SCFE

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INTRODUCTON

- Aka Adolescent Coxa Vara/ epiphyseal Coxa Vara.
- Slippage of metaphysis relative to capital femoral epiphysis.
- Shearing stress from excessive body weight and weak upper femoral physis.
- Adolescent obese males – MC
- **Muller –** epiphysis displaces primarily posterior to femoral neck.

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Anatomy

- Growth plate anchors the femoral head and neck.
- Stability- perichondrium,
  perichondrial ring,
  transphyseal collagen
  height of hypertrophic zone
  maxillary process
  angle of inclination

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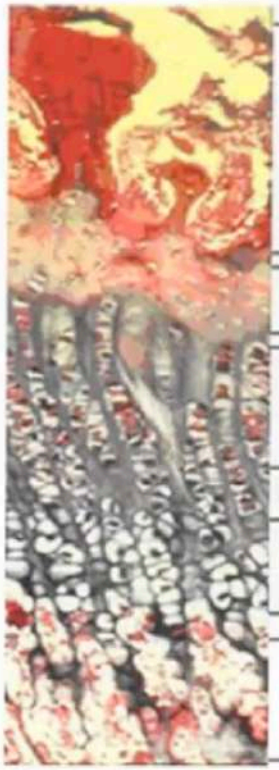

Reserve Zone
(Gaucher's, diastrophic dysplasia)

Proliferative Zone
(Achondroplasia)

Hypertrophic Zone
(SCFE, Rickets, SED, MED)

Spongiosa
(Corner fracture, Scurvy)

Decrease in chondrocytes and increase In cellular matrix

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Etiology

- Thinning of Peri-chondrial ring complex with maturation
- Relative absolute retroversion of femoral neck
- Change in inclination of adolescent proximal femoral epiphysis relative to femoral neck and shaft

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- Age : occurs between 10-16 years (boys 13-15, girls 11-13)
- Male: female = 2:1 (male: frohlic type obesity, female: slender long)
- Left > right (bilateral 25 - 40 %)
- Trivial trauma or no cause

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Risk Factors

- Obesity
- Acetabular and Femoral retroversion – increases shearing stress
- History of previous radiotherapy to femoral head

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Associated conditions

- Hypothyroidism : MC etiology of non idiopathic SCFE
  elevated TSH
- Renal osteodystrophy : elevated BUN and creat.
- Growth hormone deficiency
- Panhypopituitarism
- Down syndrome

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- Indication for endocrine workup:
- Child < 10 years
- Weight is < 50th percentile

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Theories

- **Harris Hormonal theory :** increased growth hormone and decreased sex and thyroid hormone
- **Traumatic theory :** weak epiphyseal line
- **Theory of periosteal thinning :** thinning of periosteum (retinacula of Weitbrecht) during adolescent with increased shearing forces

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Classification : temporal

- Depending on clinical course: no prognostic value

1. Acute Slip (11%): sudden onset, symptoms < 2 weeks, post trauma, no remodeling changes in x-rays

2. Chronic slip (60%): >2 weeks, x-ray shows callus formation and attempted remodeling

3. Acute on chronic (23%): > 1month with recent sudden exacerbation of pain following trivial injury, x-ray shows remodeling and displacement of epiphysis

4. Pre-slip (6%): irregularity, widening and indistinctness of physis

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Depending on amount of displacement

- **Southwick slip angle classification:**
- **Mild** : neck displaced **>1/3rd of diameter head.**
  head-shaft angle **<30 degree**
- **Moderate** : neck displaced **> 1/3rd to half of head diameter**
  head-shaft angle **30-60 degree**
- **Severe** : neck displaced **> half of head diameter**
  head-shaft angle **> 60 degree**

If bilateral hips are involved, use 145° as "unaffected" hip reference for AP and 10° as "unaffected" hip reference for lateral

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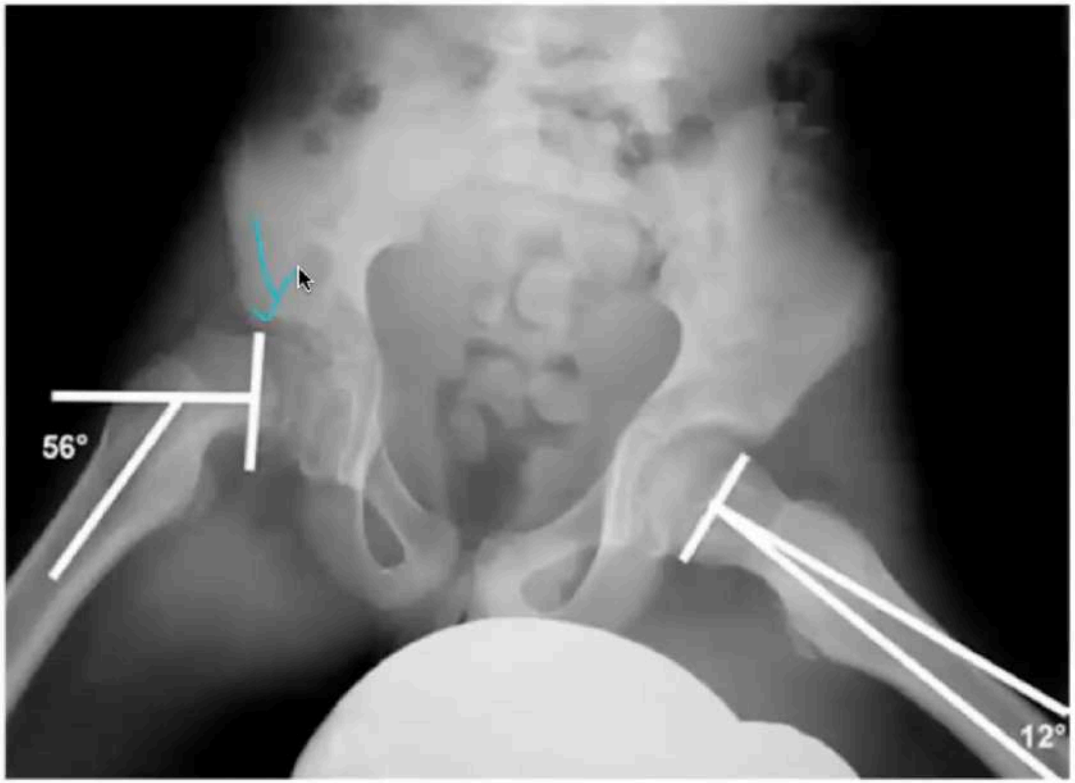

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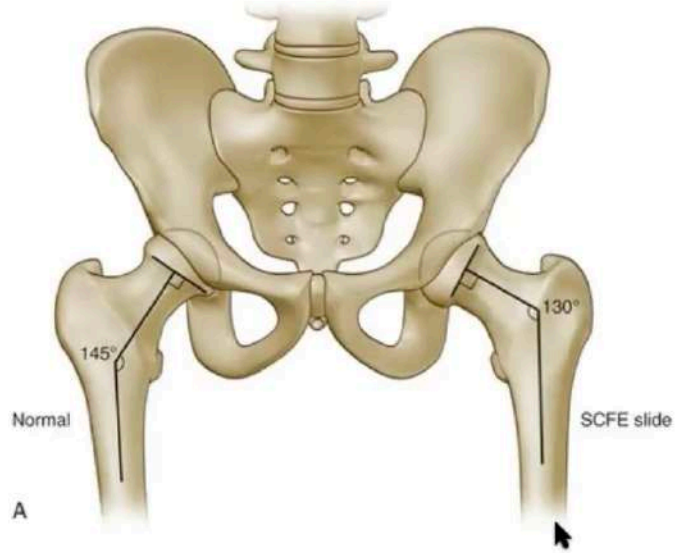

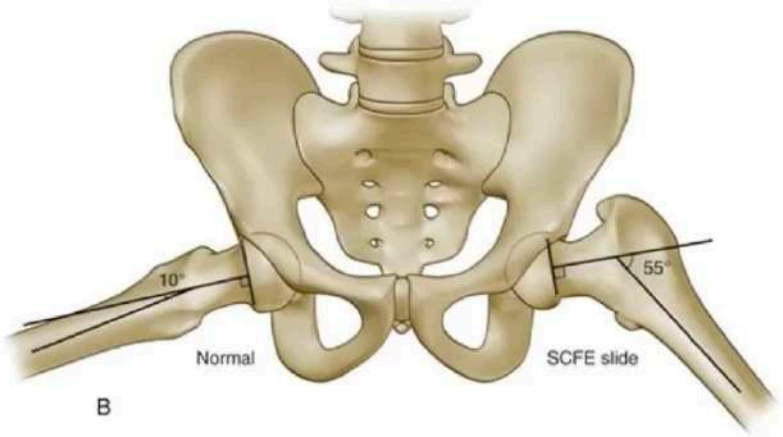

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Based on stability of Physis: Loder et al

- Provides prognostic information for complication of femoral head osteonecrosis
- **Unstable :**
    a. able to bear weight with or without crutches
    b. minimal risk of osteonecrosis(<10%)
- **Stable :**
    a. unable to ambulate even with support
    b. high risk of osteonecrosis (24%)

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Based on USG: Kallio et al

- **Acute slip :** joint effusion
- **Chronic slip:** remodeling but no effusion
- **Acute on chronic slips :** joint effusion and remodeling

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- 12-year-old girl presents with groin pain six months after treatment of a slipped capital femoral epiphysis. Preoperative radiographs are seen in Figure A, radiographs six months after in situ fixation are seen in Figure B. Which of the following is associated with the radiographic abnormality seen in post op radiograph?

  a. lack of reduction prior to fixation

  b. single screw fixation

  c. female sex

  d. inability to bear weight pre-op

  e. obesity

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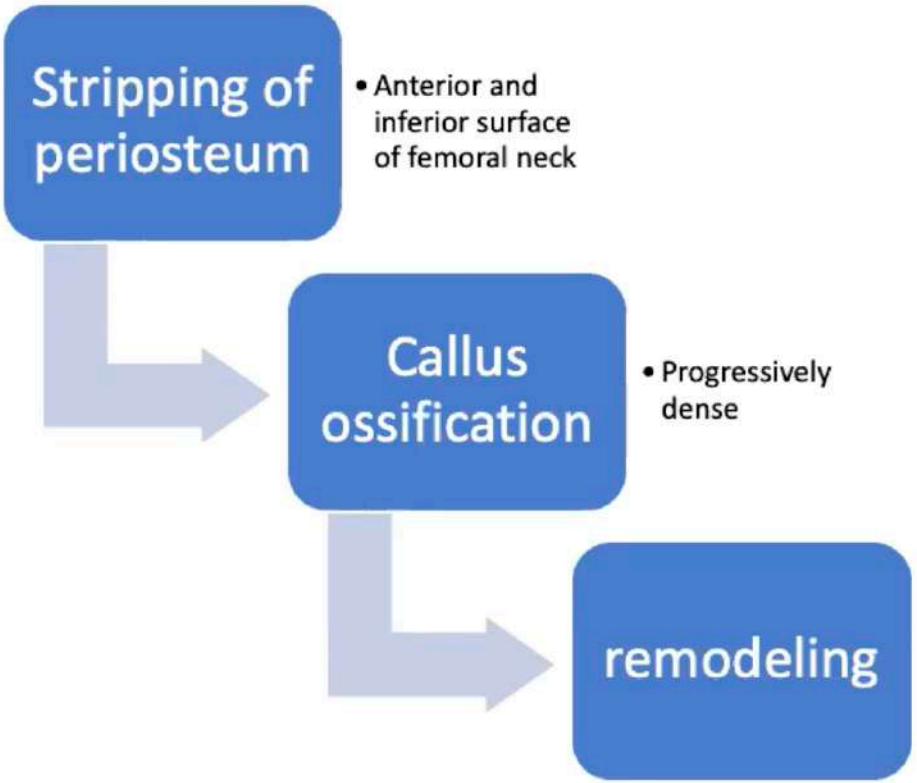
Pathology



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Pathoanatomy

- Slippage through hypertrophic zone
- Weakening of perichondrial ring
- Undulating mammillary processes in physis unlocks, further destabilizing the physis.
- physis is still vertical in this age group (160° at birth to 125° at skeletal maturity), resulting in increased shearing forces

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- **Angulation :**

metaphysis translates anterior and externally rotates

epiphysis remains in the acetabulum, lies posterior to the translated metaphysis

- similar to **Salter-Harris type I fracture**, but may differ by
  - antecedent epiphysiolysis
  - slower displacement
  - periosteum remains intact (chronic SCFE)
    - in acute SCFE, periosteum is can be partially torn anteriorly over the prominent metaphysis

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- A 14-year-old overweight boy complains of vague left knee pain which worsens with activity. He has an antalgic gait and increased external rotation of his foot progression angle compared to the contralateral side. Knee radiographs, including stress views, are negative. What is the next step in management?
- Knee MRI
- CT knee
- AP pelvis and frog lateral view
- MRI pelvis
- Diagnostic knee arthroscopy

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Clinical features

- **Spontaneous limp**
- **Chronic** : groin pain referred to anteromedial aspect of thigh and knee.
- **Acute** : sudden onset of fracture like pan after trivial fall. Limb externally rotated and inability to move hip
- Knee pain: due to pain activation of the medial obturator nerve
- can lead to missed diagnosis.
- patients prefer to sit in a chair with affected leg crossed over the other

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Physical examination

- **Signs :** externally rotated and adducted limb

  pelvis tilted upward on affected side

  atrophy of buttocks and gluteal fold lower than normal side
- Antalgic gait
- External rotated foot progression angle
- Decreased Hip Motion: obligatory external rotation during passive flexion of hip **(Drehmann sign)**
- Loss of hip internal rotation, abduction, and flexion

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Investigations: X-rays : gold standard

- **Frog leg internal rotation view and AP view**
- **Early changes :**

  a. marginal blurring of proximal metaphysis

  b. **klein's line/ Trethovan's sign**: line along superior margin of neck transects epiphysis normally but will be above in a slip.

  c. depth of physis is reduced

  d. step between metaphysis and epiphysis

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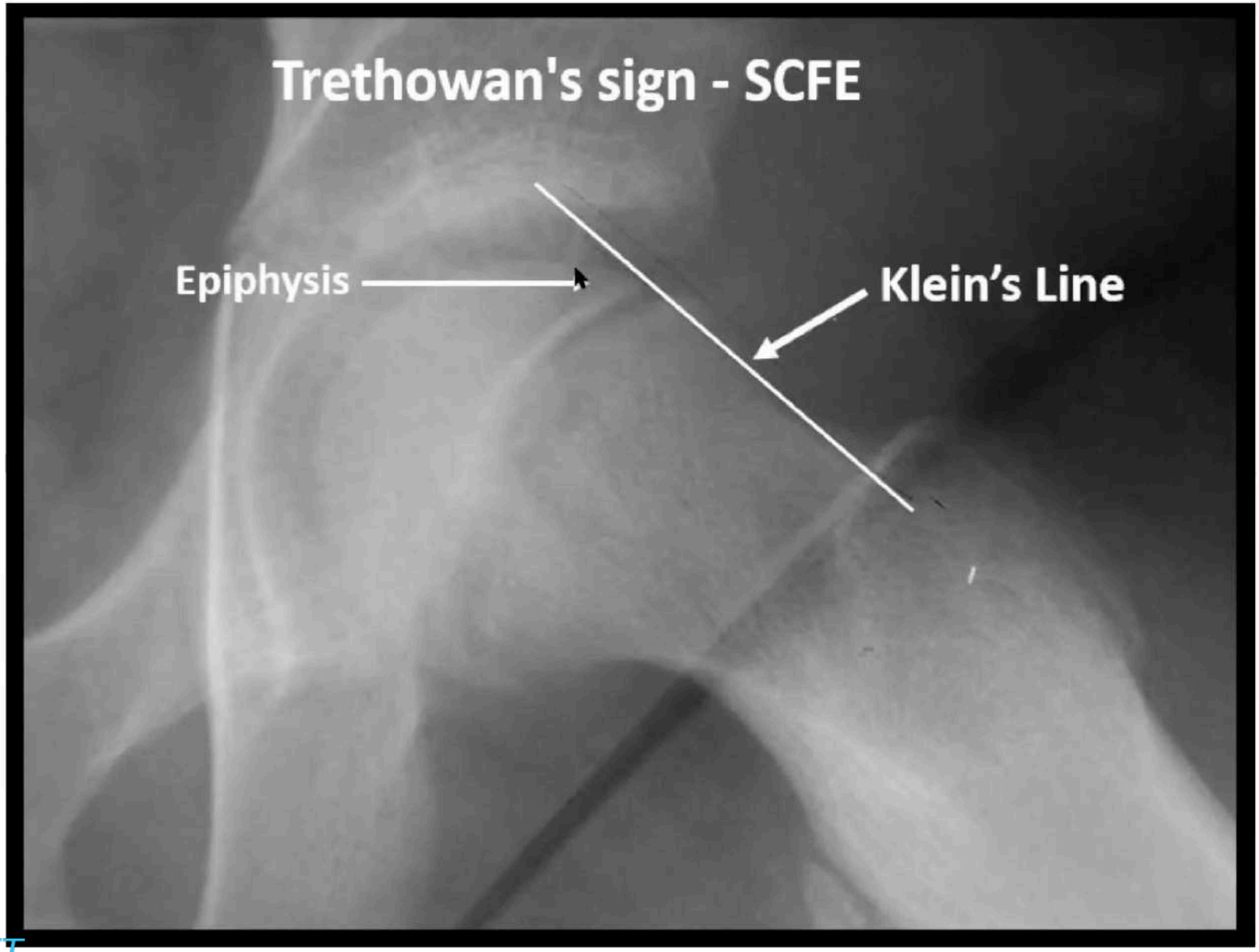

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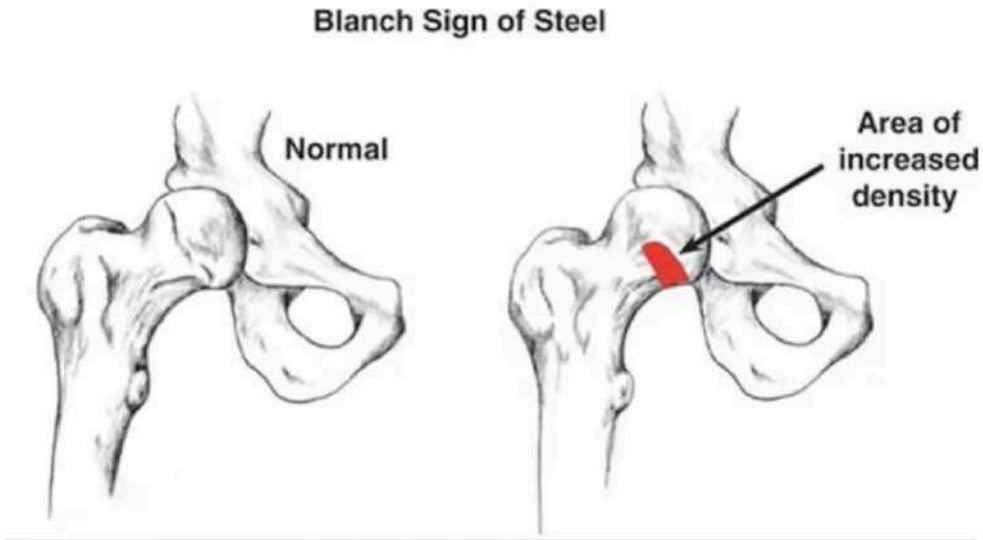

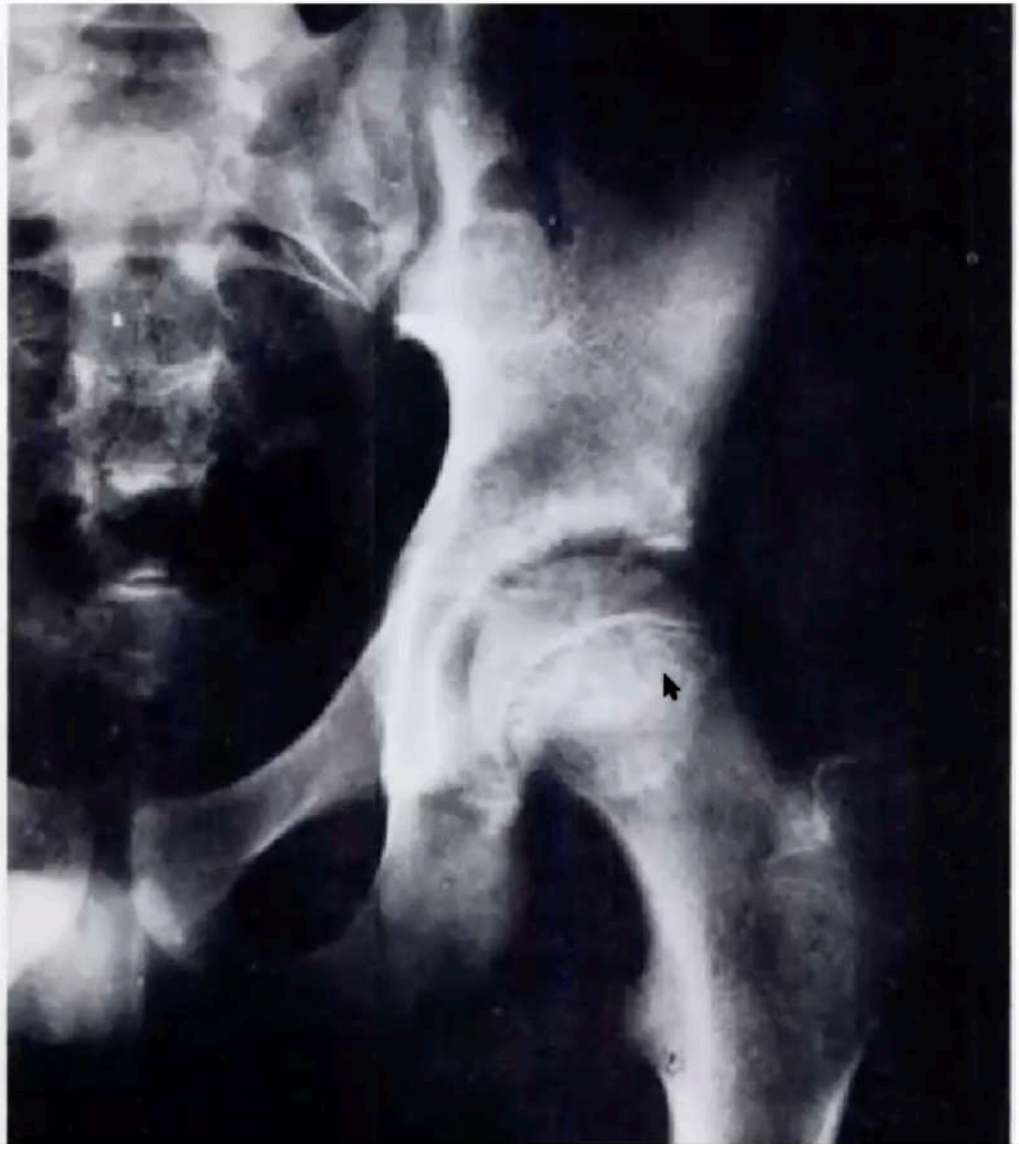

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- **Late changes :**
    a. Trethovan's sign
    b. Atrophic Head
    c. Neck shaft angle < 90 degree
    d. New bone formation seen at antero-superior part of neck
    e. Clear joint space
    f. Shenton's line is broken

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- **CT scan :** femoral anteversion , measurement of Head Neck angle
- **Bone scan :** increased uptake

  abnormally decreased uptake – AVN

  increased uptake in joint space - chondrolysis
- **USG :** joint effusion and remodeling changes
- **MRI :** rule out AVN

  may help diagnose a preslip condition when radiographs are negative

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Management : SCFE is an emergency

- Conservative :
    a. absolute bed rest
    b. abstinence from weight bearing
    c. longitudinal traction with medial rotation

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- **Mild displacement : Fixation in situ** for both Acute, chronic and pre-slip
- **Moderate or Severe:** Acute (Acute on Chronic)

  gentle closed reduction by traction or by boyd method of manipulation and fixation

  in no satisfactory reduction – ORIF (cervical osteotomy)
- **Chronic slip :** cervical or trochanteric osteotomy

  Ferguson and Haworth bone peg epiphysiodesis

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A 13-year-old boy complains of a 3-month history of left knee, thigh and groin pain. His pain has significantly worsened over the past week. He denies pain in the right leg. Radiographs are taken and shown in Figures A and B. The history and physical do not reveal any findings concerning for an endocrine disorder. What is the preferred method of treatment?

a.Subtrochanteric valgus external rotation extension osteotomy
b. Non weight bearing on left side for 6 weeks
c. Bilateral in-situ single screw fixation across proximal femoral epiphysis
d. Varus derotational osteotomy of left femur
e. In situ single screw fixation of left femoral proximal epiphysis.

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Percutaneous in situ fixation

- For both stable and unstable slips
- one vs. two cannulated screws is controversial
- reduction
  - forceful reduction is not indicated and increases risk of osteonecrosis
  - "serendipitous reduction" is often obtained with positioning on OR table
  - capsulotomy is controversial
  - decreases intra-capsular pressure
  - primarily indicated in the setting of unstable SCFE: intracapsular pressure in unstable SCFE is double that of control hips, while pressure in stable SCFE is roughly equal to control hips
  - may mitigate intracapsular tamponade, though no clear evidence that this reduces AVN rates

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Screw insertion:

- **perpendicular to physis:**
- starts on the anterior surface of the proximal femur
- should not be medial to intertrochanteric line - will result in impingement between the head of the screw and acetabulum with hip flexion
- **Oblique to the physis:**
- in severe slips, a relatively oblique insertion starting at the intertrochanteric region may be required, rather than perpendicular, to avoid impingement from head of the screw

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- **screw position**
  - advance until 5 threads cross physis
    - < 5 threads engaged in epiphysis increases risk of progression of slip >10° (<5 threads 41% progressed, >/= 5 threads 0% progressed)
  - screws should be at least 5mm from subchondral bone in all views
- **approach-withdraw technique**
  - rotate hip from maximal internal rotation or maximal external rotation under live fluoroscopy
  - the screw tip appears to approach the subchondral bone, then withdraw from it
  - the moment of change from approach to withdraw is the true position of the screw and can be used to insert the screw to appropriate position
  - appropriate position confirmed when screw does not violate articular surface in all views

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Contralateral hip fixation

- current indications are high risk patients for contralateral slip(~ 40-80%)
  - initial slip at young age (< 10 years-old)
  - open triradiate cartilage
  - obese males
  - endocrine disorders (e.g. hypothyroidism)

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Open techniques

- **Surgical hip dislocation, open capital realignment and fixation (Modified Dunn procedure):** to correct the acute proximal femoral deformity, protect femoral head blood supply and stabilize the epiphysis
- **Osteochondroplasty:** to address pain and loss of motion related to hip impingement from prominent metaphyseal bump in mild to moderate chronic SCFE deformity
- **Flexion intertrochanteric (Imhauser) femoral osteotomy :** to correct symptomatic proximal femoral deformity in moderate to severe chronic SCFE deformity

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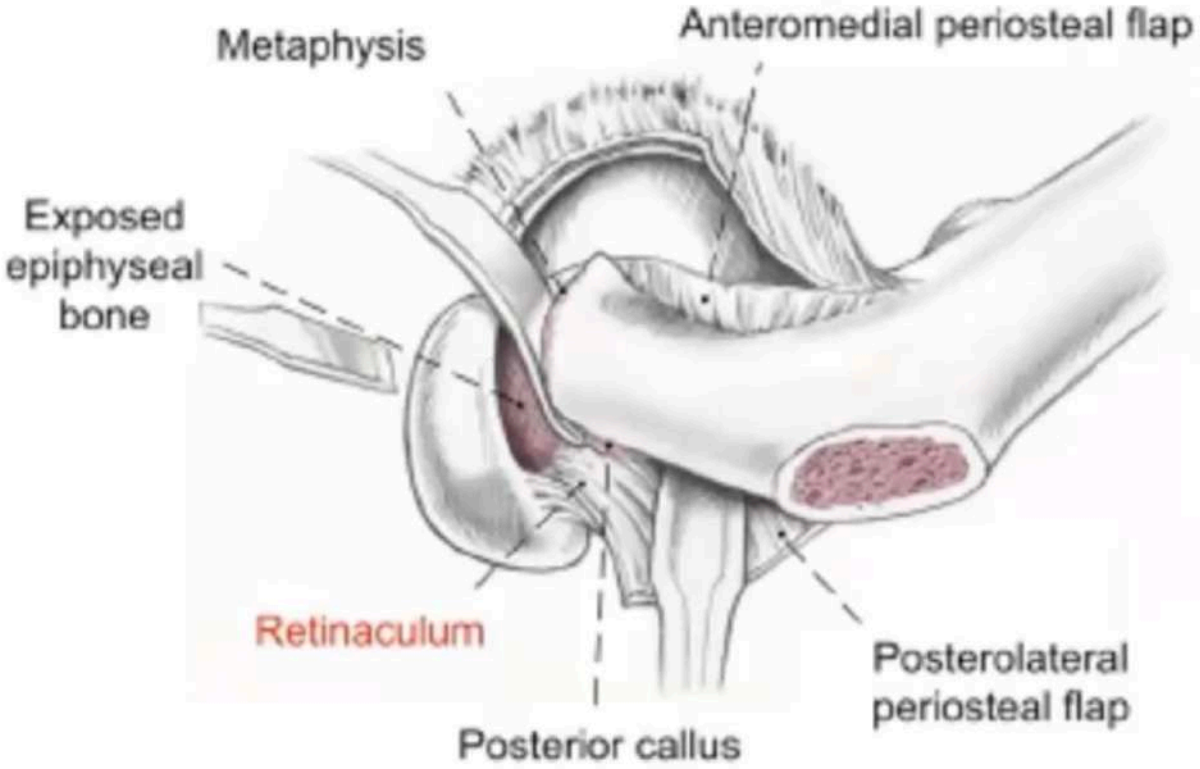

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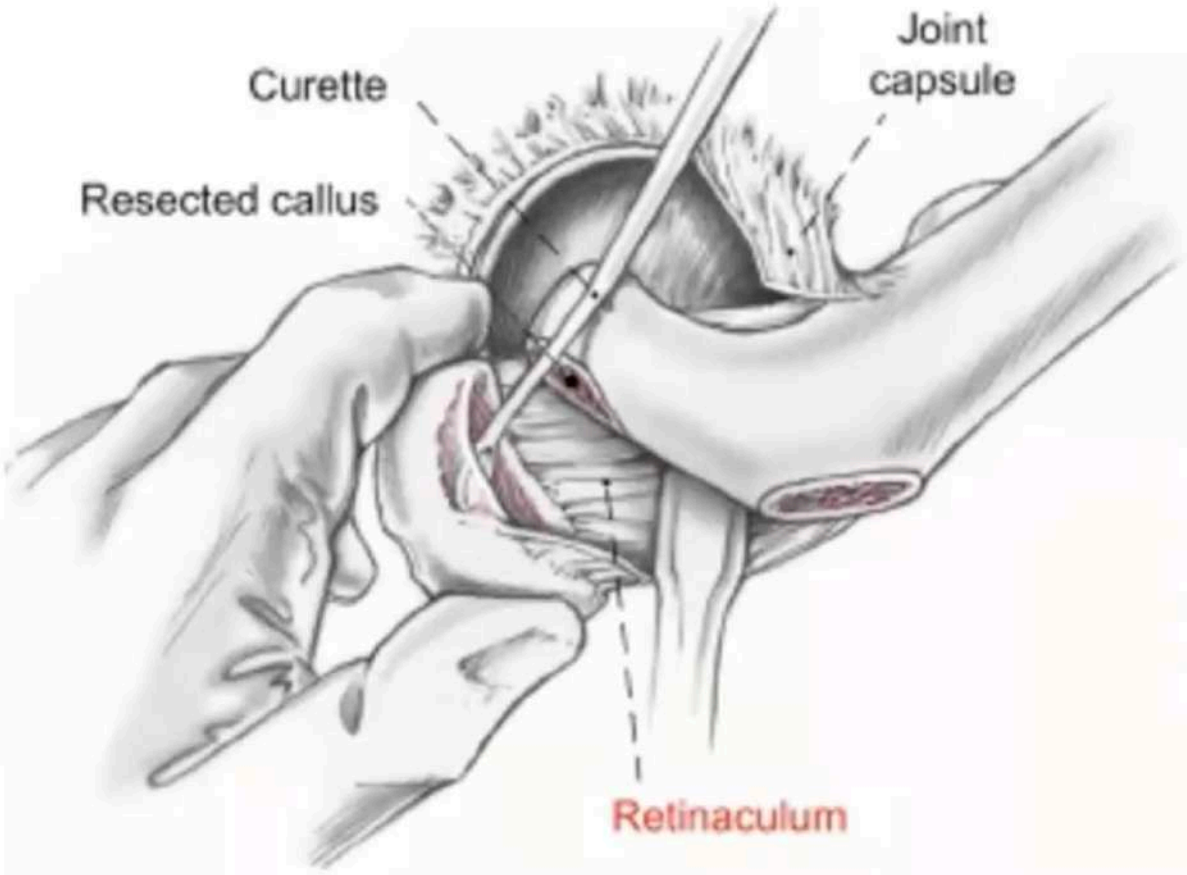

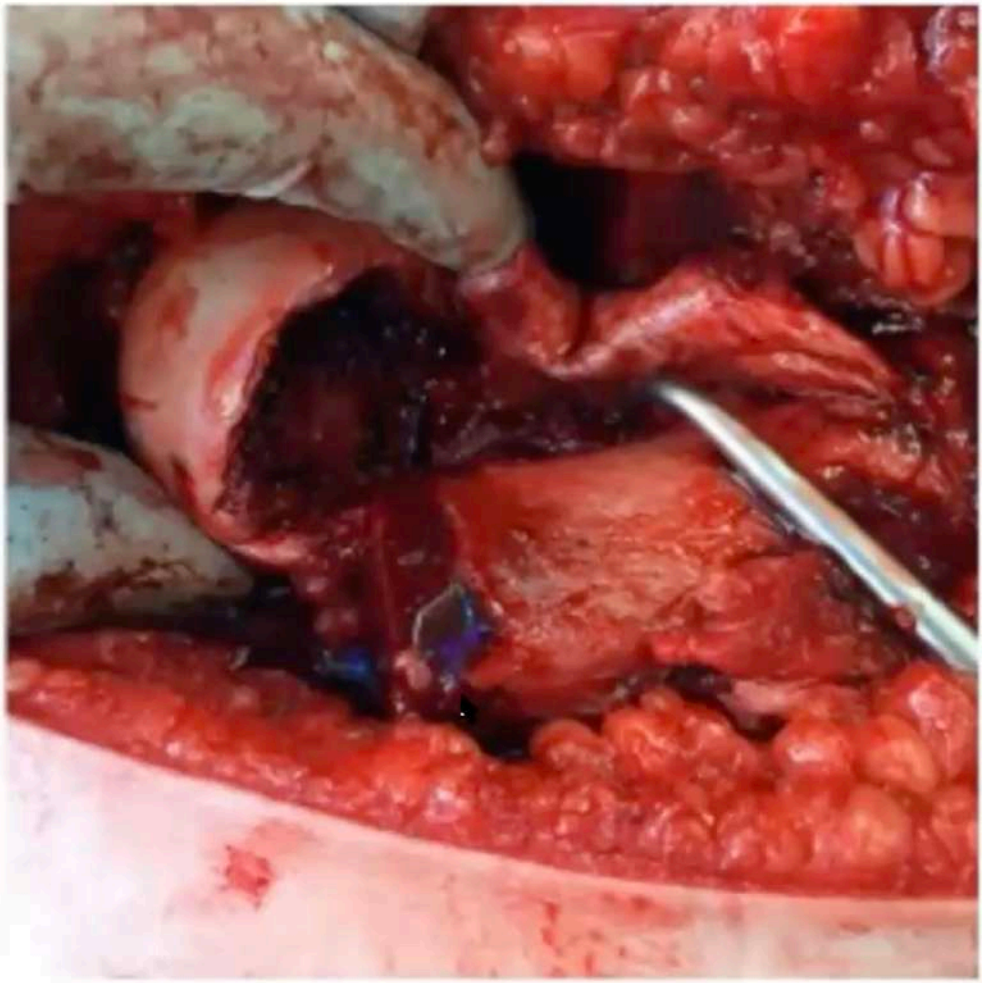

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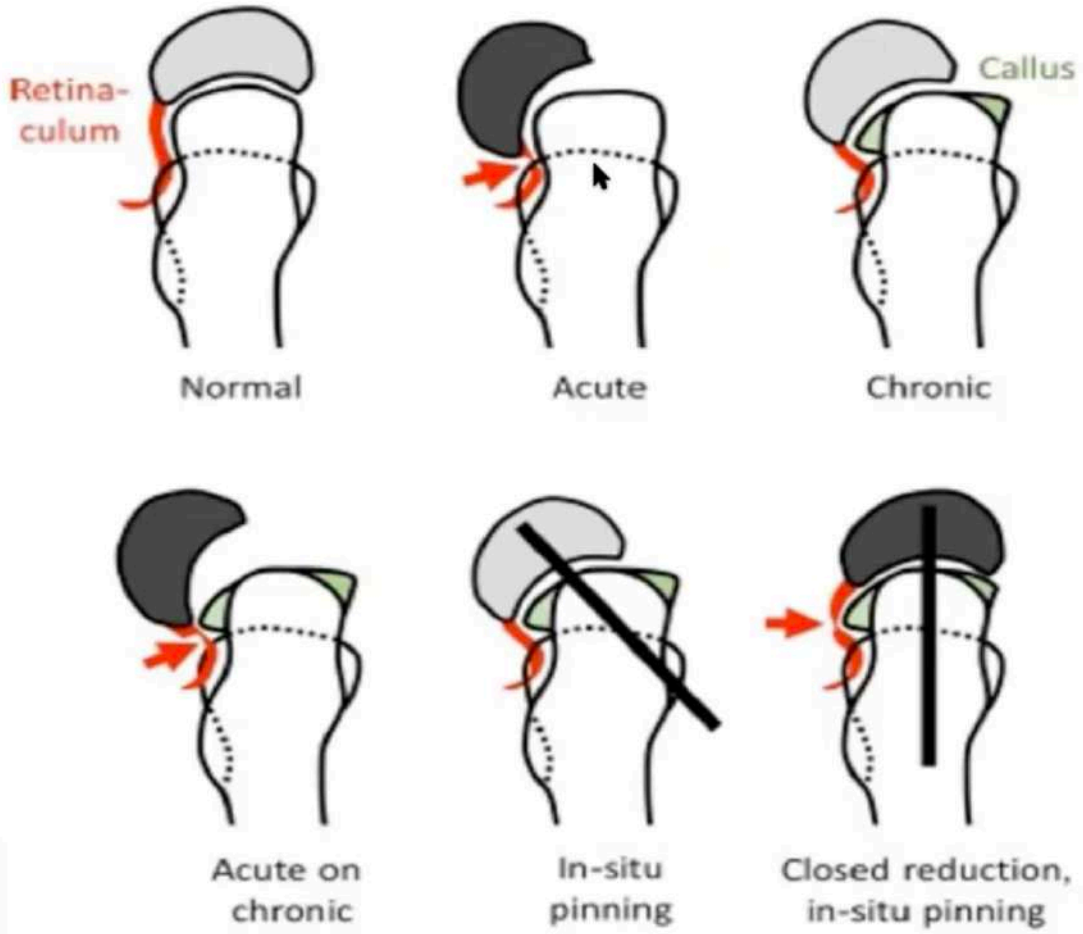

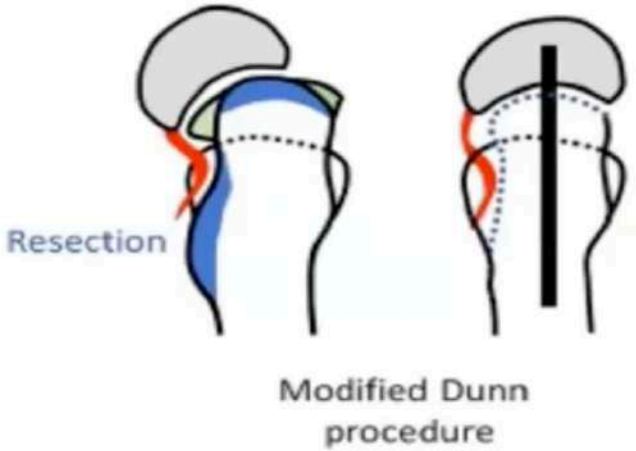

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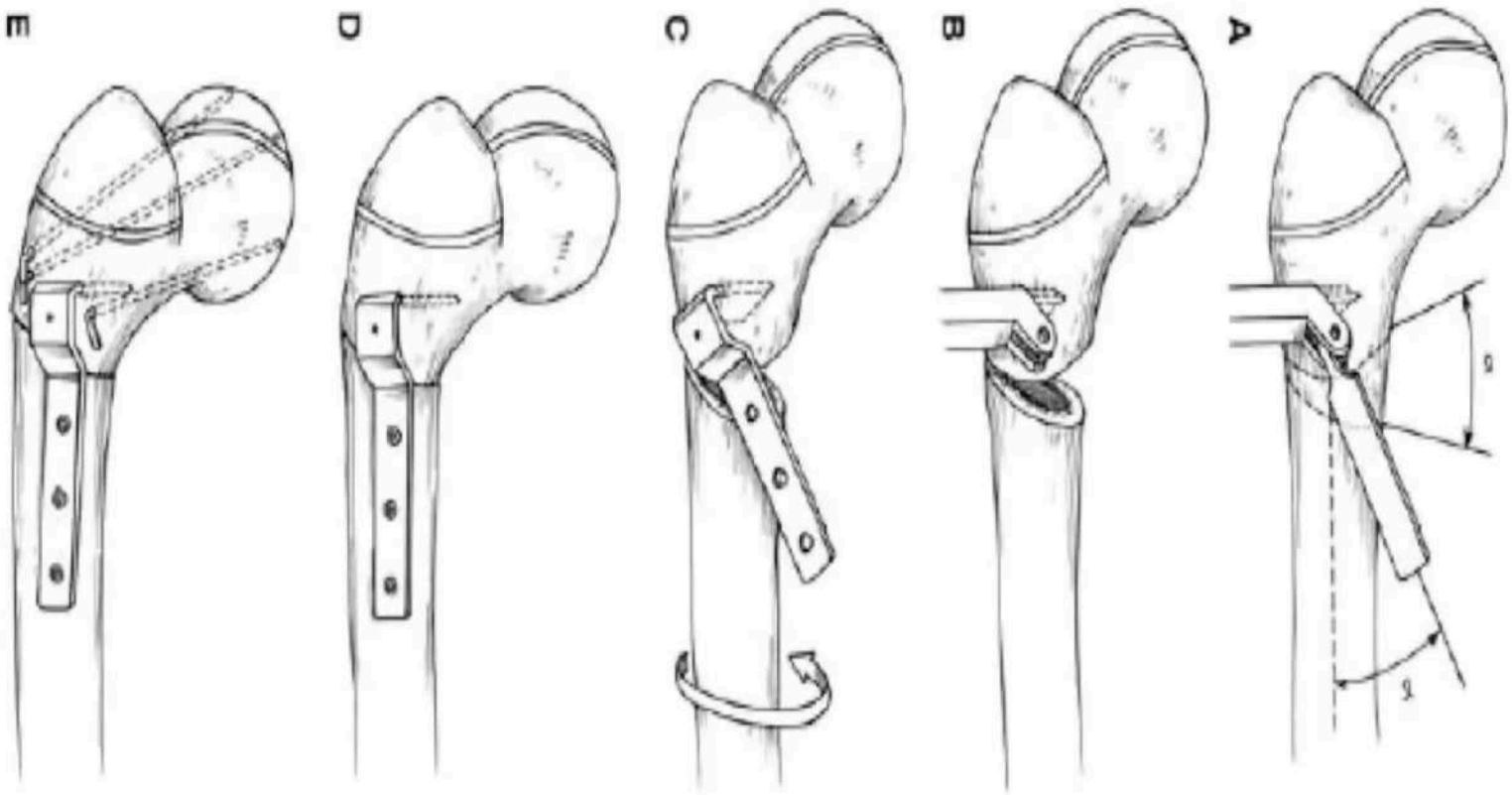

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Complications

- Chondrolysis – cartilage necrosis
- AVN- total head necrosis or partial segmental nerosis
- Contralateral SCFE
- Slip progression
- Residual proximal femoral deformity & limb length discrepancy increased α-angle associated with symptomatic impingement
- caused by failure of proximal femur to remodel
  - pistol-grip deformity

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- Infection (0-2%)
- Chronic pain (5-10%)
- Degenerative arthritis
- Pin associated proximal femur fracture
- Labral tearing and degeneration

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Hot Topics in the Management of SCFE: Cases and Controversy

- Should the contralateral hip be pinned?
- Does the capsule need to be decompressed?
- Surgical dislocation and reduction for unstable SCFE
- Non-resurfacing surgical options for SCFE
- Arthroplasty Options for SCFE sequelae

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When to Pin the Opposite Hip

- **The Goal**
  - To prevent a SCFE from occurring in the opposite hip of a unilateral SCFE especially one severe in magnitude or unstable in type
- **The Utility Value**
  - Underlying concept in decision analysis
  - Objective clinical outcome measures assigned a utility value in the form of a linear scale

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Recent Studies

- **Schultz et al.**
  - Determined threshold level for prophylactic fixation when considering rates of sequential slip, rate of slip overlooked at follow-up, and complications associated with prophylactic fixation of the opposite hip (AVN and chondrolysis)
  - Threshold rate that favors observation is:
    - 18.1% for AVN, 21.6% for chondrolysis
  - Since rates of AVN and chondrolysis are <<, prophylactic fixation is beneficial for the long-term outcome of the uninvolved hip

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Recent Studies

- **Kocher et al.**
  - Used utility values obtained from questionnaires on patient preferences by 25 adolescent boys without SCFE
  - Risk of prophylactic fixation > benefits when probability of a contralateral SCFE is > 27% or when reliable follow-up is not feasible
  - Advocate patient-physician shared decision-making model in which outcome probabilities and patient preferences are considered

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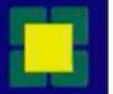
Recent Studies

- Different conclusions reached because different methods of determining utility values
- Real dilemma is how to determine when the risk for contralateral SCFE is > 27%



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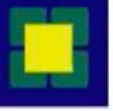
Factors for Contralateral SCFE

- What is the probability of a unilateral SCFE → bilateral SCFE?
- Is the SCFE idiopathic or atypical?
- Do the benefits outweigh the risks?



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Potential Predictors for Sequential Bilateral SCFE

- Age/skeletal maturity
- SCFE type – atypical vs idiopathic
- Physeal slope
- Ethnicity/race

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Statistics

- Of all bilateral SCFEs:
  - 50% present simultaneously
  - 50% present sequentially
    - 82% of the sequential cases appear within 18 months of the 1st SCFE
- So age would likely be a predictor, as younger children will be more likely to have open physes after the 1st SCFE

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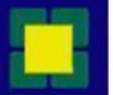
Age – Recent Studies

- Bilaterality is age dependent – both chronological and skeletal

- Chronological age (Loder et al. *CORR*:1996)
  - 12 years (unilateral → bilateral)
  - 13 years (unilateral → unilateral)



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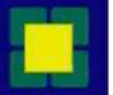
Age – Recent Studies

- Koenig et al. *JPO* 27:2007
  - 71 unilateral SCFEs
  - 12 became bilateral (17%)
  - Age, physeal slope angle, modified Oxford bone age, triradiate cartilage open or closed – none were predictors of sequential SCFE



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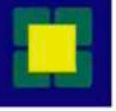
Type of SCFE
Atypical vs Idiopathic

- **Idiopathic SCFE**
  - -Routine SCFE seen in clinical practice
- **Atypical SCFEs – Associated with:**
  - Endocrinopathies
    - ↓ T4 before T4 supplementation
    - ↓ GH after GH supplementation
  - Metabolic disorders – ie. renal failure
  - Radiation therapy



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Type of SCFE
Atypical vs Idiopathic

- In certain atypical groups, risk of 2nd SCFE in those presenting with a unilateral SCFE is so high that nearly all authors recommend prophylactic fixation
  - Endocrine – 61%
  - Metabolic – 90%

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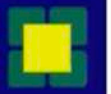
Posterior Physeal Slope Studies

- **Barrios et al.**
  - 18 ° in those unilateral → bilateral
  - 12° in those unilateral → unilateral
- **Zenios et al.**
  - 19° in those unilateral → bilateral
  - 14° in those unilateral → unilateral
  - 4° in controls
- **Recommend prophylactic pinning if PS > 14.5°**



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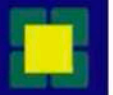
Ethnicity/Race

- Bidwell & Stott *Aust New Zeal J Surg* 76:2006
  - Unilateral → bilateral 4.0 times higher in New Zealand Caucasians compared to New Zealand Maori/Polynesians
- At odds with other data



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Ethnicity/Race

- Loder et al *CORR*: 1996 – Sequential bilateral SCFEs - % of all bilateral SCFEs
  - Polynesian 62%
  - Hispanic 56%
  - White 43%
  - Black 32%
  - Asian 18%

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Absolute Indications

- All endocrine/metabolic SCFEs

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Relative Indications

- Chronological age: < 9 girls, < 11 boys
- Ethnicity:
  - Polynesians, Hispanics, ? Caucasians
  - Especially if young
- High posterior physeal slope
  - Especially if young and high racial predilection

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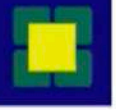
Does the Capsule Need to be Decompressed When Pinning SCFE? (Yes it does)

- Tomkakova and Stanton *JBJS 2004*
  - 21 patients who developed osteonecrosis presented with an unstable SCFE
  - None in 204 who had a stable SCFE
  - Conclusion:
    - Complete or partial reduction of an unstable SCFE increases the risk of developing osteonecrosis
  - None underwent a decompression



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Intracapsular Pressure Data

- **Maeda et al. *JPO* 2001.**
  - Of 5 unstable slips, superior retinacular artery (SRA) was stained in two and was not filled in three
  - In one slip examined before and after manipulative reduction, the SRA was not seen before it but was well stained after reduction
  - Results suggest that the vascular injury occurs at time of injury, before reduction and that reduction does not necessarily contribute to risk of AVN after unstable SCFE

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Intracapsular Pressure Data

- Gordon JE et al. *JPO* 2002.
  - 10/16 patients were treated within 24 hours after the onset of acute symptoms by reduction, arthrotomy, and cannulated screw fixation using two screws
  - None of these patients developed AVN of femoral head

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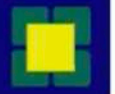
Intracapsular Pressure Data

- **Herrera-Soto, et al. *JPO* 2008.**
  - Mean pressure of affected hip was 48 mmHg
  - Mean pressure of unaffected hip was 23 mmHg
  - Significant increase in intraarticular hip pressure after attempted manipulation (mean 75 mmHg)
  - Hip pressures are increased in unstable SCFE to levels higher than for compartment syndrome probably causing a tamponade effect
  - Need to perform capsulotomy if manipulation is performed



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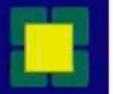
Technique

- Place patient supine on radiolucent table
- Surgeon holds leg while prepping and draping, then scrub
- Insert the side-bored needle with venous pressure gauge
  - Medial approach, Stryker or arterial line set-up
- Leave it inside the hip while performing the controlled reduction and capsulotomy



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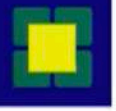
Technique

- Place two guide wires, measure and insert screws
- Along the same incision, insert key elevator anteriorly and elevate the neck
  - Look for pressure to go down
  - Inject dye and look for extravasation



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Non-Resurfacing Surgical Option for Residual SCFE Deformity

- **Natural history of residual SCFE deformity**
  - Iowa study; Carney and Weinstein: *CORR* 1996.
  - Mean patient follow-up from onset of symptoms was 41 years
  - Mean patient age at onset of symptoms was 13 years
  - Degenerative arthritis developed in hips with displaced SCFE
  - Untreated SCFE can progress to a severe degree
  - Natural history favorable provided displacement is minimal and remains so

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Surgical Options
Femoral head/neck osteoplasty

- When to intervene:
  - Evidence of FAI
  - Labral tear
    - Scope vs Open

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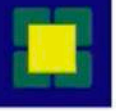

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Surgical Options
Femoral head/neck osteoplasty

- **Spencer et al. *JPO* 2006.**
  - Surgical dislocation approach, combined with osteoplasty and/or bony realignment is safe, efficacious treatment option for symptomatic pistol grip deformity
  - Outcomes worse if preexisting cartilage damage

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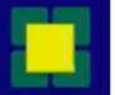
Surgical Options
Osteotomy

- Does every patient require an osteotomy?
- Timing
- Type of osteotomy



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Surgical Options
Osteotomy - Imhauser

- **Schai Orthopade 2002.**
  - 51 patients after ostetomy with average follow-up of 24 years (20-29 years)
  - 55% without degenerative changes
  - 28% with moderate degenerative changes
  - 17% with advanced arthritis
  - Compares favorably to natural history or to in-situ screw fixation

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Surgical Options
Osteotomy - Southwick

- Patients followed for average of 22 years (16-28 years)
- External rotation deformity corrected
- Trendelenberg sign hardly observable
- 36% with radiographic evidence of degenerative joint disease but none symptomatic
- Safe but technically demanding
- Good, predictable outcome with low compliation rate

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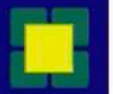
Surgical Options
Keys/Trends for the Future

- Make alignment as mechanical as possible
- MR arthrogram for pre-op work-up
- Combined proximal femoral osteotomy and surgical hip dislocation with femoral head/neck osteochondroplasty
- Remove implants at some point
- Educate patients about outcome
- Remember what might be next (THR or resurfacing)



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Surgical Dislocation/Open Reduction Approach for Unstable SCFE

- **Hip preserving surgery in young patients**
  - Definition:
    - Utilizing various surgical techniques to preserve, repair or reconstruct the anatomical aspects of the hip to prolong it's natural history
  - Strategy:
    - Treat FAI and/or hip dysplasia either in combination or individually based on abnormalities identified

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Femoroacetabular Impingement

- FAI is a mechanism to explain early osteoarthritis
- Surgical treatment of impingement improves femoral head clearance and alleviates femoral abutment against the acetabular rim

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CAM Impingement

- Abnormal femoral head (increased radius)
- Shear forces create outside-in abrasion of cartilage
- May get avulsion of cartilage from labrum and subchondral bone
- Treatment: Femoral head/neck osteoplasty (increase offset)

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Pincer Impingement

- Linear contact between acetabular rim and head-neck junction
- Result of acetabular abnormality
  - Over coverage of acetabulum (ie. Retroversion)
  - Generalized excess coverage (coxa profunda)
- Labrum is first to fail, later degeneration, ganglion formation
- Chronic leverage of the head – posterior head OA
- Treatment: Reducing anterior over coverage of acetabulum

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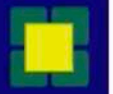
Surgical Hip Dislocation Approach

- **Advantages:**
  - Complete access to femur and acetabulum
  - All abnormalites can be effectively treated
  - No muscle detachment from bone
    - Greater trochanter osteotomy has vastus lateralis, gluteus medius and minimus attached
  - Recovery is easy
  - Gold standard for treatment of FAI
- **Disadvantages:**
  - Longer incisions
  - Recovery slower than for arthroscopy



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Surgical Dislocation of Hip
Ganz et al. JBJS-B: 2001

- 213 adult hips primarily treated for anterior impingement
  - Causes: residual Perthes, idiopathic, PVNS
  - Average age: 33 years
  - 19 simultaneous IT osteotomies
    - Blood supply of femoral head verified at surgery
    - No AVN at follow-up

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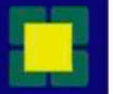
Surgical Hip Dislocation Principles

- Blood supply from the deep branch of the MFCA
- During dislocation, the MCFA is protected by the intact obturator externus
- Greater trochanter osteotomy anterior to the insertion of the gluteus medius
- Dissection always proximal to the piriformis



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Surgical Technique

- Lateral position
- Lateral incision centered over greater trochanter
- Trochanteric osteotomy:
  - Distal: posterior to the vastus lateralis
  - Proximal: just lateral to the piriformis
  - Interval between piriformis and gluteus minimus
- Dissection down to the capsule
- Z capsulotomy

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Surgical Technique

- Surgical subluxation then ligamentum teres excision
- Surgical dislocation
- Placement of shart Hohmans between the capsule and labrum
- Full access to the femoral head and acetabulum

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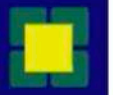
Surgical Technique

- **At completion of surgery:**
  - Loose closure of capsule
  - Placement of trochanter with two 3.5mm diameter cortical screws
- **Postoperative Care:**
  - Touch down WB for 6 weeks or until trochanteric osteotomy heals



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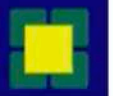
Surgical Hip Dislocation for Unstable SCFE

- Very controversial
- Theory:
  - Assume all unstable (acute) SCFEs have some chronic component
  - With shortening of neck and removal of posterior and medial callus, the epiphysis is reduced without tension on the blood supply
  - Surgical hip dislocation is a controlled approach that can reproducibly accomplish a safe reduction



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Surgical Hip Dislocation for Unstable SCFE

- **Accomplishes two goals:**
  - Prevents FAI
    - Restoration of normal femoral head contour to avoid CAM impingement
  - Decreases risk of AVN

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Surgical Hip Dislocation for Unstable SCFE - Technique

- Patient taken urgently to OR
- Surgical dislocation performed in routine fashion, but must pin femoral head prior to dislocation
- Resection of posterior and medial callus with some shortening of femoral neck
- Retrograde placement of guidewires with antegrade placement of screws
- Touch-down WB for 3 months

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Surgical Hip Dislocation for Unstable SCFE - Results

- Ganz et al.
  - 45 cases
  - No AVN

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Surgical Hip Dislocation for Unstable SCFE - Results

- **TSRH**
  - 15 cases
  - 1 case of AVN (6.7%)
    - Attributed to technical error at time of surgery
  - No impingement or decreased range of motion of hip
  - Other complications:
    - Two patients with broken screws (4.5 mm cannulated screws successfully revised to 6.5 mm screws)

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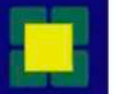
Surgical Hip Dislocation for Reduction of SCFE

- Leunig M, Slonto T, Ganz R. *Oper Orthop Traumatol* 2007;19:389-410.
  - Surgical description
  - Assumes that even minor slip displacement can regularly produce acetabular cartilage damage and early clinical symptoms
  - Perfusion of epiphysis via MFCA actively protected during surgical dislocation of hip by developing a soft tissue flap consisting of retinaculum and external rotator muscles



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Surgical Hip Dislocation for Reduction of SCFE

- Ziebarth K, Zilkens C, Spencer S, Leunig M, Ganz R, Kim YJ. *CORR* 2009;467:704-16.
  - 40 patients with stable and unstable SCFE
  - 1-3 year follow-up at two institutions
  - No osteonecrosis of chondrolysis
  - Correction of slip angle
  - Mean alpha angle after correction 40.6 degrees
  - Technique appears to have an acceptable complicaiton rate and appears reproducible for full correction of moderate to severe SCFE with open physes

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Arthroplasty Options

- SCFE may lead to degenerative joint disease secondary to abnormal joint kinematics and/or FAI
- Chondrolysis and osteonecrosis of the hip with severe joint destruction has been reported following treatment of SCFE and could lead to end stage hip disease

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Prevalence of THR after SCFE

- Not well known
- Danish hip registry
  - THA for childhood hip disorders 4.3%
  - Not specific for SCFE (included DDH, Perthes)
  - Subsequent study:
    - 0.5% performed in patients with previous SCFE
- Norwegian arthroplasty register
  - 1.3% performed for Perthes and SCFE combined

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Prevalence of THR after SCFE

- **Mayo Clinic**
  - 146 patients/176 hips treated with in-situ screw fixation for SCFE
  - 8 hips required THR at an average of 19.5 years following the slip
- **Carney et al.**
  - 155 SCFE
  - 44 patients (28%) required additional procedures at median age of 28 years after onset of symptoms
  - 13 patients required THR

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Arthroplasty Options

- Total hip arthroplasty
- Resurfacing arthroplasty

- SCFE patients presenting for arthroplasty:
  - Typically younger
  - Anatomic features of slip result in unique reconstructive challenges

- Durability of arthroplasty and need for subsequent revisions not well known

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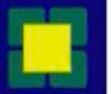
Hip Resurfacing Arthroplasty

- **Mayo Clinic**
  - 8 patients who underwent 1st Generation resurfacing arthroplasty following SCFE
  - 5 patients had failed resurfacing at a mean of 7 years post-op due to cup loosening (4) and a femoral neck fracture (1)
  - Problem was resurfacing cup and not osteolysis



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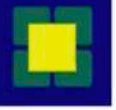
Total Hip Arthroplasty

- **Amstutz et al.**
  - 10 patients with SCFE who underwent THA
  - Average age at time of surgery 38.1 years (range 18.2 to 57.9 years)
  - Average follow-up 4.7 years but clinical follow-up only 5 months
  - Successful THA in all patients
  - No cases in which the distorted proximal femoral anatomy precluded placement of the arthroplasty



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Technical Challenges and Considerations - Resurfacing

- Risk of impingement after resurfacing greater because of decreased offset at femoral head-neck junction
- Recommended to remove anterior head/neck osteophytes at time of resurfacing or anterior translation of femoral component within the neck should be considered

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Technical Challenges and Considerations - Resurfacing

- **Size of head is another factor**
  - To prevent notching the superolateral head-neck junction, tendency is to increase head diameter which can lead to increased acetabular diameter and excess reaming
  - Larger head diameter may predispose to soft tissue impingement against the psoas or anterior capsule leading to post-op groin pain

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Technical Challenges and Considerations - Resurfacing

- Computer navigation may be useful
  - Appropriate entry point
  - Varus/valgus angulation
  - Superoinferior translation
- Intraoperative fluoroscopy can also be used in positioning of pin

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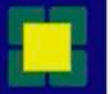
Technical Challenges and Considerations - THA

- Cumulative implant failure rates after THA for childhood hip disorders higher than for primary osteoarthritis
- Danish registry
  - 10 year failure rates 9.3% (THA for SCFE)
- Norwegian registry
  - 10 year survival rate 81% (cemented Charnley prosthesis for SCFE)



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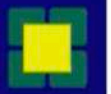
Technical Challenges and Considerations - THA

- **Issue does not pertain specifically to SCFE**
  - Surgery at young age
- **Results of cemented THA in young patients disappointing**
  - Mayo Clinic (1972-1980)
    - Radiographic loosening at 15 years:
      - Acetabular component (60%)
      - Femoral component (20%)
- **Better results obtained by Exeter group**
  - 10 year survival rate 94.4%
  - Stem survival rate at 17 years 100%



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Technical Challenges and Considerations - THA

- **Uncemented THA is treatment of choice for the young patient with endstage hip arthritis**
  - Norwegian Registry
    - Survivorship at 10 years (96-100%)
    - Men had increased risk of revision 1.3X compared to women
- **Mayo Clinic (THA < 25 y/o)**
  - Highly cross-linked polyethelyne
  - Minimal wear at 10 years

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Technical Challenges and Considerations - THA

- **Metal on metal arthroplasty**
  - Popular in males requring THA
  - Risk of metal on metal hypersensitivity, elevated metal ions and other issues should be discussed

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Other Technical Considerations

- ? Retained implants
  - ? Single stage versus two stage
  - ? Infection work-up needed

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Other Technical Considerations

- ? Proximal femur deformity
  - Is femur of adequate size to accommodate a standard implant?
  - Will proximal femur anteversion correction be required?
  - Is there a mismatch in size between the metaphysis and diaphysis?
  - Is there malposition of the trochanter requiring an osteotomy?

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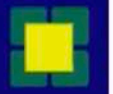
Other Technical Considerations

- ? Mismatch between acetabulum and femoral head sizes



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