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# Can We Change the Natural History of Hip Dysplasia?

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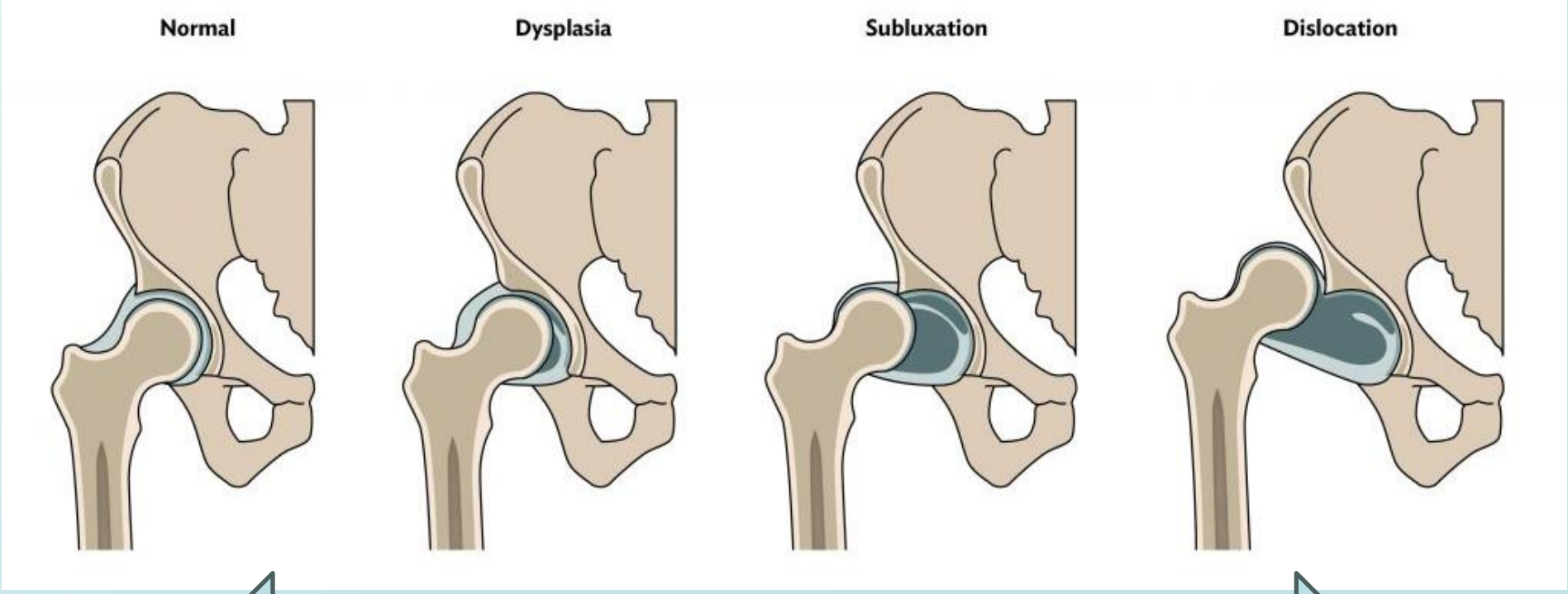
# Disclosure

- I have no financial disclosures pertinent to or conflicts of interest that impact the content presented here.




Spectrum of Dysplasia

International Hip Dysplasia Institute
hipdysplasia.org

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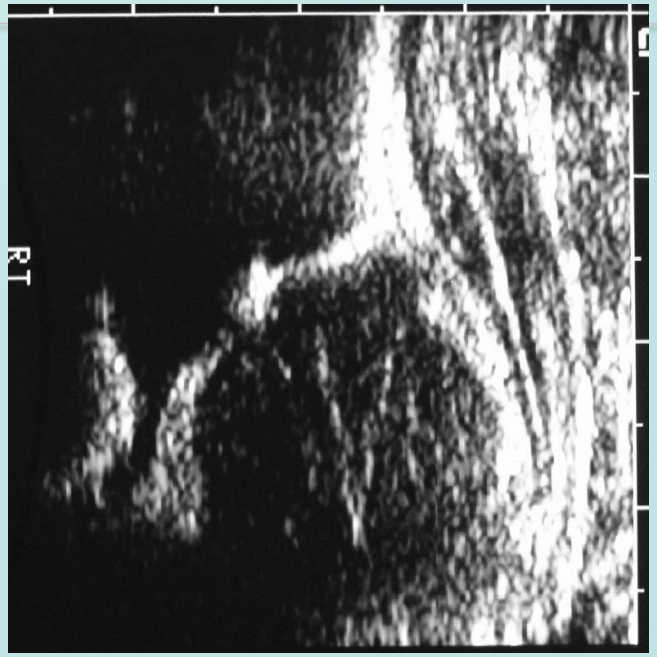
# Developmental Dysplasia

Radiographic

- Dysplastic = shallow acetabulum

Clinical or radiographic

- Subluxable – hip can be forced partially out of socket
- Dislocatable – hip can be forced out of socket
- Dislocated = hip is fully out of socket at rest
  - Reducible vs. irreducible

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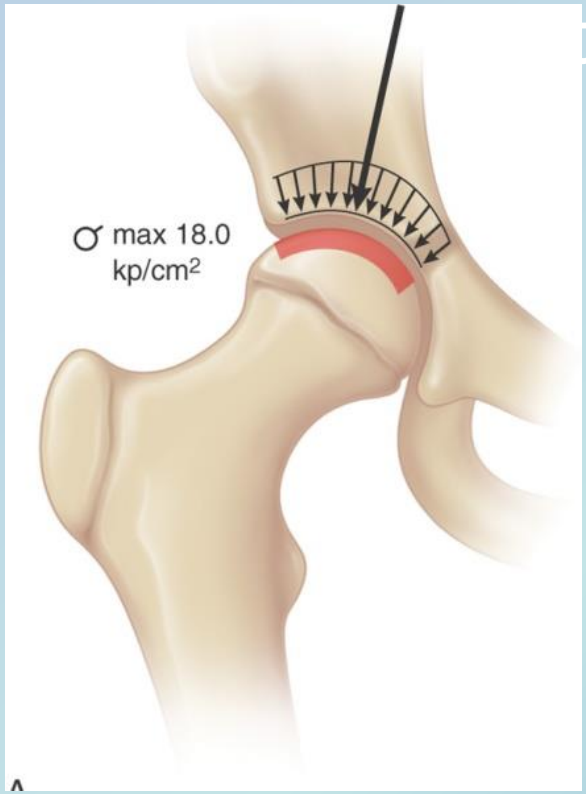
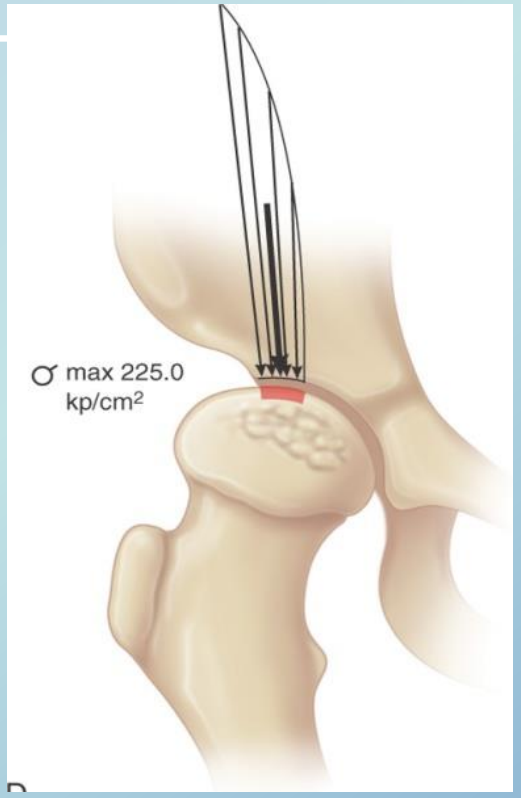
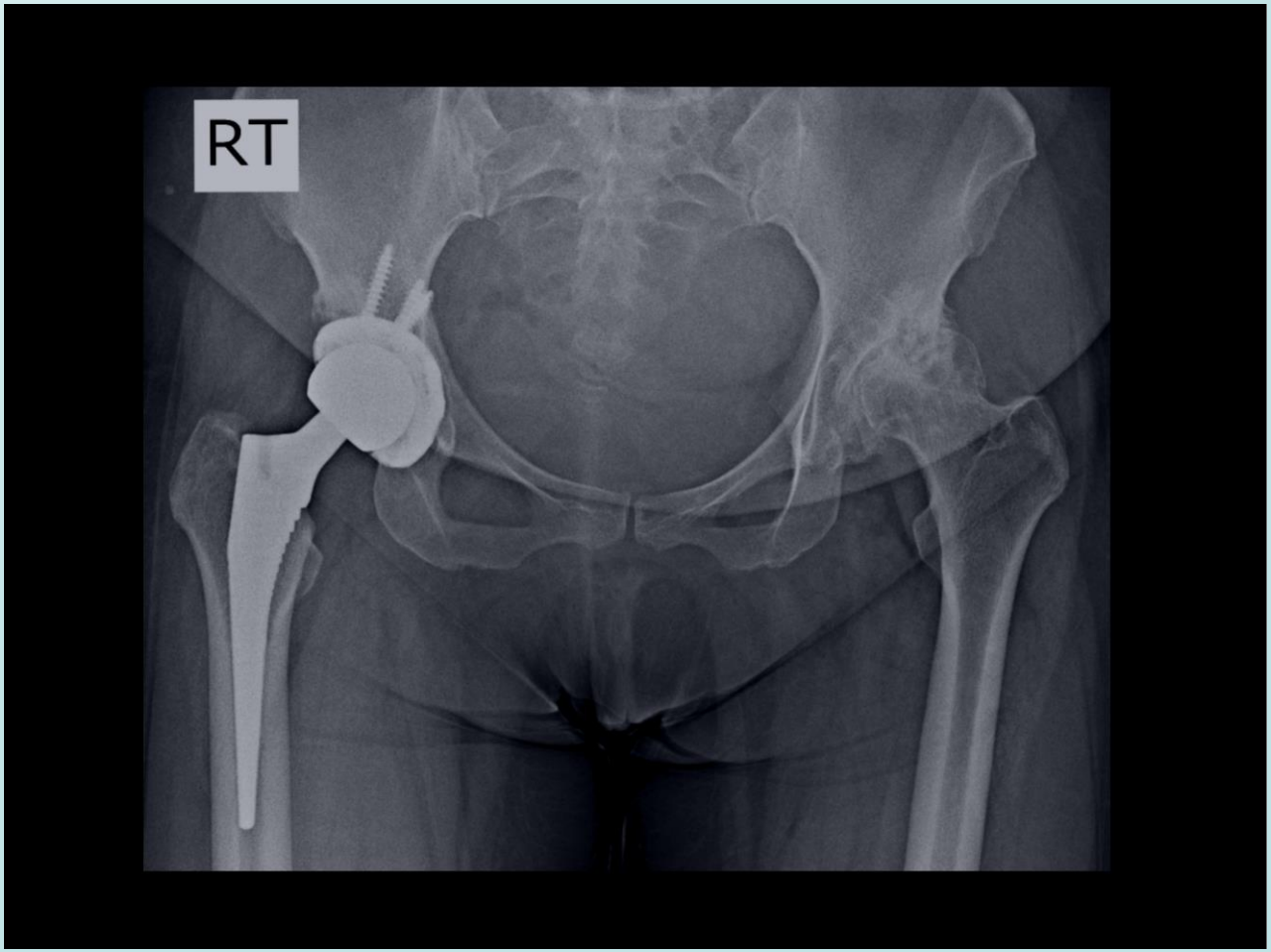



- Persistent subluxation or dislocation leads to abnormal joint reaction forces, potential progressive subluxation, and early joint arthritis
- Persistent subluxation or dislocation leads to limp, limb length discrepancy, and pain

# Trying to avoid This



# Natural History of Hip Dysplasia

- Comparative studies of patients with dysplasia who developed osteoarthritis by age 65.
  - All patients had center edge angle <17 degrees.
    - Murphy, Ganz, Muller JBJS 77(7) 1995.
- Stuart Weinstein
  - “Subluixation of the hip predicably leads to development of roetgenographic degenerative joint disease and clinical disability”

    ”Natural History of Congenital Dysplasia of the Hip”

    JBJS Clin Ortho and Related Research 255, 1985.

# Etiology of Arthritis of the Hip

- Dysplasia 43%
- Perthes Disease 22%
- Slipped Epiphysis 11%
- Other 12%
- “Idiopathic”/”Primary” 12%

(Aronson, AAOS ICL 35:119-128, 1986)

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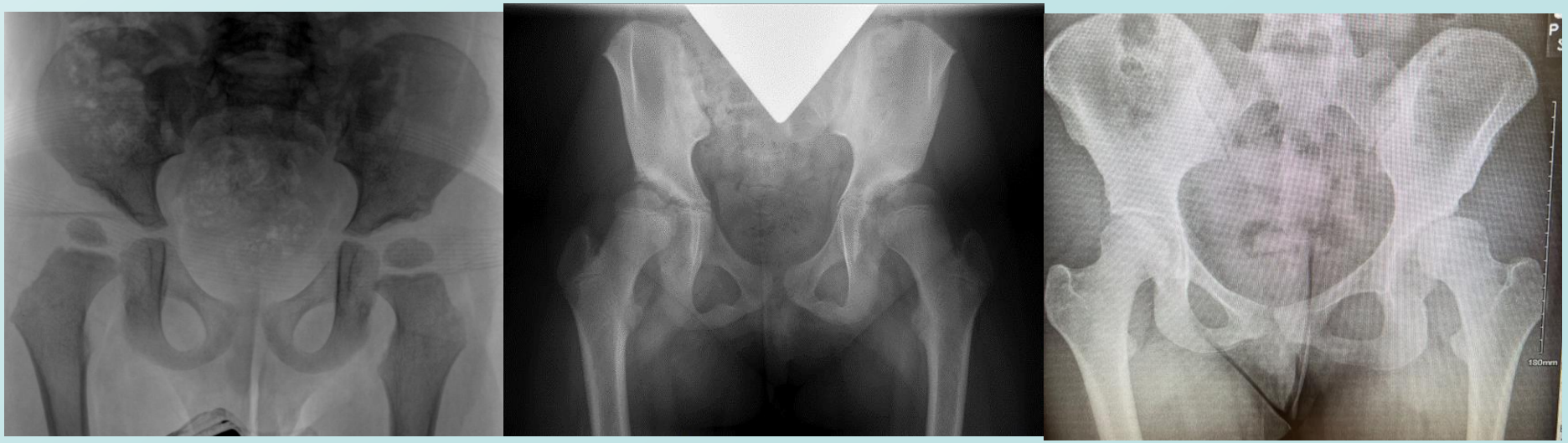
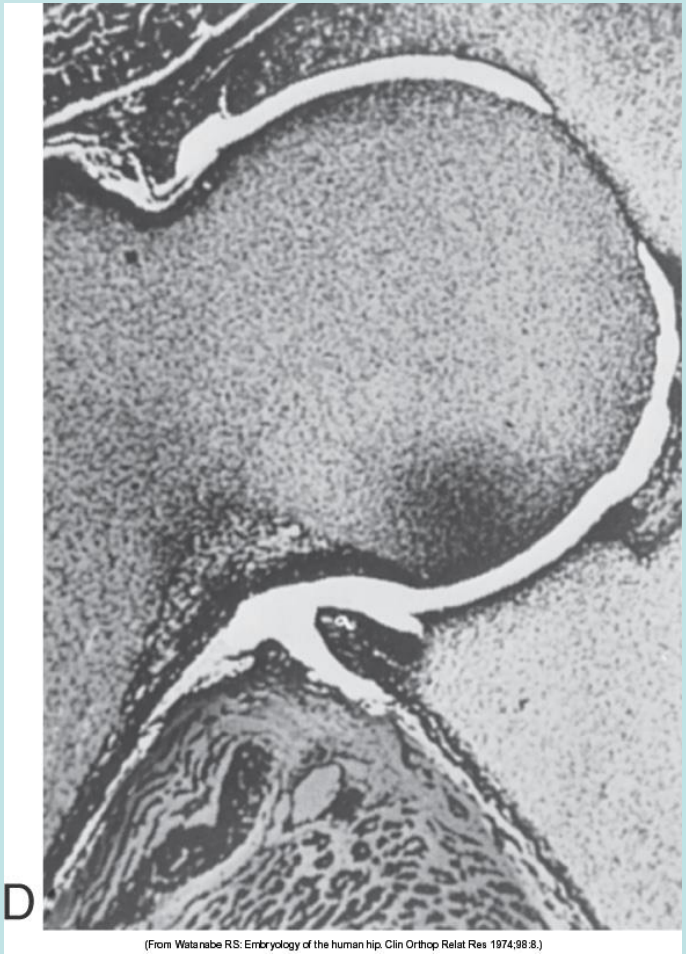
# So Can We Change Natural History?



# Embryology

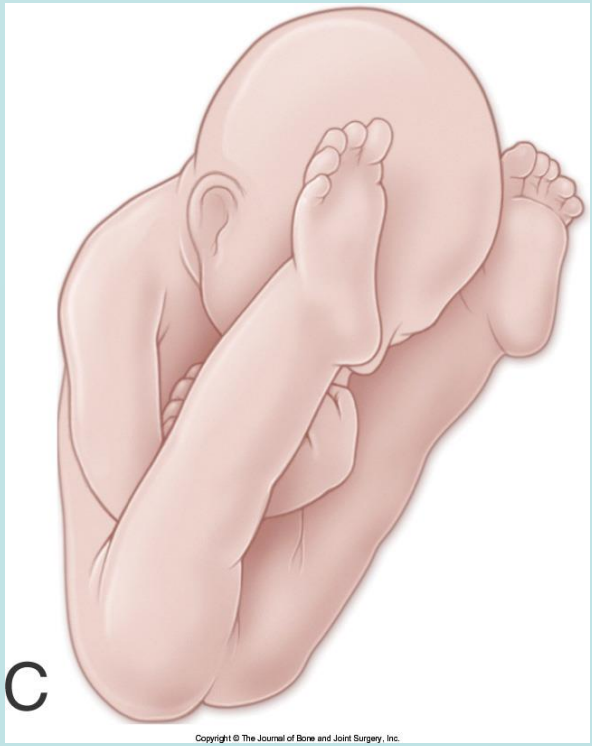
- Femoral head and acetablum form from same mesodermal plate that divides via apoptosis
- All hips reduced by definition at 20 weeks
- Suggests factor affecting later development of the hip in utero leads to DDH



(From Watanabe RS: Embryology of the human hip. Clin Orthop Relat Res 1974;98:8.)

# Epidemiology

- 1 in 100 born with dysplasia or subluxatuion
  - 8% of infants have dysplasia at birth on ultrasound
- 1 in 1000 with dislocated hip
  - Wide ethnic variation
- Female gender 70%
- Breech  30-70%
- Left hip 60%
- Bilateral 20%

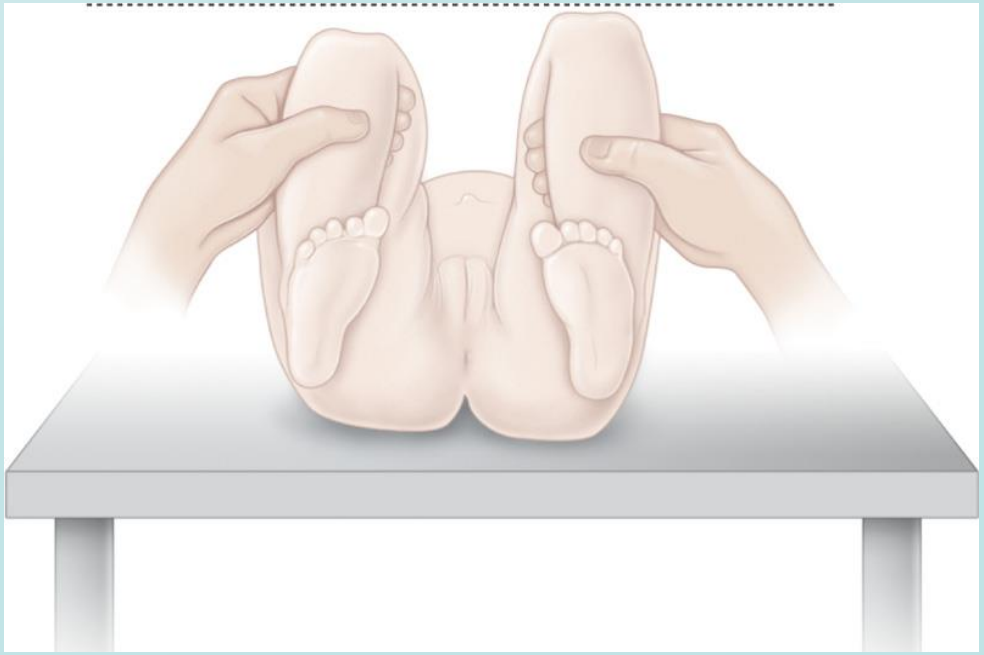


# Etiology

- Mechanical
  - Breech
  - Multiple gestation
  - LGA/oligohydramnios
  - Tight hamstring and psoas
- Genetic
  - 6% if sibling affected
  - 12% if parent affected
  - 36% if parent and sibling affected (Wynne-Davies)
  - 34% concordance in identical twins
- Hormonal
  - Maternal relaxins circulate in the child and cause temporary ligamentous laxity

# Exam of the infant with hip dysplasia

- Two most important signs of hip dysplasia
  - Decreased or asymmetric hip abduction
  - Leg length discrepancy



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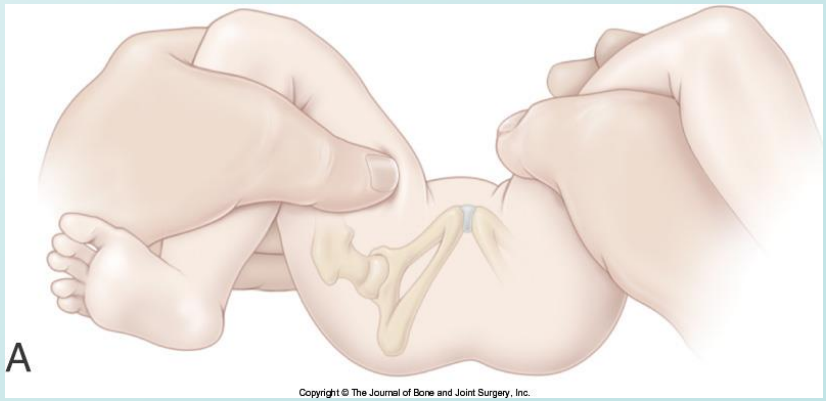
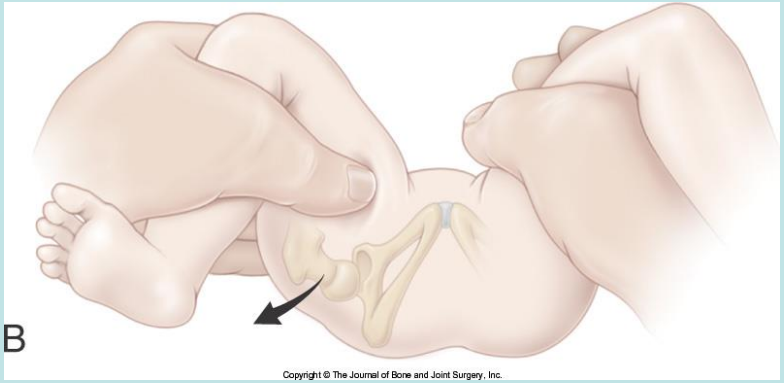
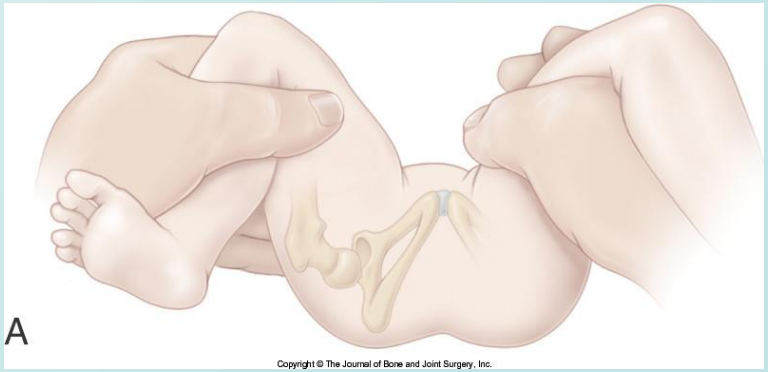
# Barlow



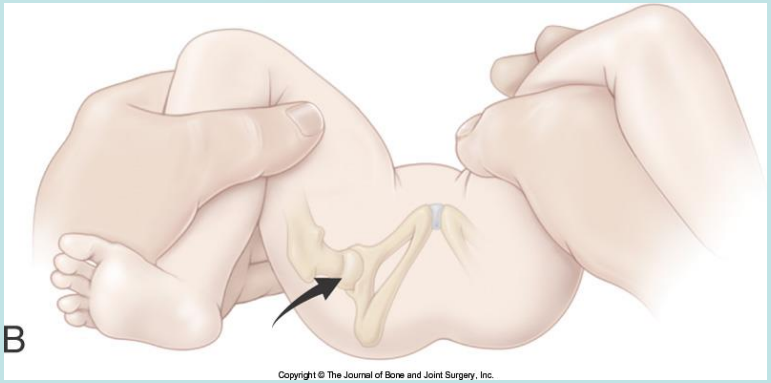

**Adducted and flexed hip with posterior axial load**



# Ortolani Maneuver

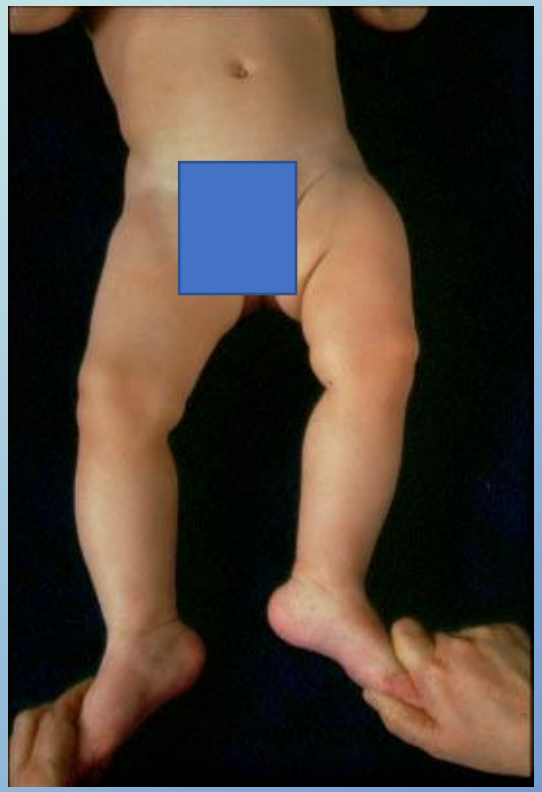



Subluxed hip is abducted with direct pressure over greater trochanter resulting in subtle reduction of hip with a clunk

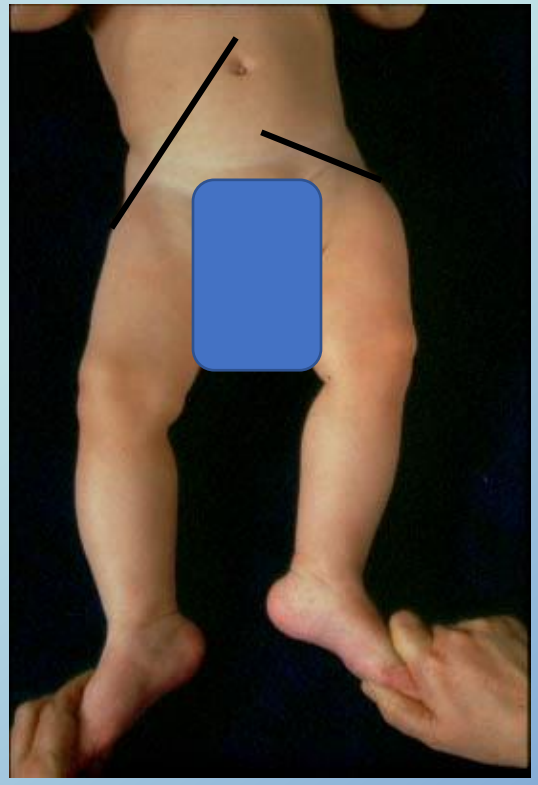


# Physical exam older infant

- Short limb
- Perineal asymmetry
- Deep thigh crease
- Limited abduction



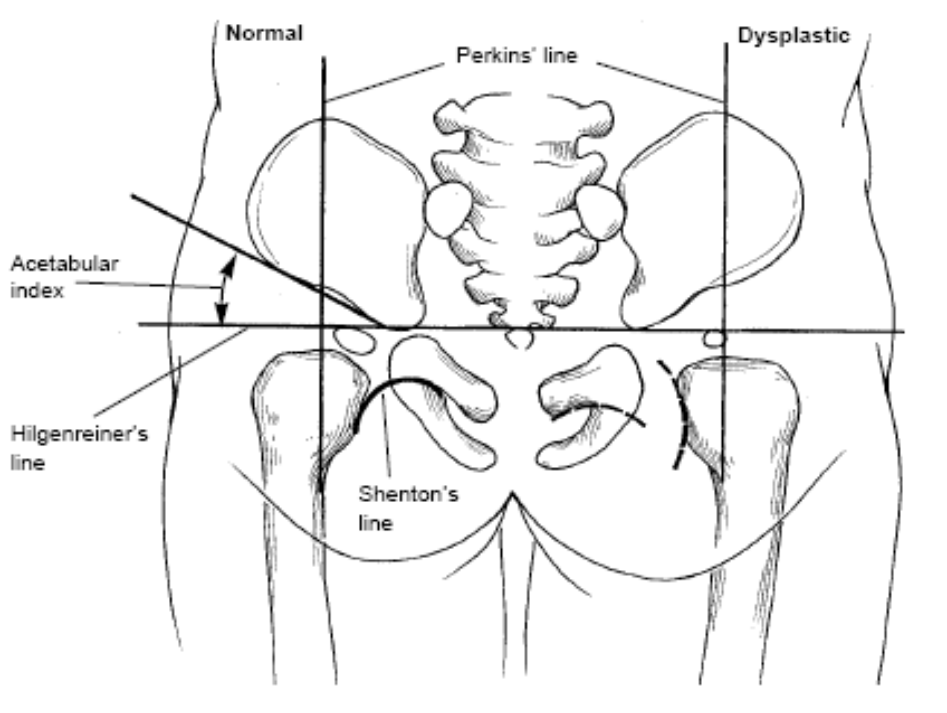
# Klisic's Sign

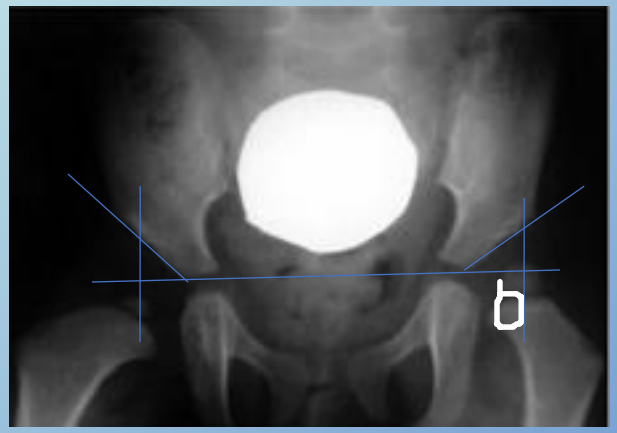


# Ultrasound Anatomy of the Infant Hip

- Alpha (α) angleDescribes bony coverage (depth of acetabuluim)
  - Normal α angle ≥ 60°
- Beta (β) angle Describes soft tissue coverage (labrum)
  - Normal β angle ≤ 55°

# Plain Film Radiography



# Treatment

## Stratified By Age

- Pavlik harness 0-6 months
- Abduction orthosis may be trialed later
- Closed Reduction w/ or w/o adductor release 6-12 months
- Open reduction 12 months or greater
  - w/ or w/o pelvic osteotomy (age 3 cutoff)
  - w/ or w/o femoral osteotomy (shortening of the femur)

# Pavlik Harness

- Designed to hold legs flexed and to prevent adduction, not to force abduction
- Recommended to wear full time.  Remove one leg at a time for bathing and hold leg in abduction
- ? Duration of use – follow ultrasonography
  - Rapid improvement in coverage

# Results of Pavlik Harness Treatment

- Dysplasia
  - 90-95% treated successfully in Pavlik harness
  - 10% recurrence rate-must be followed to maturity
- Dislocatable hips – Barlow and Ortolani positive
  - 85% success rate in achieving stable reduction
  - AVN rate less 5% (but reported up to 60%)
  - 2 to 3% may go on to have severe late dysplasia

# Treatment with Pavlik Harness

| Severity | Full Success | Early Success with late failure |
|---|---|---|
| Moderate Subluxation | 34/34 100% | 0/0 0% |
| Severe Subluxation | 36/38 95% | 2/38 5% |
| Dislocatable/ Partially Reducible | 12/14 86% | 2/14 14% |
| Dislocated/ Irreducible | 0/1 | 1/1 100% |

2/87 had AVN

Venelin *et al* JPO 26(1) 16-27.

# Pavlik Harness

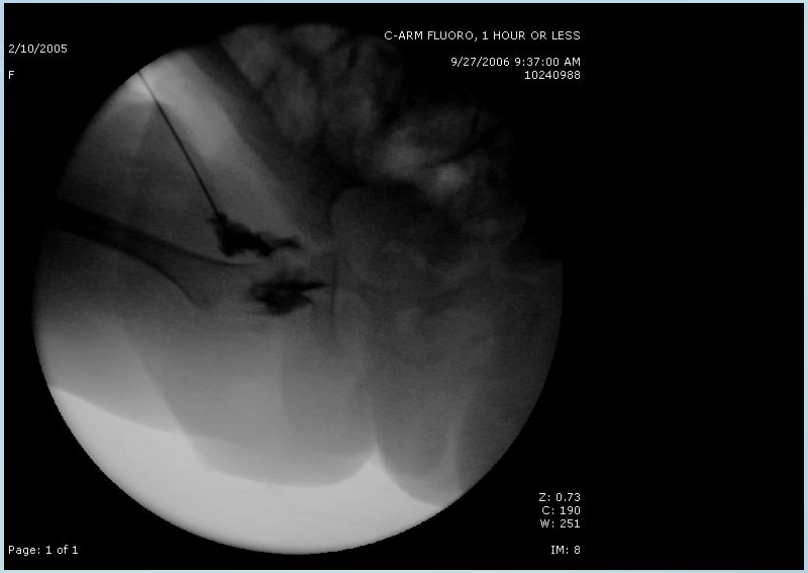
- Pavlik Harness highly successful
- Once hip stabilizes, continue with nighttime removal bracing program to improve residual dysplasia
  - Follow up with plain Xray at 6 months
  - Follow into adulthood

- What happens if it does not work?

# Closed Reduction

- Works well for failed Pavlik harness
- 80-90% success rate in appropriate hips
- 4-14 months of age
- Literature supports stretching this indication to older kids

# Closed Reduction





- Useful in children 6-12 months, indications may be stretched to 14-15 months
- Femoral head reduced into acetabulum with gentle abduction, flexion, internal rotation
- Confirmed with arthrogram

# Closed Reduction

- Once closed reduction achieved, spica cast applied in “human” position
- Spica cast worn 3 months
  - Cast change at 6 weeks

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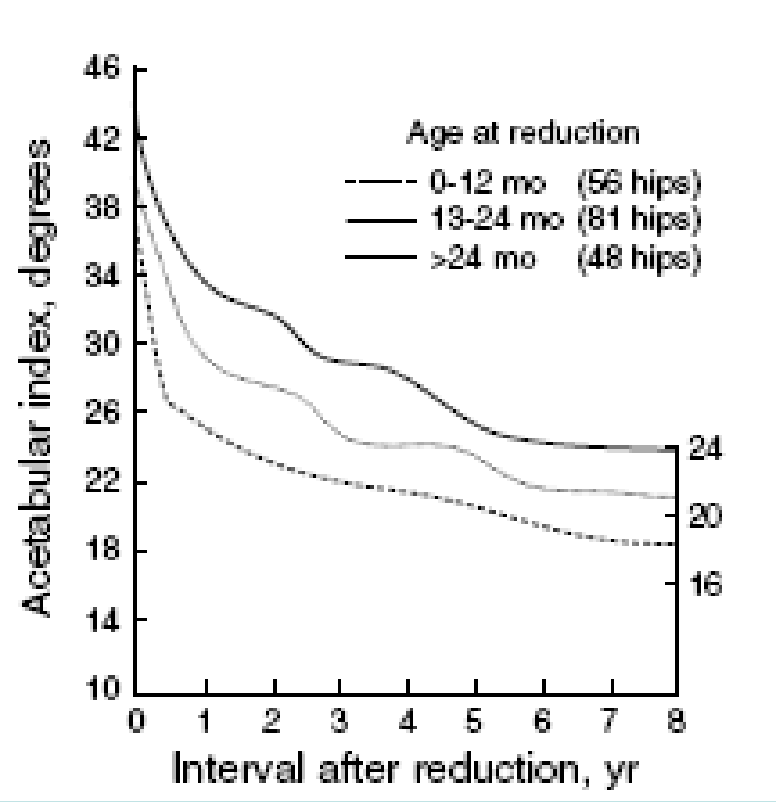
# Early treatment leads to more remodelling



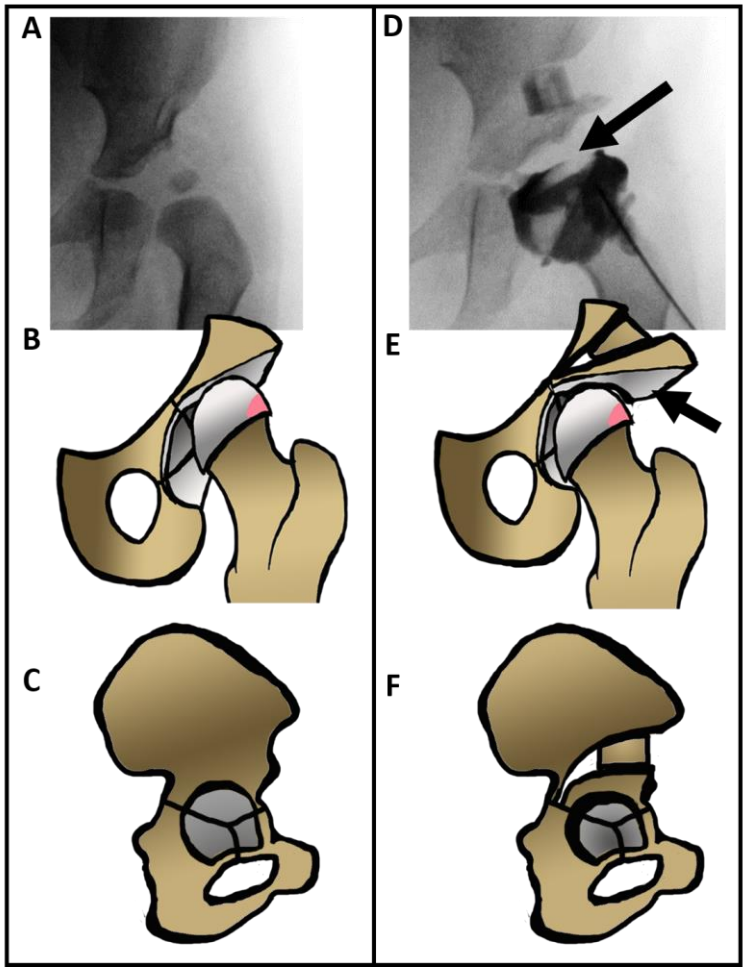

Lindstorm, Ponseti, Wenger *JBJS-A* 61(1) 112-118.

# Case 1

- 2 year old female with subluxation right hip

# Pemberton Acetabuloplasty

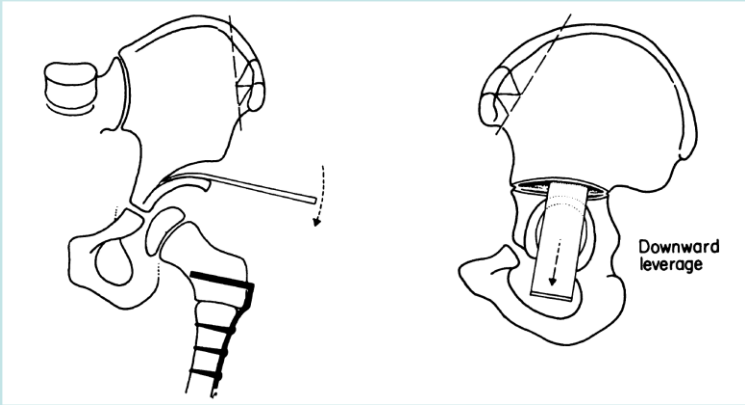
- Acetabuloplasty
- High volume acetabulum
- Antero-lateral deficiency
- Hinges through posterior limb of triradiate
- Pros:
  - No internal fixation required
- Cons:
  - Only for antero-lateral
  - Limited correction
  - Can “overstuff”




Jonathan G. Schoenecker, MD, PhD. Developmental Dysplasia of the Hip From Birth to Arthroplasty: Clear Indications and New Controversies. Instr Course Lect 2019;68:1-18

# Dega Acetabuloplasty (San Diego Modification)

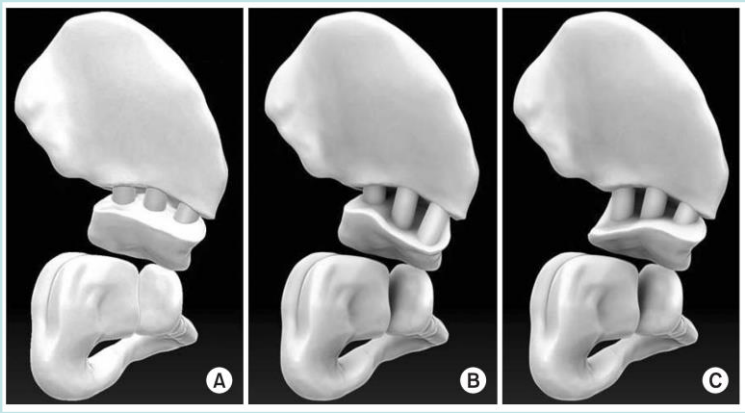
- Acetabuloplasty
- High volume acetabulum
- Hinges through medial limb of triradiate
- Pros:
  - No internal fixation
  - Choose where to cover
- Cons:
  - Posterior cut difficult
  - Limited correction




One-Stage Correction of the Spastic Dislocated Hip

Use of Pericapsular Acetabuloplasty to Improve Coverage*

by scott j. mubarak, m.d.†, francisco g. valencia, m.d.‡, and dennis r. wenger, m.d.†, san diego, california




Kim et al. Hip Dislocation in Cerebral Palsy

Clinics in Orthopedic Surgery • Vol. 4, No. 2, 2012 • www.ecios.org

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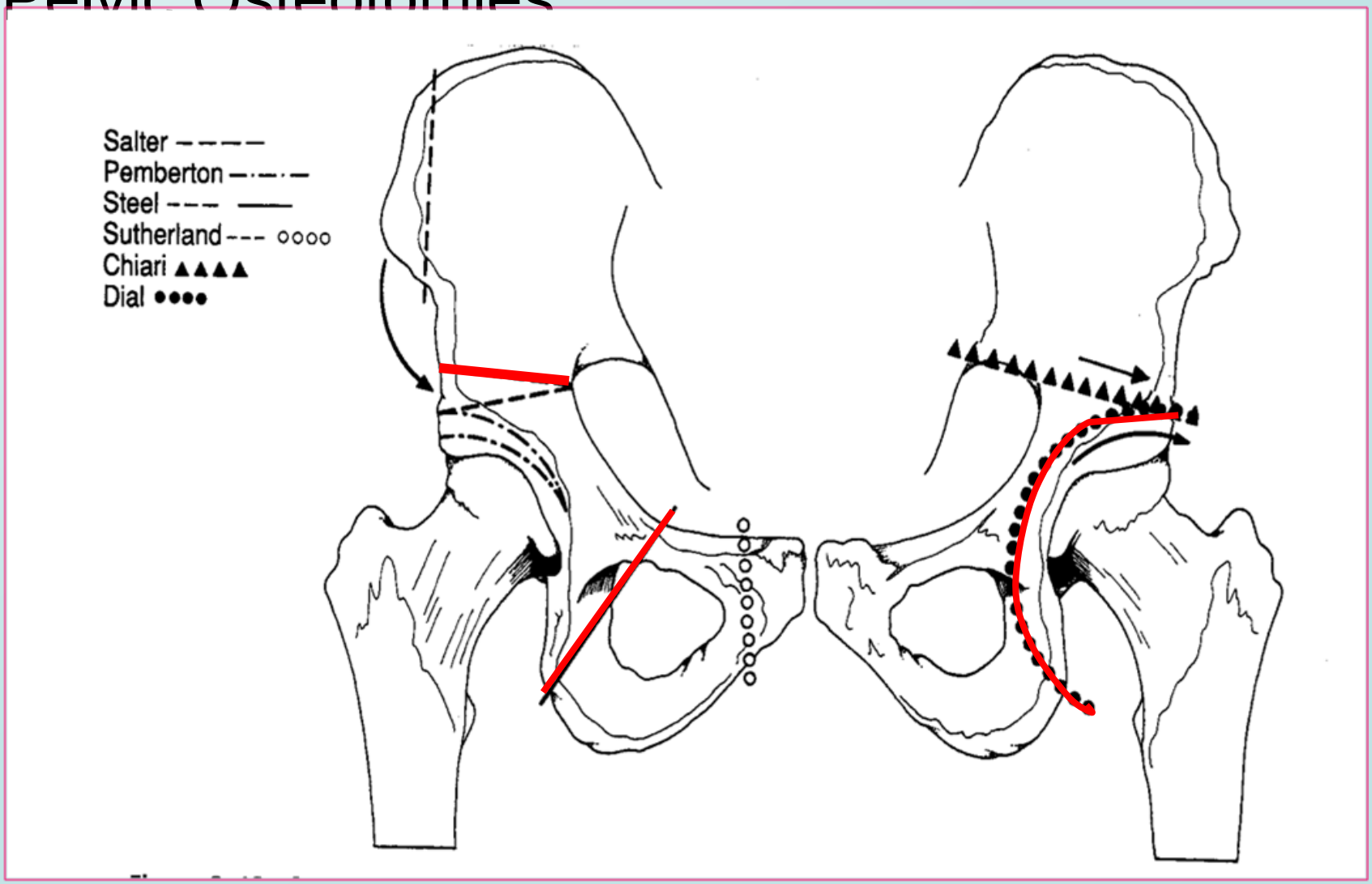
# Pelvic Osteotomies



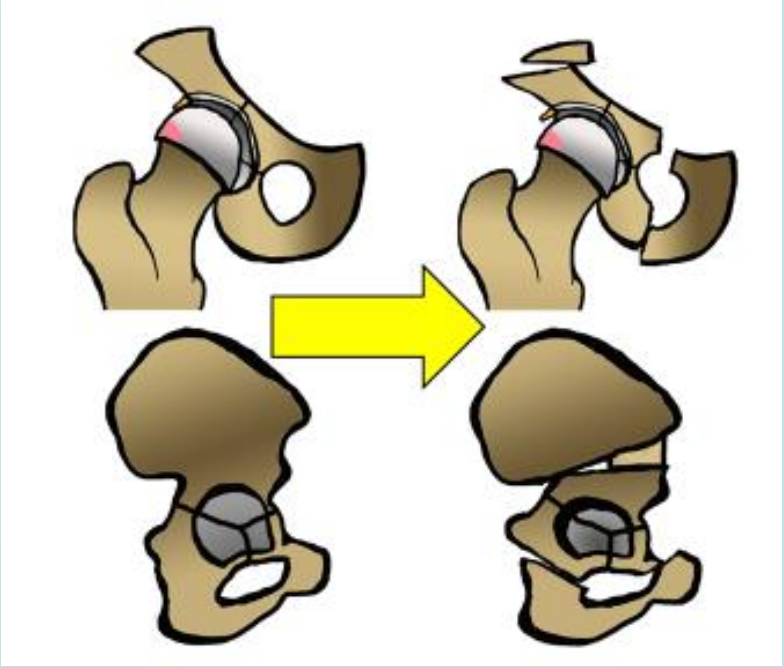
# Case 2

8 year old patient with bilateral hip dysplasia

Fatigues in right hip abductors occasionally with long walks.

# Triple Innominate Osteotomy

- Redirectional/Rotational
- Older patients
- Low volume acetabulum
- 3 cuts
- Pros:
  - Large amount of correction
  - Multiplanar correction
  - Medialization
- Cons:
  - “more complex”
  - More fixation



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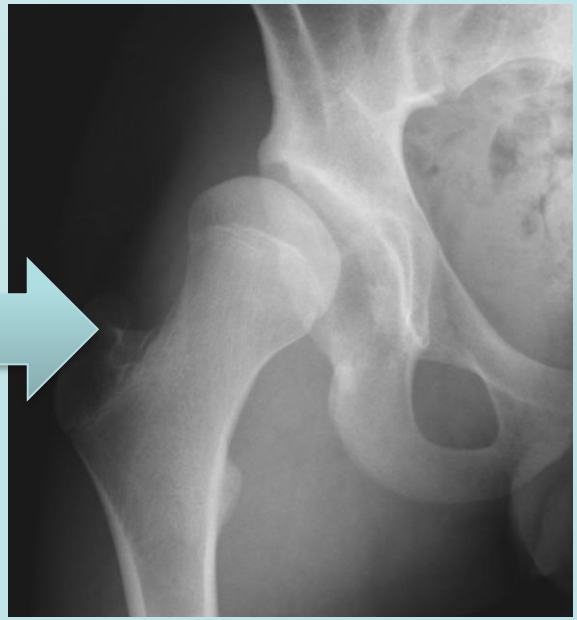
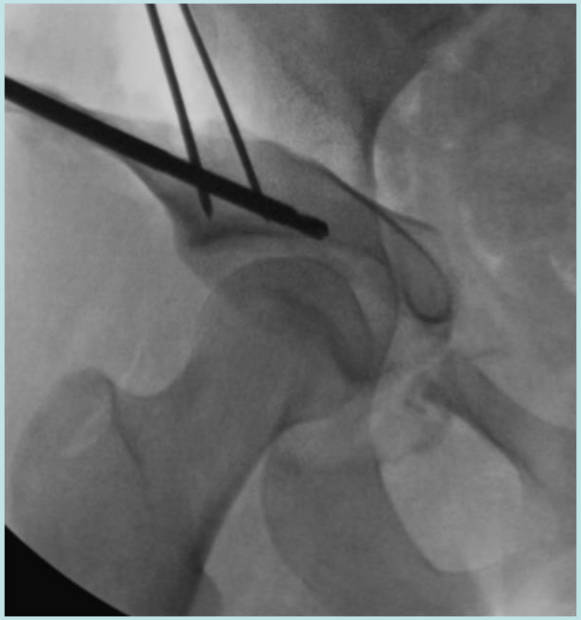
# Dysplastic Hip Undergoing Triple Pelvic Osteotmy

3.5 yrs

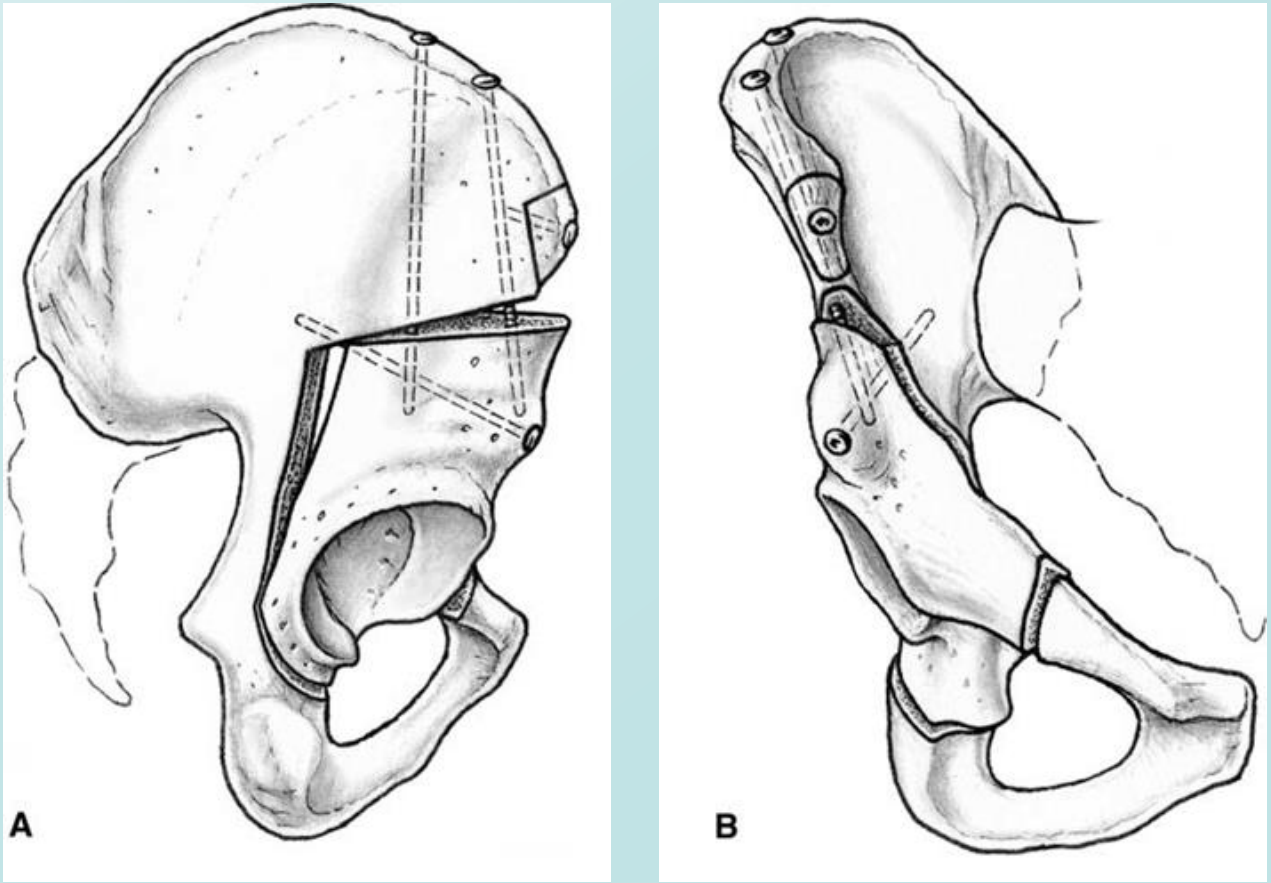




Asymptomatic

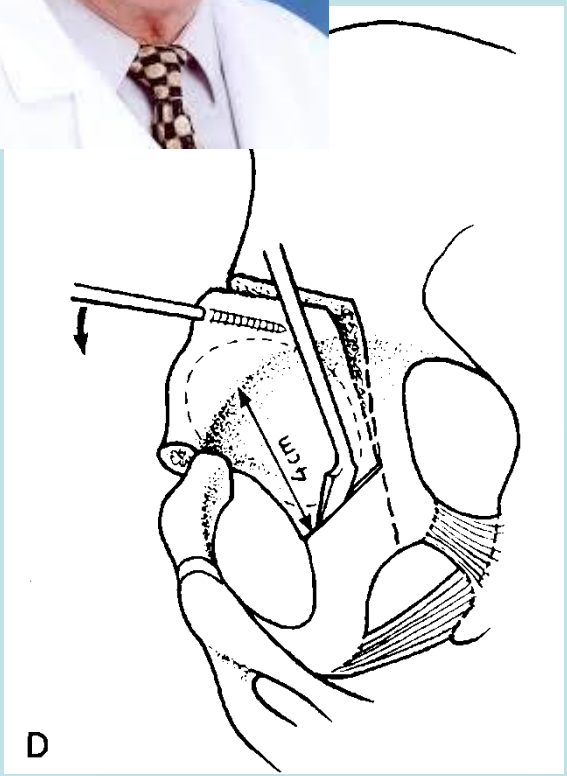
Pain

# Periacetabular osteotomy



# Bernese Periacetabular Osteotomy

- Ganz 1983
- Polygonal, juxta-articular
- Large correction, multiple planes
  - Anterior, lateral, version, medialization
- Pelvic dimensions unchanged
- Stable, Minimal fixation
- Posterior column intact
- Intra-articular access
  - Labrum, FAI



# PAO - Survivorship

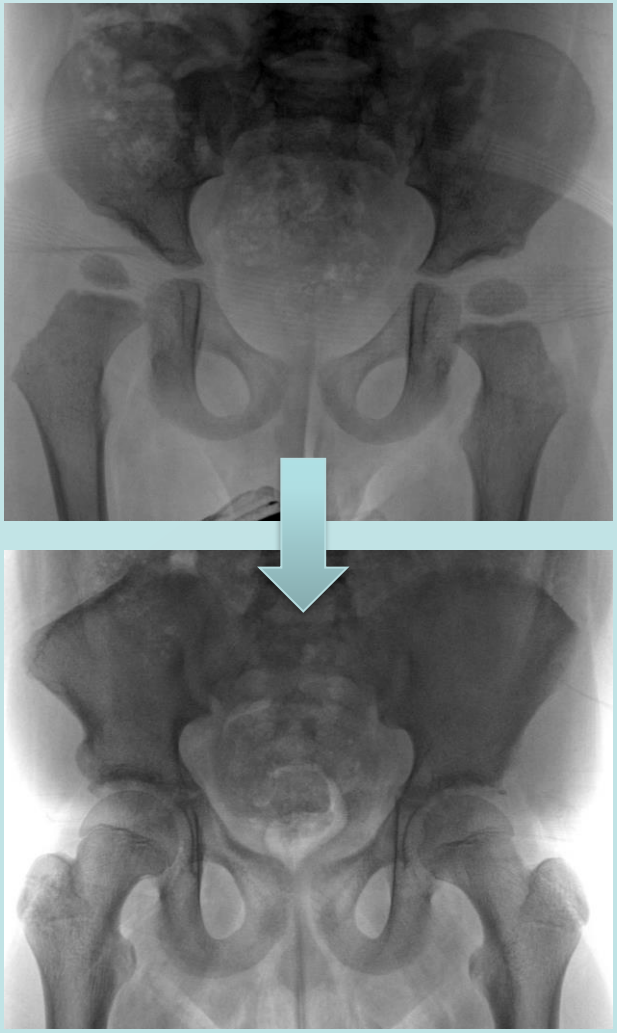
- Nakamura: RAO 13 years follow-up
  - 80% survival (THA)
- Von Hellemondt: Triple average 15 years follow-up
  - 88% preserved (THA)
- Matheney: PAO average 9 years follow-up
  - 76% Preserved (THA and WOMAC pain $\geq$ 10)
  - 12% with WOMAC $\geq$ 10
- Troelson: PAO average 7 years follow-up
  - 82% Preserved (THA)
  - 36% Groin pain
- Steppacher/Lerch: PAO average 20 and 30 years follow-up
  - 82% at 11 years, 60% at 20 years, 30% at 30 years
  - 20% with *Poor* or *Fair* pain/function

# Predictors of Poor Outcome After PAO

- Older age
- Congruency: poor/fair
- Arthrosis
- Pre-operative limp
- Pre-operative labral tear
- “Increased” pre-op pain

# Summary

- Acetabular Dysplasia results in a mechanical problem of the hip joint
  - Changes the loading forces
  - Lead to joint damage
- Timely osteotomy can change the mechanical environment
- Many ways to skin a cat
- Age, severity, volume, surgeon preference



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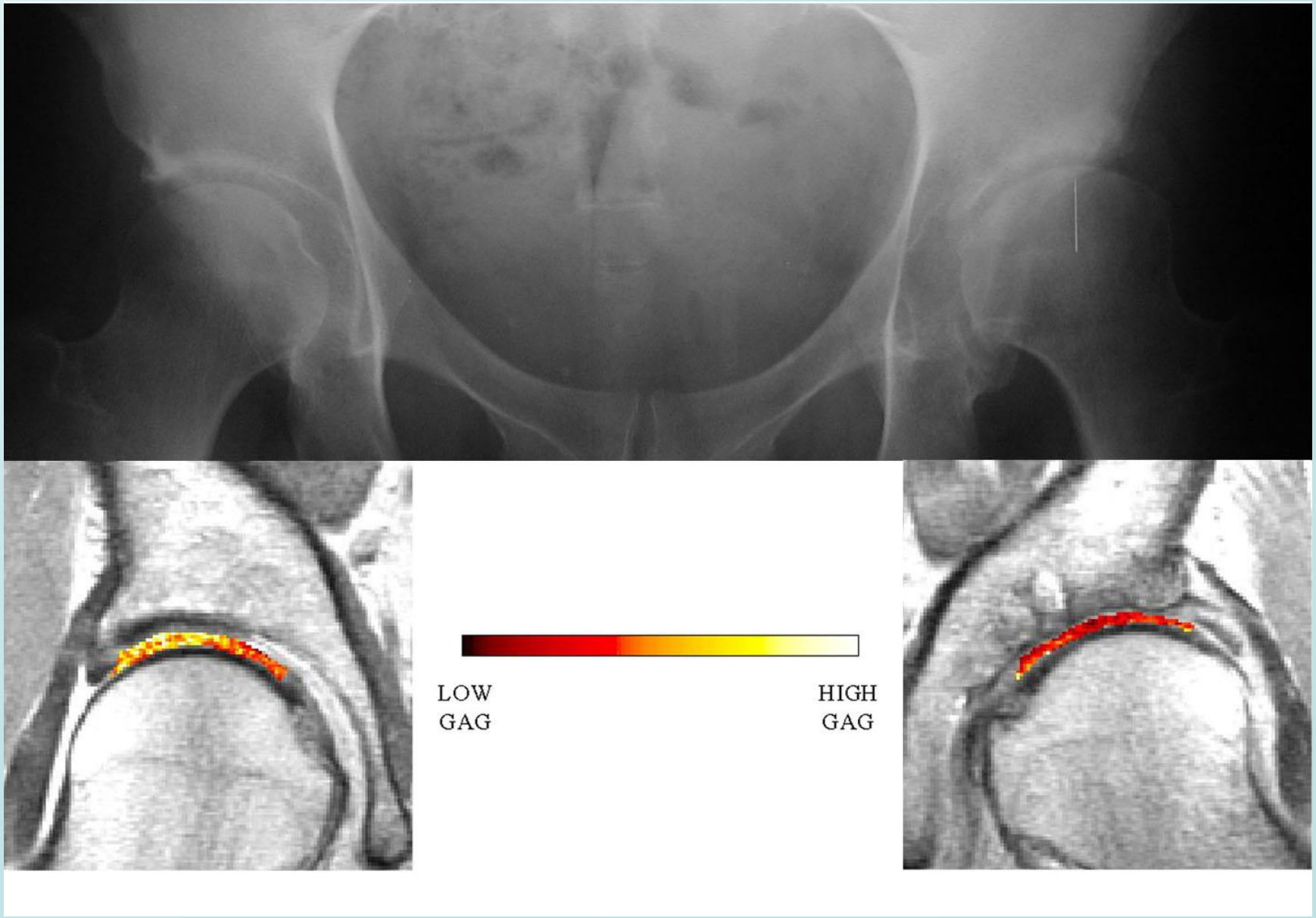
# dGEMRIC MRI



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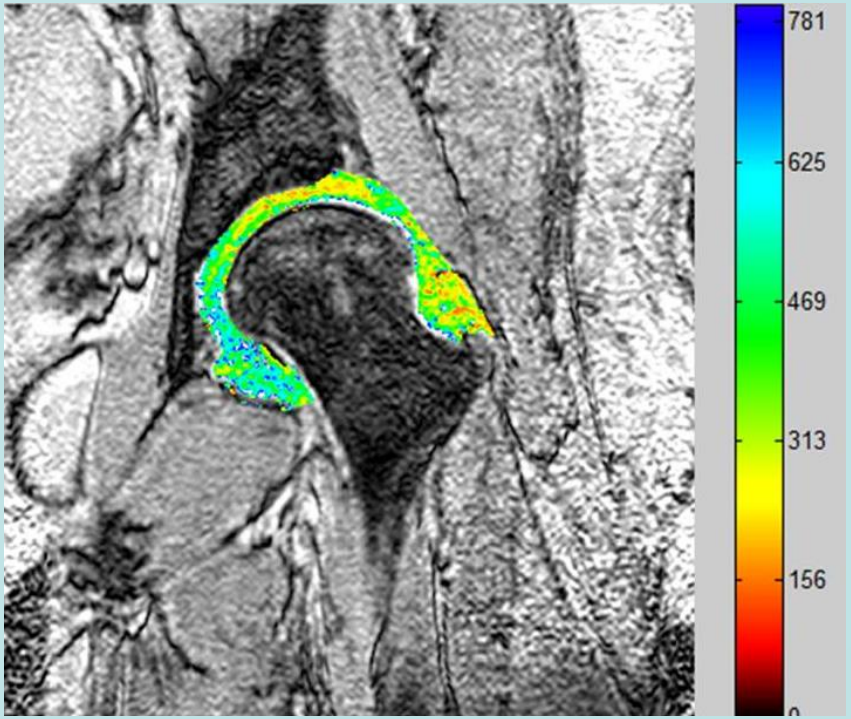
# DGEMRIC

- Improves ability to predict successful outcome of surgery based on pre-existing cartilage damage



# HOWEVER

- Originators of procedure published 30 year follow up on first 75 surgeries performed 1984-1987.
  - Only 30% avoided having a total hip replacement

BUT

Many of these patients were older and had evidence of arthritis at the time of surgery

# Consensus

- Consensus opinion
  - Abnormal biomechanics of the hip should be corrected
  - Correcting dysplasia leads to improvement in pain and function
  - Earlier treatment leads to better results
  - We have effective treatment at most ages for dysplasia or subluxation of the hip prior to onset of osteoarthritis
  - We need to find these hips and treat them
    - Effective screening
    - Effective evaluation tools

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# References


- *Morris, Andrew et al Does Late Hip Dysplasia Occur After Normal Ultrasound Screening in Breech Babies? JPO 39(4) 187.*

- Wyles, Cody C. BS1; Heidenreich, Mark J. MD2; Jeng, Jack MD3; Larson, Dirk R. MD4; Trousdale, Robert T. MD2; Sierra, Rafael J. MD2,a. The John Charnley Award: Redefining the Natural History of Osteoarthritis in Patients With Hip Dysplasia and Impingement. Clinical Orthopaedics and Related Research 475(2):p 336-350, February 2017. | DOI: 10.1007/s11999-016-4815-2.

- Andreas M. Hingsammer, Leslie A. Kalish, PDavid Stelzeneder,Sarah Bixby, MD, Tallal Charles Mamisch, MD, Patricia Connell, MPH, Michael B. Millis, MD,Young-Jo Kim, MD, PhD Does Periacetabular Osteotomy for Hip Dysplasia Modulate Cartilage Biochemistry? JBJS 97(7) 544, 2015.

- Harris, W. H.: Etiology of osteoarthritis of the hip. C/in. Orthop., 213: 20-33. 1986.
- Amanatullah, D. F., Stryker, L., Schoenecker, P., Taunton, M. J., Clohisy, J. C., Trousdale, R. T., & Sierra, R. J. (2015). Similar clinical outcomes for THAs with and without prior periacetabular osteotomy. *Clinical Orthopaedics and Related Research®*, *473*, 685-691.

- Murphy SB, Kijewski PK, Millis MB, Harless A. Acetabular dysplasia in the adolescent and young adult. Clin Orthop Relat Res. 1990 Dec;261:214-23.

- Wedge JH, Wasylenko MJ. The natural history of congenital disease of the hip. J Bone Joint Surg Br. 1979 Aug;61-B(3):334-8.

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# References Continued


- Van Bergayk, A. B., & Garbuz, D. S. (2002). Quality of life and sports-specific outcomes after Bernese periacetabular osteotomy. *The Journal of Bone & Joint Surgery British Volume*, *84*(3), 339-343.
- Steppacher SD, Tannast M, Ganz R, Siebenrock KA. Mean 20-year followup of Bernese periacetabular osteotomy. Clin Orthop Relat Res. 2008 Jul;466(7):1633-44.
- Wells J, Millis M, Kim YJ, Bulat E, Miller P, Matheney T. Survivorship of theBernese periacetabular osteotomy: what factors are associated with long-term failure?Clin Orthop Relat Res. 2017 Feb;475(2):396-405.
- Matheney T, Kim YJ, Zurakowski D, Matero C, Millis M. Intermediate to longterm results following the Bernese periacetabular osteotomy and predictors of clinical outcome. J Bone Joint Surg Am. 2009 Sep;91(9):2113-23.
- Zaltz I, Baca G, Kim YJ, Schoenecker P, Trousdale R, Sierra R, Sucato D, Sink E, Beaul´e P, Millis MB, Podeszwa D, Clohisy JC. Complications associated with the periacetabular osteotomy: a prospective multicenter study. J Bone Joint Surg Am. 2014 Dec 3;96(23):1967-74.
- Weinstein SL. Natural history of congenital hip dislocation (CDH) and hip dysplasia. Clin Orthop Relat Res. 1987 Dec;225:62-76.