable/"Chronic" SCFE

1. In Situ Percutaneous Screw Fixation
2. Hip Spica Cast
3. Open Epiphysiodesis with Bone Graft
4. ORIF with Cuneiform Osteotomy
5. Compensating Base-Of-Neck Osteotomy with In Situ Stabilization
6. Intertrochanteric Osteotomy with Internal Fixation
Unstable/”Acute” SCFE

1. In Situ Percutaneous Screw Fixation

2. Open Epiphysiodesis with Bone Graft

Controversial Points:
- Reduction? How gentle, if any?
- Traction?
In Situ Percutaneous Screw Fixation

- The most common method

Principles of the device:
- Must not penetrate the joint
- Must be positioned so it will not interrupt blood supply
- Must provide adequate stabilization
Procedure

- Fracture table with affected hip in neutral internal rotation “gentle unintentional reduction”
- Adequate visualization of hip with C-arm
- Identification of entry point (skin markings)
- Aim for screw to be in the central axis of the femoral head in all views & perpendicular to growth plate (in most patients, this requires starting point on anterior neck)
Procedure

- Avoid superior & anterior quadrant of head
- Single 7.5mm cannulated screw, if possible
- Keep the number & size of starting holes to a minimum (to avoid fracture)
- Tip should be at least 5mm from subchondral
- Check lateral imaging while pinning
- “APPROACH-WITHDRAW” Technique
Blind Spot
Blind Spot
Postoperative Care

1. Partial weight bearing with crutches for 1-2 weeks in stable, 6 weeks for unstable

2. Refrain from competitive sports until physis closed

3. Educate for contralateral hip

4. Follow up every 4 months until physis closure, x-rays both hips

5. Do not remove screw unless complications
Hip Spica Cast

Complications:
- Chondrolysis: 19-67%
- Recurrent slip after cast removal: 18%
- Full-thickness pressure ulcers: 16%
- Osteonecrosis: 7%
- Psychosocial
Open bone-peg epiphysiodesis

Rationale:
- Rapid physeal closure
- Direct visualization → less complications

Complications/Disadvantages:
- Extensive surgical approach
- Longer OR time
- Increased blood loss
- Potential continued slippage
- Need for hip spica immobilization
Bone graft epiphysodesis

- Corticocancellous bone pegs
- Cylindrical tunnel across physis
- Rectangular window in femoral neck
Osteotomies

Cuneiform  Base-of-Neck  Intertrochanteric
Intertrochanteric Osteotomy

- The most common osteotomy for residual deformity
- Numerous types

Complications:
- Chondrolysis: 10-40%
- ON: rare
- Difficult future total hip arthroplasty
Complications
Complications

- Early:
  - Unrecognized joint penetration
  - Pathologic Fracture
  - Continued Slippage
  - Infection
  - Osteonecrosis
  - Chondrolysis
Complications

- Late:
  - Residual deformity
  - Osteoarthritis
Osteonecrosis

- Incidence: 10-15% with old treatment methods, recent reports 0-5% with in situ screw fixation

- Risk Factors/Etiology:
  - Unstable SCFE (vascular compromise most likely at time of injury): 47% incidence
  - Severe SCFE
  - Iatrogenic (malposition of screw)
Osteonecrosis

- Most symptoms within 2-12 mo (up to 18)
- Loss of motion, pain on extreme of motion
- High index of suspicion & close observation
- X-rays, Bone Scan, SPECT, MRI
Treatment of ON

1. Symptomatic:
   - Protected weight bearing with crutches for 1-2 yr, NSAIDs
   - Swimming, riding stationary bicycle
   - Stop when evidence of bone healing

2. Remove & replace hardware in zone of collapse.

3. Vascularized Fibular Graft

4. Redirectional osteotomy
Chondrolysis

Definition: narrowing of the joint space
  – to at least 1/2 in the contralateral hip in unilateral cases
  – to <3 mm in bilateral cases

Groin or knee pain, loss of hip ROM, esp. Internal Rotation

5-7% of SCFE
Chondrolysis

Risk Factors:
- Unrecognized permanent pin penetration
- Cast immobilization
- Severe SCFE
- Chronic SCFE
Chondrolysis

Treatment:

- Non-operative:
  - NWB with crutches
  - ROM exercise
  - NSAIDs

- Operative:
  - If pin protrusion: back it out; or if physis closed, remove it.
  - Arthrodesis in severe cases.
Salvage Procedures
Hip Arthrodesis

- The procedure of choice for adolescent with severe hip pain & stiffness due to deformity, ON or chondrolysis
- Relieves pain, high level of activity & employment
- Position: 20° flexion, neutral rotation, neutral to slight adduction
Mowery
Arthrodesis
Hip Arthroplasty

Not recommended in adolescent because:
- Early component loosening & wear
- The need for several revisions → chronic infections

Exception for bilateral disease:
- One arthrodesis & one arthroplasty
Thank You