SCFE: Latest Technique

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HIP TREATMENT CENTER INFANT • ADOLESCENT • ADULT

Children's Healthcare of Atlanta — Children need Children's.

Children's Orthopaedics of Atlanta at Children's Healthcare of Atlanta

Disclosures

- Patent pending
- Consultant for Orthopediatrics

- A device described in this presentation is being used off label and not in an FDA approved manner
  - Intra-cranial pressure (ICP) monitor
    - Camino, Integra LifeSciences, Plainsboro NJ

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SCFE

- Most common adolescent hip problem

- 10-14 years of age
- Groin, thigh or knee pain
- External rotation of the foot
- Trendelenburg gait
- Obligate external rotation with flexion
  - Positive anterior impingement sign

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Femoral head stability - Loder

- Stable
  - Patient can ambulate with or without crutches
- Unstable
  - Patient unable to ambulate
- Good correlation with AVN
  - Stable 0%
  - Unstable 47%
    - Zaltz (CORR 2013) – Overall rate 23.9%
    - Ibrahim (JCO 2015) – meta-analysis 16.2%

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Stable slips

- In situ screw stabilization
- Secondary procedures
  - Anterior head/neck decompression
    - Mini-open anterior
    - Arthroscopy
    - Surgical dislocation
  - Osteotomy
    - Triplanar proximal femoral osteotomy
    - Femoral rotational osteotomy
    - Femoral head repostioning

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Unstable SCFE

Sonnega RJ, van der Sluijs JA, Wainwright AM, Roposch A, Hefti F. Management of slipped capital femoral epiphysis: results of a survey of the members of the European Paediatric Orthopaedic Society. J Child Orthop. 2011 Dec;5(6):433-8.

Mooney JF 3rd, Sanders JO, Browne RH, Anderson DJ, Jofe M, Feldman D, Raney EM. Management of unstable/acute slipped capital femoral epiphysis: results of a survey of the POSNA membership. J Pediatr Orthop. 2005 Mar-Apr;25(2):162-6.

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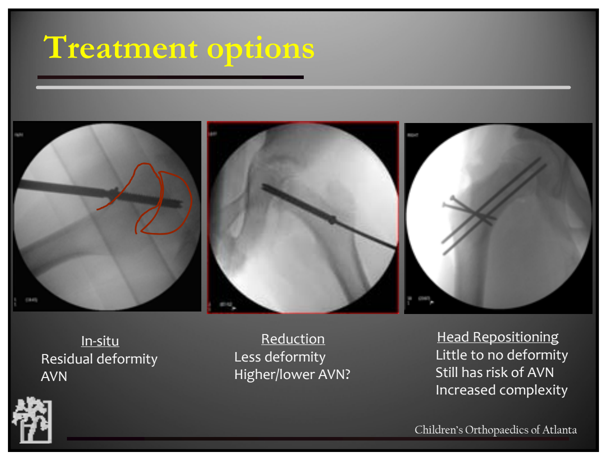

SCFE and AVN

- ~0% for stable SCFE
- 0-60% for unstable SCFE
  - 23.9% overall AVN rate with unstable SCFE
  - 0-67% with surgical dislocation

Result of injury or treatment?

Zaltz *et al.* (CORR 2013), Alves *et al.* (J Child Orth 2012), Leunig *et al.* (Oper Ortho Traum 2007), Sankar *et al.* (JPO 2010)

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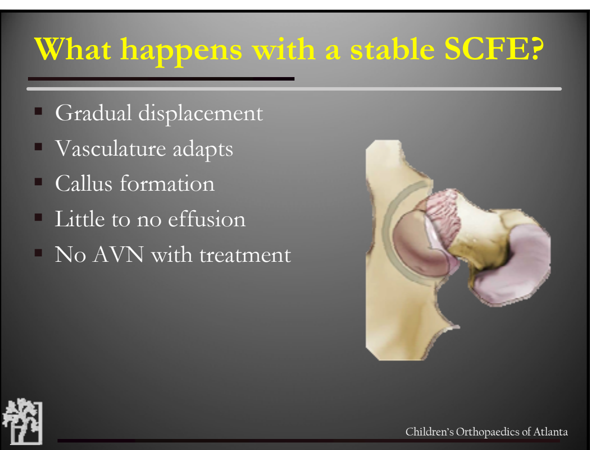

What happens with an unstable slip?

- Initially, the exact same thing as a stable SCFE
- Sudden displacement of epiphysis
  - Typically low energy trauma
- Hemarthrosis
- Vasculature
  - Disrupted
  - Remains intact
    - Kinked, stretched, compressed
- Thrombosis

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Pre-op perfusion studies?

- Maeda (JPO 2003)
  - Angiogram
  - 12 hips (7 stable, 5 unstable)
    - All stable slips had SRA filling
    - 2 unstable had filling and 3 did not
      - After reduction one unstable then filled
- Chambenois (JCOT 2014)
  - Perfusion MRI
  - 19 hips (10 stable, 9 unstable)
    - All stable had perfusion
    - 1 unstable had perfusion, 8 did not
      - After surgery 6/8 had perfusion
      - 1 previously perfused hip had no perfusion

Is this really helpful?

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Role of hemarthrosis?

- Ibrahim (JCO 2015)
  - Meta analysis
    - 9 studies, 302 unstable SCFE
  - Capsular decompression not associated with AVN
- Pressure increase with closed reduction
  - Herrera-Soto (JPO 2008)
- Pressure decrease with capsulotomy
  - How much of a capsulotomy is adequate?
    - Aspiration, scissors, Cobb, open
    - Parsch (JPO 2009)
      - 4.7% AVN

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SCFE and AVN

- Type of reduction?
  - Positional, "serendipitous"
  - Closed
    - Gentle or Manipulative (ie. Leadbetter)
  - Open

Ideal treatment

- Treatment before vessel thrombosis
- Reduction to previous stable position
- Secure stabilization
- Release of hemarthrosis
- Demonstrate perfusion of femoral head before leaving the OR

Current Technique

- Percutaneous method of intra-operative monitoring of femoral head perfusion during screw stabilization of slipped capital femoral epiphysis patients
- ICP probe
- A-line
- Tubing has to fit down cannulated screw

Positioning

- C-arm EUA to assess physeal stability
  - Many unstable SCFE with partial reduction
- If stable then standard in situ screw stabilization
- If unstable then closed reduction
  - Abduction, flexion, IR, adduction, extension

GOAL is to reduce the unstable slip to its previous stable position

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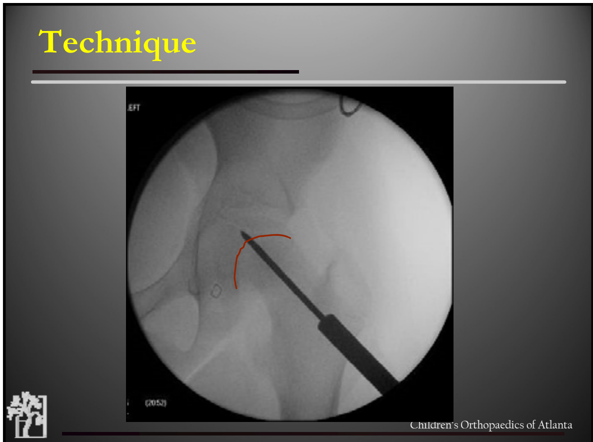
Technique



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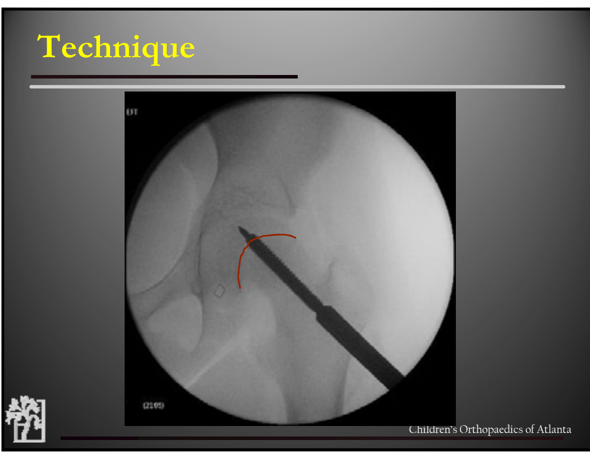

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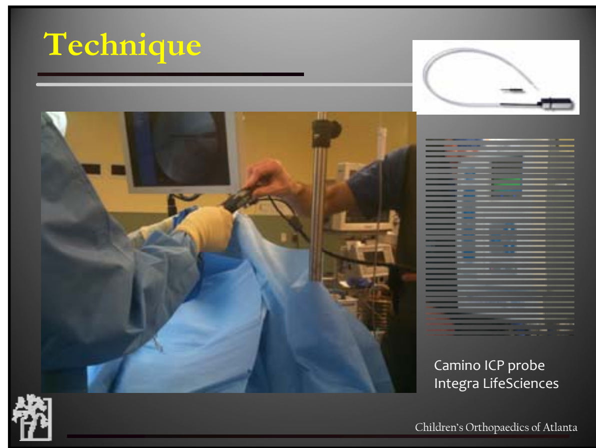
Technique
Camino ICP probe
Integra LifeSciences
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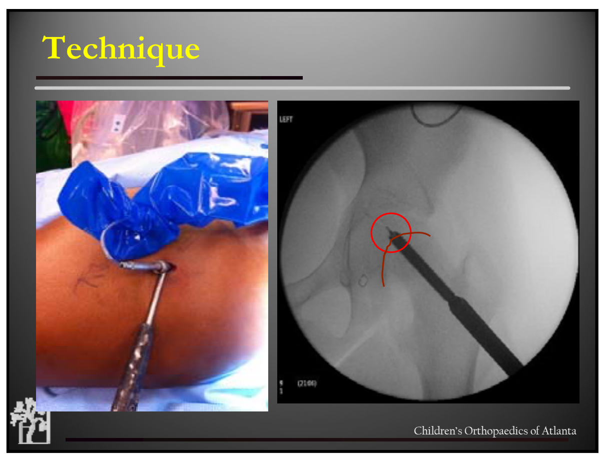
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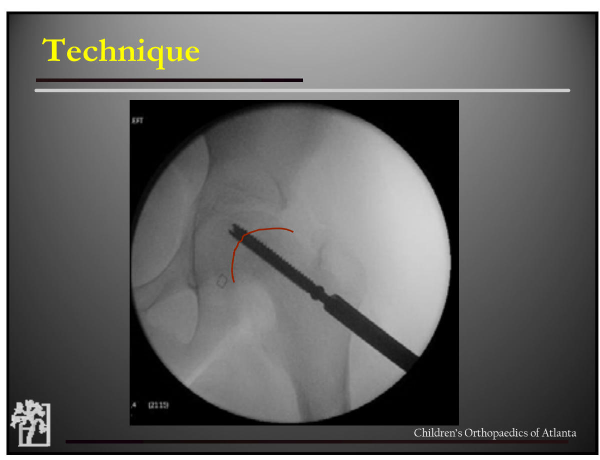
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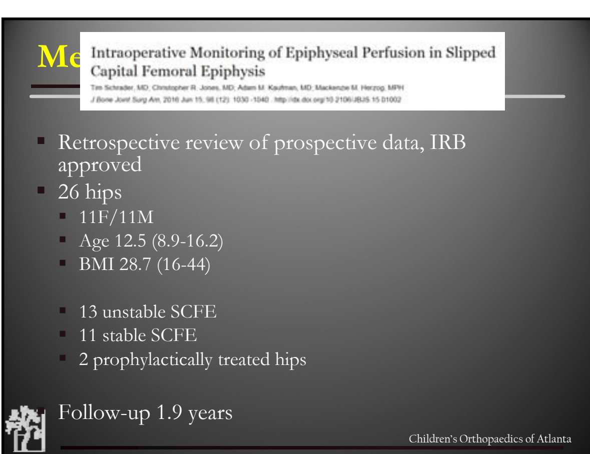
Me
Intraoperative Monitoring of Epiphyseal Perfusion in Slipped Capital Femoral Epiphysis
Retrospective review of prospective data, IRB approved
26 hips
11F/11M
Age 12.5 (8.9-16.2)
BMI 28.7 (16-44)
13 unstable SCFE
11 stable SCFE
2 prophylactically treated hips
Follow-up 1.9 years
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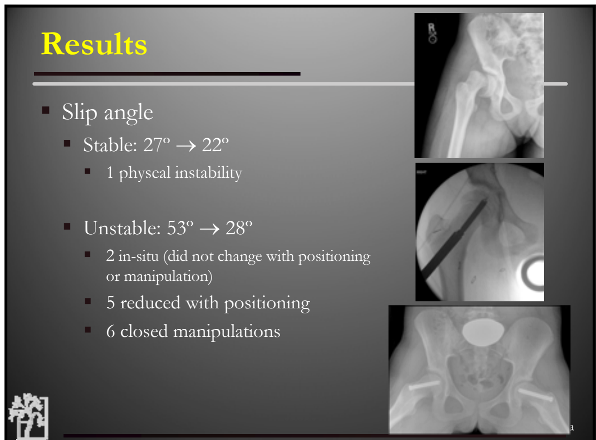
Results
Slip angle
Stable: 27° → 22°
1 physeal instability
Unstable: 53° → 28°
2 in-situ (did not change with positioning or manipulation)
5 reduced with positioning
6 closed manipulations

Stable group

- All stable SCFE hips (11/11) and the 2 prophylactically treated hips had measurable, pulsatile waveforms synchronous with the heart rate at initial insertion of the probe

EKG

ICP – femoral head perfusion

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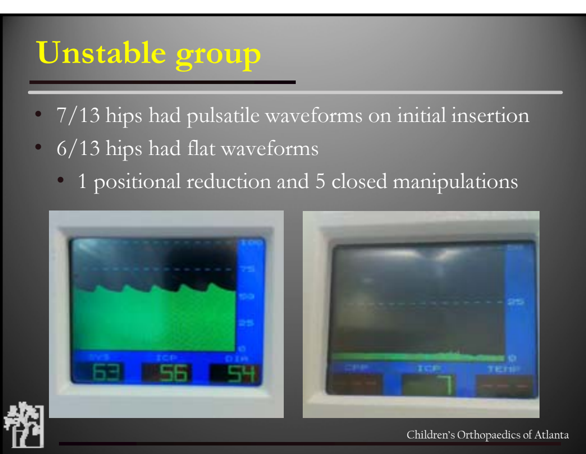

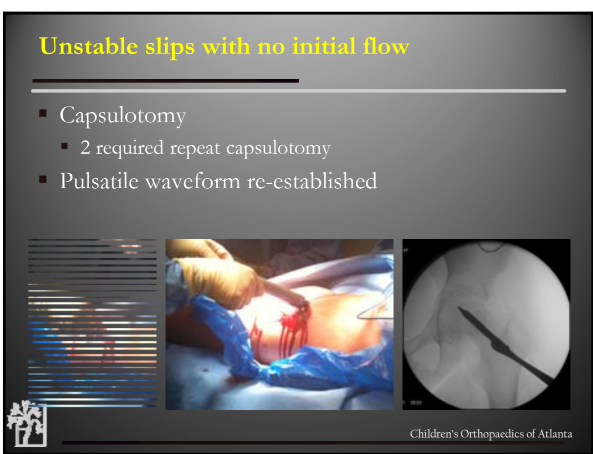

Results

- All patients left the OR with a pulsatile waveform
- No patient has subsequently developed AVN of the femoral head
  - Average follow-up 1.9 years (0.7 – 4.2)
    - Stable group 1.6 years (0.7 – 2.5)
    - Unstable group 2.0 years (0.9 – 4.2)
    - 2 patients (stable) were lost to follow-up

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Potential AVN rates

- Stable + prophylactic
  - 13/13 with pulsatile waveform → 0%
- Unstable without capsulotomy
  - 6/13 without waveform → 46%
- Unstable with capsulotomy
  - 2/13 without waveform → 15%
- Unstable with "adequate" capsulotomy
  - 0/13 without waveform → 0%

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Safe reduction is possible

- Unstable slips can be reduced to previous "stable" position
- Intra-operative assessment of femoral head perfusion is key
  - Capsulotomy
    - Make sure it is adequate
  - Reduction
    - Leadbetter maneuver

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Potential pitfalls

- There is a residual deformity
  - Only reduced to previous stable position
  - Transfer to specialized center with hip stabilized and perfused
- Expense of the probe
- Zero AVN may not be possible
  - Vessel disruption

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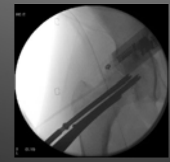
Other uses

- Can be applied to other orthopaedic conditions
  - Femoral neck, scaphoid, talus, proximal humerus fractures
  - Open femoral head re-positioning
    - Perfusion can be monitored through capsular closure and trochanteric re-fixation



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