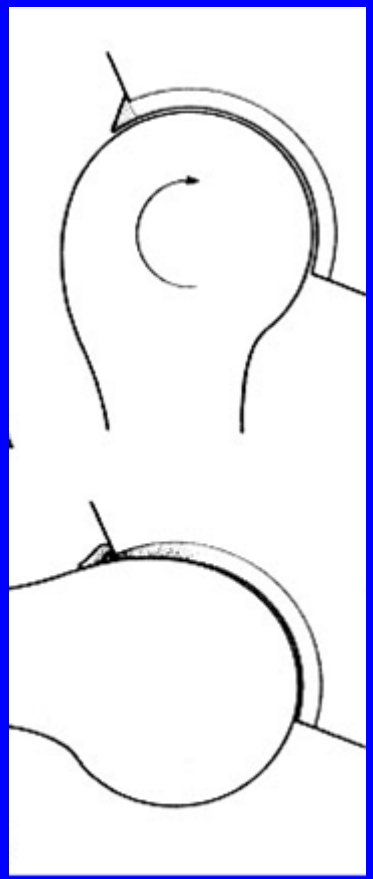
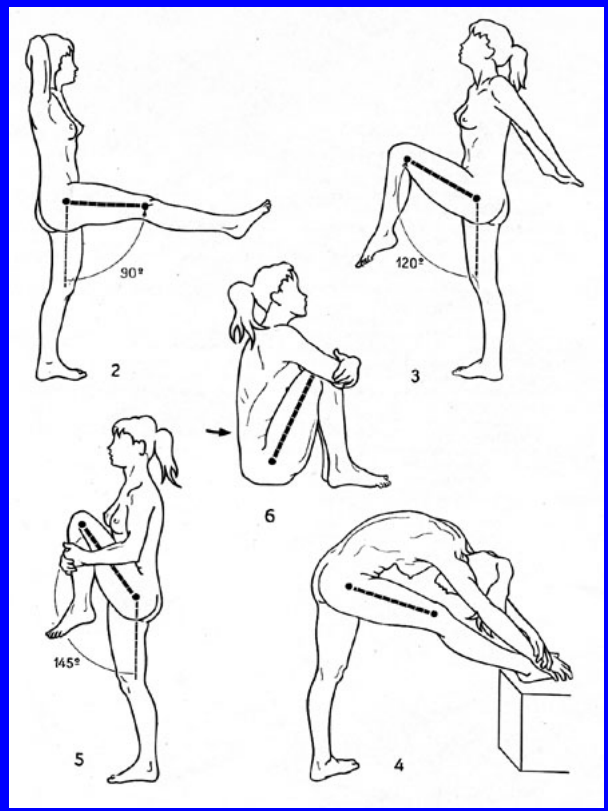
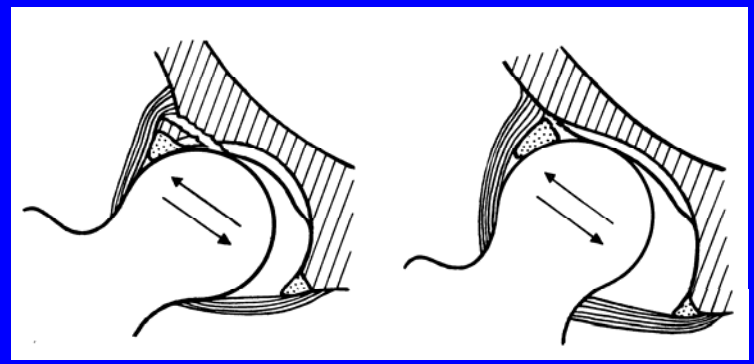
Hipology 2010

COA Meeting

April 17, 2010

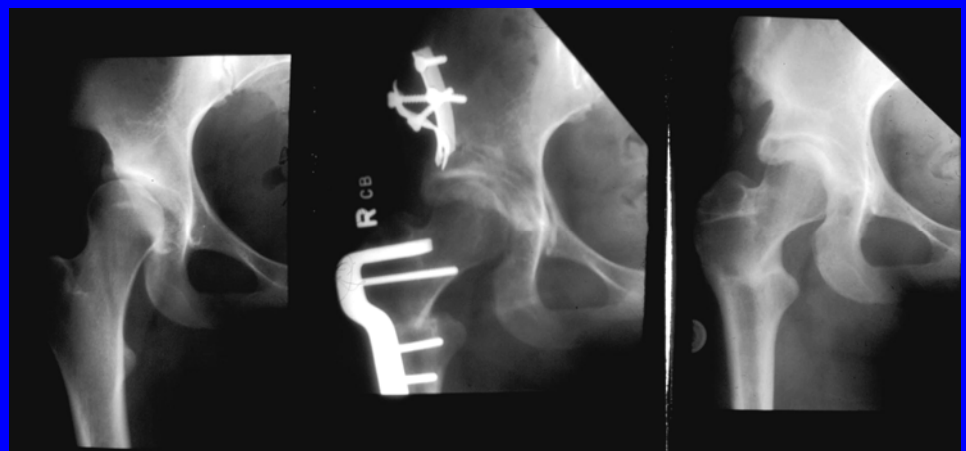


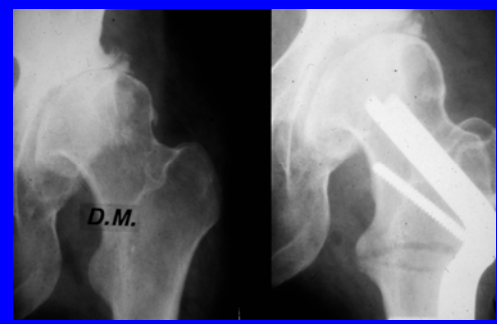




Hip Joint-Preserving Surgery: An Etiologic Approach to Prevent and Treat Osteoarthrosis

Michael B. Millis, M.D.
Director, Adolescent and Young Adult Hip Unit
Children's Hospital/Harvard Medical School





Disclosures

- None relevant to this presentation
- Hip Unit research support from Siemens (YJK)

Major Points

* **In North America, most OA in the hip is secondary**
- Developmental hip deformity is the commonest etiology of this secondary OA
- A mechanical perspective is very helpful in understanding the nature of secondary hip OA
  (i.e., most OA in the hip is caused by abnormal mechanics)
* Accurate analysis of the mechanical hip abnormality can often allow its surgical correction (and prevent OA!!)
- Instability and impingement are the common bad actors
- The acetabular rim is the usual locus of early damage
  - The labrum is often damaged but labral tears rarely can be repaired successfully in isolation
  - (>90% of labral tears have important associated bony abnormalities)
* Joint-preserving hip surgery can be highly effective IF performed before there is major articular cartilage damage

Major Points

* **In North America, most OA in the hip is secondary**
  (Most OA in the hip is caused by abnormal mechanics)
* Accurate analysis of the mechanical hip abnormality can often allow its surgical correction (and prevent OA!!)
* Joint-preserving hip surgery can be highly effective IF performed before there is major articular cartilage damage

Acknowledgements

- Classic Teachers: Pauwels; Bombelli, Maquet
- Basic Researchers: Mankin, Buckwalter, Grodzinky et al
- Great Joint-Saving Surgeons: Ganz, Mueller, Ninomiya, Salter, Sugioka,Wagner
* Mentors: Ganz, Hall, Harris, Wagner
- Colleagues: Felson, Jaramillo, **Kim and CHB Hip Unit**, Leunig, Murphy, Poss, Santore et al; ANCHOR Group
- Our patients

"It seems clear that either osteoarthritis of the hip does not exist as a primary disease entity or if it does, is extraordinarily rare."

William H. Harris

Risk Factors for Osteoarthritis: Understanding Joint Vulnerability

- "Risk factors for OA can be best understood as either:

  1) impairment of joint protectors

  →increasing joint vulnerability OR

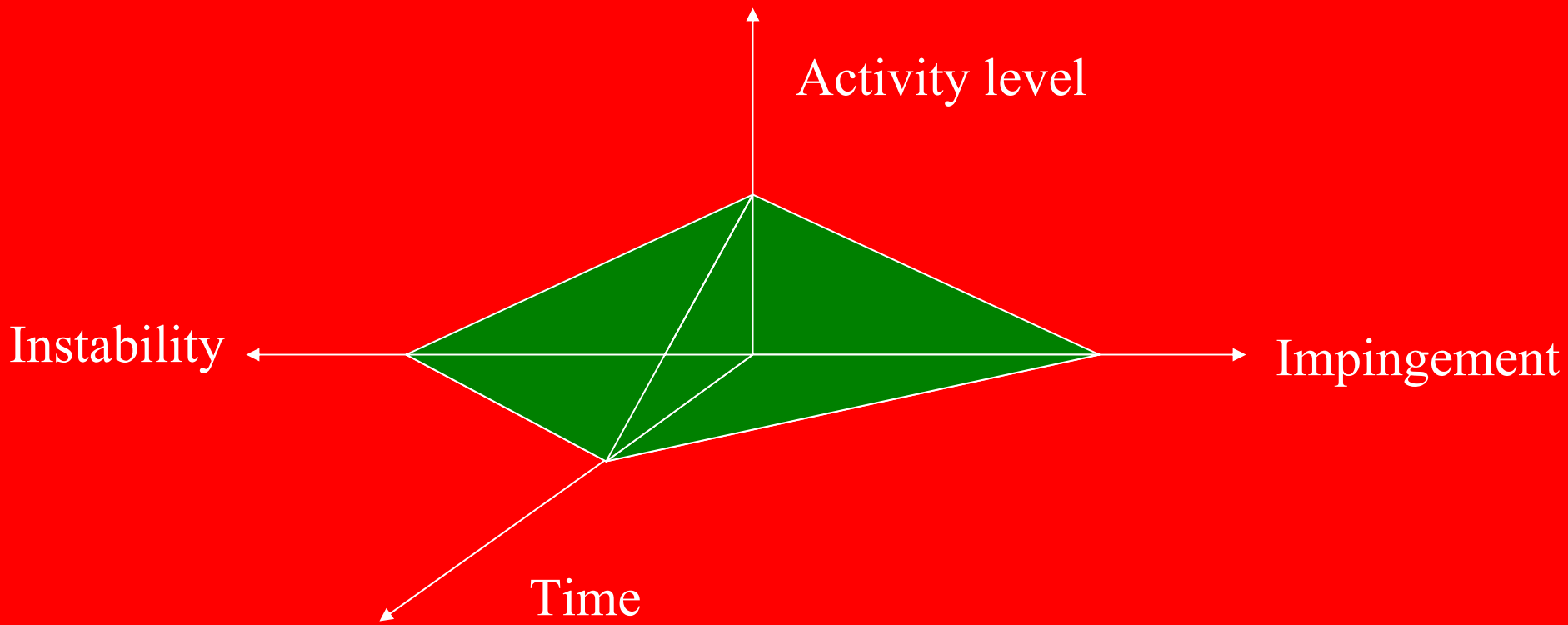
  2) factors that excessively load the joint

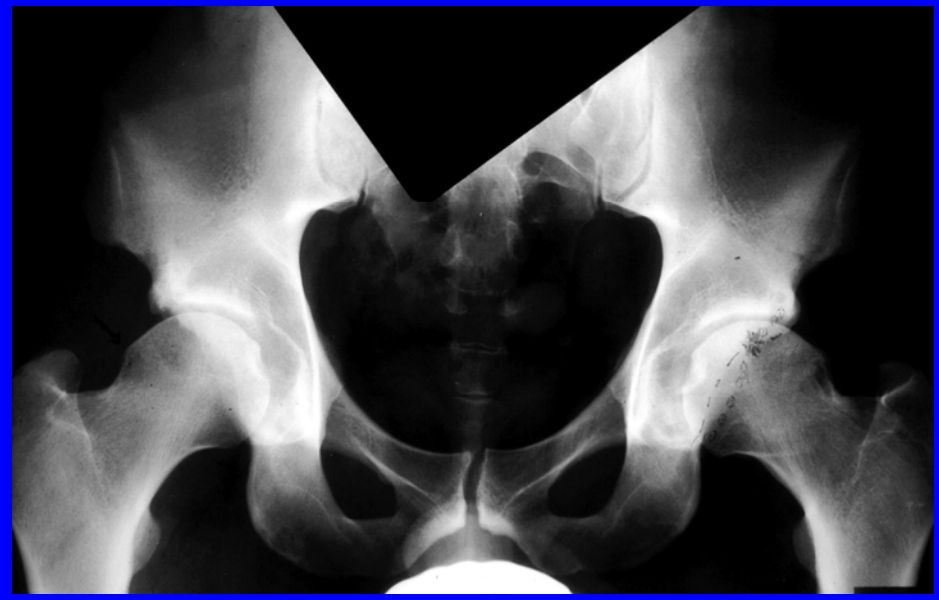
  OR <u>BOTH</u>

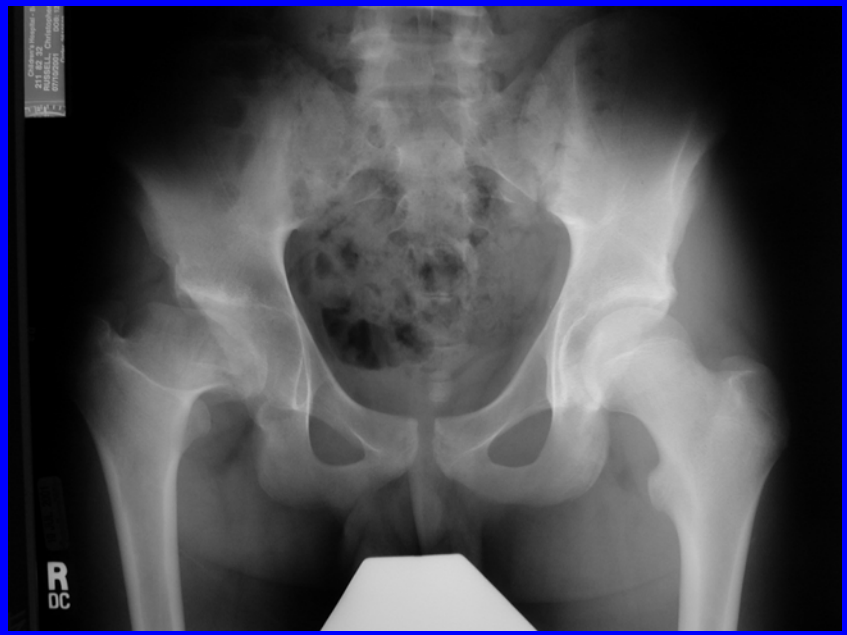
  ----leading to injury."

  CORR 427S:16-21, 2004 D Felson

Joint Function



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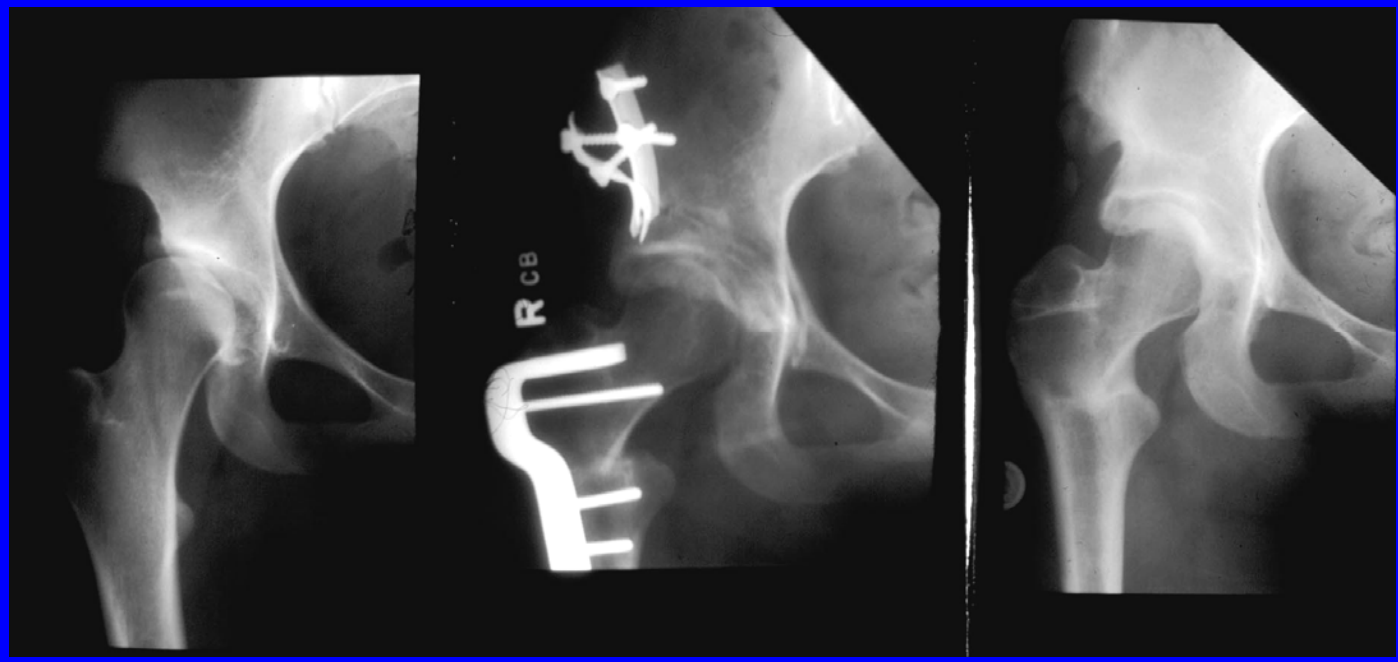
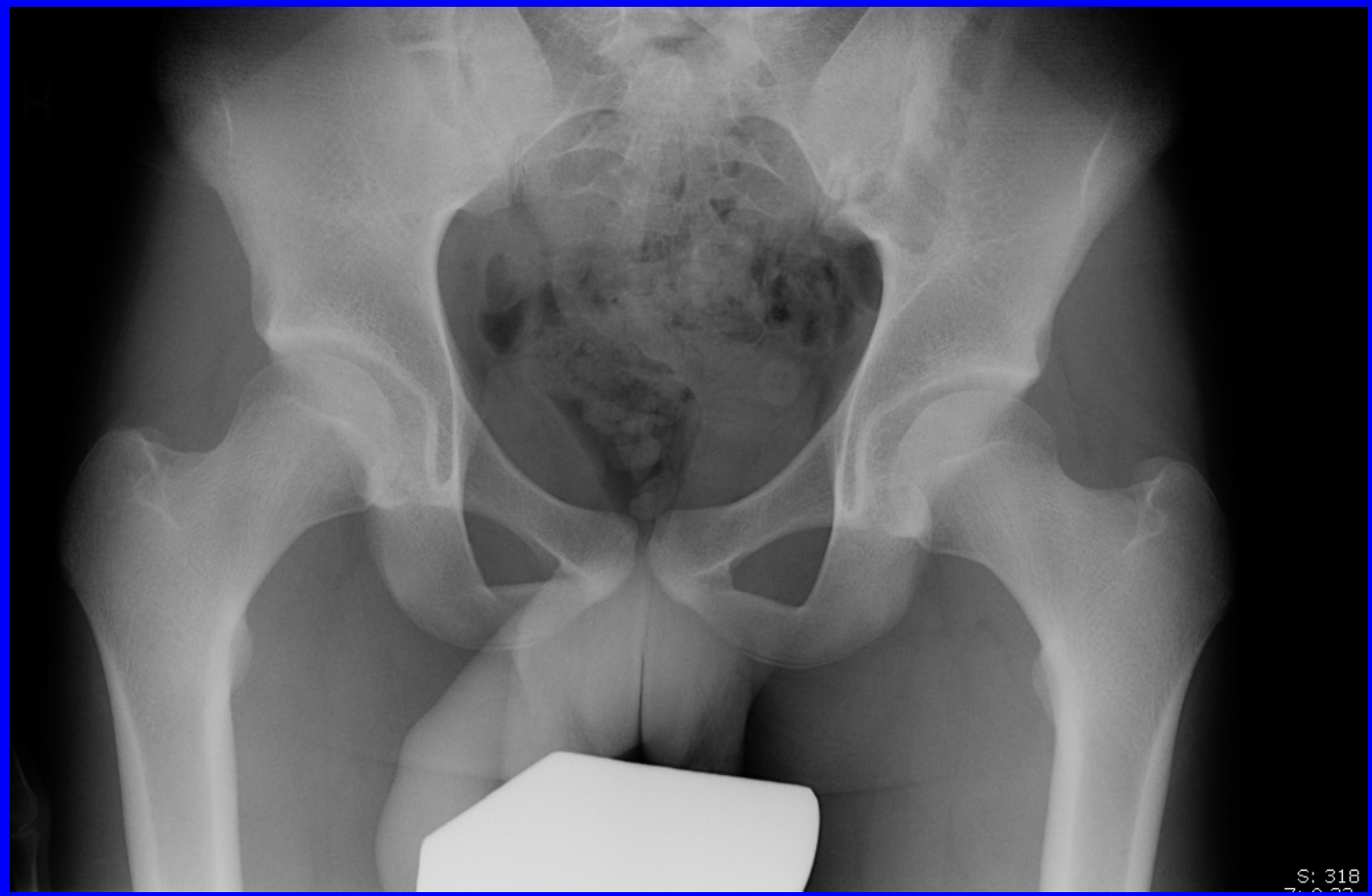


"The best hip replacement has an unknown but certainly finite life, whereas a hip healed after osteotomy will often last a lifetime."

Prof. Maurice Mueller

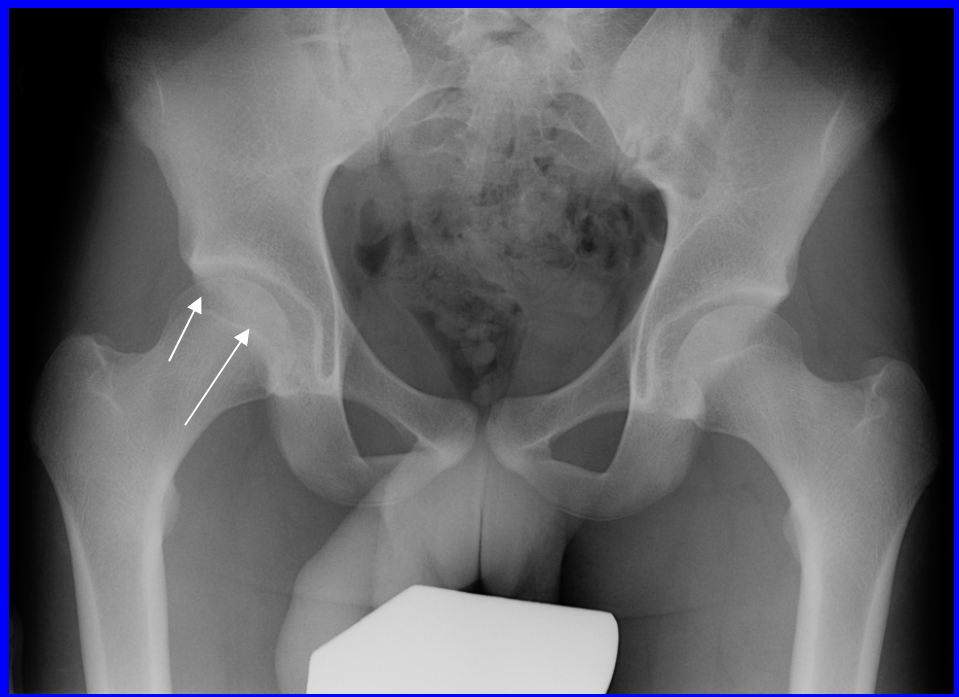
“We see what we know.”

Frank Phillip Stella, artist



“We see what we know.”

18 yo son; mild groin pain

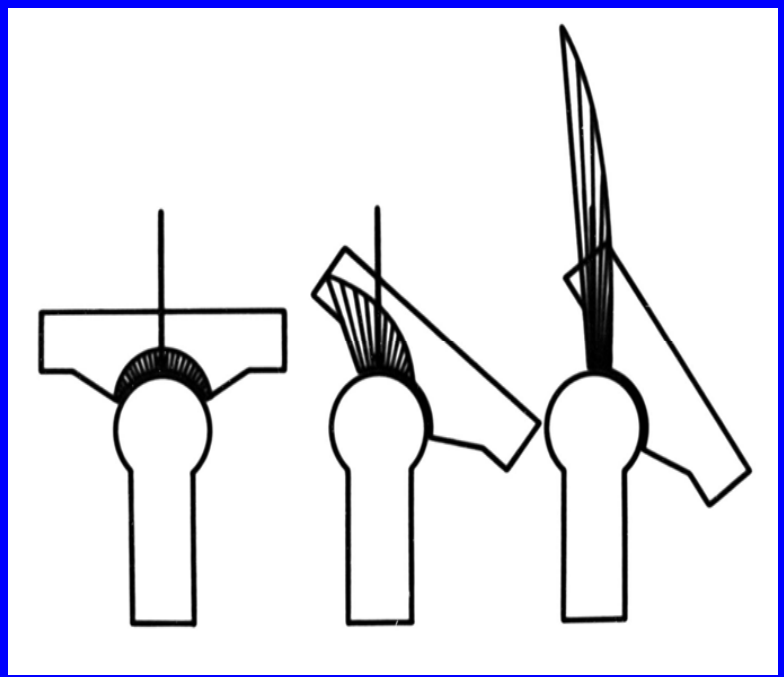


43 yo father; R>>L groin pain

Bilateral crossover signs and posterior wall signs

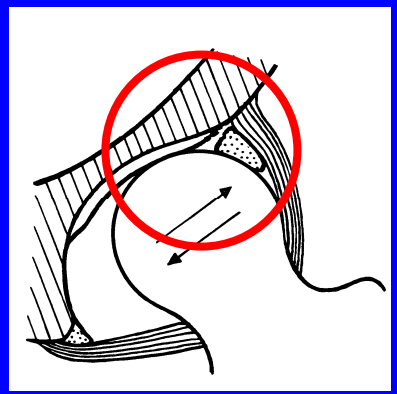
The Contemporary Mechanical Theory of Osteoarthrosis in the Hip

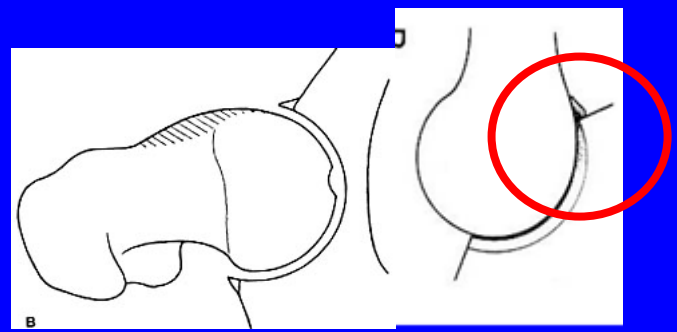
- OA in the hip usually is SECONDARY: a **final common pathway of mechanically-based degradation** rather than a distinct disease



The Contemporary Mechanical Theory of Osteoarthrosis in the Hip

- OA in the hip usually is secondary: mechanically-based degradation rather than a distinct disease
* Major etiologic factor in hip OA: **loading of the acetabular <u>rim</u>**, by <u>instability or impingement</u>



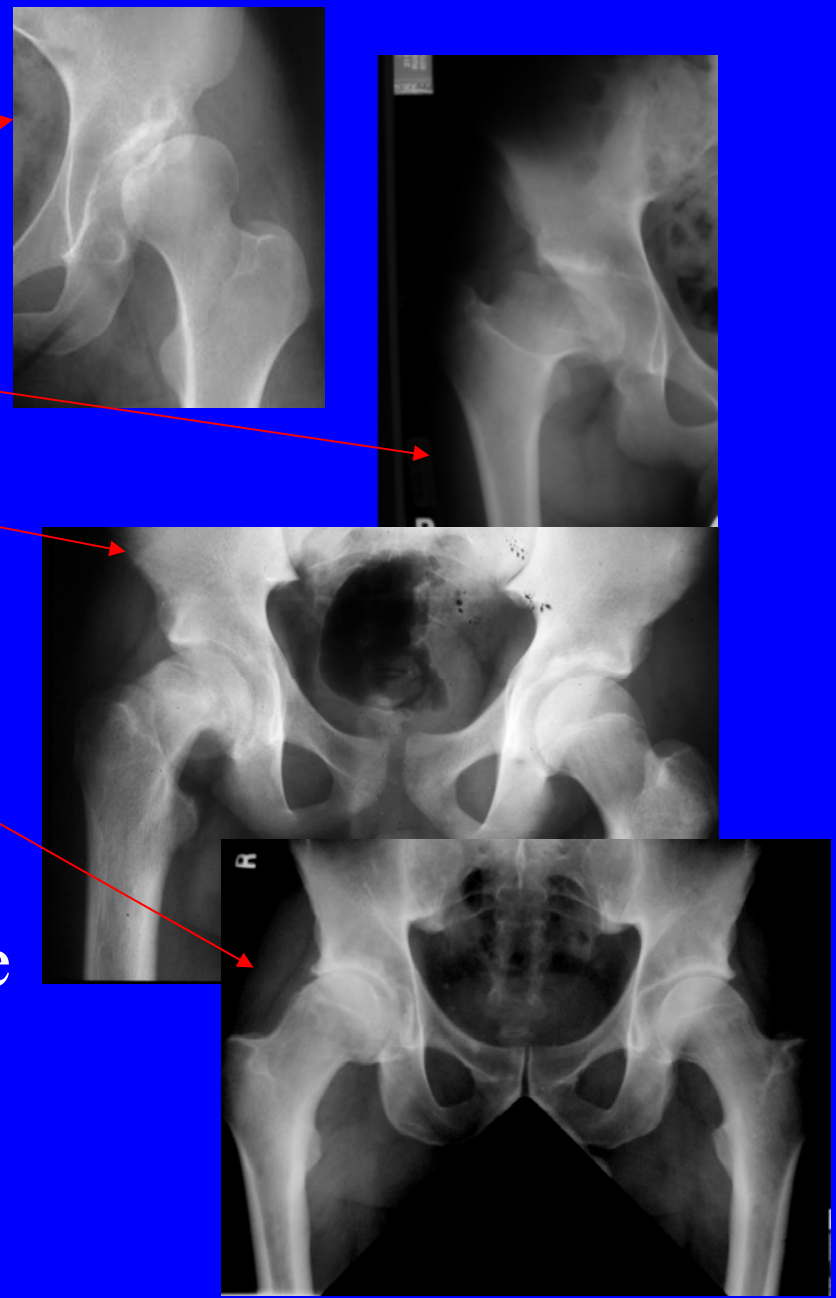


Etiology of OA of the Hip-1986

- Dysplasia 43%
- Perthes Disease 22%
- Slipped Epiphysis 11%
- Other 12%
* "Idiopathic"/"Primary" 12%

  (Many were probably impinging hips!!)

  (Aronson, AAOS Instr. Course Lec. 35:119-128, 1986)

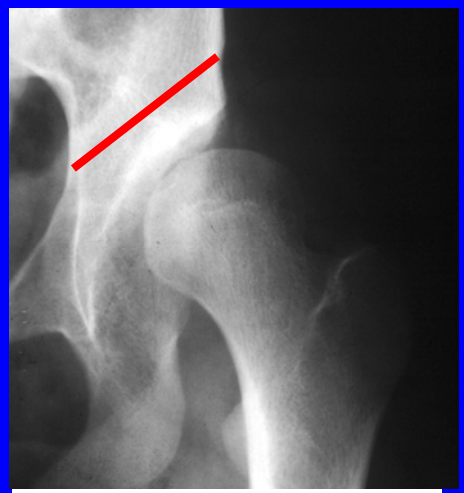


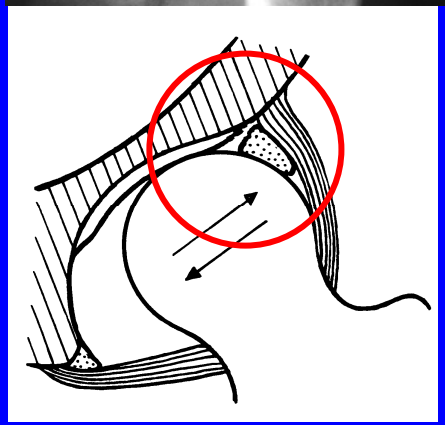
MAJOR POINTS

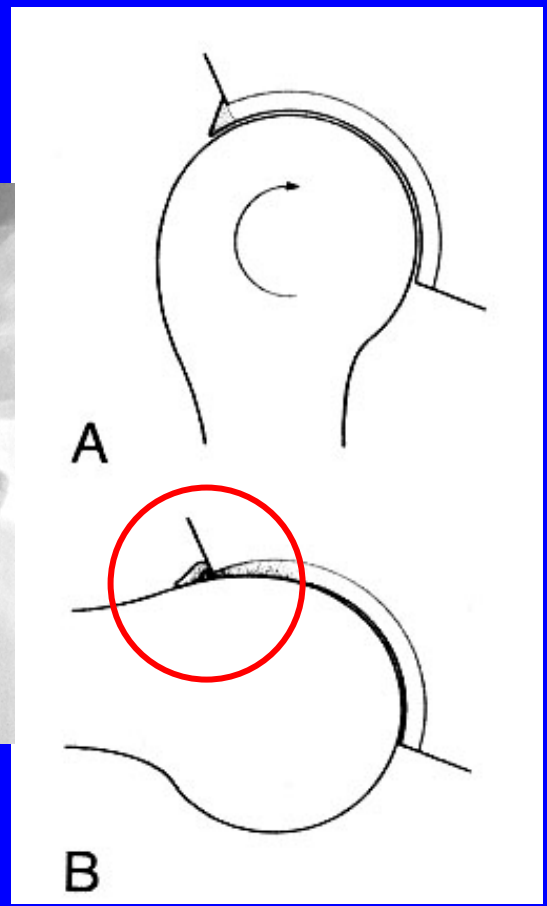
* Hip OA is rarely idiopathic.
* Hip OA usually begins at the acetabular RIM.
* Labral tears are usually **secondary lesions**.
  * **Wenger D et al: "Acetabular labral tears rarely occur in the absence of bony abnormalities" Clin Orthop Relat Res 2004: 426:145-150.**

MAJOR POINTS

* A labral tear is usually SECONDARY to another structural problem (90+%!!)







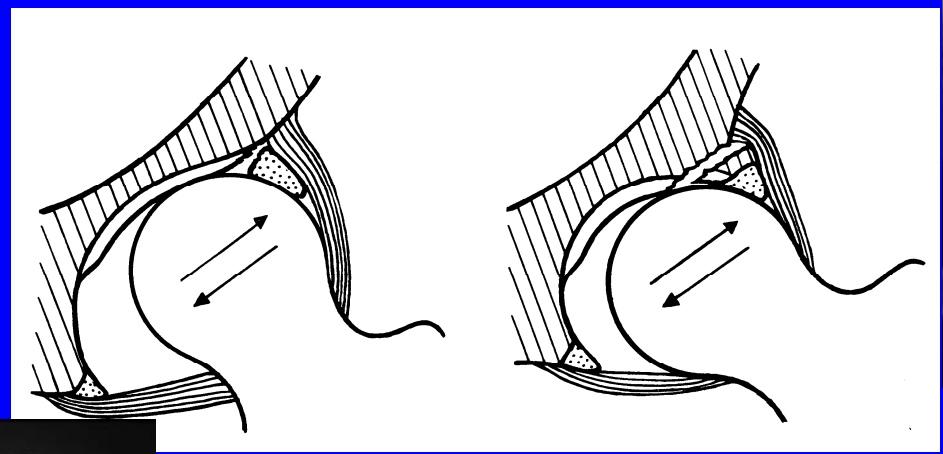
MAJOR POINTS

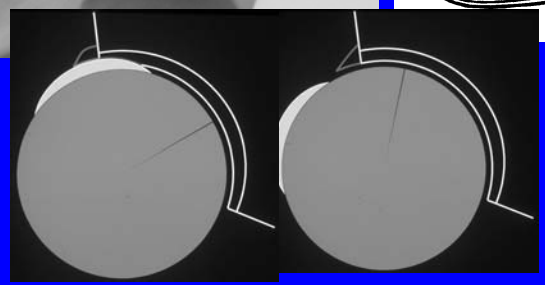
* Hip OA is rarely idiopathic.
* Hip OA usually begins at the RIM.
* Labral tears are usually **secondary lesions**.
* Joint-preserving procedures are effective IF they correct the hip's mechanical problem **in time**.

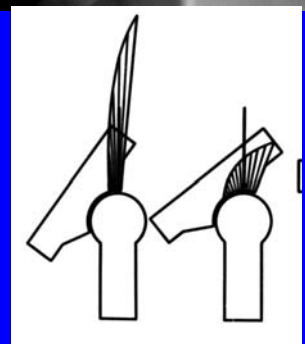
Acetabular Rim Syndrome(s)

- Groin/thigh pain with certain maneuvers
- Sensation of locking/catching/instability
- Labral damage, cartilage damage, or rim fractures from either: **instability**(DDH) OR femoro-acetabular **impingement** (FAI)

(Klaue et al: JBJS, 73-B: 423-429, 1991)





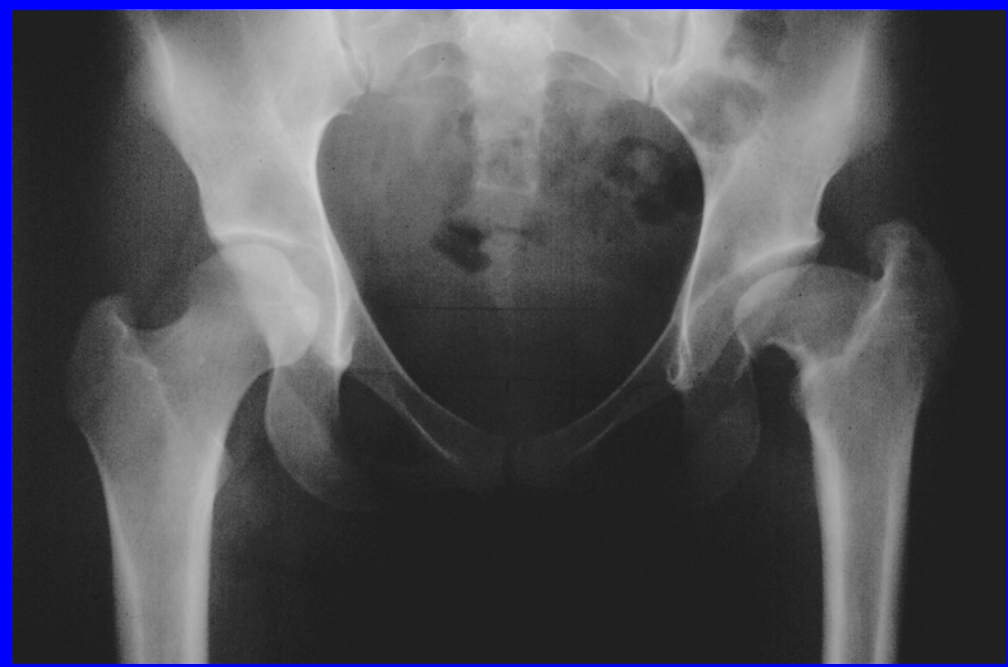


Principles of Joint Preservation

- Key Initial Questions
  - Is there a MECHANICAL BASIS for part or all of the clinical problem?
  - (Is there a correctable mechanical problem?)
  - Can a MECHANICALLY-BASED joint-preserving technique improve clinical function or the prognosis?

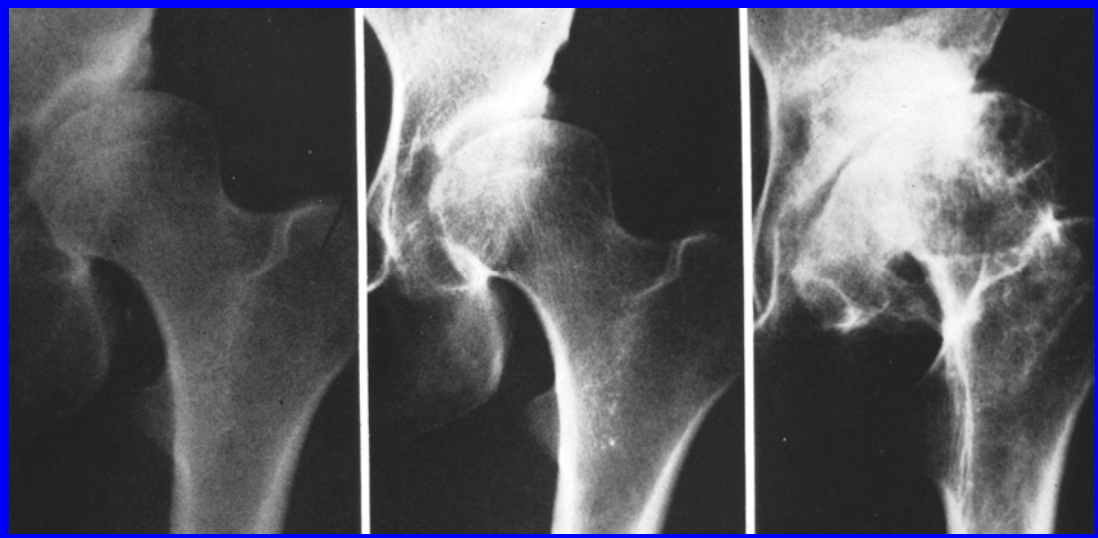
Step-Wise Analysis of the Symptomatic Hip

- Is there a correctable mechanical lesion? YES?
- How can the mechanical lesion be corrected???
* Is hip preservation preferable to replacement arthroplasty for this patient???



Hard Truths (Bad News)

- No good substitute yet for hyaline cartilage
- Biologic resurfacing is difficult AT BEST.
- OA is progressive UNLESS the unfavorable mechanics within the joint can be fixed.

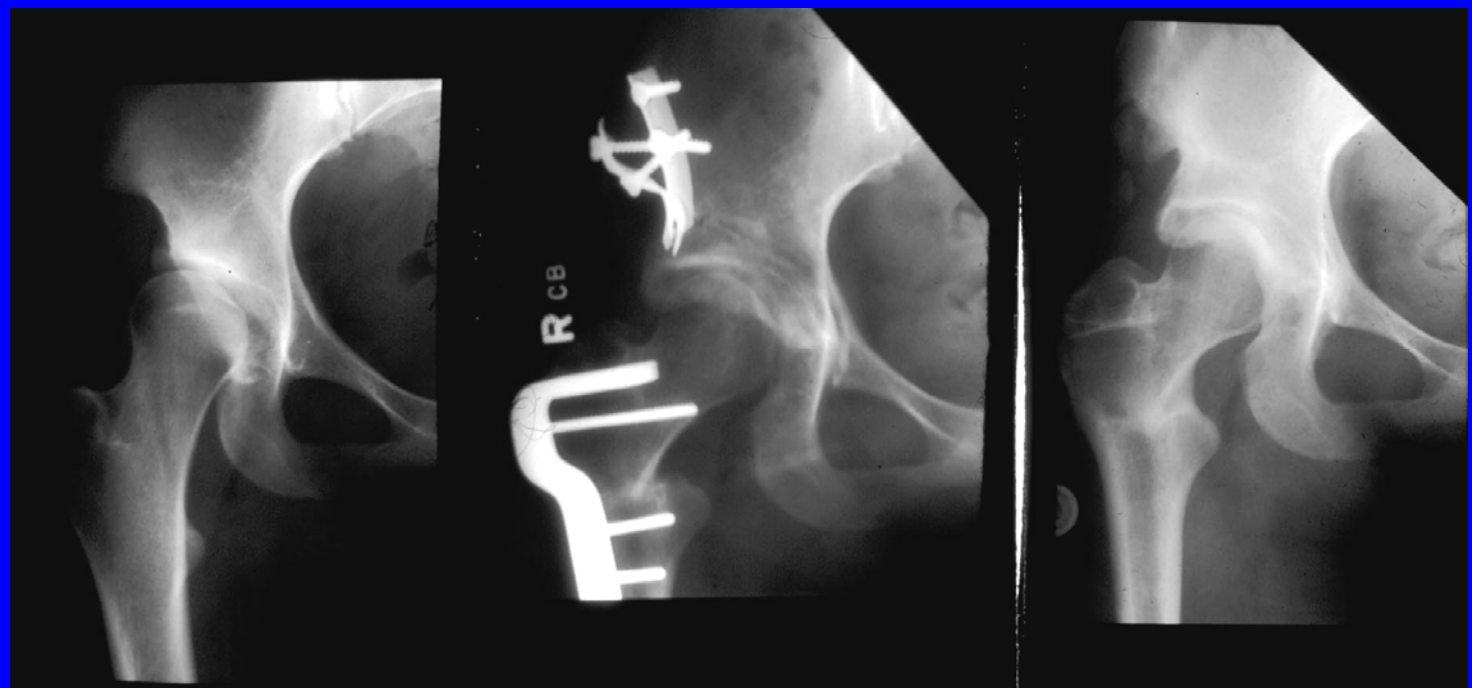


Good News About OA in the Hip

- Rarely idiopathic or "primary"
- Mechanical nature, familiar to the orthopaedist
- Treatable/preventable by mechanical means
* **Several joint-preserving alternatives exist**
  - Arthroscopy
  - Arthrotomy
  * Surgical hip dislocation/osteoplasty/debridement
  - Realignment osteotomy(Femoral or pelvic)
  - (Biologic resurfacing of articular surfaces)
  - Combinations

Goals for Every Orthopaedist

* Learn to recognize the mechanically-compromised joint before arthrosis occurs
* Learn how to save/preserve those joints rather than replacing them
  (if possible and reasonable)

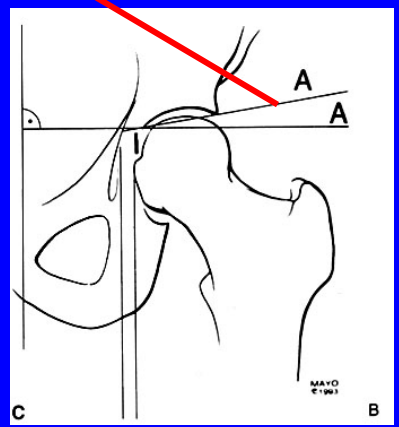


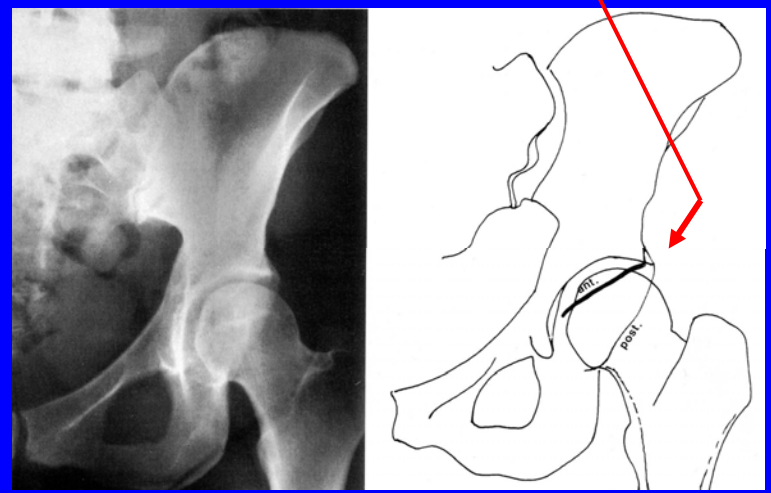
The Normal Hip: Anatomic Characteristics

- Congruous, well-aligned surfaces
- "Good" coverage: not too little; not too much!
- Normal version: A and P rims
- Symmetric, wide cartilage space
- Thin, almost horizontal sourcil: the weight-bearing zone

The Normal Hip: Anatomic Characteristics

- Congruous, well-aligned surfaces
- "Good" coverage: not too little; not too much!
  - Lateral C-E angle 25-35°
- Normal version: A and P rims
  - No crossover sign; rims meet at corner of acetabulum
- Symmetric, wide cartilage space
- Thin, almost horizontal sourcil: the weight-bearing zone
  - Tönnis roof angle: 0 to 10°





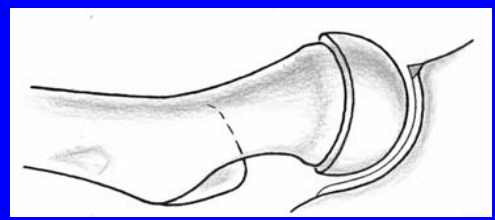
The Normal Hip: Mechanical Characteristics

- Free mobility: **ROM>needed for ADL**
- Stability
- Narrow physiologic range of loading

"Normal" Hip

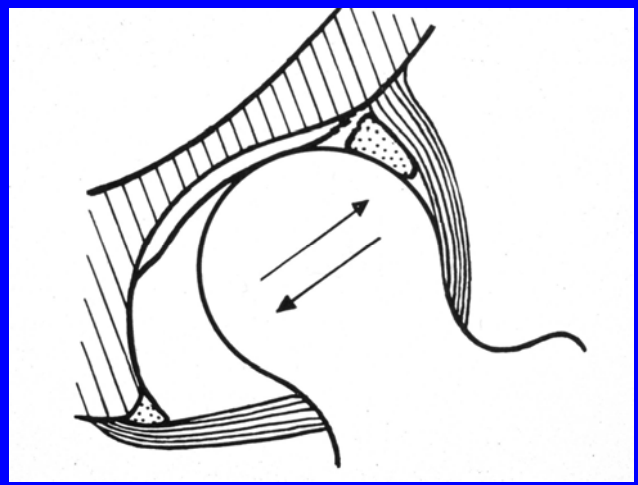
- Anatomy:
  - Spherical head congruous with spherical acetabulum **in all positions**
  - "Sufficient" head-neck offset; "normal" version
  - "Sufficient" coverage without overcoverage

- Mechanics : **Motion should be MORE than needed for ADL**
  - Motion smooth/gliding/non-jamming throughout ROM
  - Stability; tolerable contact conditions throughout ROM



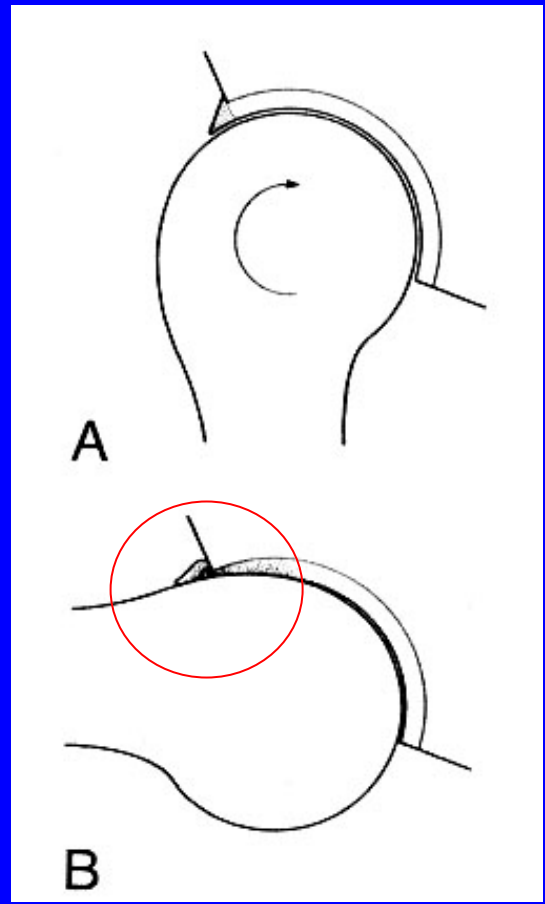
Important Definitions

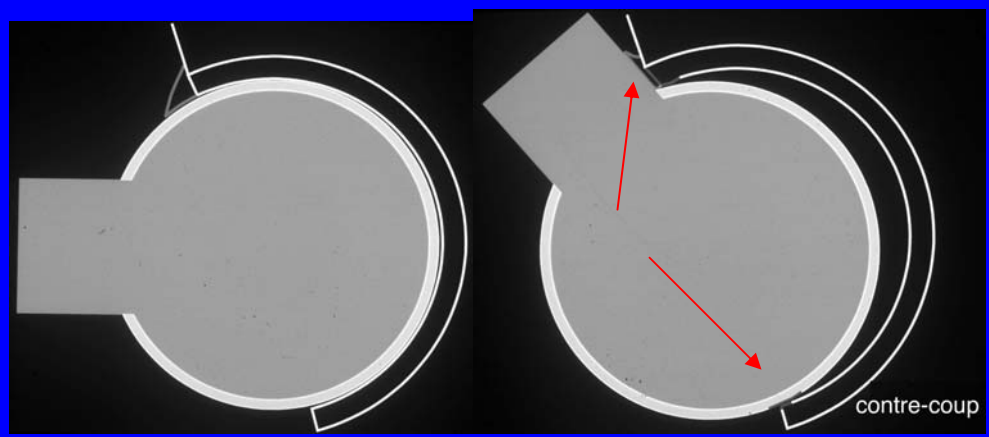
- **Instability**: the mechanical environment at the rim in acetabular dysplasia
  - Shearing stresses on cartilage
  - High loads on rim



Important Definitions

- **<u>Femoro-acetabular impingement</u>**: abnormal dynamic contact/"conflict" between the proximal femur and acetabular rim, and the adjacent acetabular cartilage
  - **FAI is a clinical diagnosis, NOT an imaging diagnosis**





Hip Mechanics

(INSTABILITY) <<<******>>> (IMPINGEMENT)



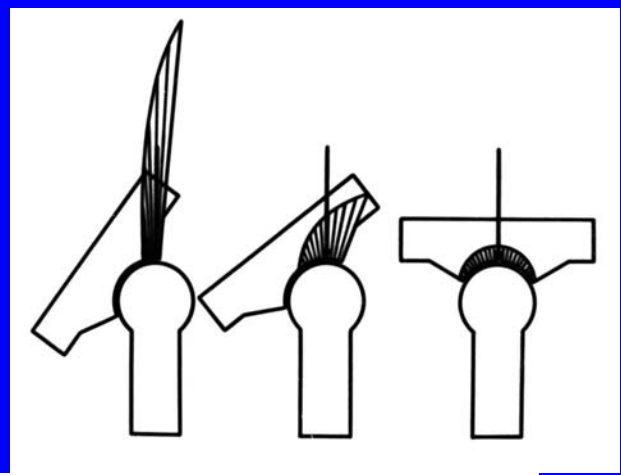
"**The human hip represents an *uneasy compromise*** between the need for stability in a joint that transmits loads of several times our body weight and the need to provide movement.

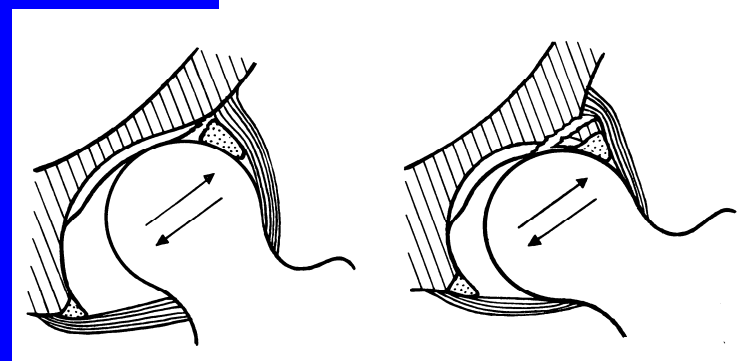
..Any geometric restriction has the potential to cause damage."

RE Field, e-commentary JBJS 87B, 2005

How can joints go wrong mechanically?

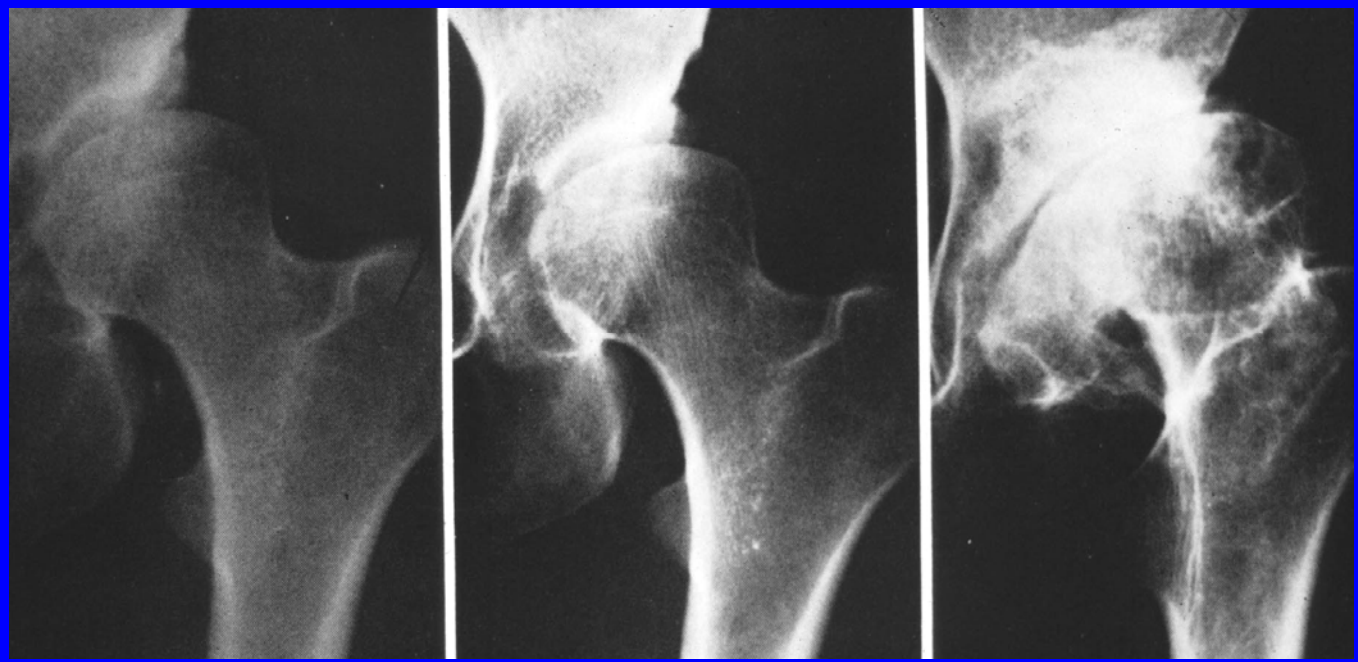
- Abnormal anatomy; “normal” use leads to articular damage over time





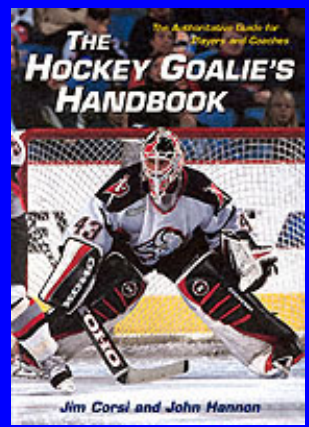
How can joints go wrong mechanically?

- Abnormal anatomy; “normal” use leads to articular damage over time



How can joints go wrong mechanically?

- Abnormal anatomy; "normal" use
* **Normal anatomy; <u>abnormal use</u> exceeds tolerance of joint structures**
  - ✓ <u>Acute injury</u> → → → →
  - ✓ <u>Chronic abuse/overuse</u> (occupational, recreational)



Hip Mechanics

- IMPINGEMENT<<**********>>INSTABILITY

(SCFE, Perthes) (DDH)

Etiologies of Hip OA in North America-UPDATED

- Dysplasia 43%

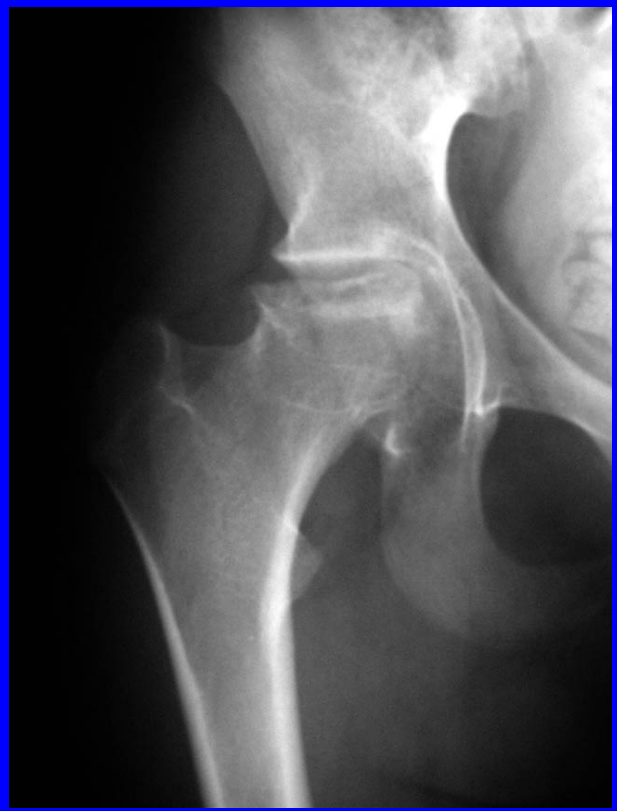
✓ Perthes-Impingement 22%
✓ SCFE-Impingement 11%
* Non-Perthes, non-SCFE FAI >10%?
"Impingement-related" 43%?

- Idiopathic + Other 16%

(modified from Aronson, 1986)

Femoro-Acetabular Impingement as a Cause of OA

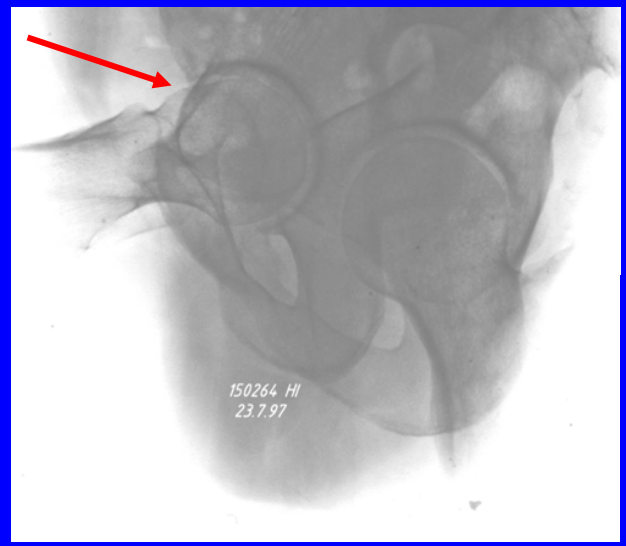
- "Classical" Impingement: Pauwels, Bombelli
  - Intraarticular incongruity; "static" overload



Femoro-Acetabular Impingement as a Cause of OA

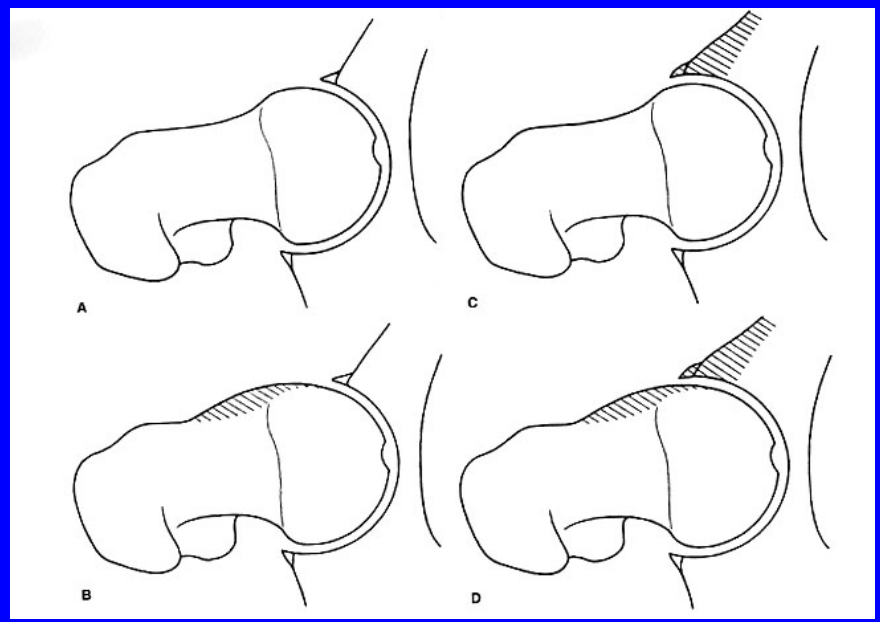
* "Contemporary" Hypothesis:
  (Ganz et al)

  Abnormal ***dynamic*** contact between proximal femur and acetabulum causes damage to rim and adjacent acetabular cartilage→OA



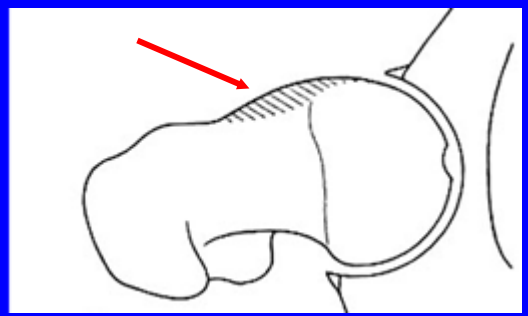
Femoro-Acetabular Impingement

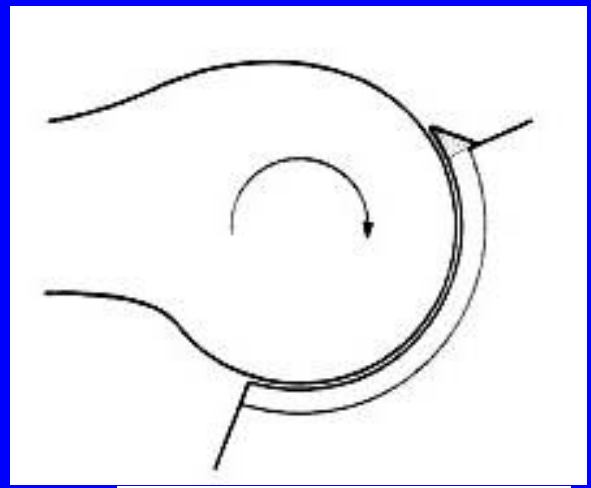
- Femur-based: **Cam type, from cam-shaped femoral head-neck junction (b)**
- Acetabulum-based: **Pincer type**, from acetabular overcoverage or retroversion (c)
- Combination: Cam and Pincer (d) (very common)



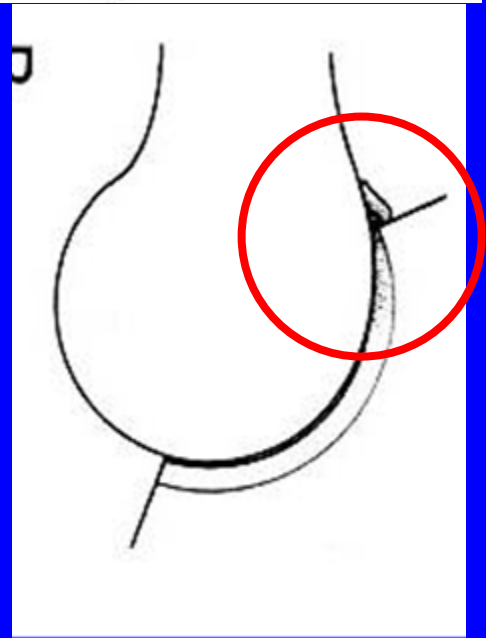
Femur-based FAI: Cam Impingement

- Pathoanatomy: asphericity of head or insufficient offset at head-neck junction





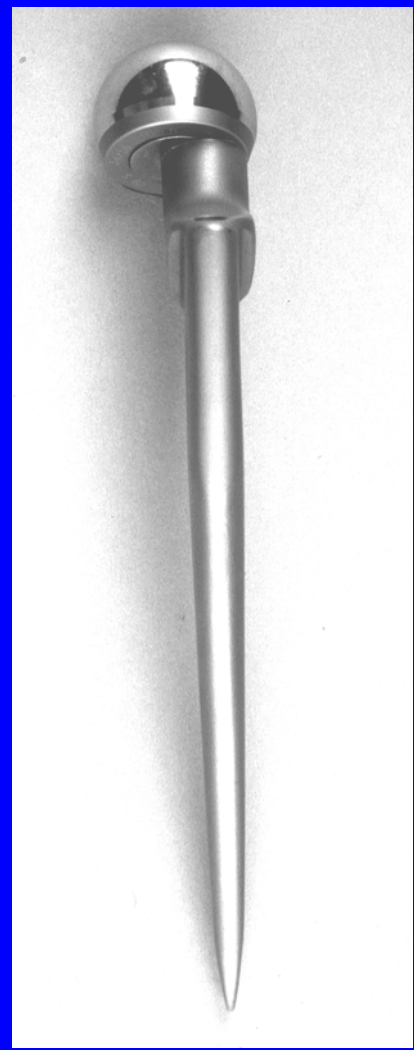
- Pathomechanics: jamming/squeezing of anterior acetabular cartilage(+++) and labrum(+) in flexion



Femoro-Acetabular Impingement as a Cause of OA

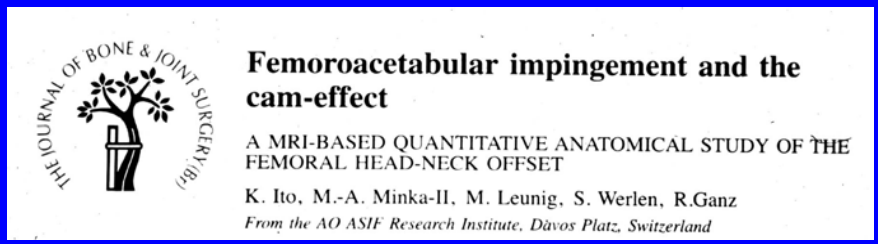
Femoro-acetabular impingement causes damage to rim and adjacent acetabular cartilage→OA

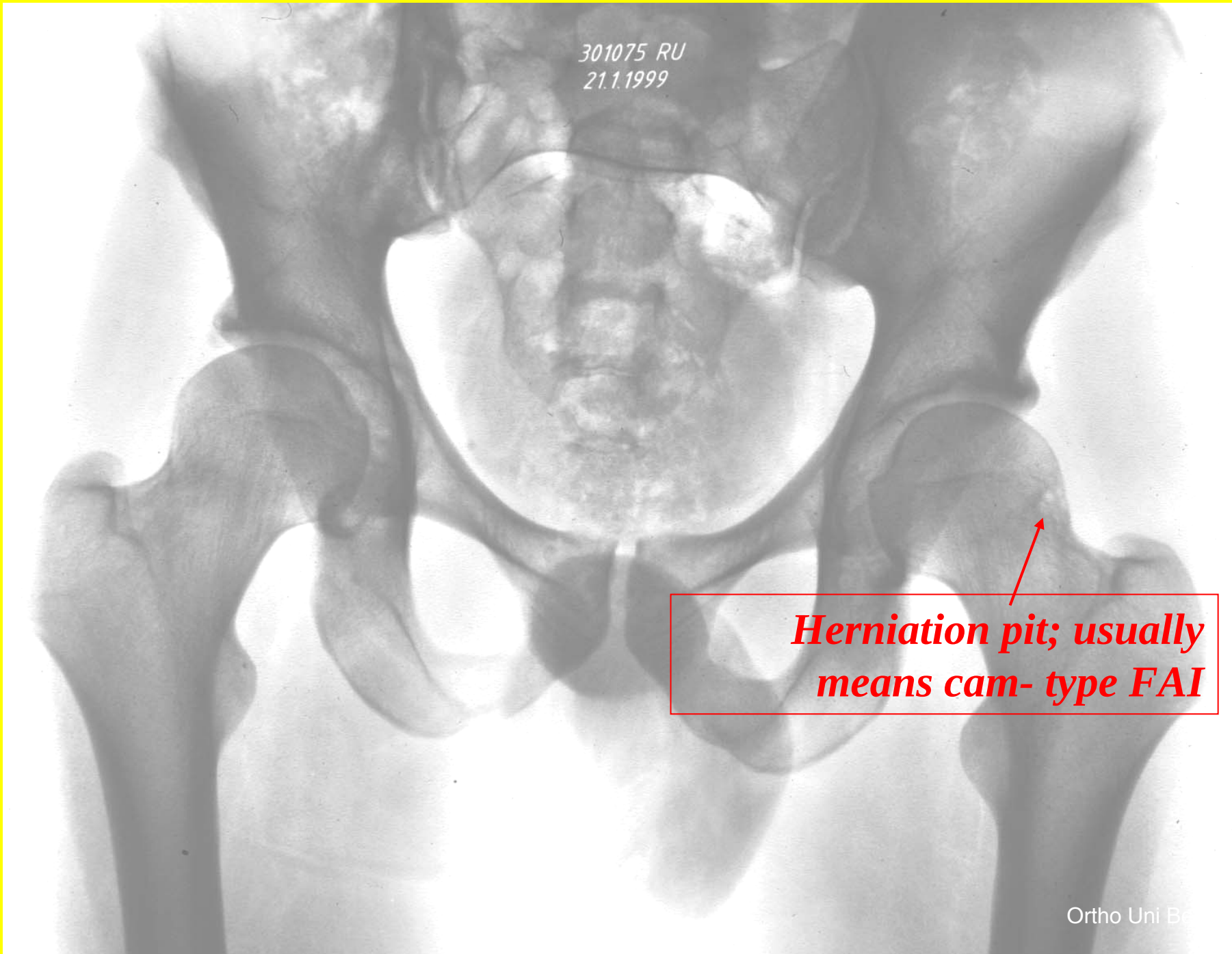
* **THR analogy:**
  Impingement between components due to poor prosthetic design or malorientation

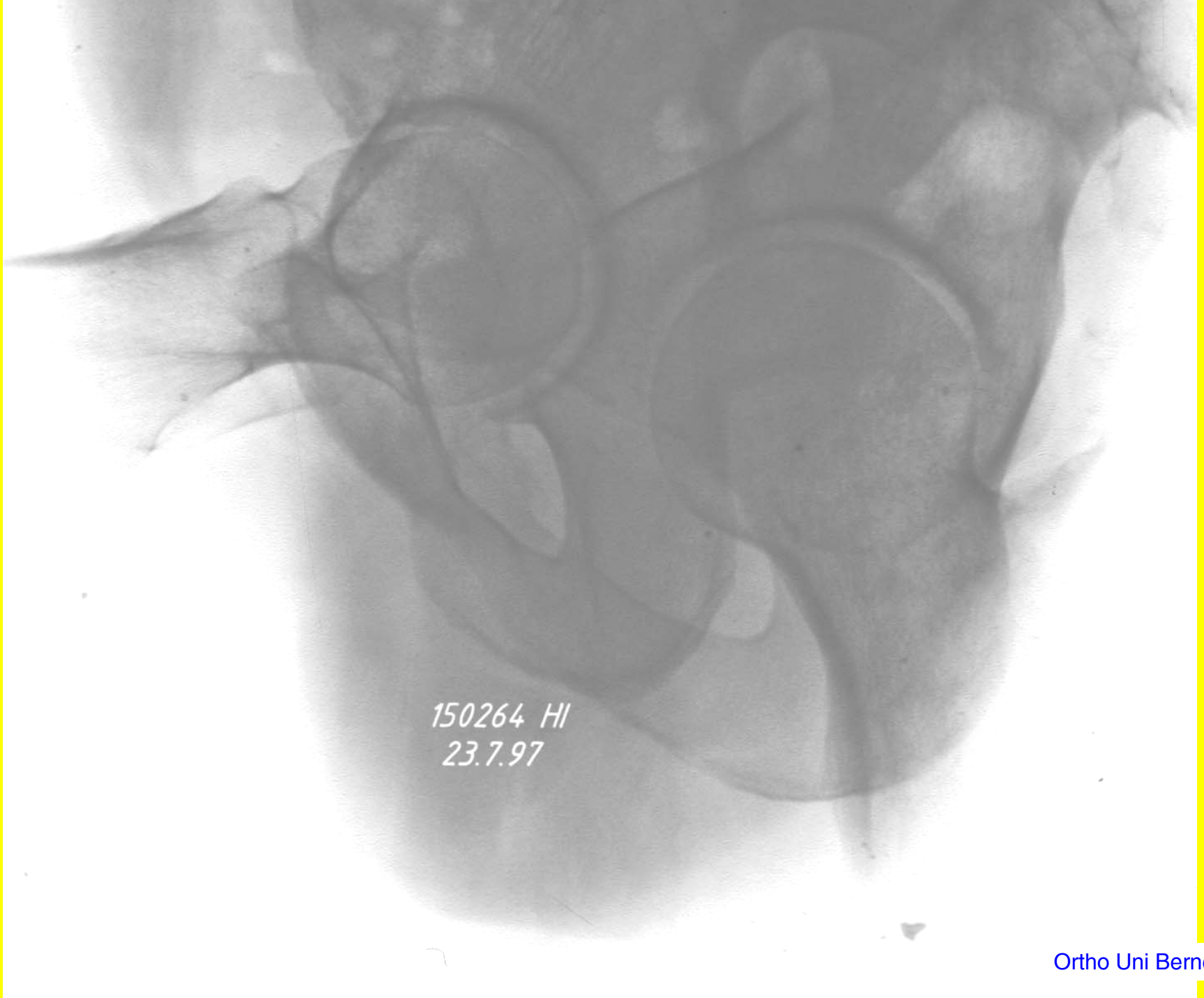


Femoro-Acetabular Impingement (Ganz et al)

- Similar to THR impingement due to component "design flaws":
  the native hip can have impingement-producing anatomic patterns!!!!!



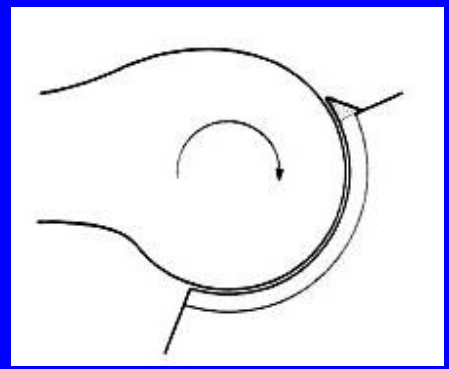

301075 RU
21.1.1999
Herniation pit; usually means cam- type FAI



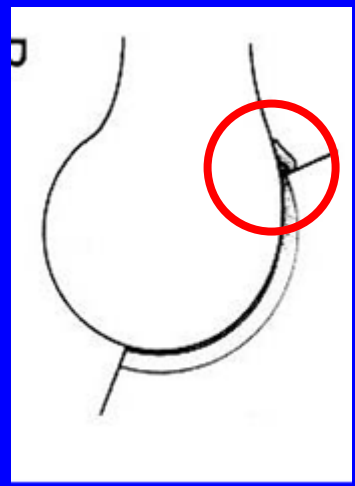
Ortho Uni Berne

Femur-based FAI: Cam Impingement

- Pathoanatomy: asphericity of head or insufficient offset at head-neck junction
- Pathomechanics: jamming/squeezing of anterior acetabular cartilage(+++) and labrum(+)

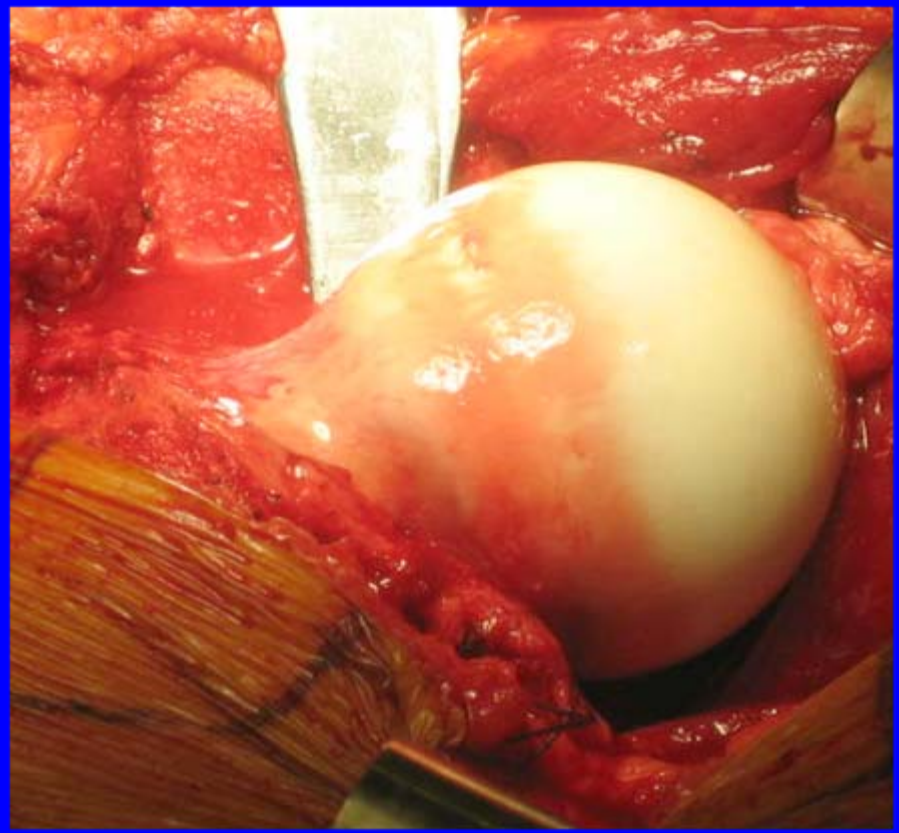


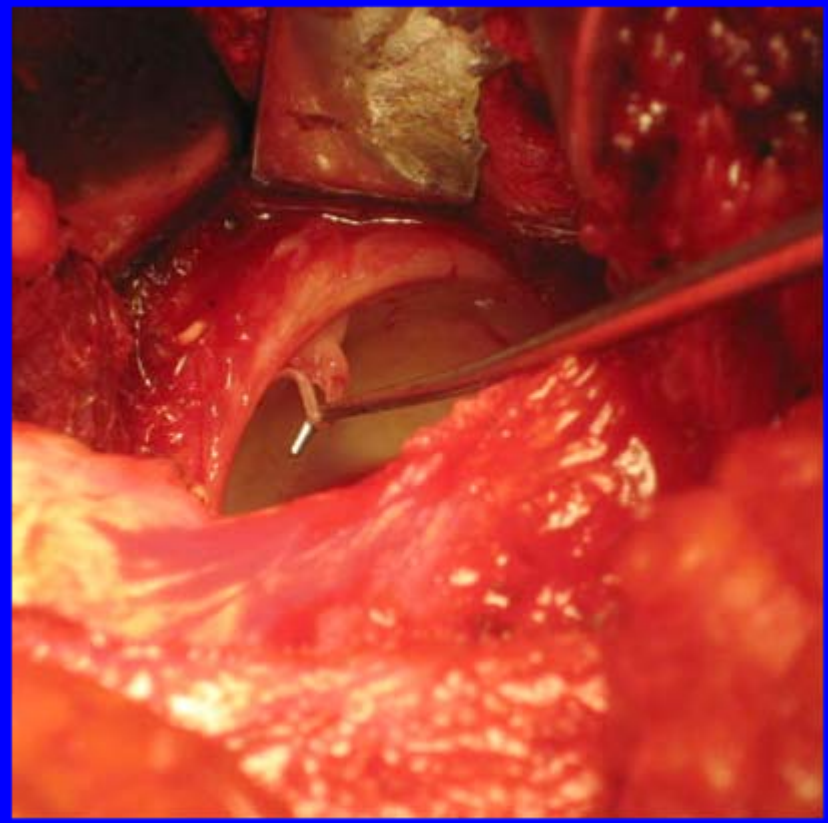
* **Damage pattern: anterolateral rim;**
* ***Cartilage>>labrum!***
* ***Cartilage>>labrum!!***
* ***Cartilage >>labrum!!!***



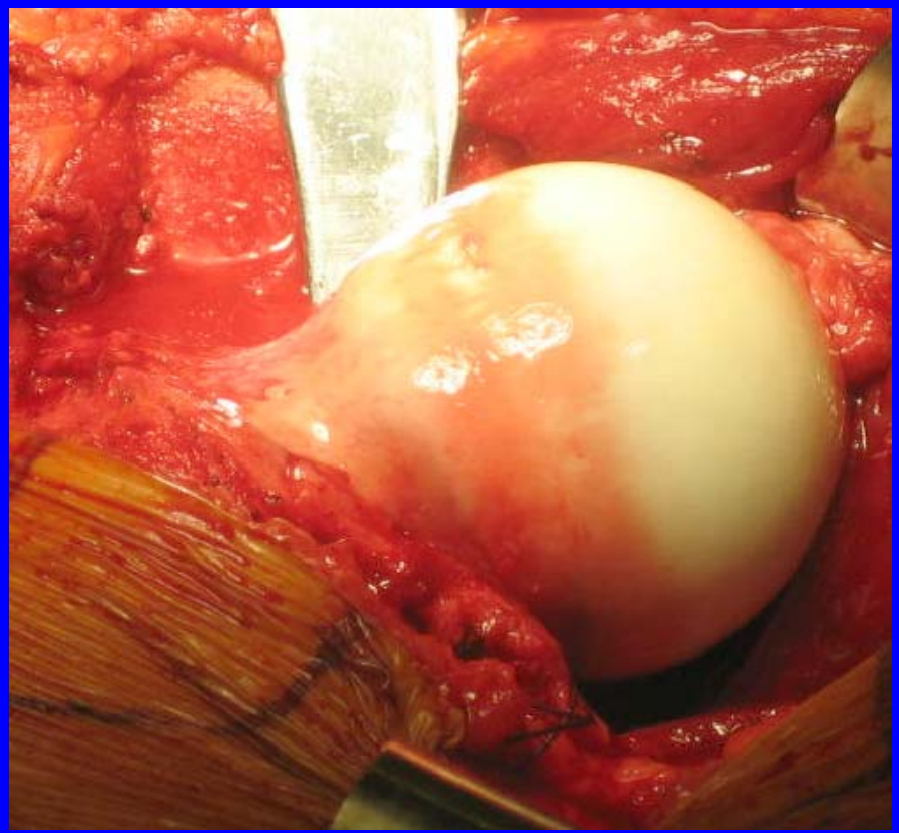
Schematic FAI

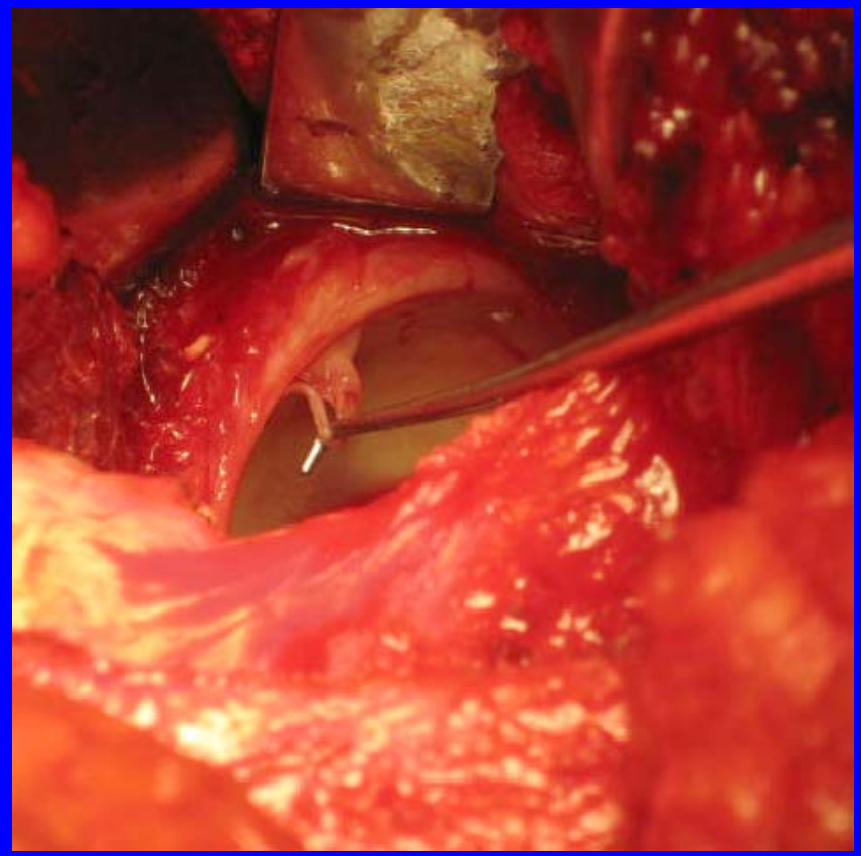
- Thanks to Dr. Ira Zaltz for the following diagrams and software

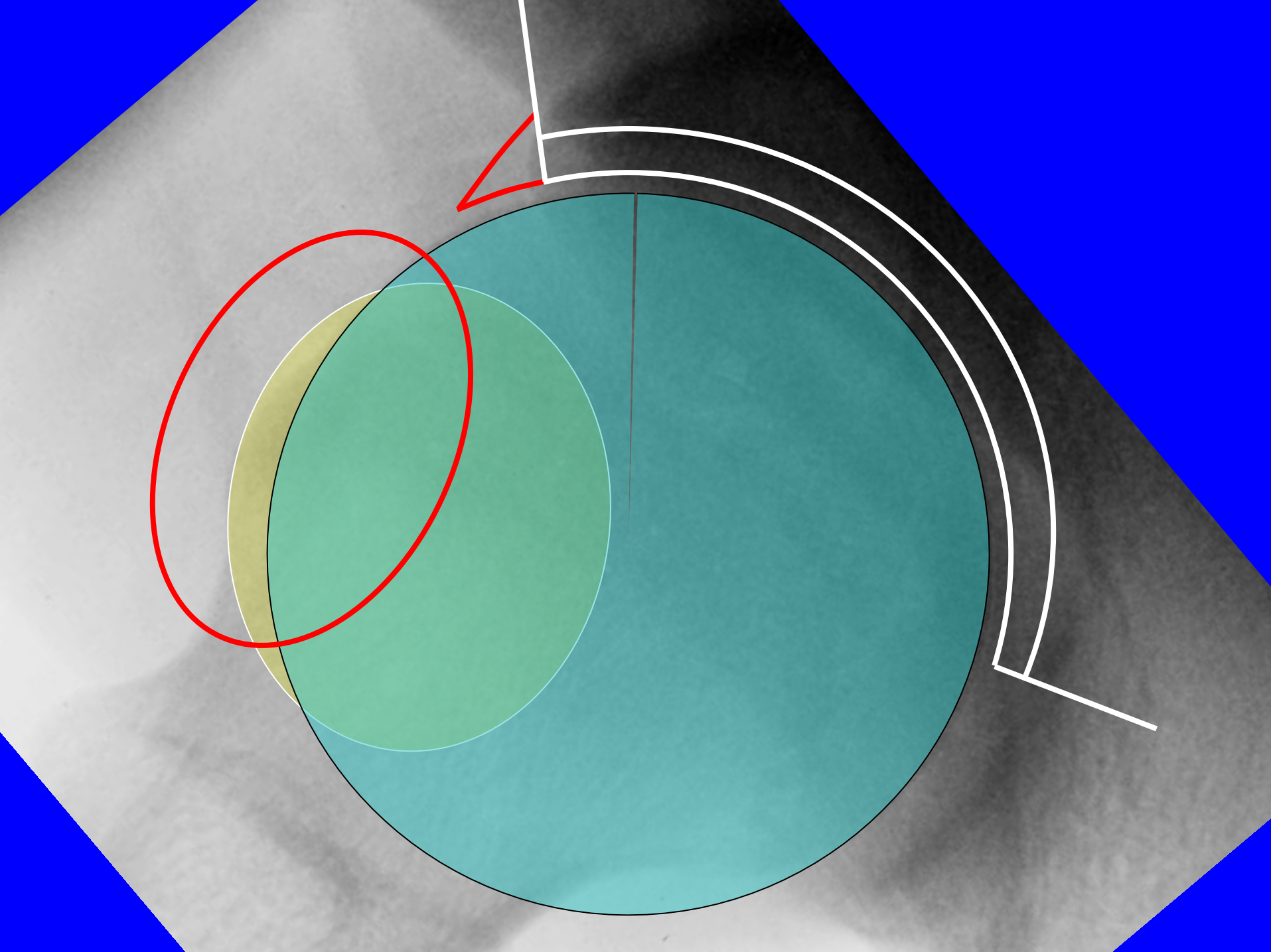


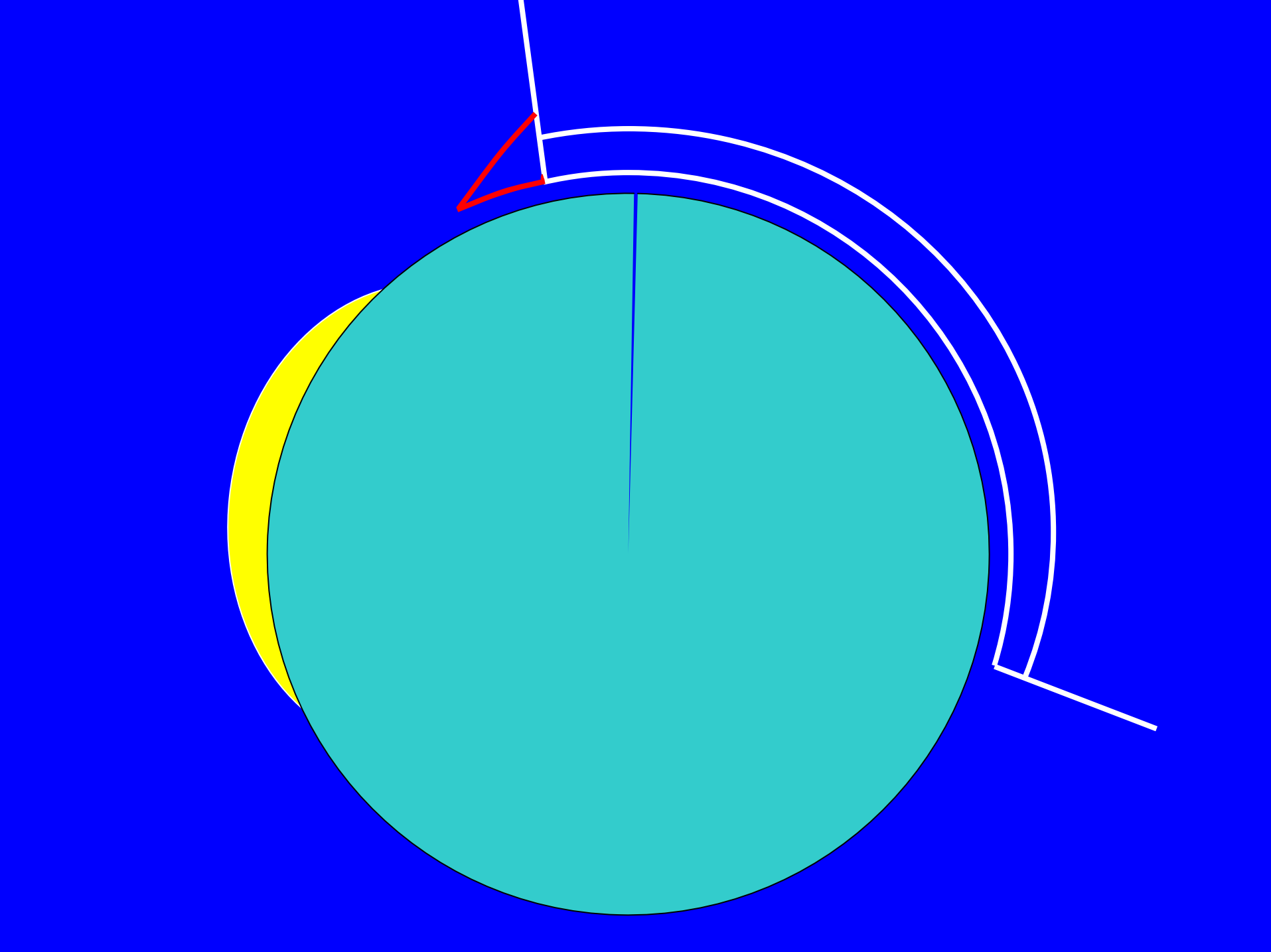


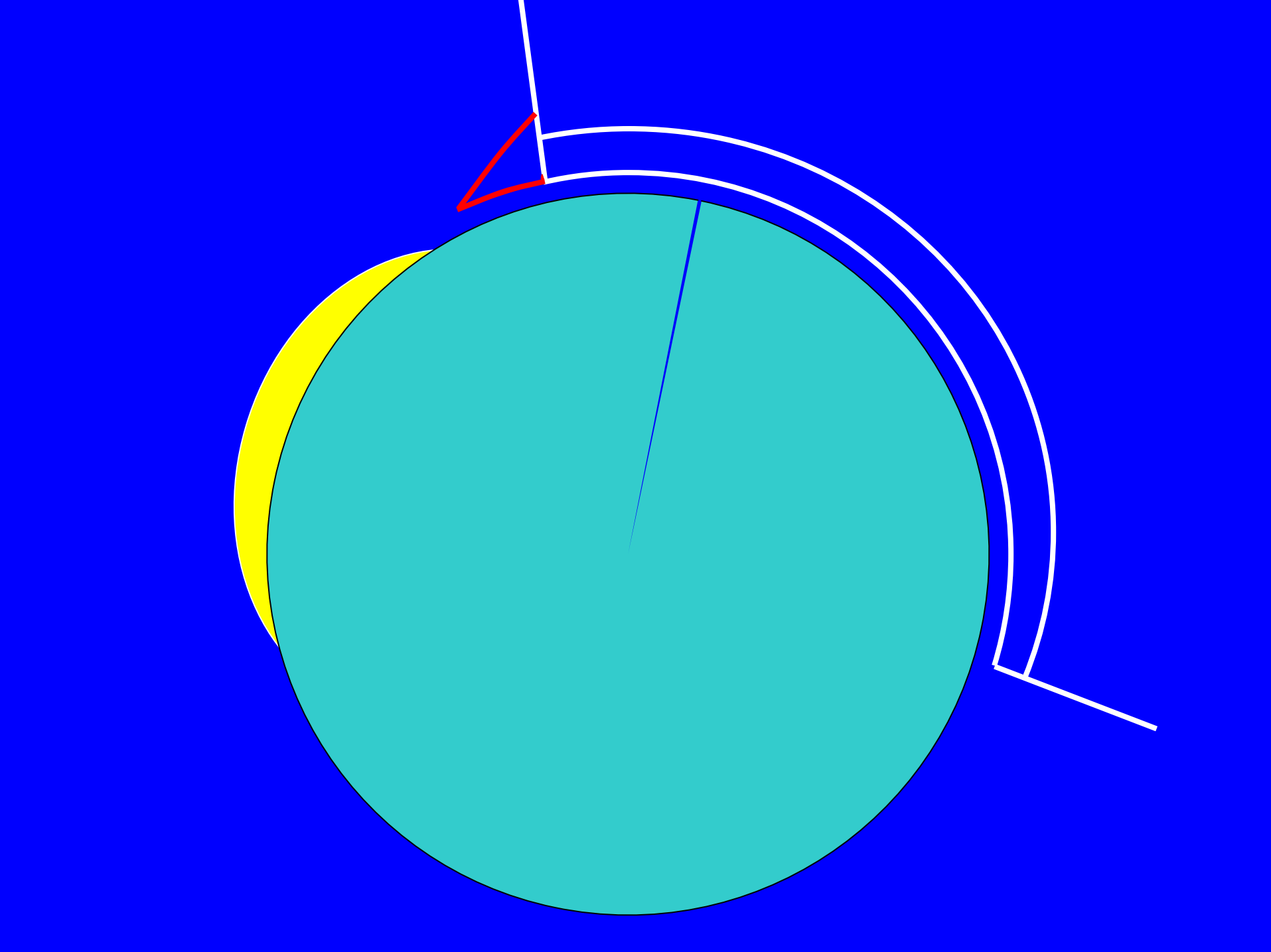
CAM Impingement-Mechanism

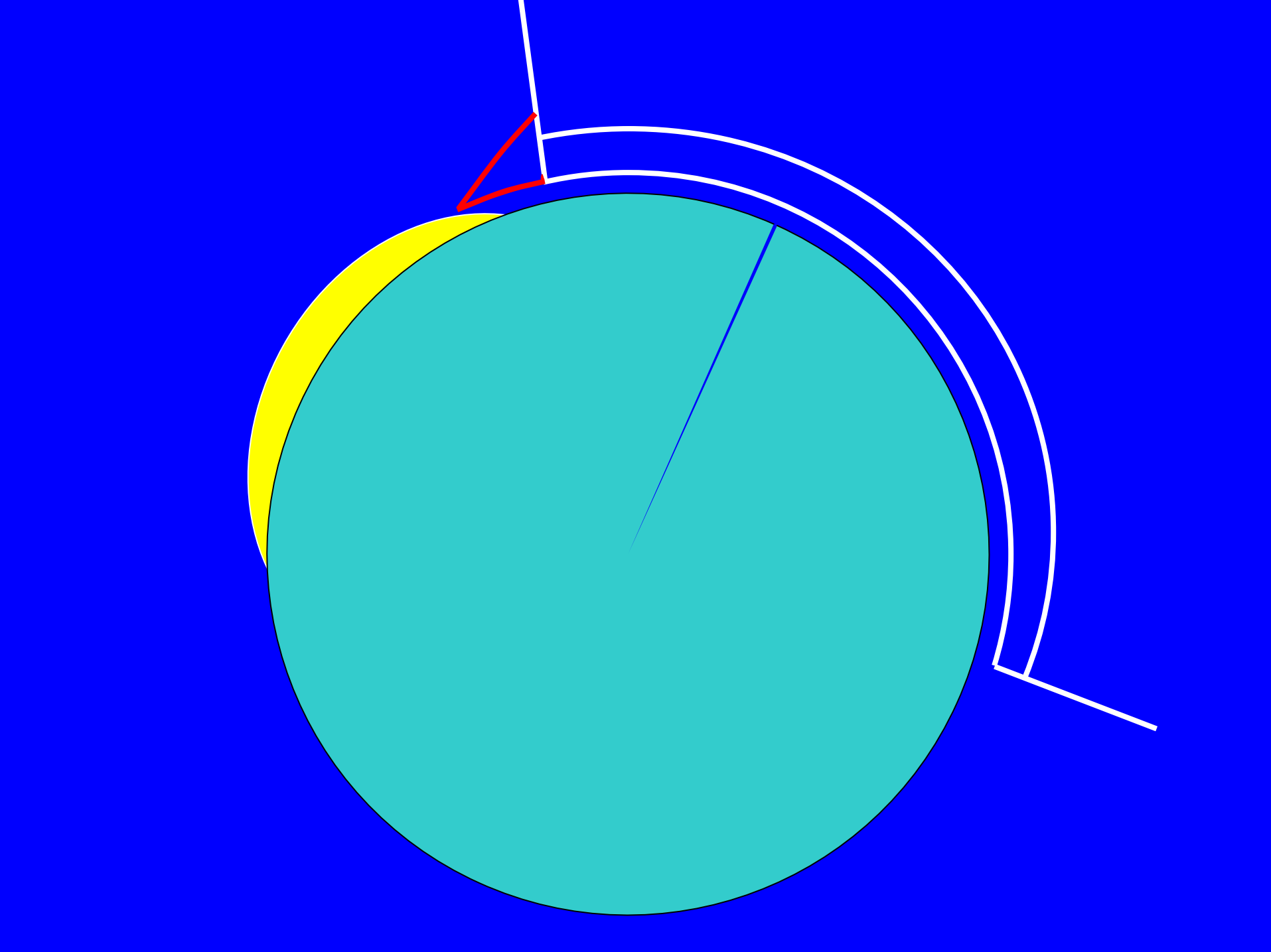


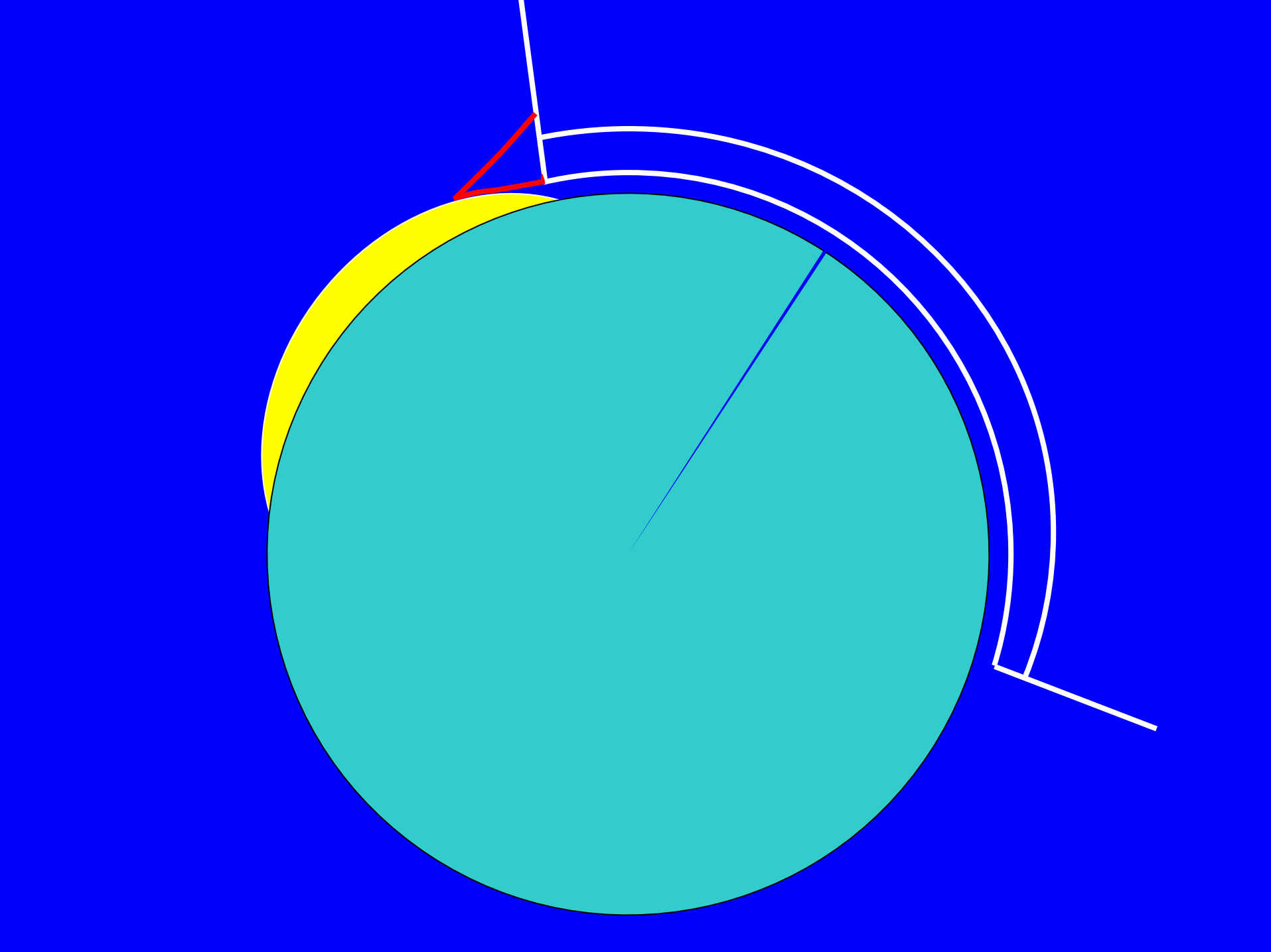


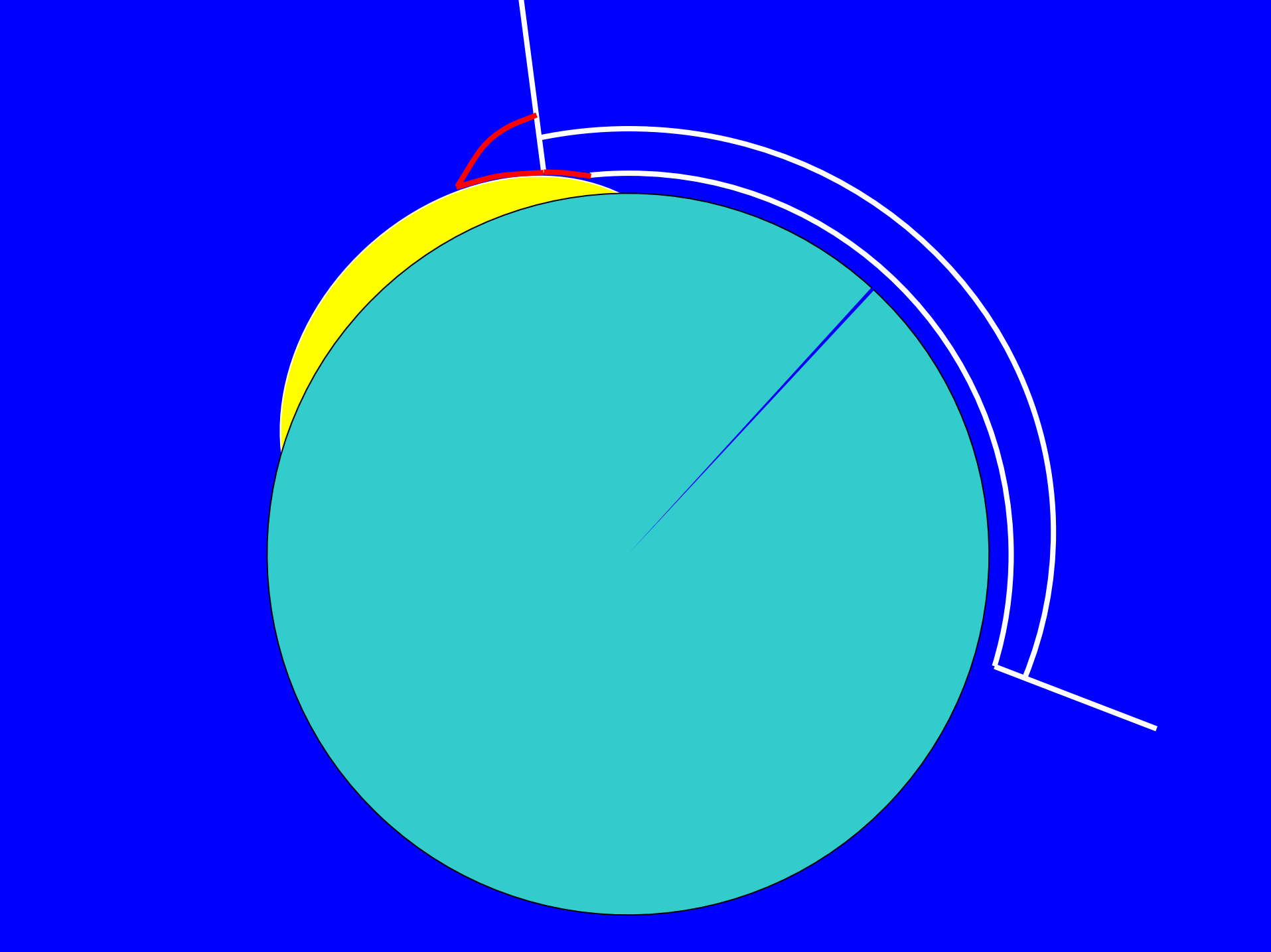


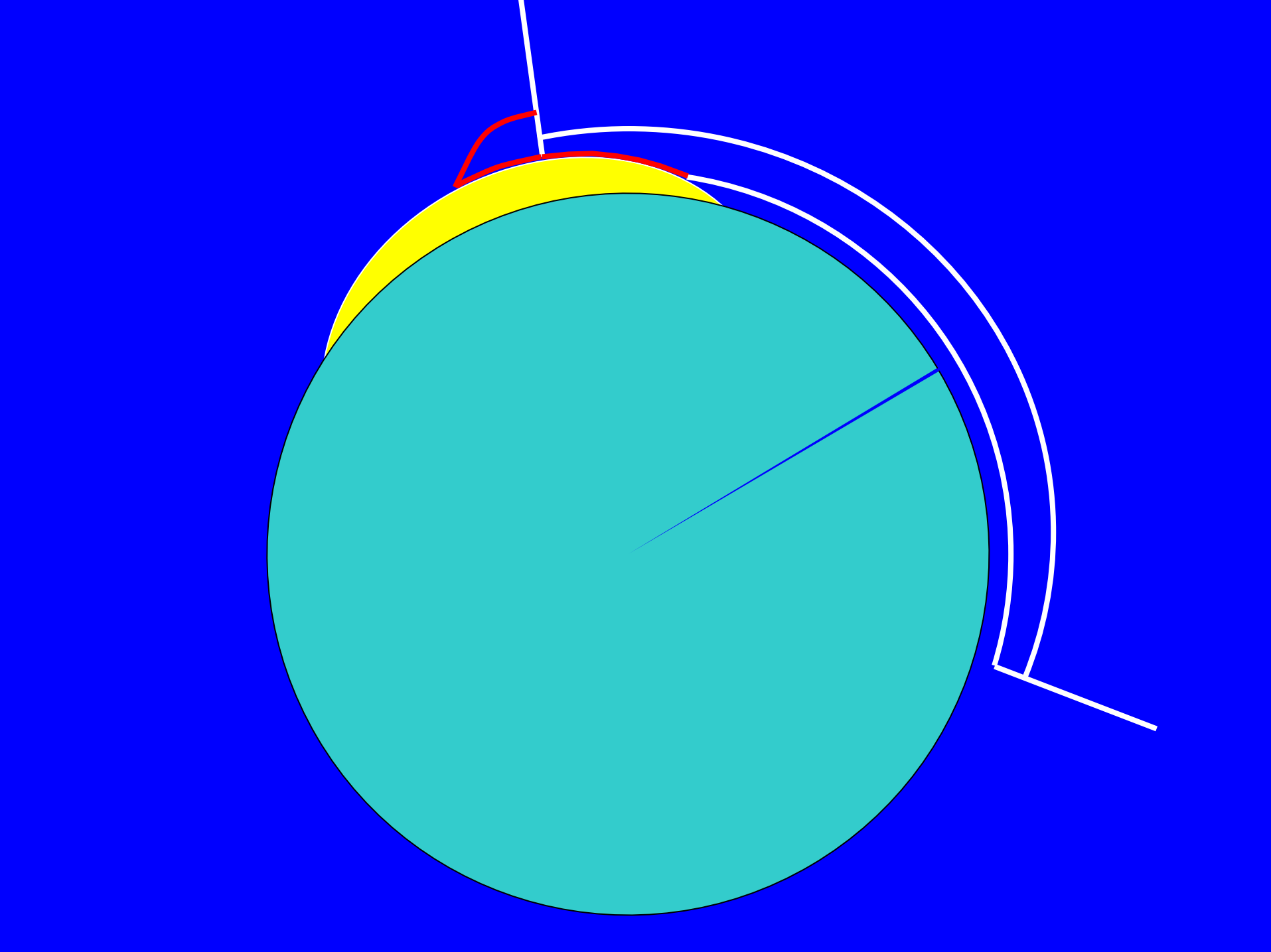


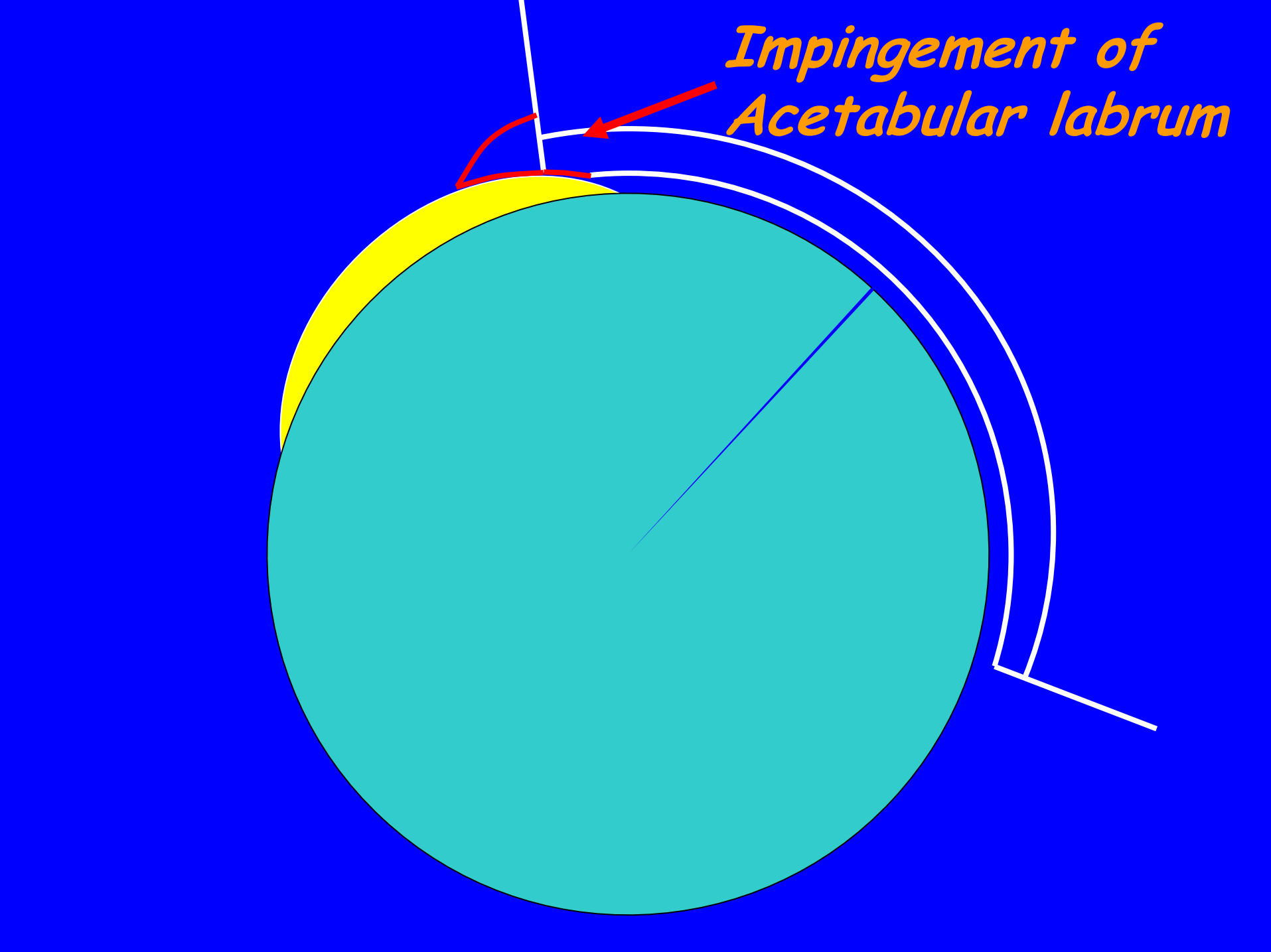


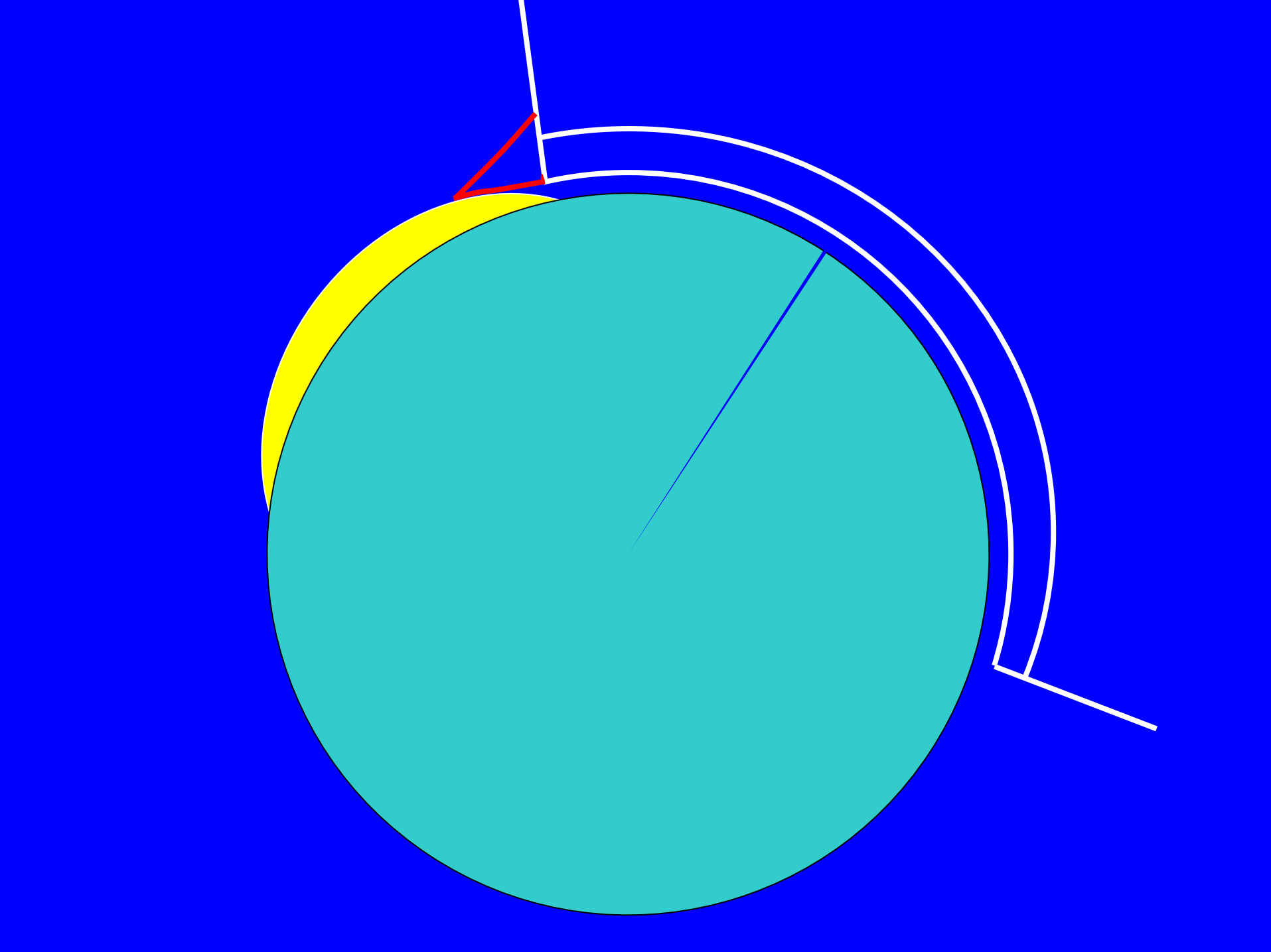


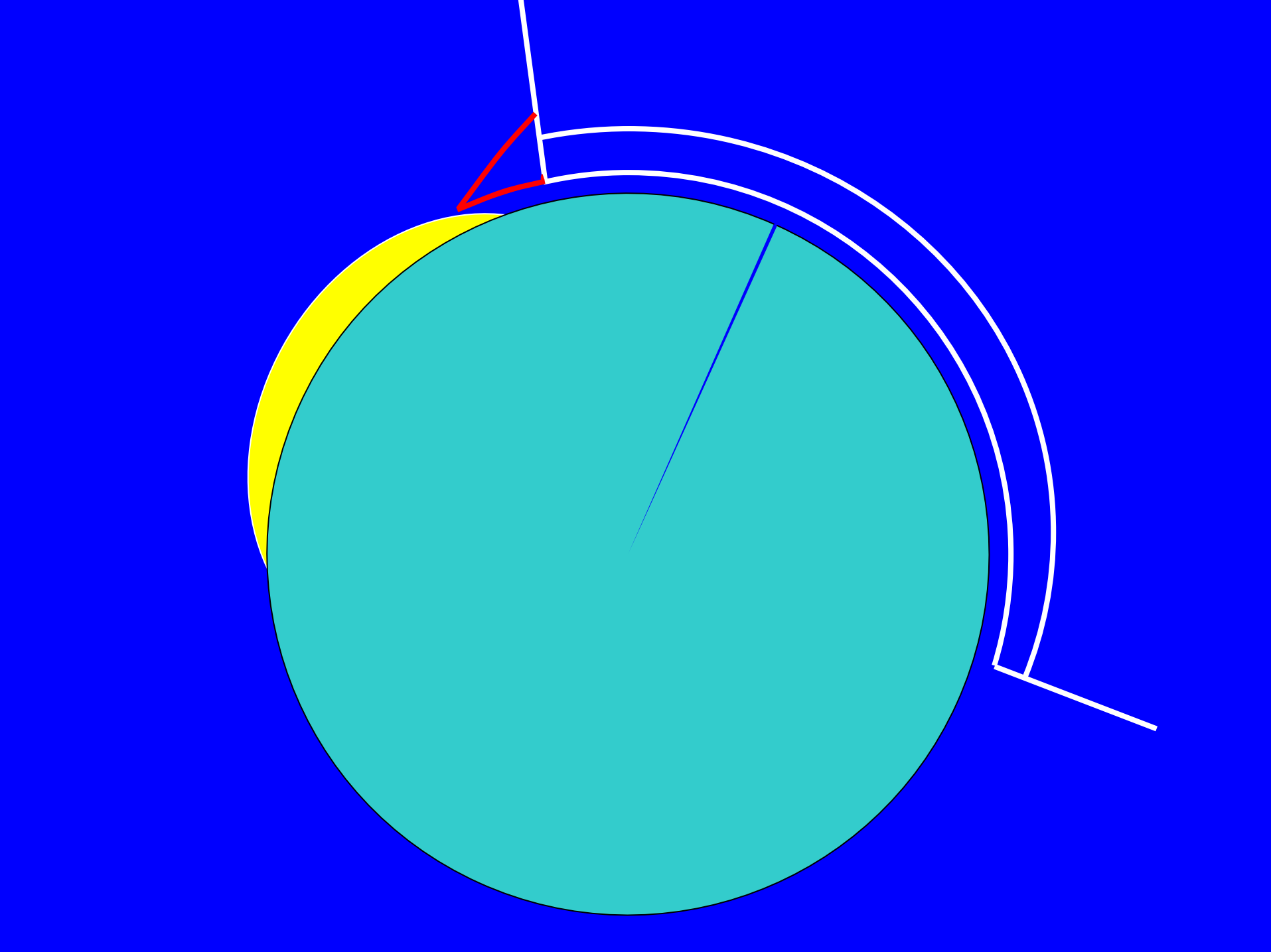


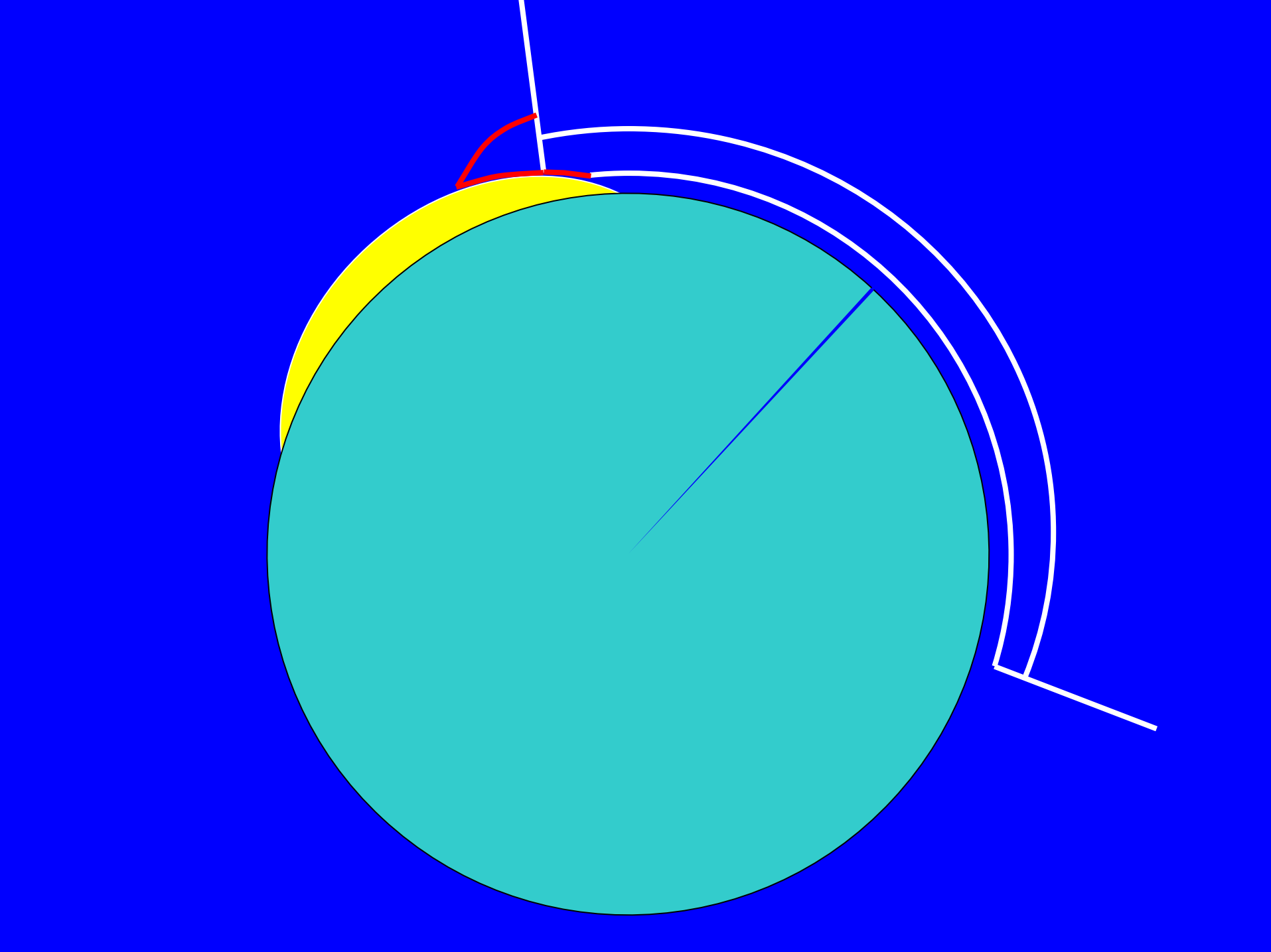


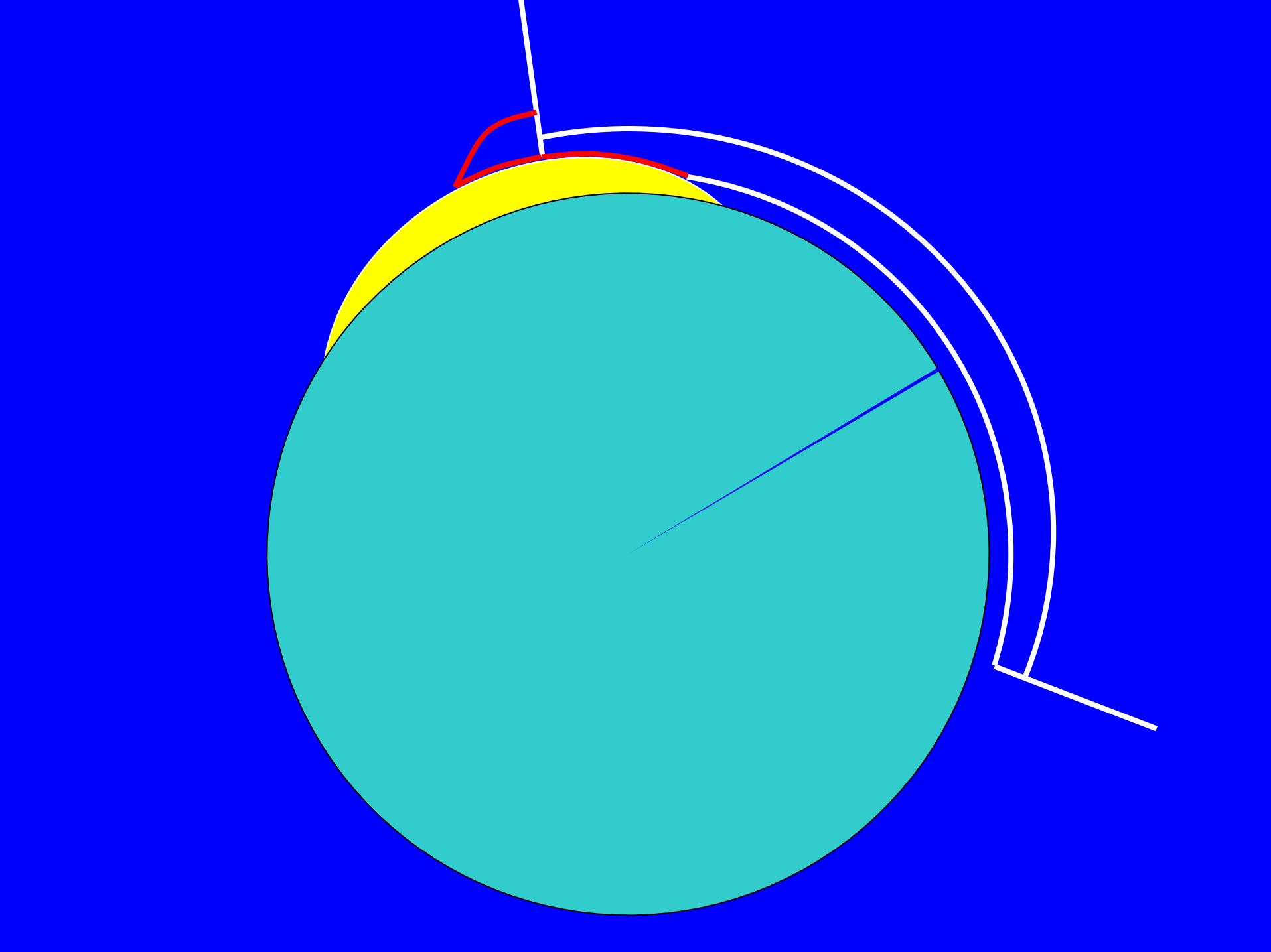


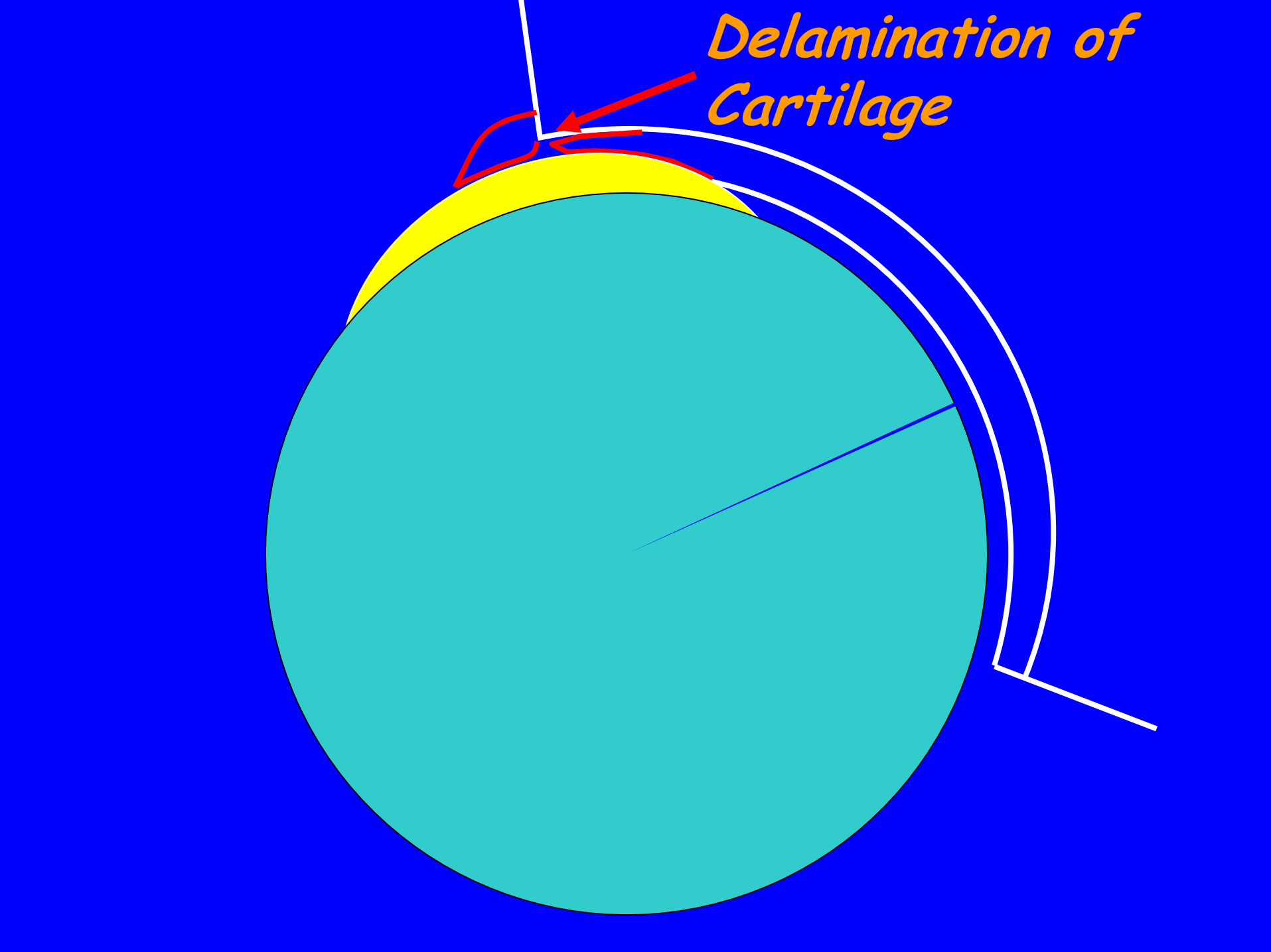

Impingement of
Acetabular labrum





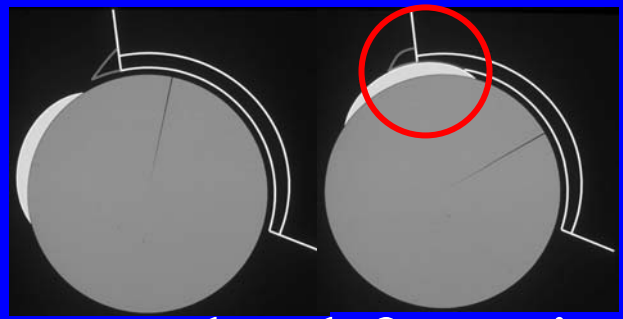





Delamination of
Cartilage

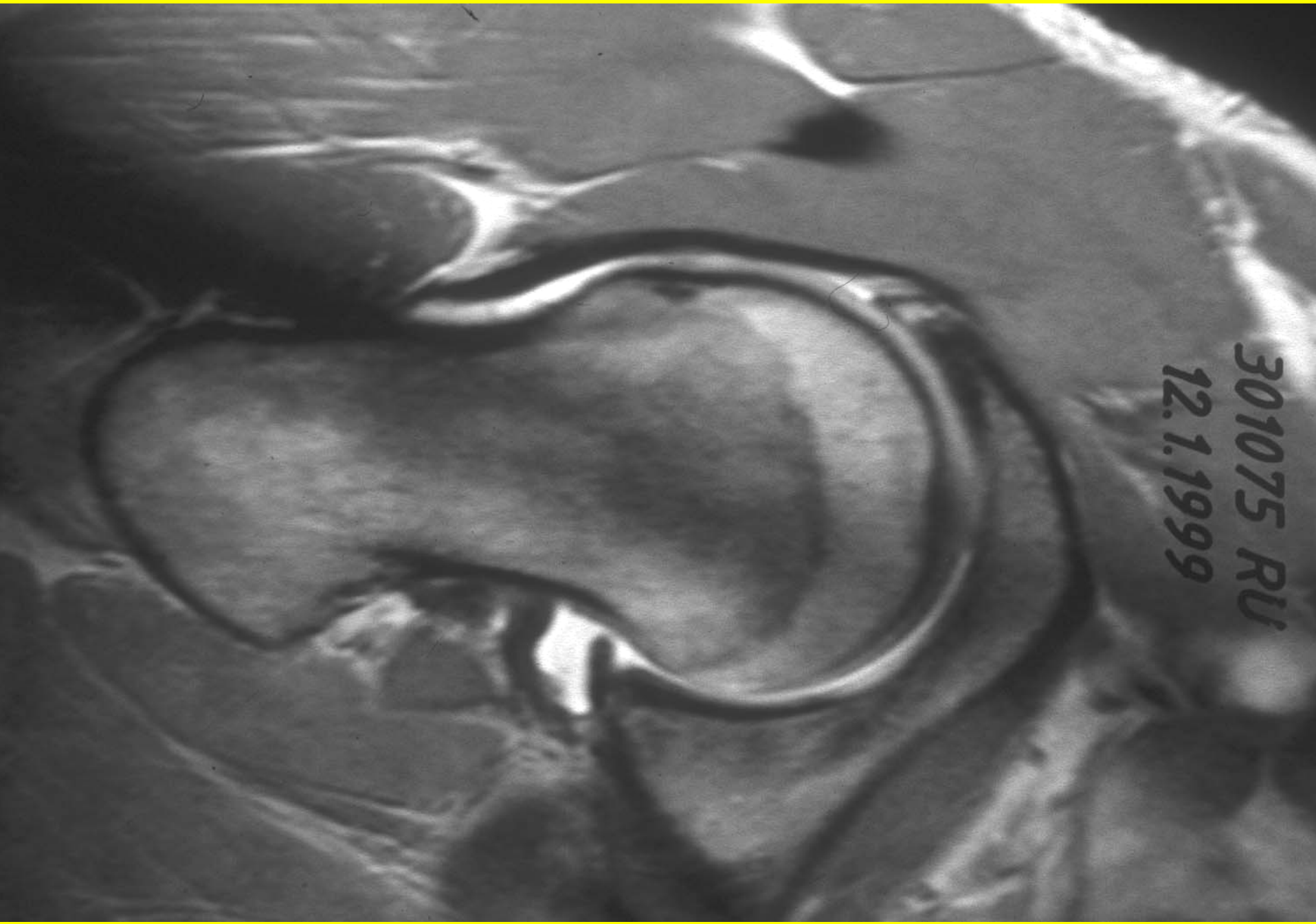
Pathology Seen w. Cam Impingement

- Outside-in abrasion of ant. acetabular cartilage in flexion



* **<u>Chondral flaps</u>** avulsed from inner labral edge
- Degeneration of labrum (<u>less</u> damage than to adjacent articular cartilage)
- <u>Intact</u> femoral head cartilage till very late!

Ganz et al: CORR 417:112-120, 2003; Beck et al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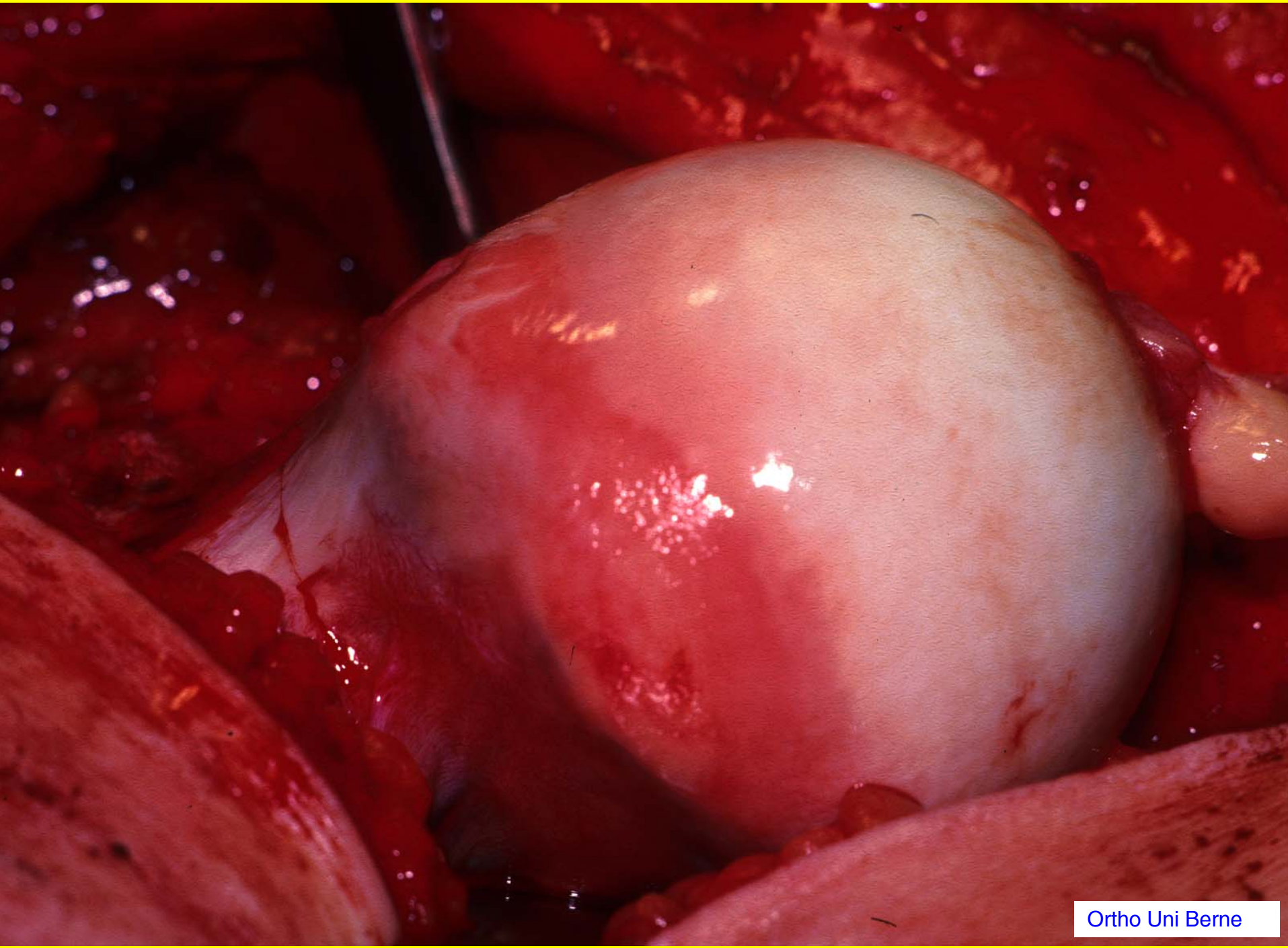
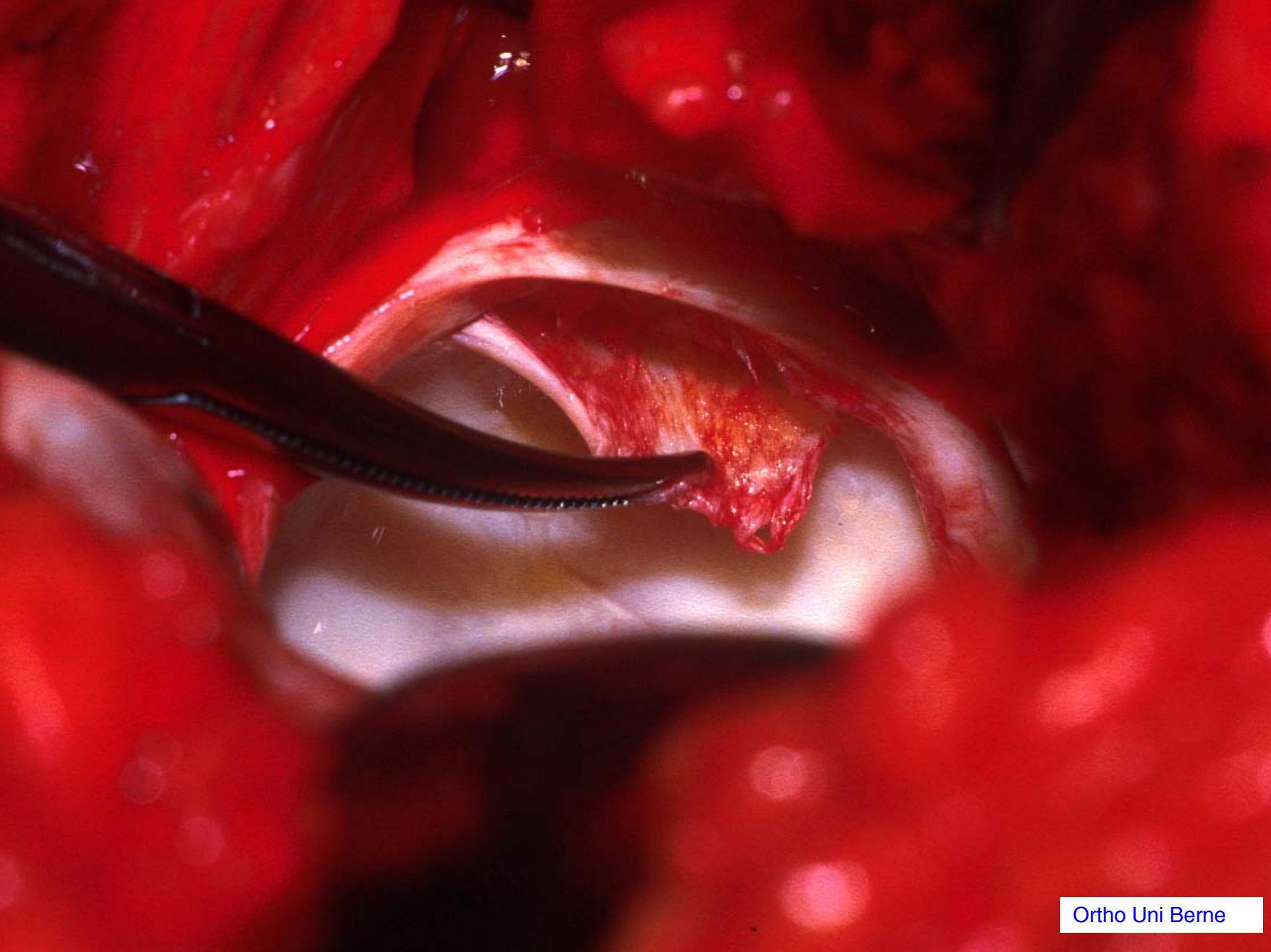
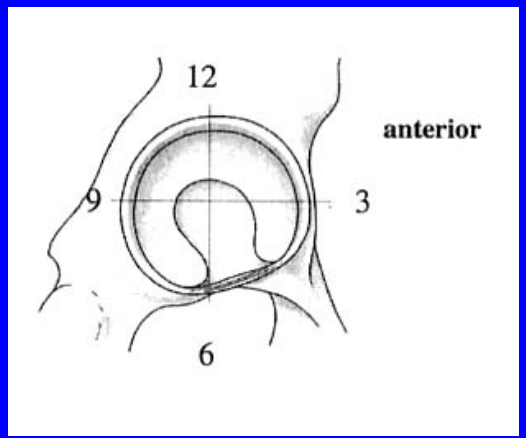

Ortho Uni Berne

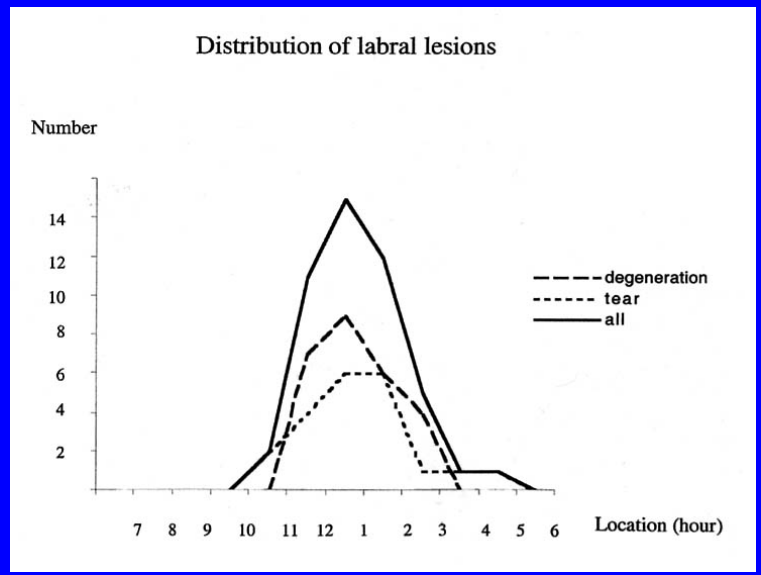


Ortho Uni Berne

Cam Impingement: Location of acetabular cartilage lesions

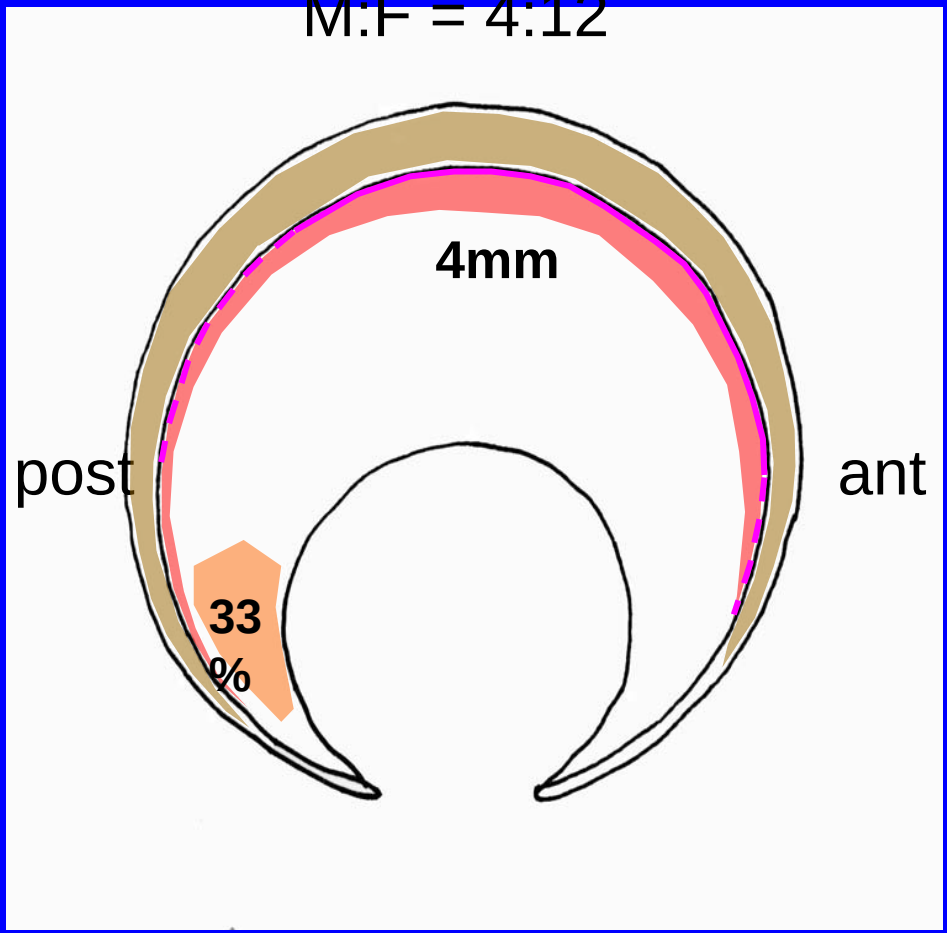
- Chondral bruising, flap, or full-thickness loss primarily from 11 o'clock to 1 o'clock (anterosuperior)





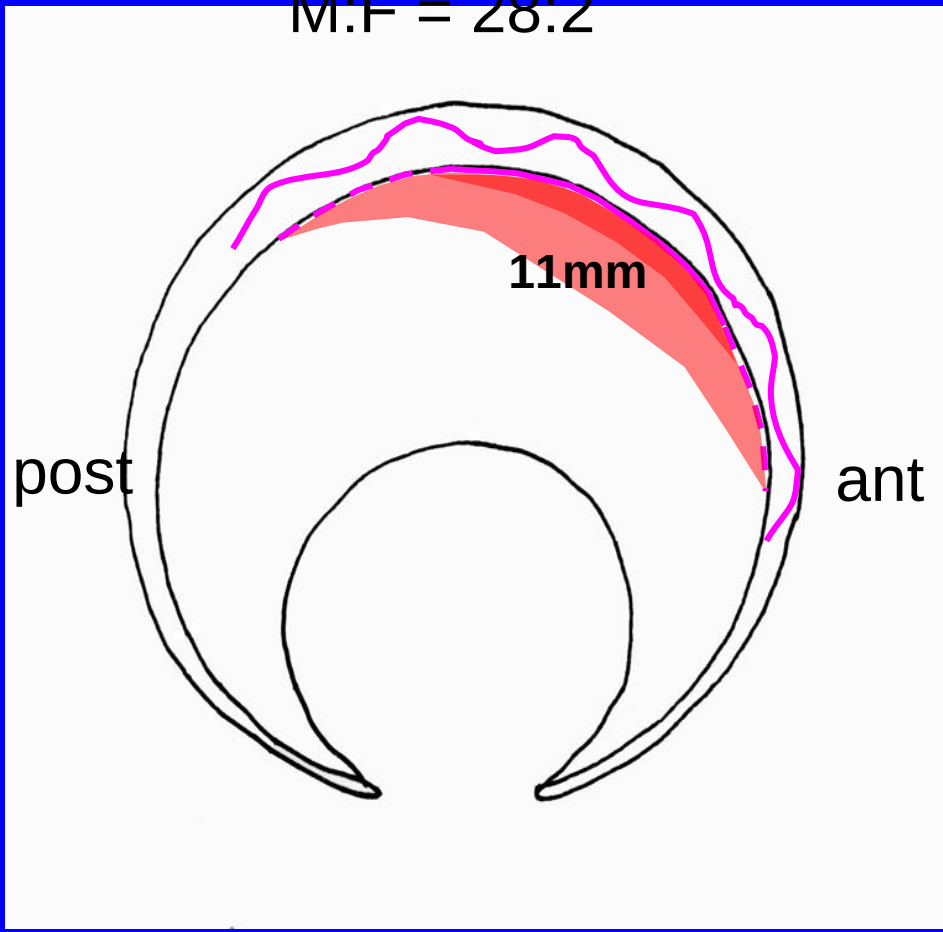
(pincer)

M:F = 4:12



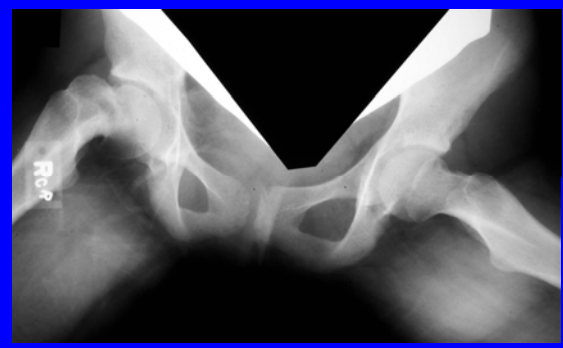
pistol grip/ **cam**

M:F = 28:2



Femur-Based F-A Impingement: "Cam Impingement"

- Anatomic causes:
  - ✓Femoral Head:
    - Asphericity (Perthes, etc)
      - Retrotilt (SCFE)
    - No anterior offset
      - (SCFE, idiopathic, etc.)
  - ✓Femoral Neck:
    - Retroversion
    - Coxa vara
    - Femoral neck malunion



Etiologies of Hip OA in North America-UPDATED

- Dysplasia 43%

✓ Perthes-Impingement 22%
✓ SCFE-Impingement 11%
* Non-Perthes, non-SCFE FAI >10%?
"Impingement-related" 43%?

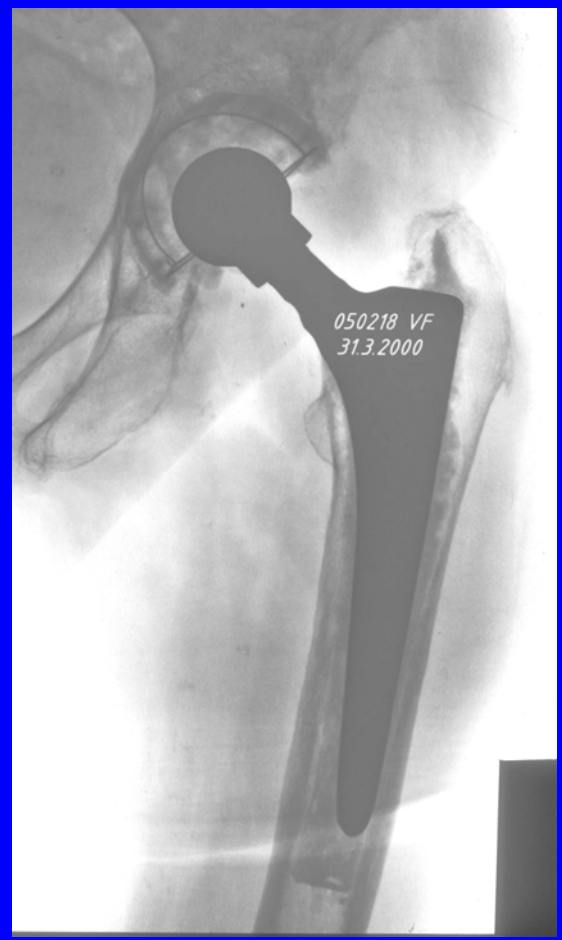
- Idiopathic + Other 16%

(modified from Aronson, 1986)

Acetabulum-based (Pincer) FAI as a Cause of OA

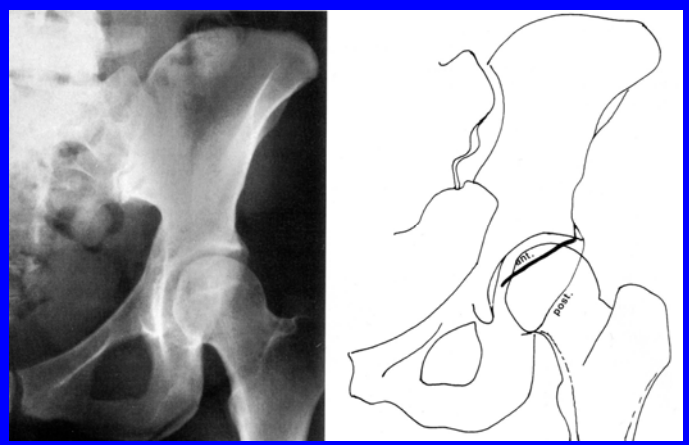
Anterior impingement causes damage to rim and adjacent acetabular cartilage→OA

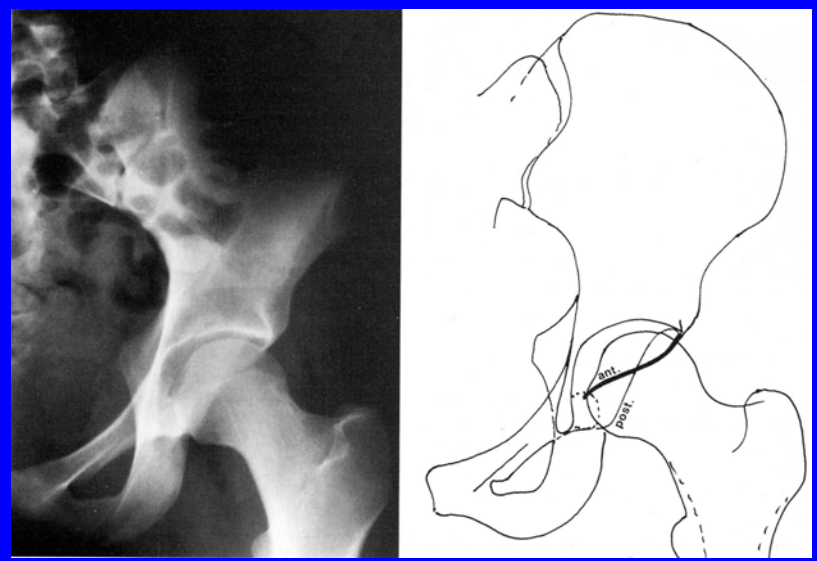
* **THR analogy: Impingement due to cup retroversion**

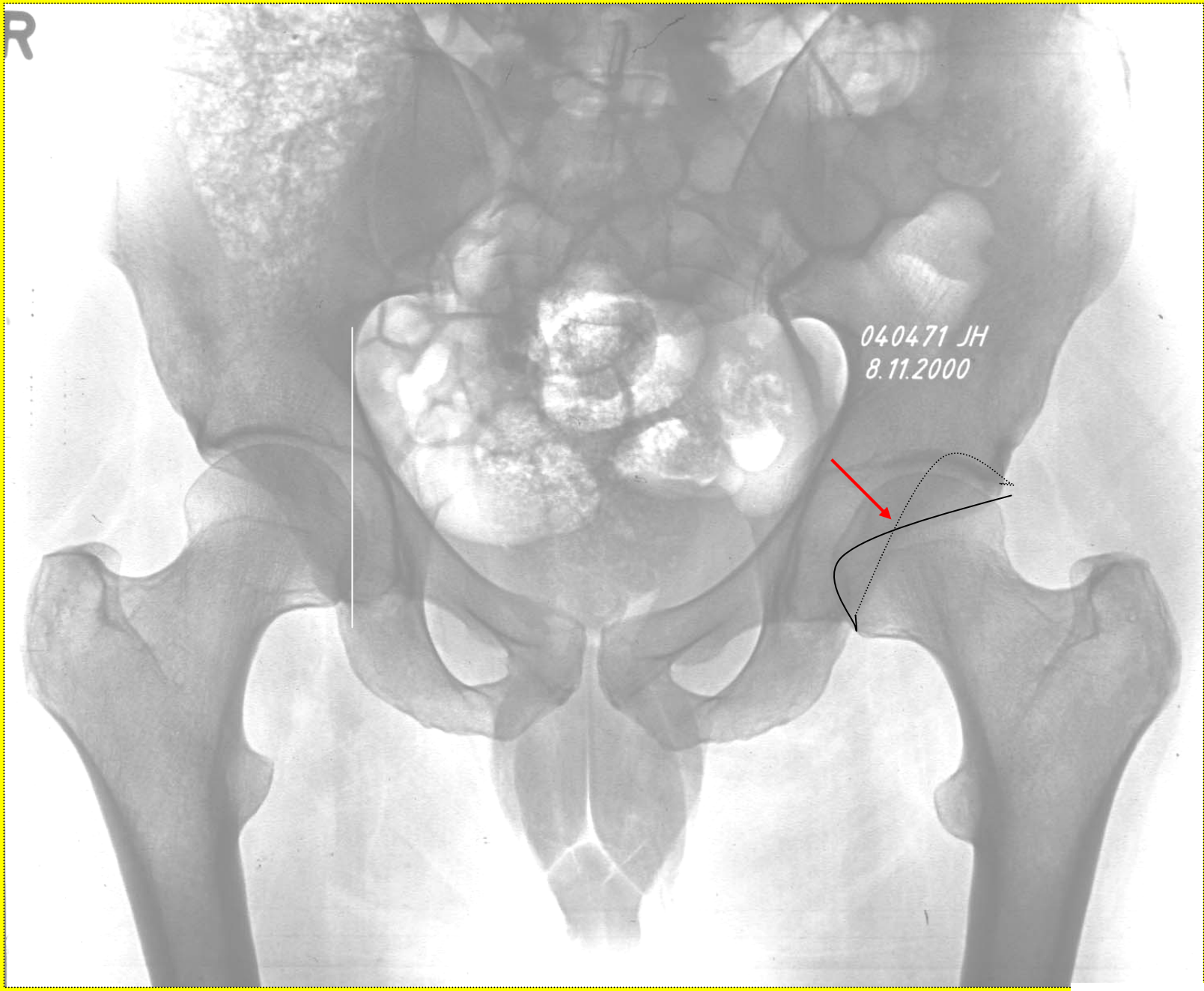


Acetabulum-Based Femoro-Acetabular Impingement: "Pincer Impingement"

- Anatomic causes:
  - Retroversion: **crossover sign**; **posterior wall sign**
  - Overcoverage: protrusio or coxa profunda






040471 JH
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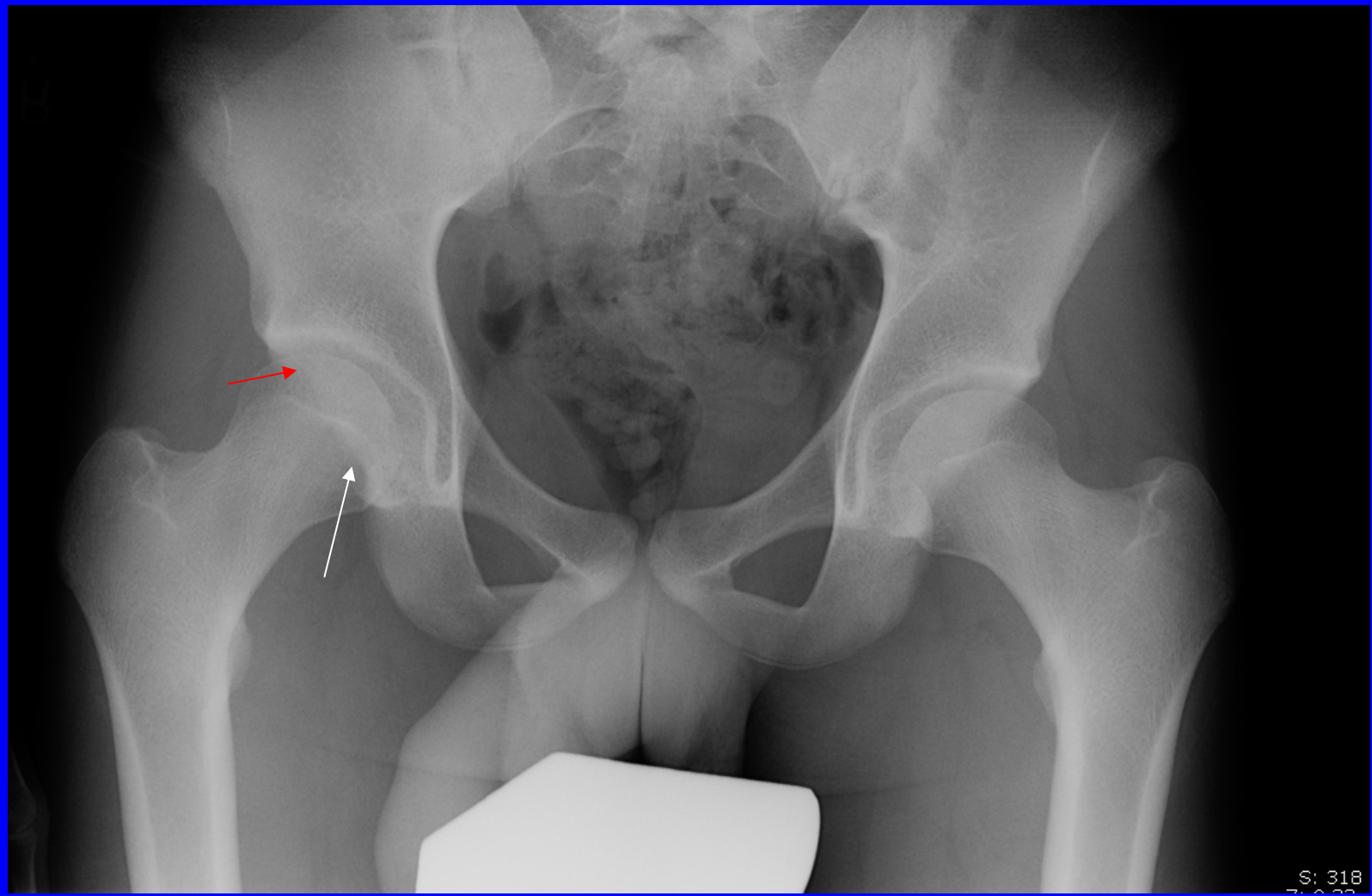
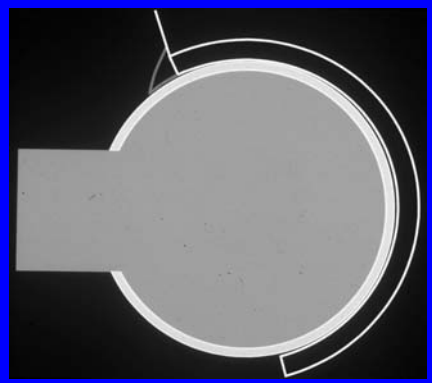
“We see what we know.”

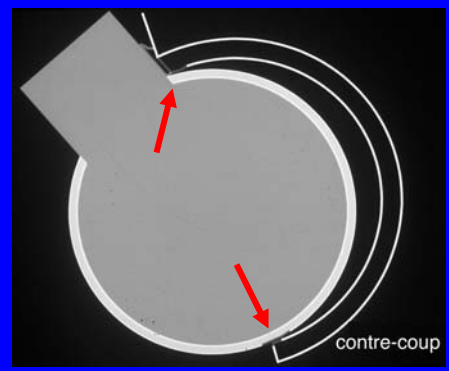
Frank Phillip Stella, artist

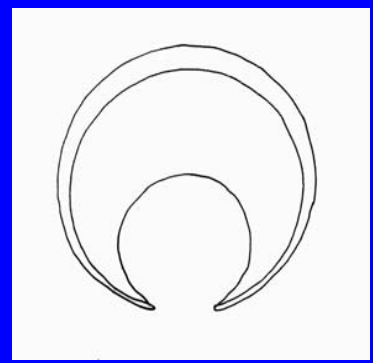


Pincer Impingement

- Extensive direct damage by femoral neck to overhanging anterior and anterolateral rim/labrum and adjacent articular cartilage
- Contrecoup lesions of posteroinferior joint

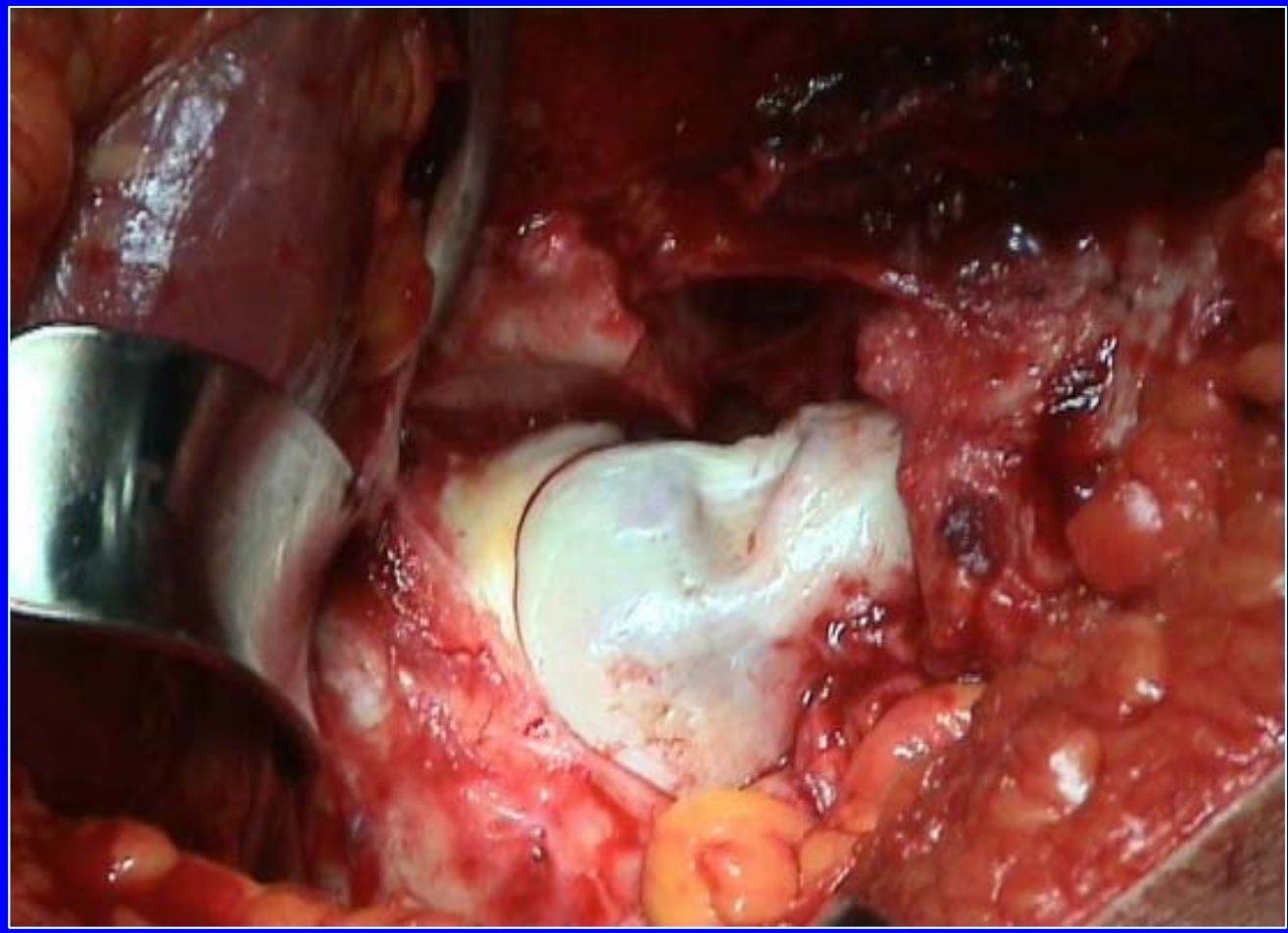


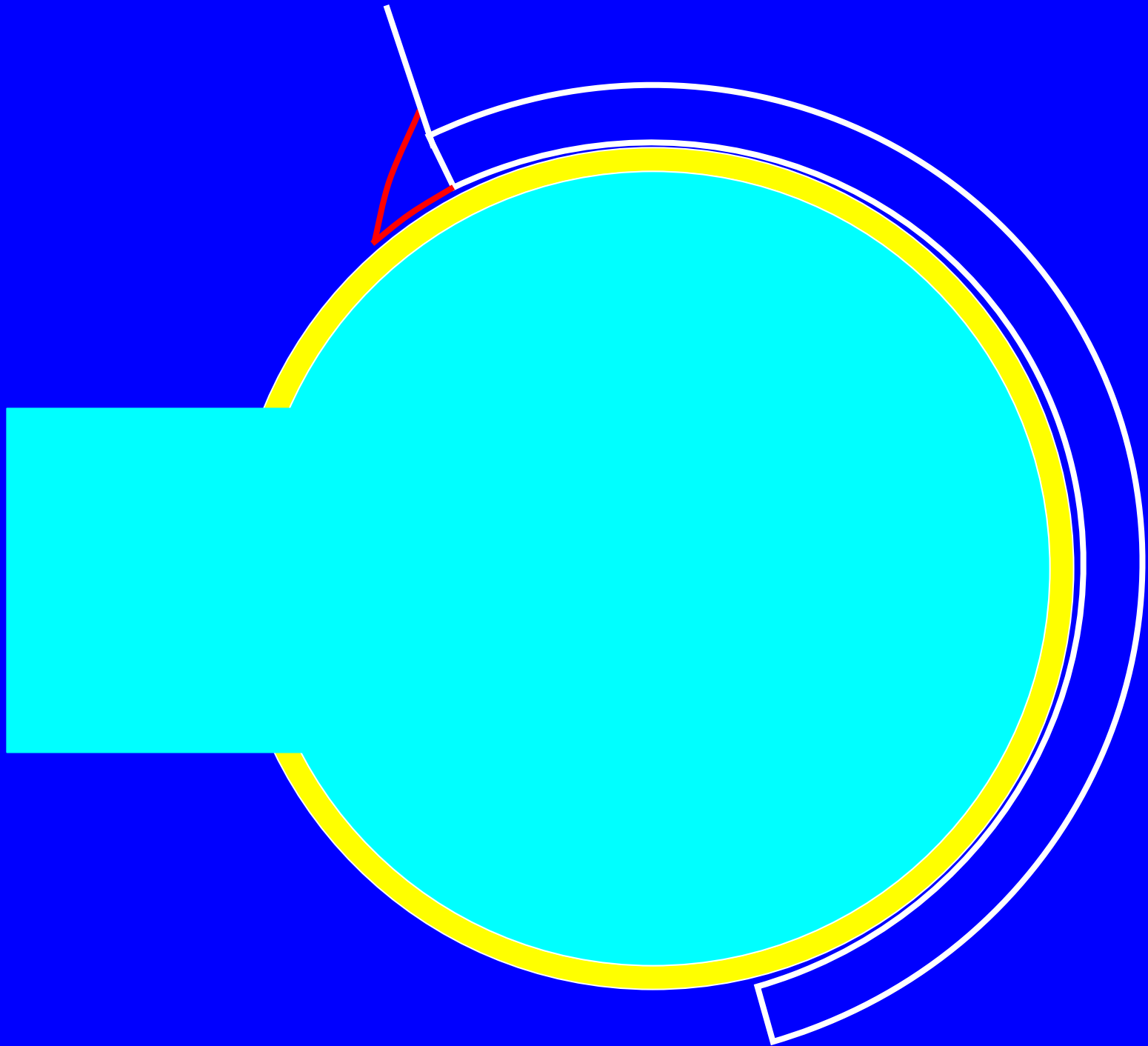


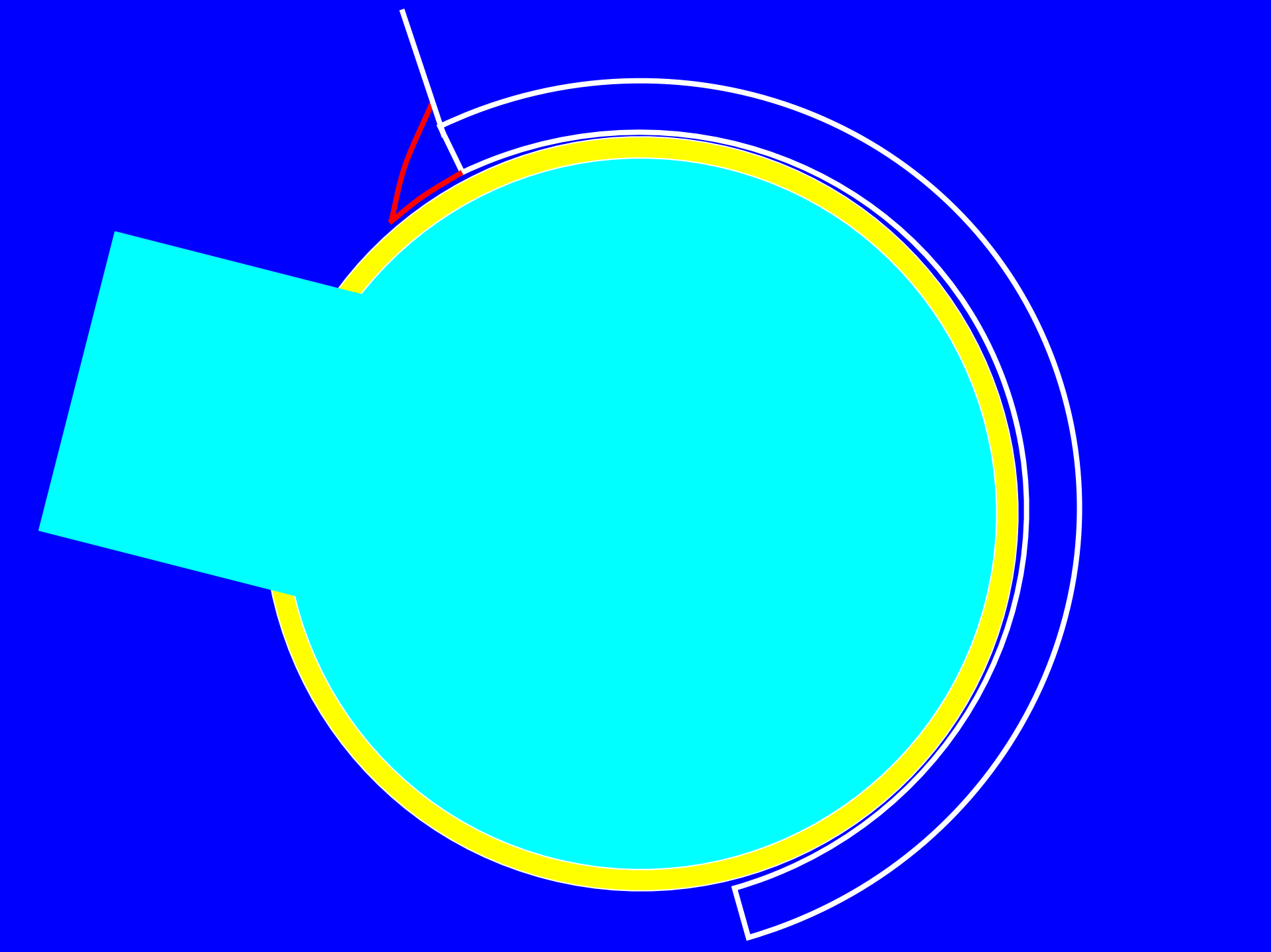


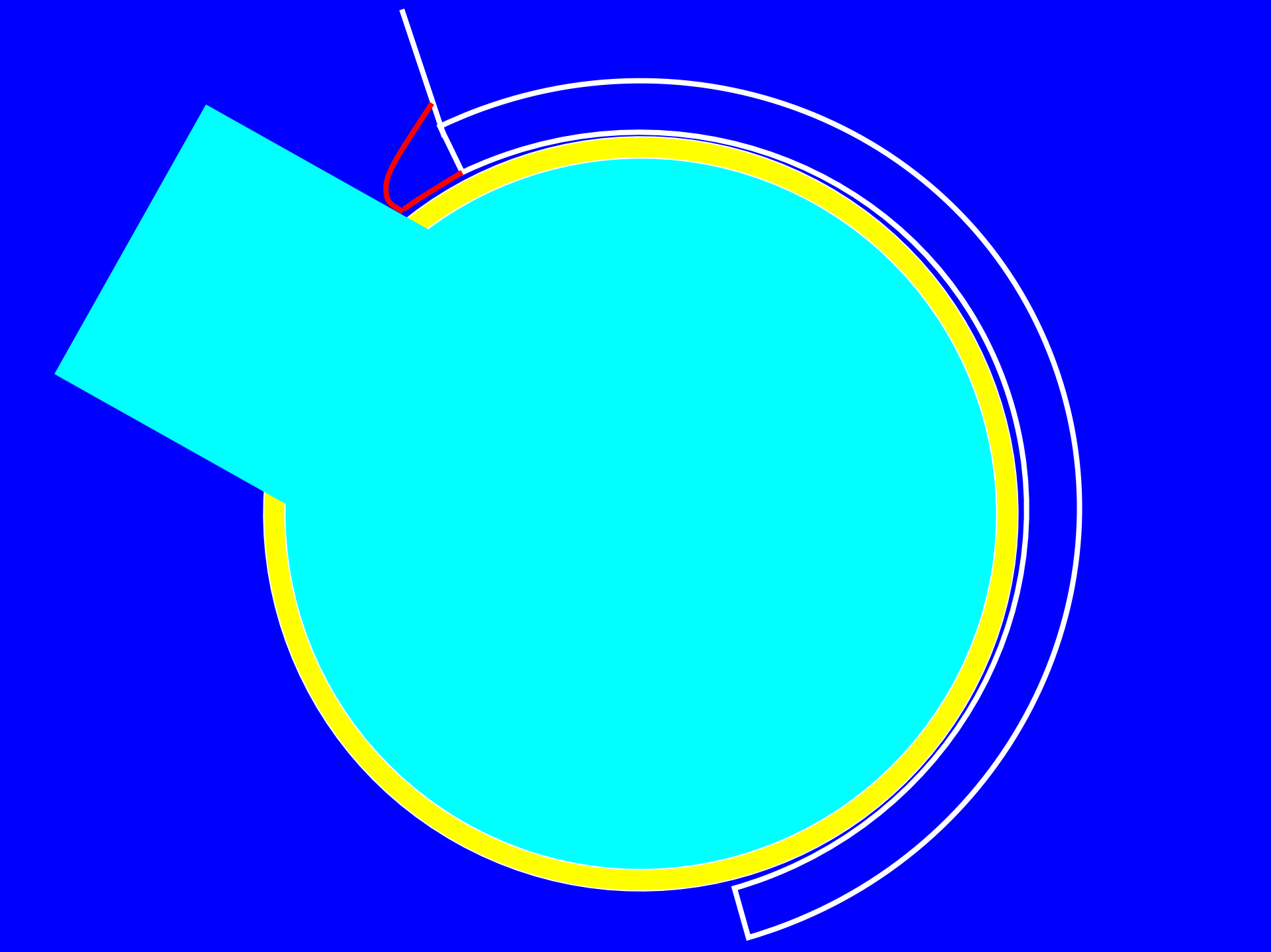
"Hip morphology influences the pattern of damage to the acetabular articular cartilage"
Beck et al: JBJS 87-B:1012-1018, July 2005

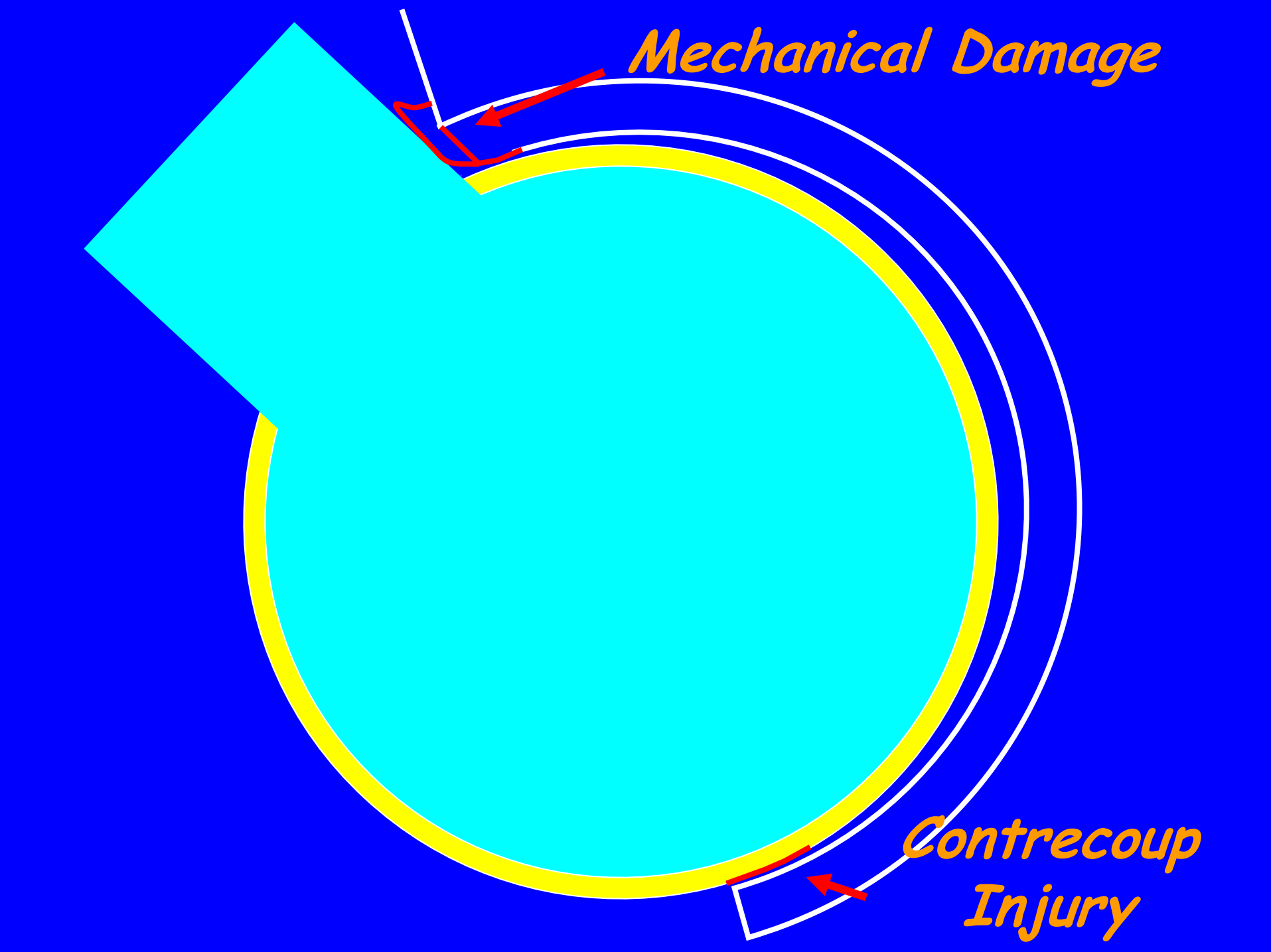
Pincer Impingement-Mechanism

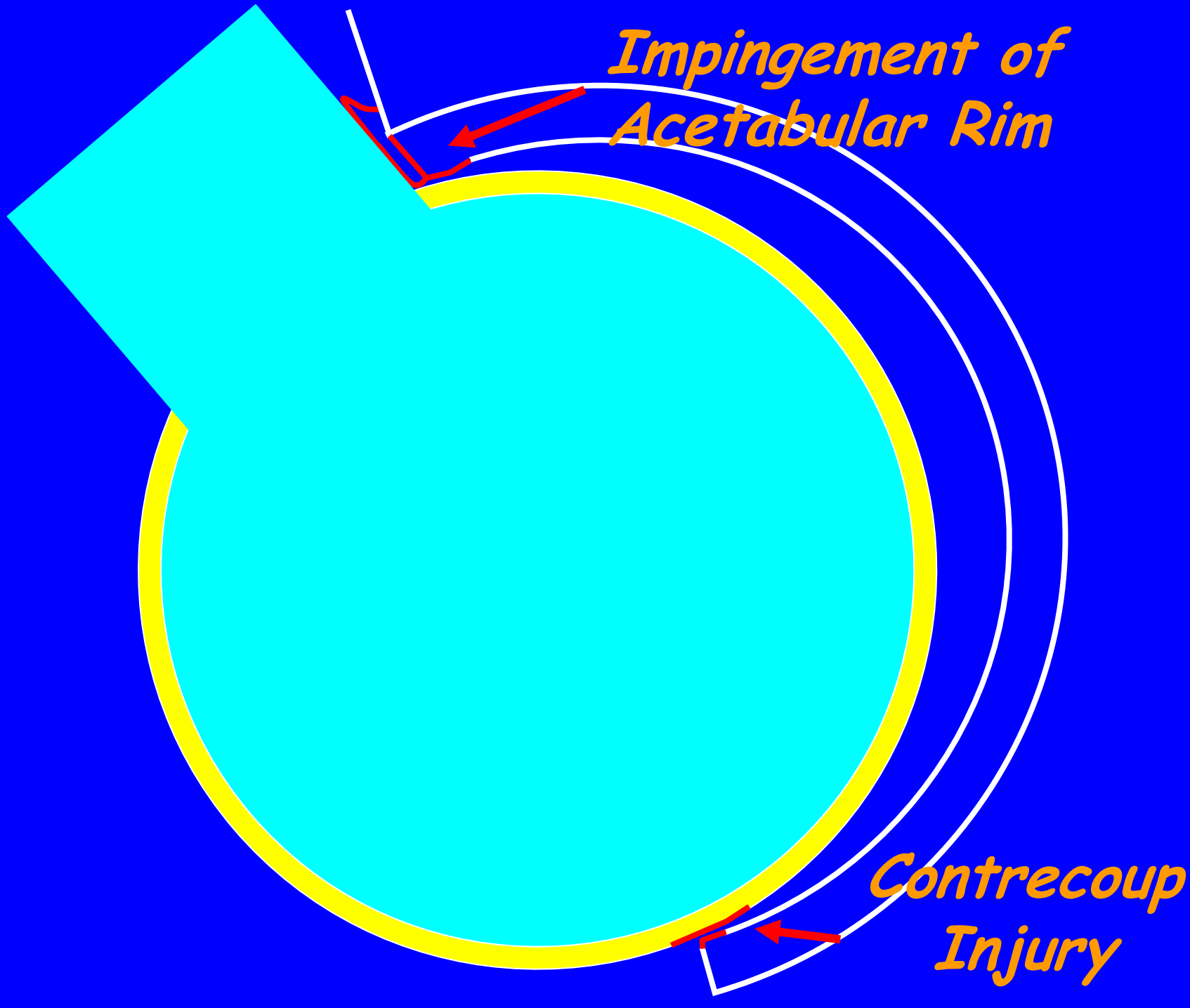


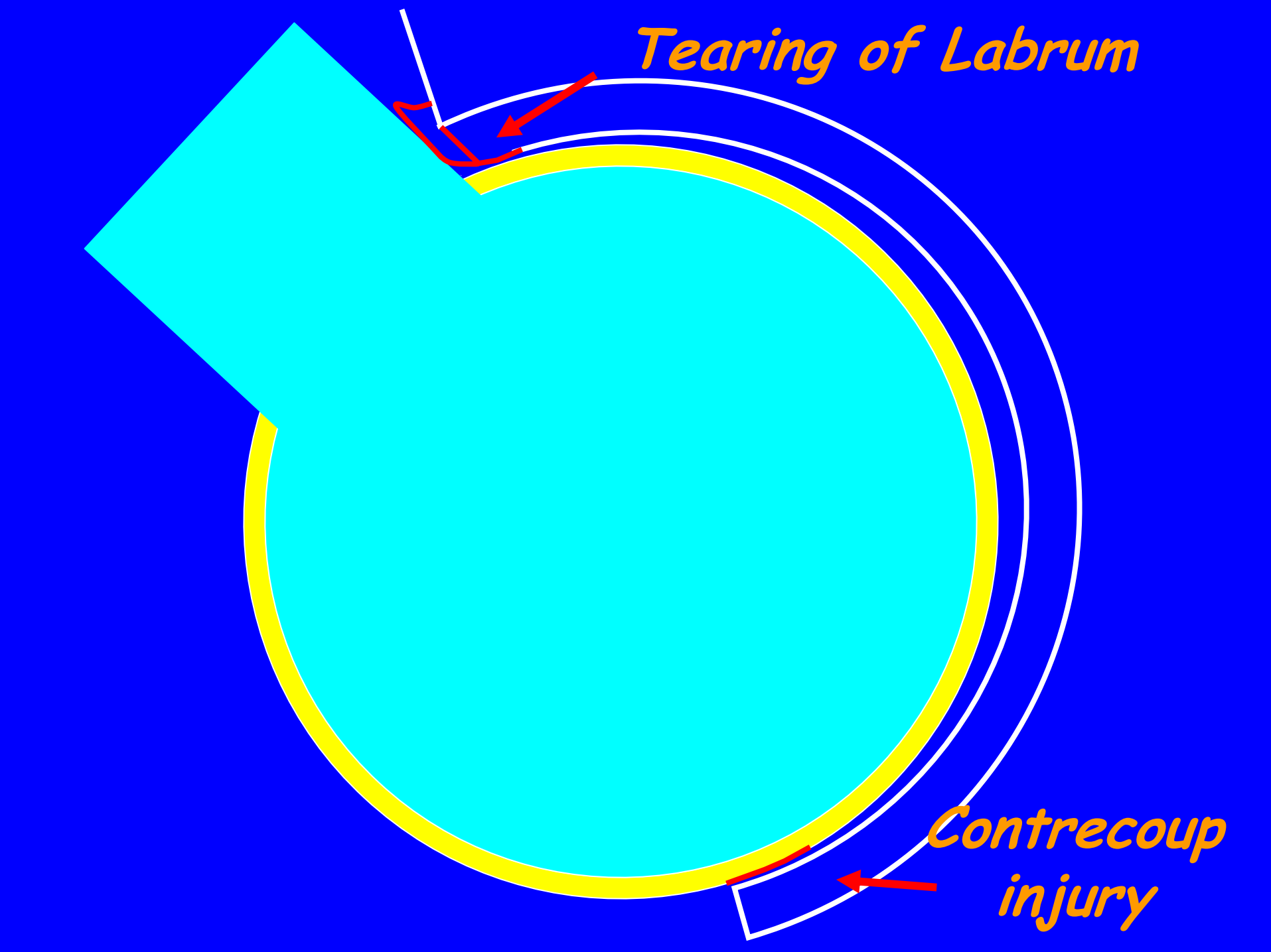


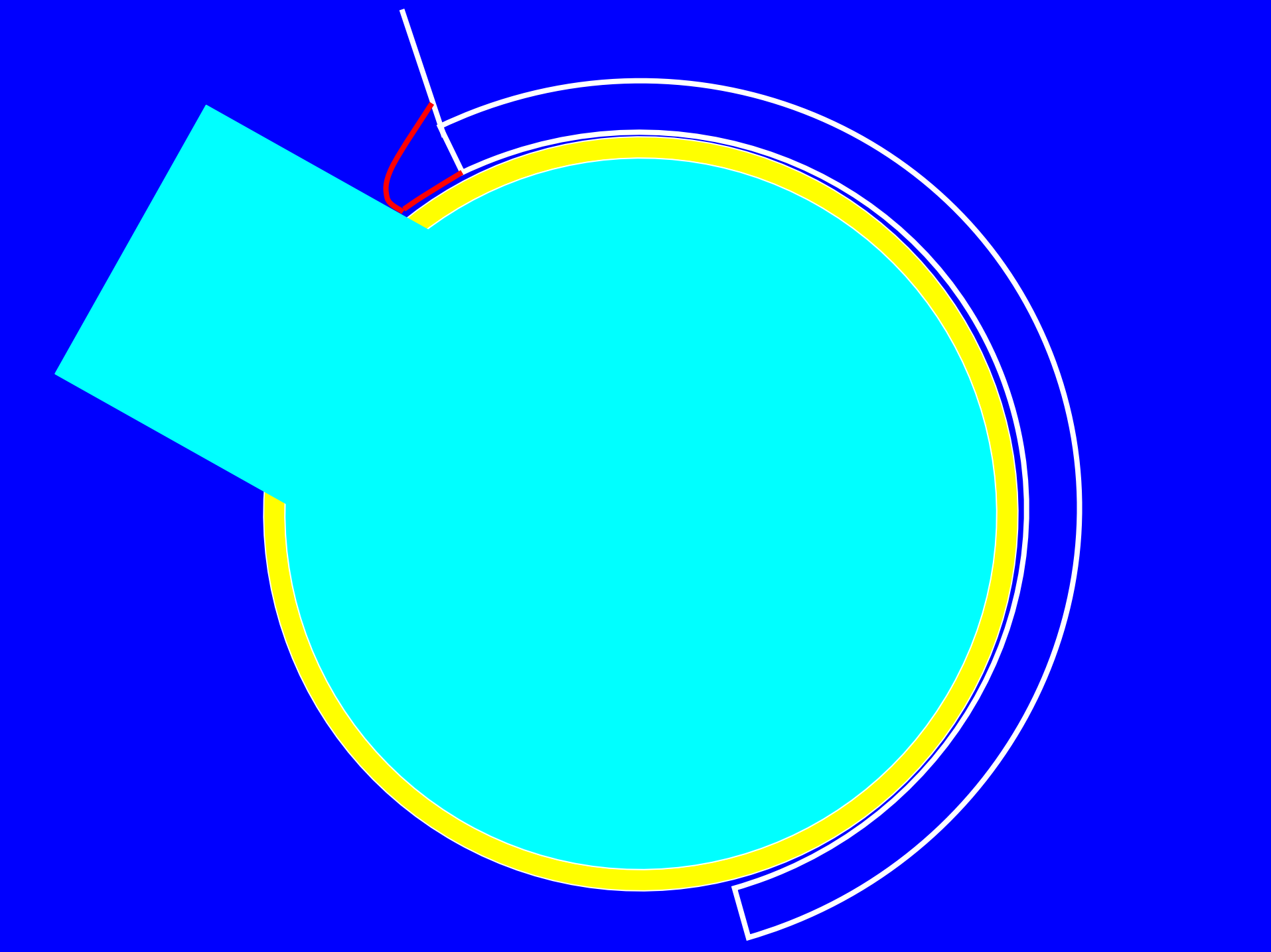


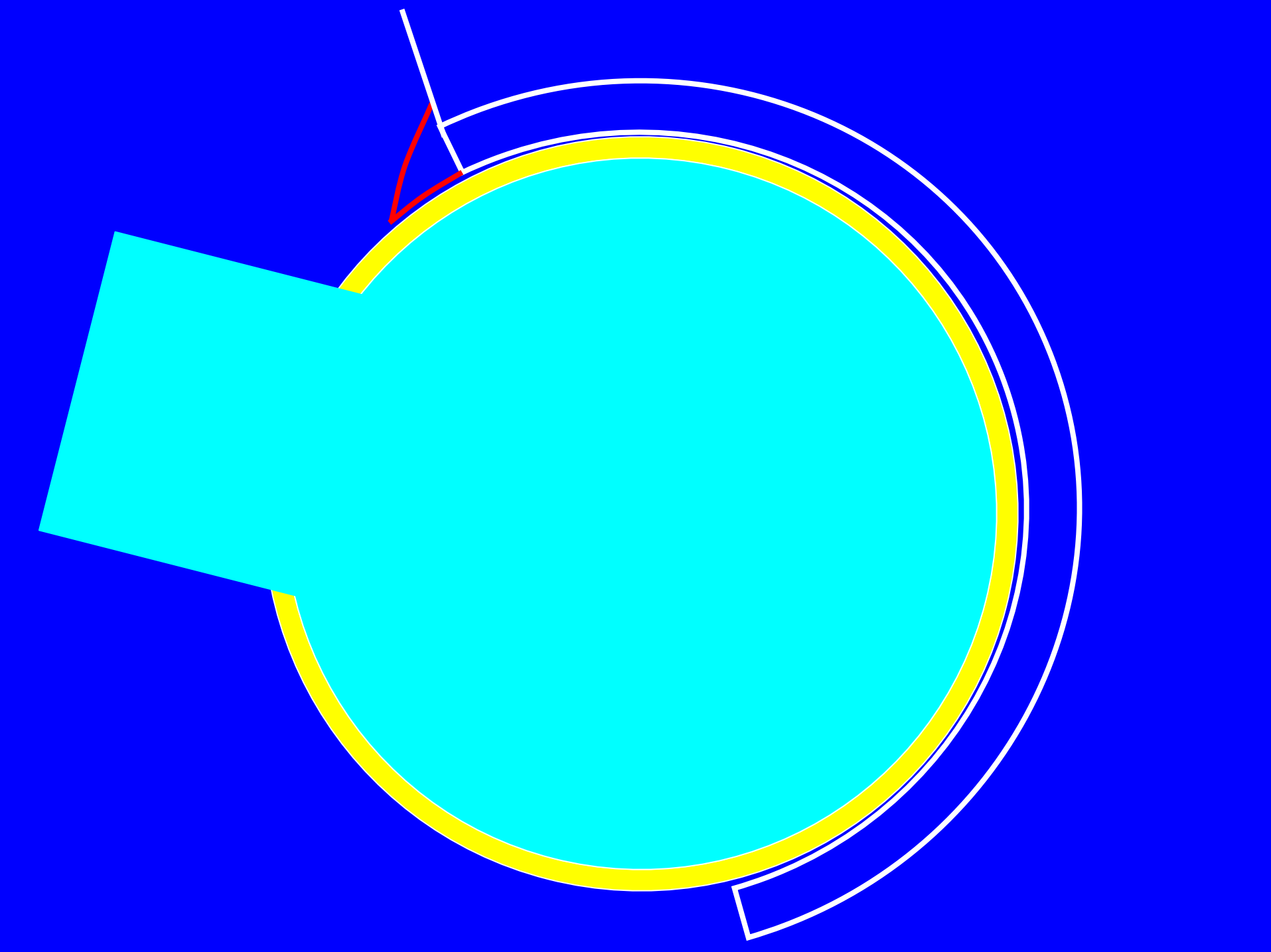


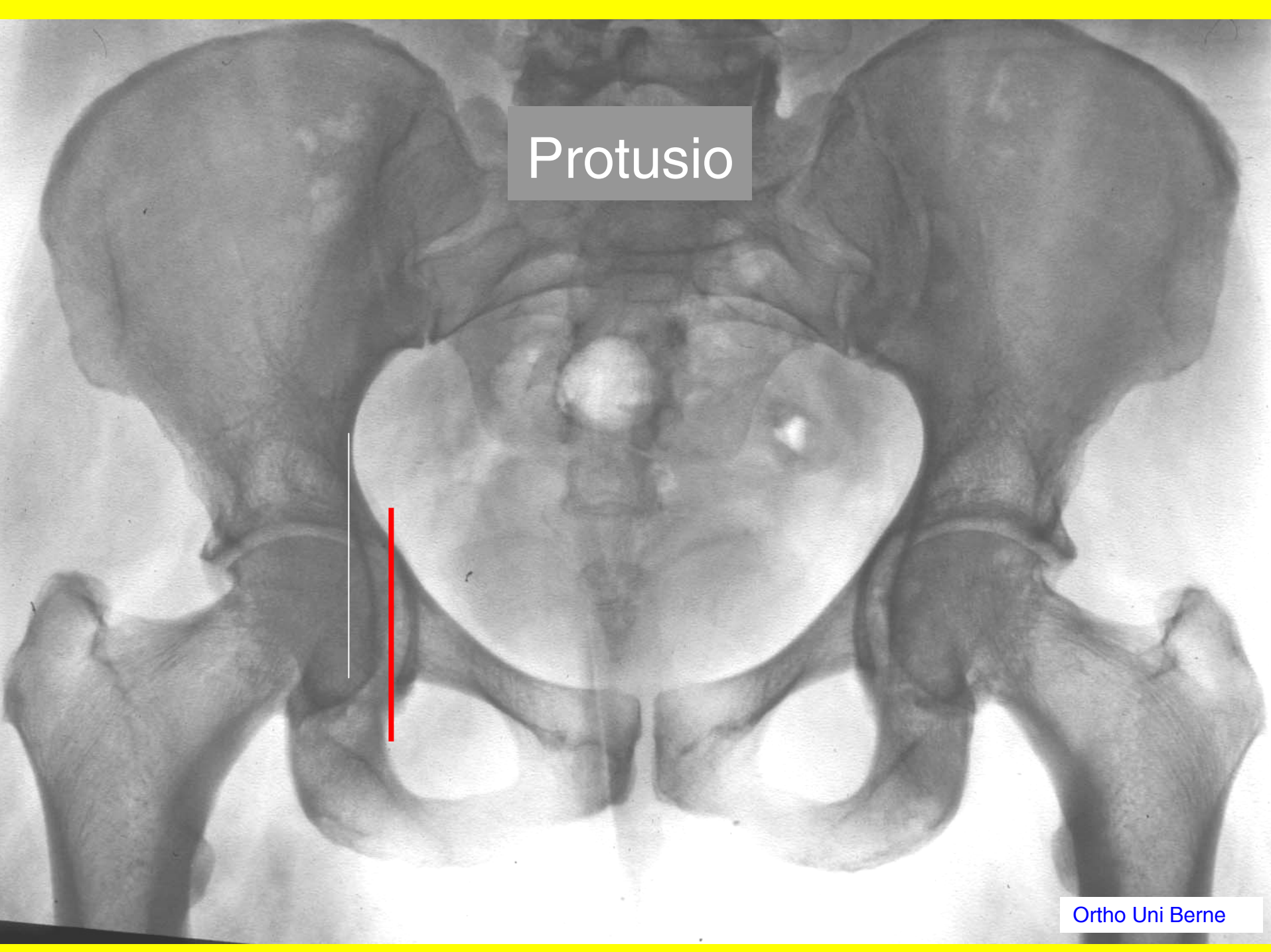

Mechanical Damage
Contrecoup
Injury


Impingement of
Acetabular Rim
Contrecoup
Injury


Tearing of Labrum
Contrecoup injury





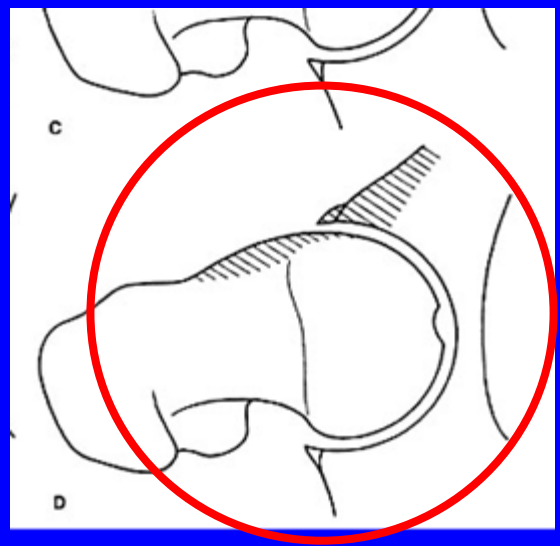

Protusio

Pincer Impingement

- Pathoanatomy: deep or retroverted socket
- Pathomechanics: neck crushes labrum directly around a wide portion of rim
- Damage pattern: circumferential area of labral crush injury; shallow zone of lesser indirect damage to adjacent acetabular cartilage (labral damage>cartilage damage)

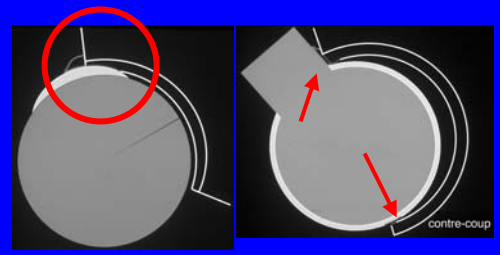
Campincer Impingement

- Commonest pattern: ~70%
- Pathoanatomy: cam AND pincer patterns
- Pathomechanics: cam AND pincer patterns
- Damage pattern: cam AND pincer patterns

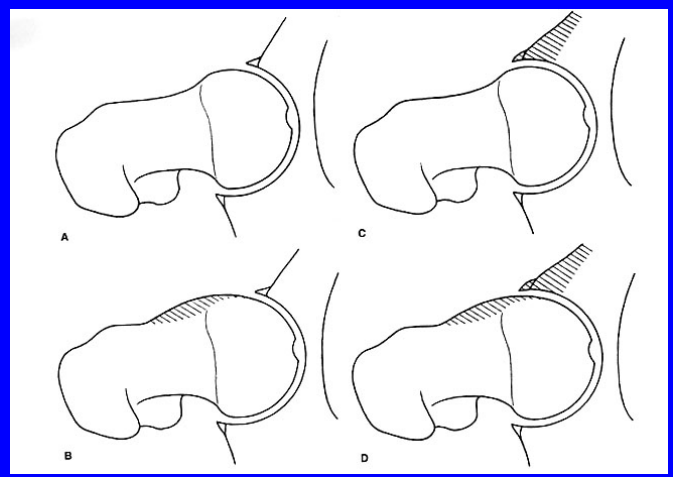


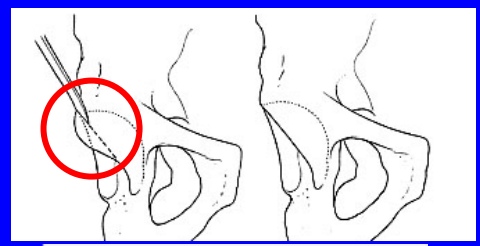
Contemporary Concept of Impingement-Based Arthrosis

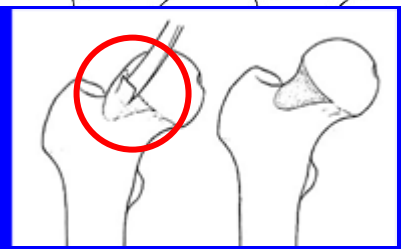
* Chronic impingement <u>with motion</u> causes mechanical damage to the acetabular rim and adjacent cartilage



* **Mechanically-based treatment goal: <u>Improvement in joint clearance</u> for ADL!**





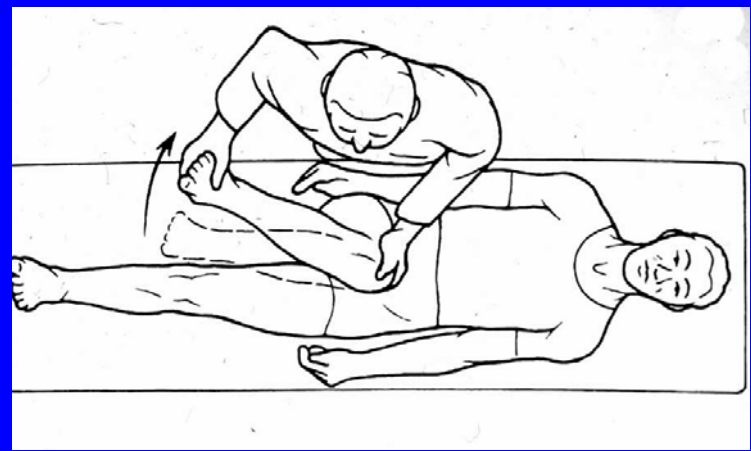


Clinical Evaluation for Femoro-Acetabular Impingement

- History: Groin ache worse with flexion
* Physical Exam
  * **1. Limited flexion**>lim int rot>lim abd

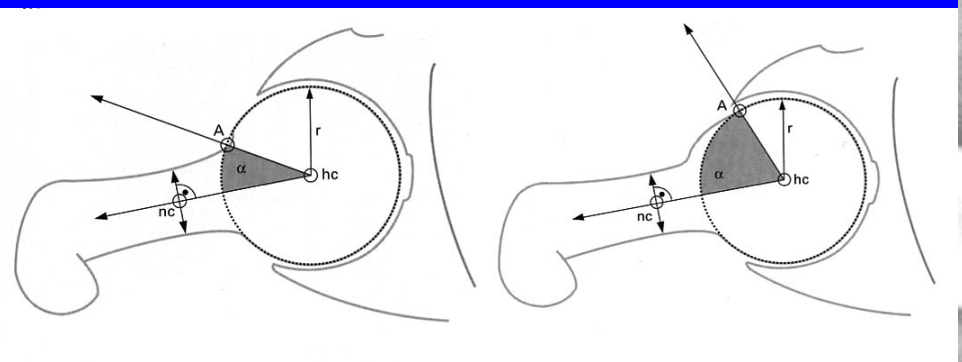
    OFTEN<90°!!
  * **2. Passive ER>>IR!!!**
  * 3. Anterior Impingement Test

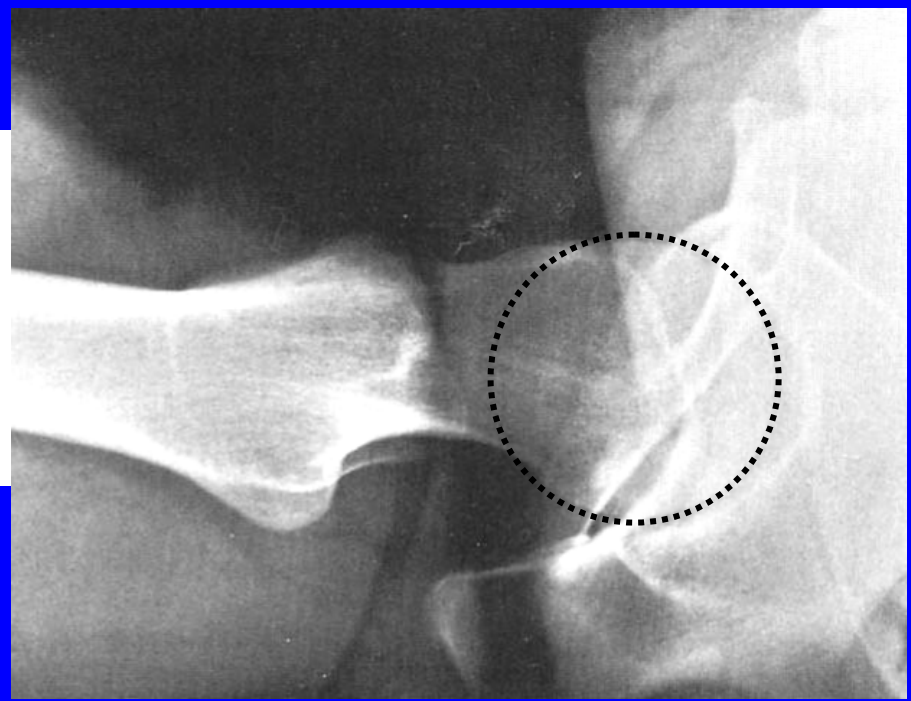
    (pain on passive F/Add/IR)



The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement

- Nötzli HP et al JBJS 84-B: 556-560, 2002

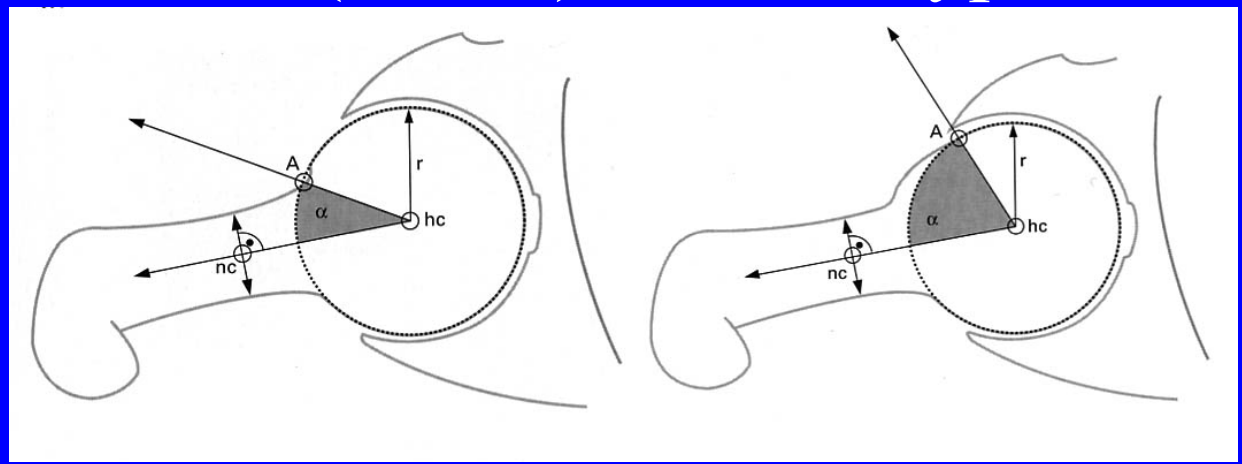




Contour of the Head-Neck Junction and Cam-Type FAI: The Alpha Angle

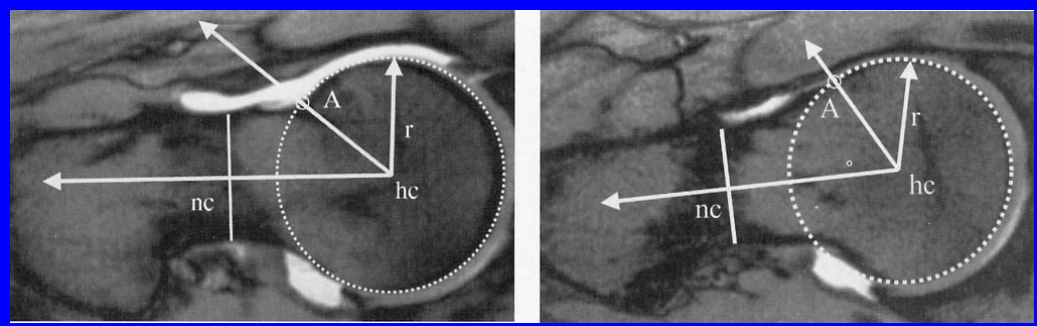
- Measures angle from center of neck to the anterior margin of the head-neck junction
- Measured on axial MRI or true lateral film
- Smaller angle is better; less risk of FAI

normal($\alpha<45°$) cam-type femur



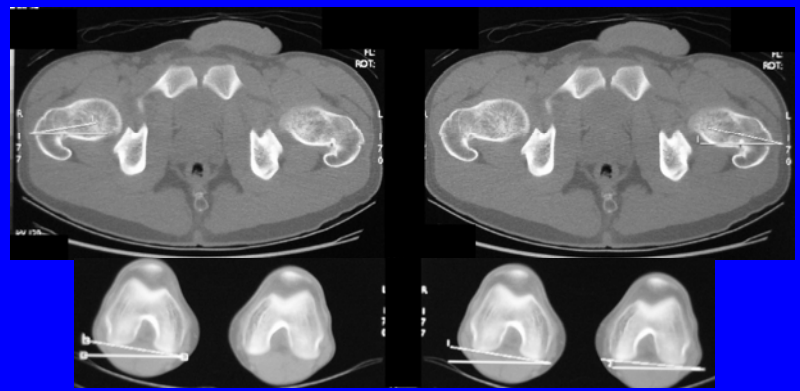
Imaging for F-A Impingement

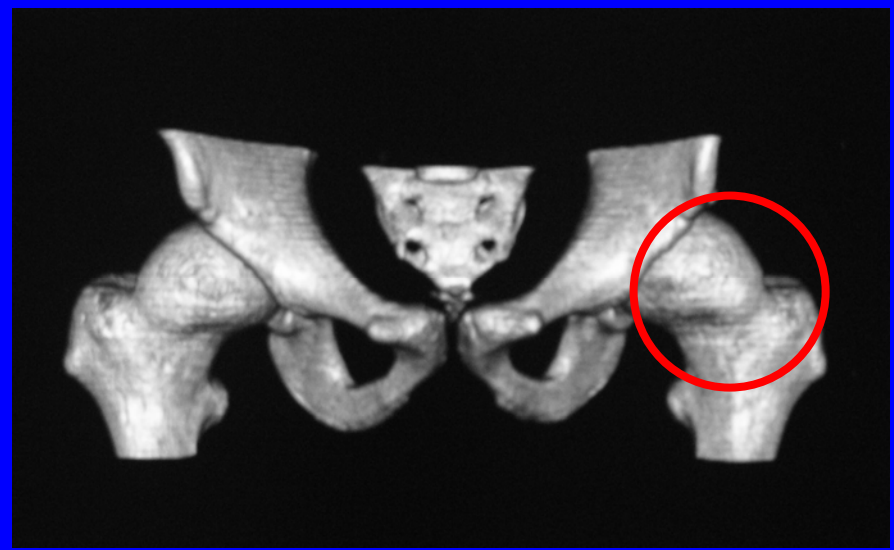
- Plain Radiography
- MRI/MR Arthrography (MRA)
  - MRA best for diagnosing labral lesions
    * MRA with radial sequences best for finding certain impingement patterns (Locher et al, Z Orthop 140: 52-57, 2002)



Imaging for F-A Impingement

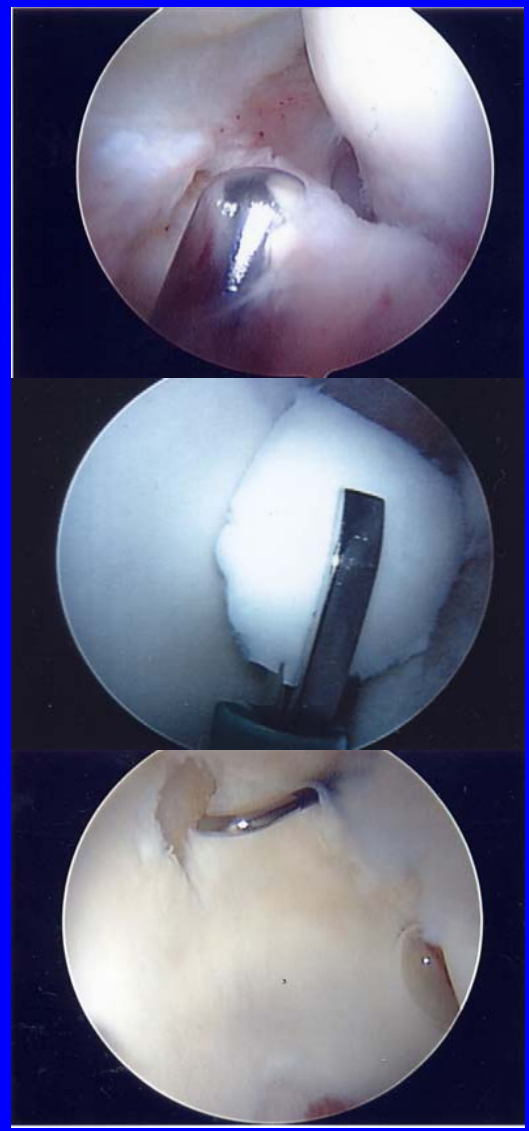
- Plain Radiography
- MRI/MR Arthrography (MRA)
- CT Scan: With distal femoral cuts, can measure femoral version; with 3D reconstruction, can show asphericity and reduced-offset areas





Imaging for F-A Impingement

- Plain Radiography
- MRI/MR Arthrography (MRA)
- CT Scan
- **Arthroscopy**
  - **Can** find cartilage lesions not otherwise found
  - * BUT: Dynamic assessment difficult 2° to traction

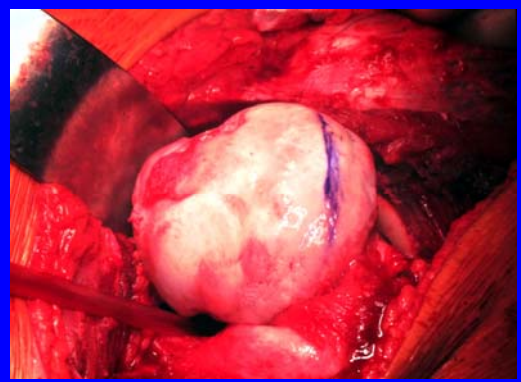


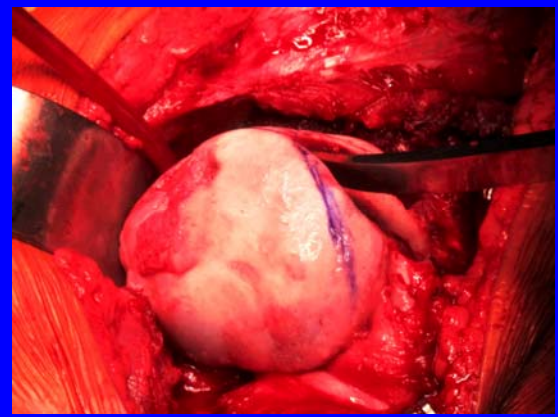
Analysis for F-A Impingement

- Plain Radiography
- MRI/MR Arthrography (MRA)
- CT Scan
- Arthroscopy
* **Surgical dislocation/arthrotomy** (Ganz, 2001)
  * Excellent DYNAMIC assessment and visualization (but much more invasive than arthroscopy)
  * (and excellent for direct intraarticular treatment)

Treatment Options for Impingement

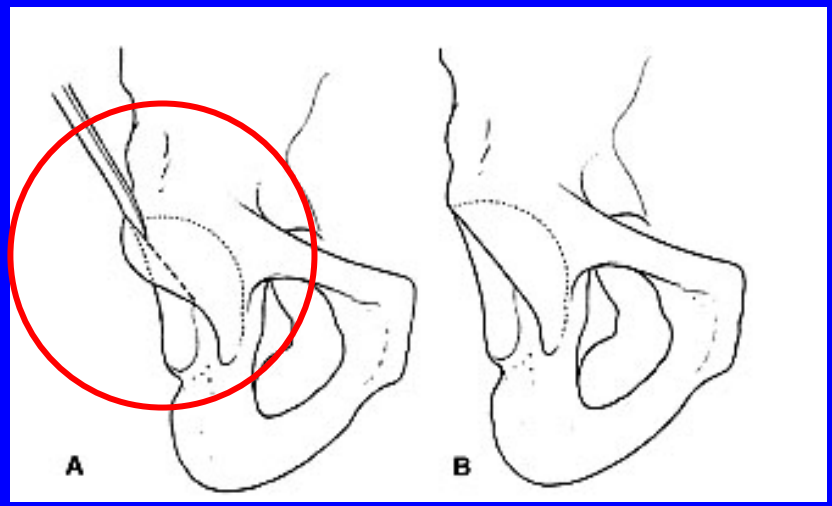
- Extra-articular procedures
  - Proximal femoral osteotomies: ITO, esp. valgus
  - Acetabular procedures: “Reverse” PAO; Chiari
* Intra-articular procedures
  - Trimming of femoral head
  - Subcapital osteotomy
  - Rim trim
  - Combinations

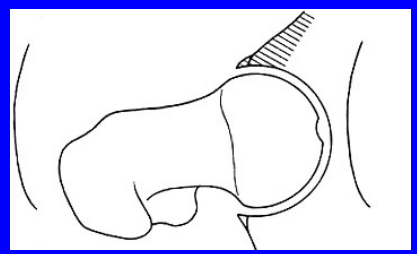


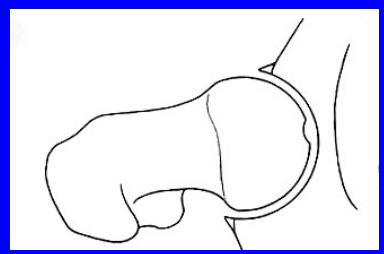


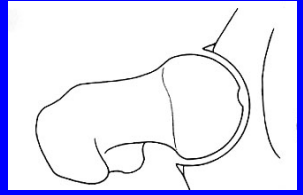
Treatment of pincer impingement (protrusio or coxa profunda)

- Rim trim, with labral refixation if possible



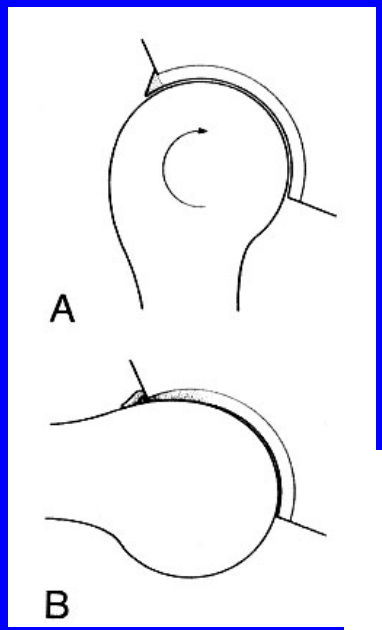


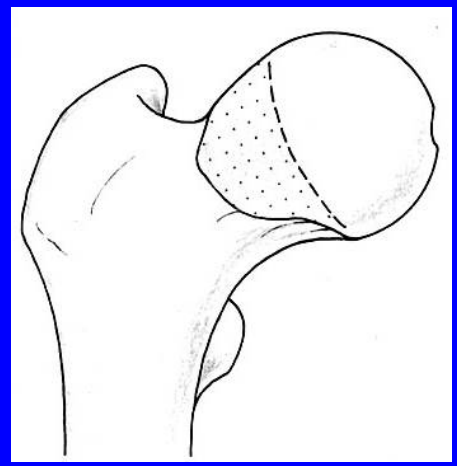


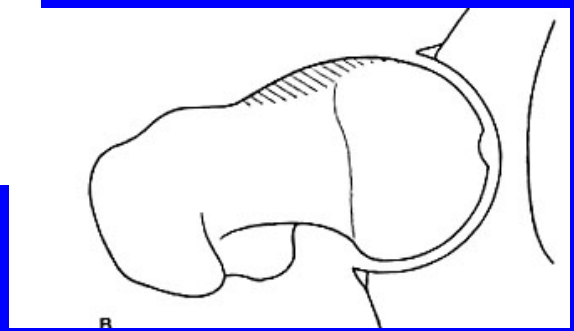


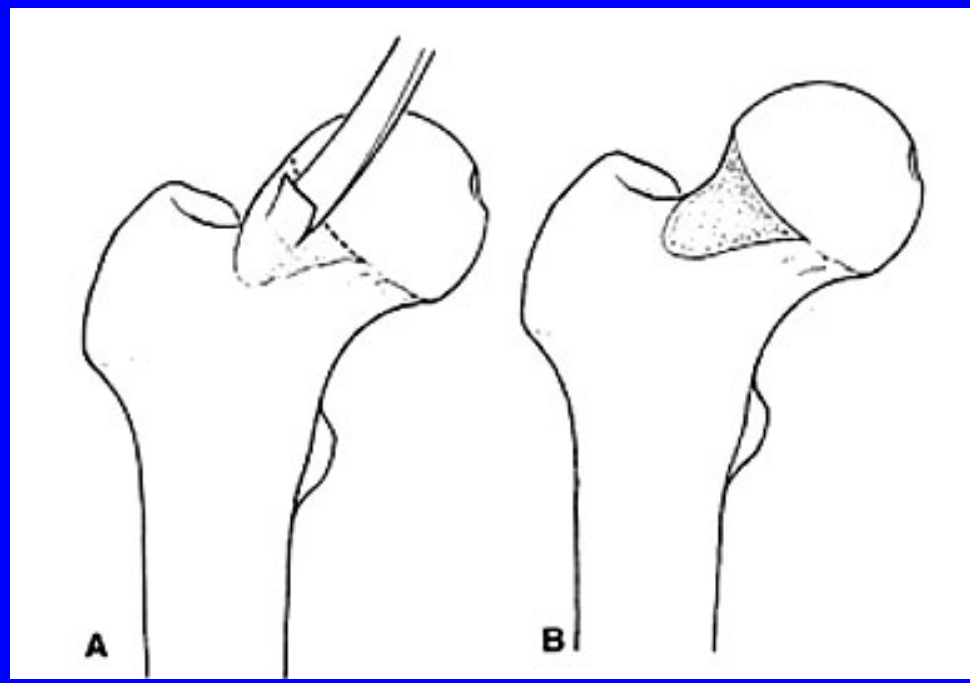
Treatment of cam deformities

- Femoral head/neck osteochondroplasty



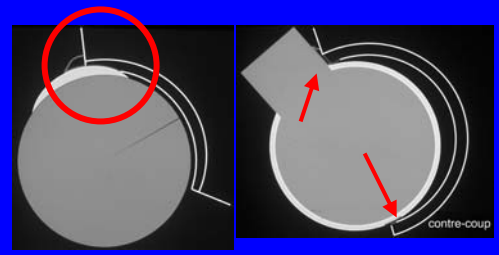


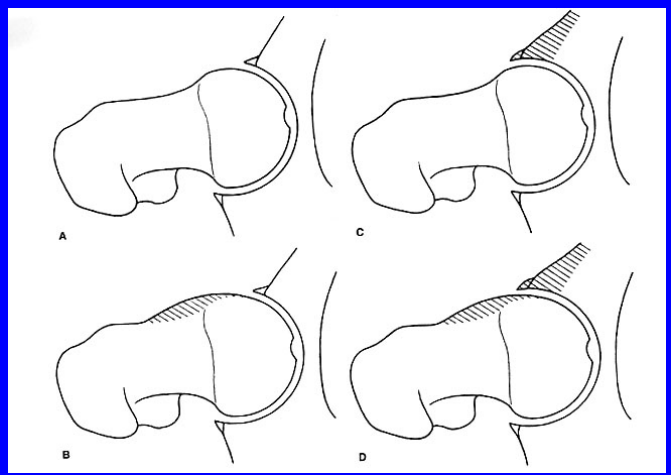


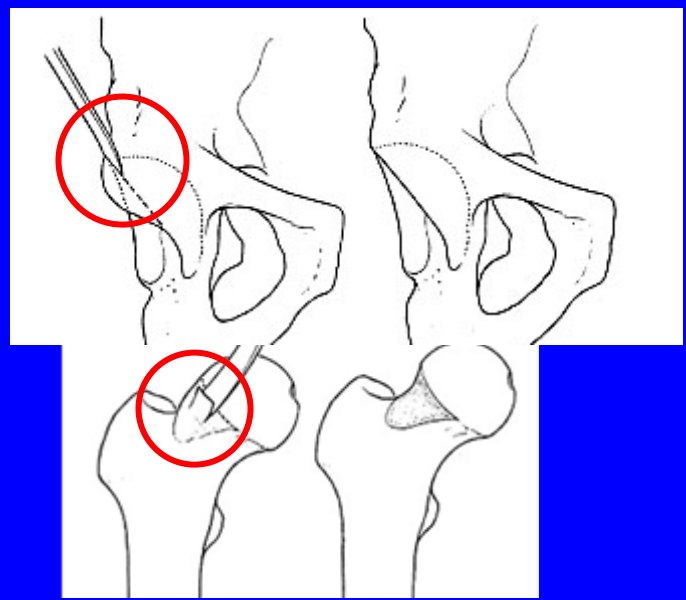


Treatment of combined femoral and acetabulum-based FAI (~70%)

* **Rim trim with labral refixation if possible (Espinosa, 2006)**
* **Femoral head/neck offset creation**
* **Other debridement, microfx as needed**



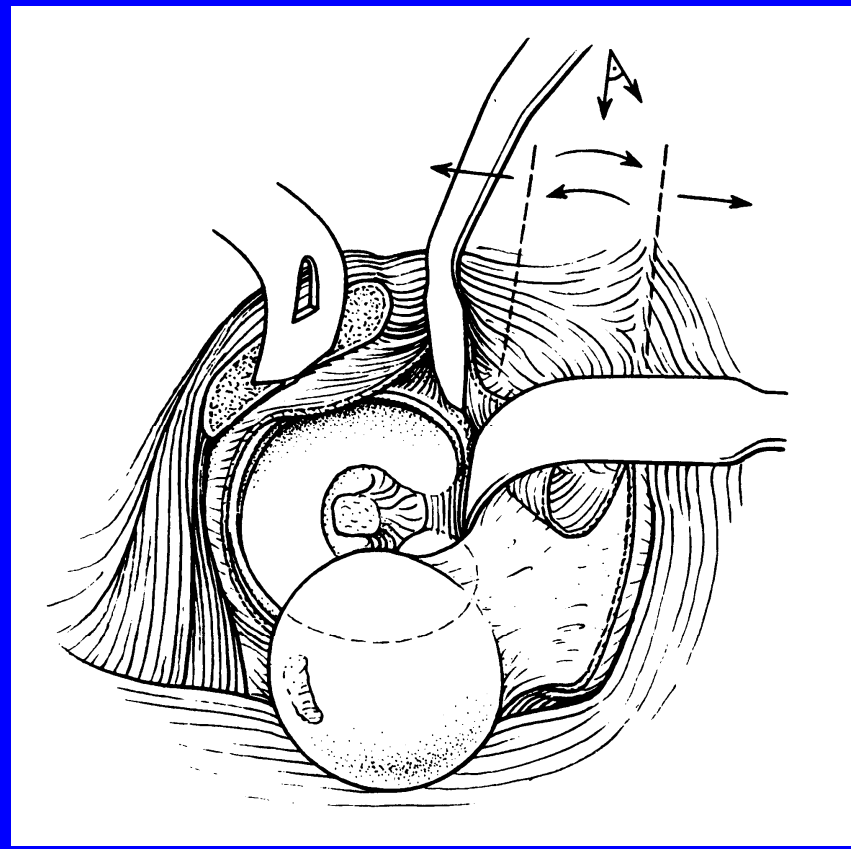




"Safe" Surgical Hip Dislocation: A New Tool for Extensive Intraarticular Surgery

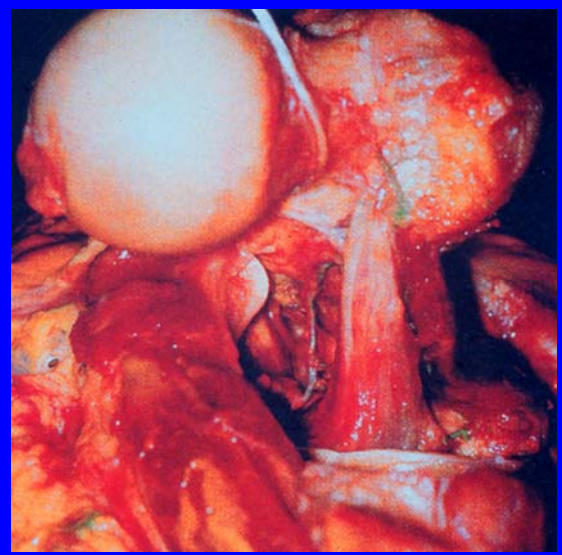
- Ganz: >1500 hips over 15 y; 1 case AVN w fem neck fx
- Ant. disloc/Gibson approach
- Troch. flip osteotomy
- Very useful for impinging hips; allows relocation to assess motion/impinging

  (Ganz et al: JBJS 83-B(8): 1119-1124, 2001.



Prerequisite for "Safe" Surgical Hip Dislocation:

* Knowledge of blood supply to femoral head
* Technique to dislocate and do intra-articular work without disturbing blood supply to the femoral head

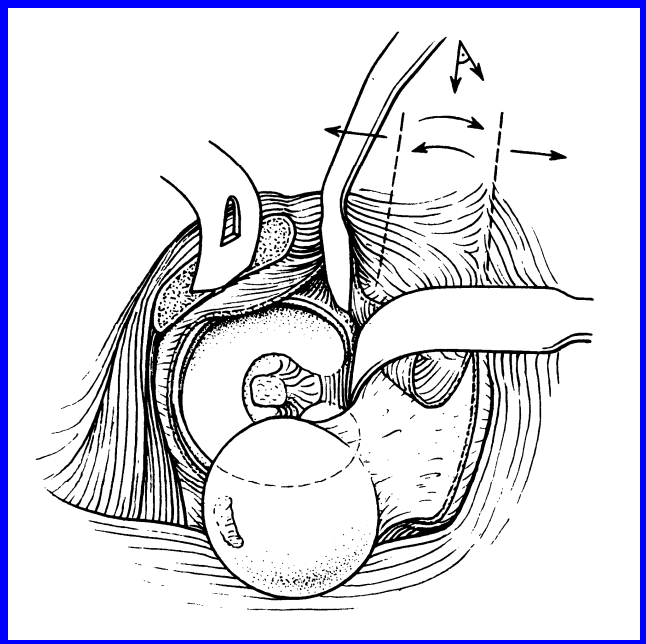


Surgical Technique

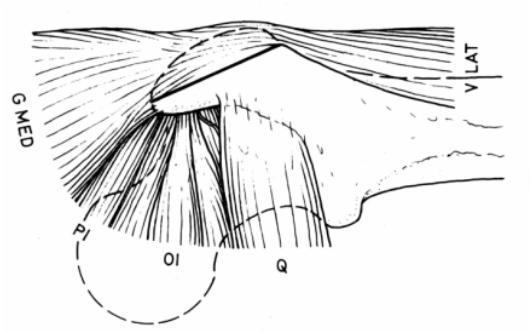
- Exactly as per Ganz et al
- Lateral position/Gibson approach/troch flip
- peripheral capsulotomy
* Spare obturator externus
- Anterior dislocation
- Intraarticular surgery as needed
- Occasional simultaneous ITO

Surgical Dislocation Technique

- Diagrams and concept: Professor Ganz
- Intraop photos: Young-Jo Kim, M.D., Ph.D.

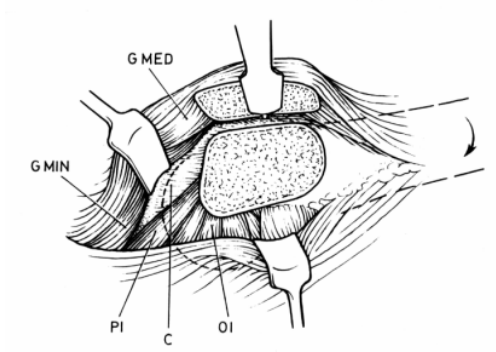


Step I



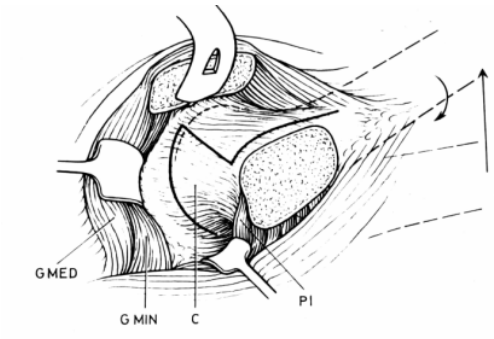
Ortho Uni Berne

Step II



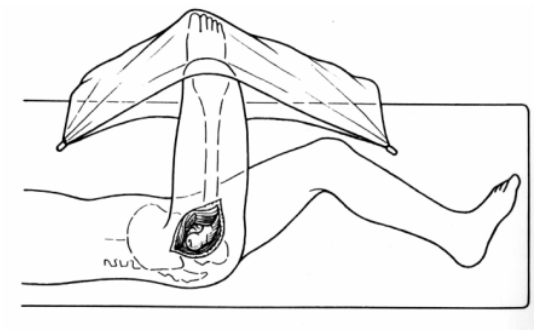
Ortho Uni Berne

Step III



Ortho Uni Berne

Step IV



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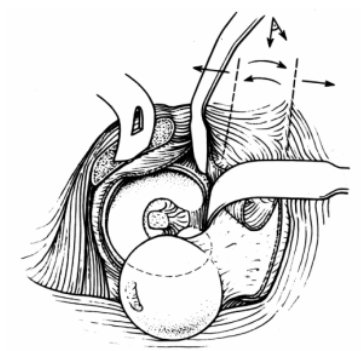
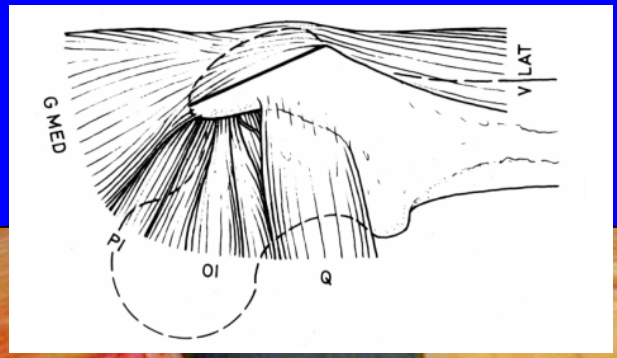
Step V



Ortho Uni Berne

Lateral Position

ANTERIOR



HEAD

FEET

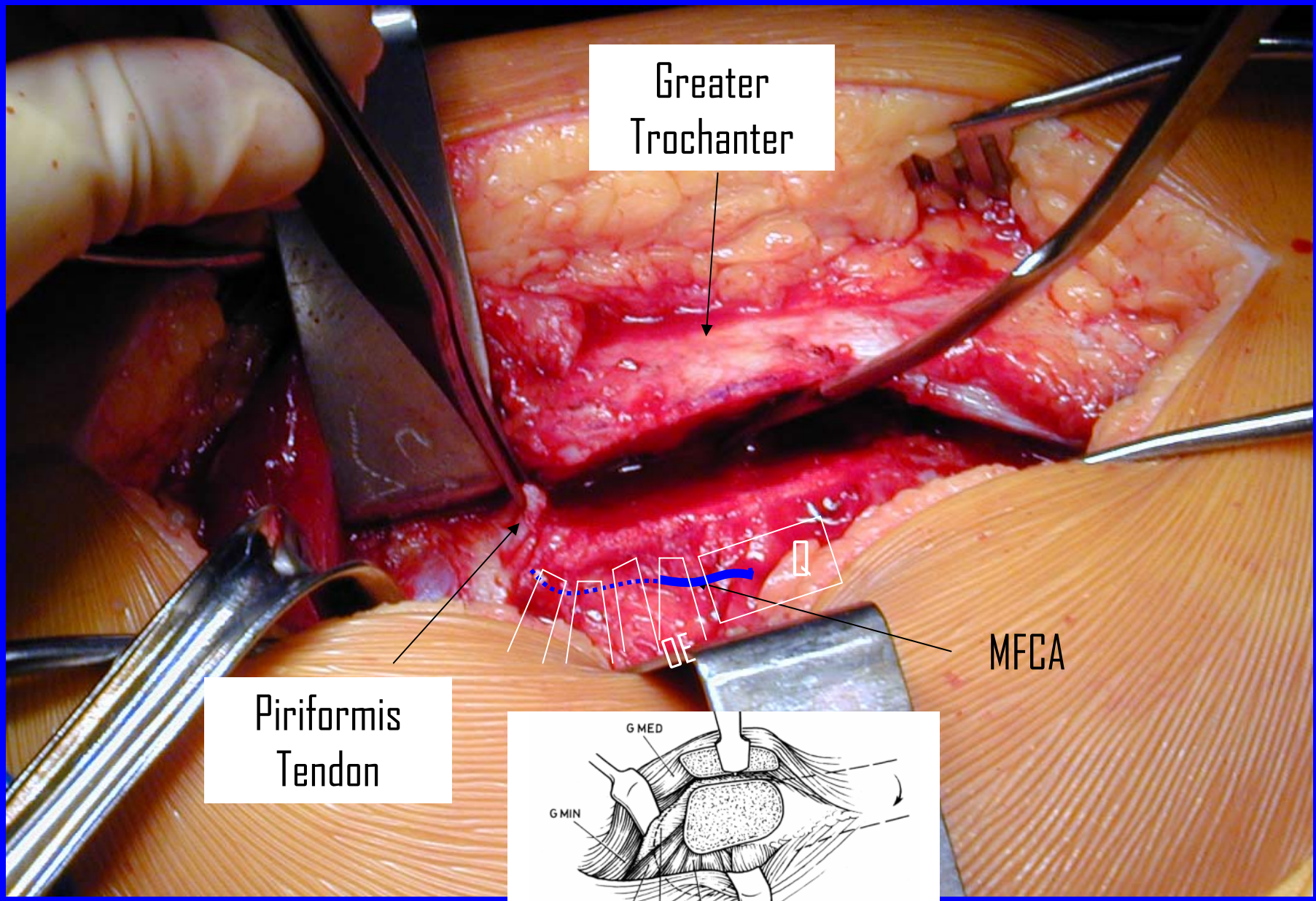
Trochanteric Branch of the MFC

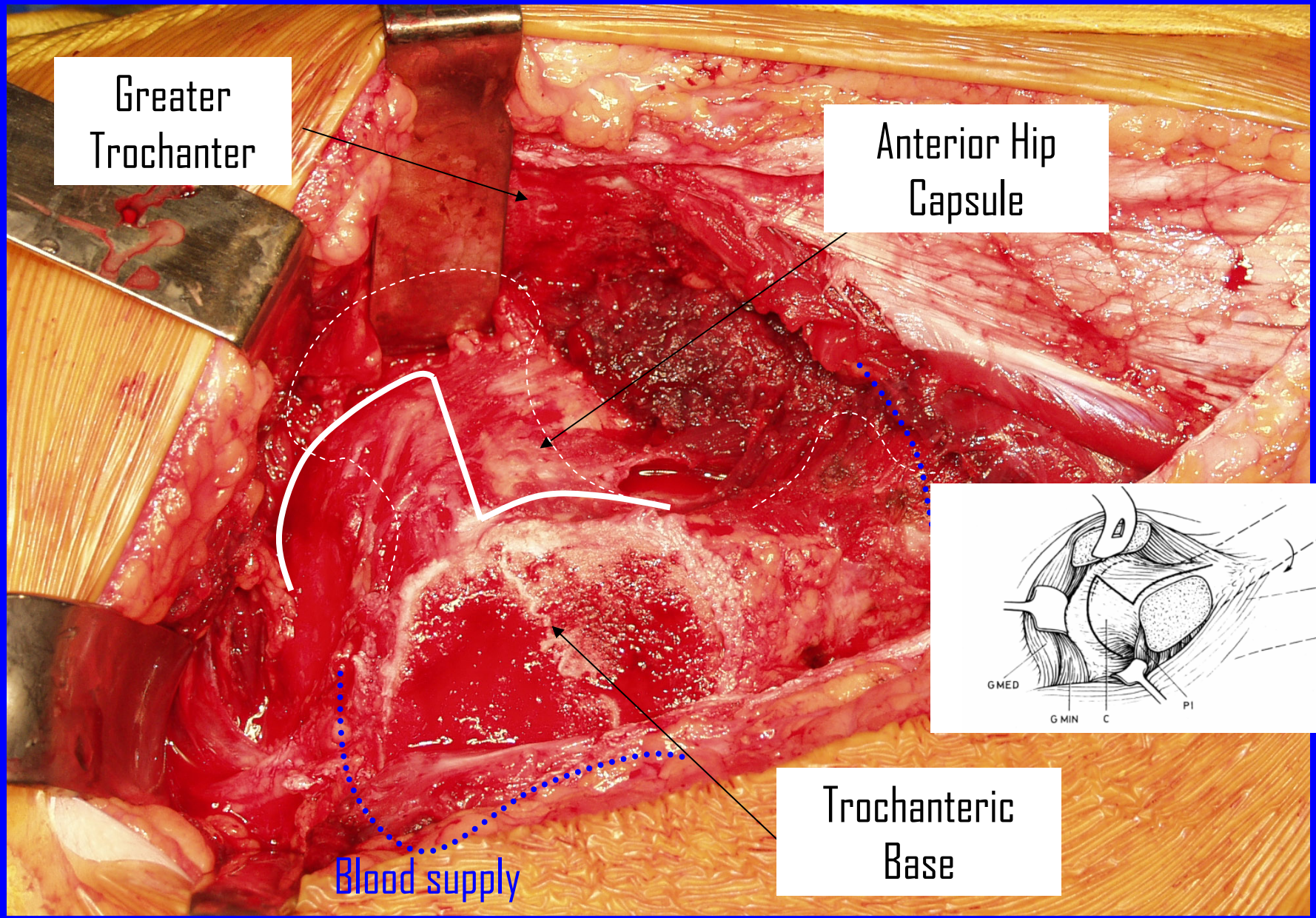
Q

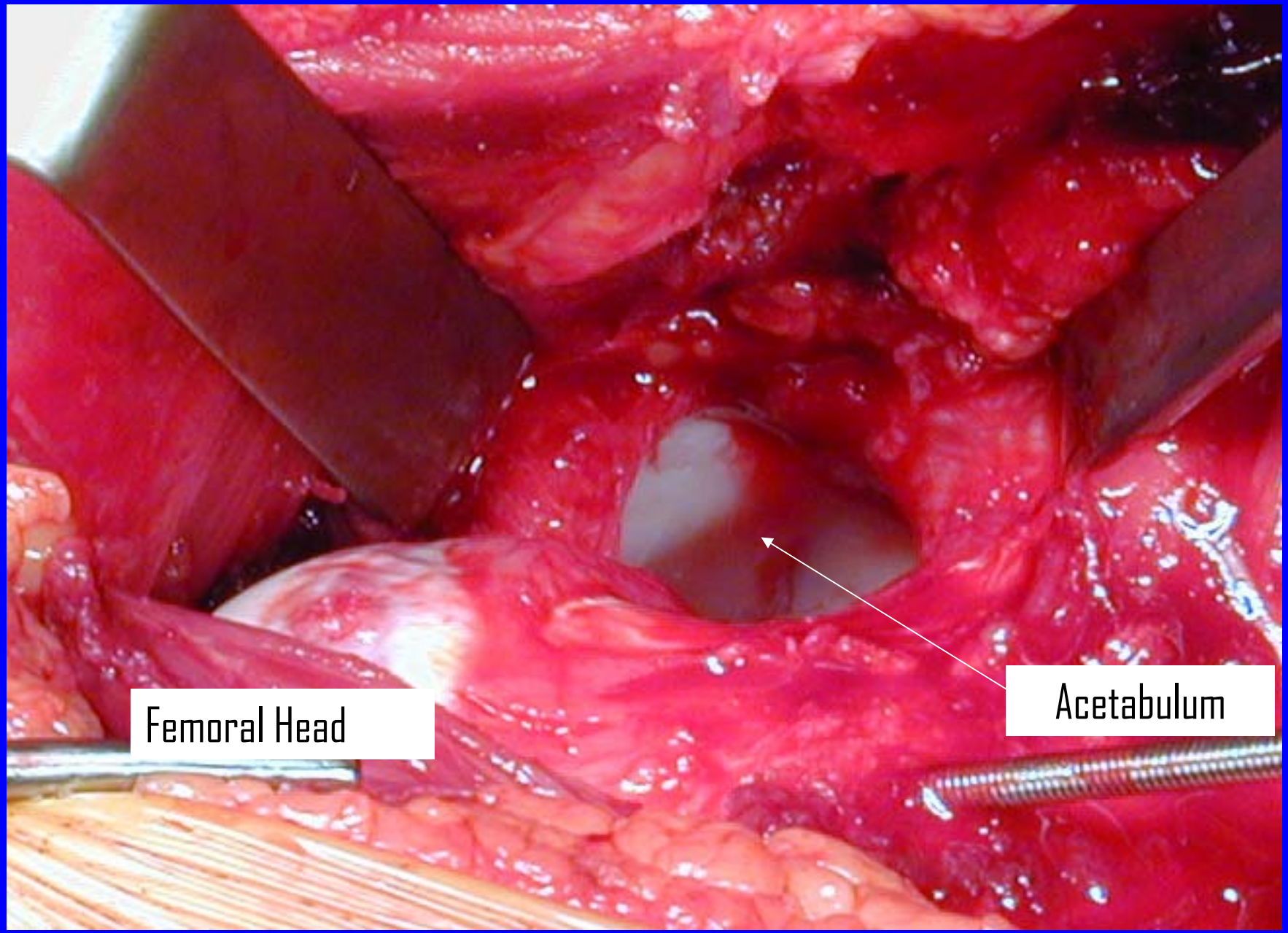
OE

Posterior edge of gluteus medius

Vastus Tubercle


Greater Trochanter
Piriformis Tendon
MFCA
Q
OE
G MED
G MIN
PI
C
OI

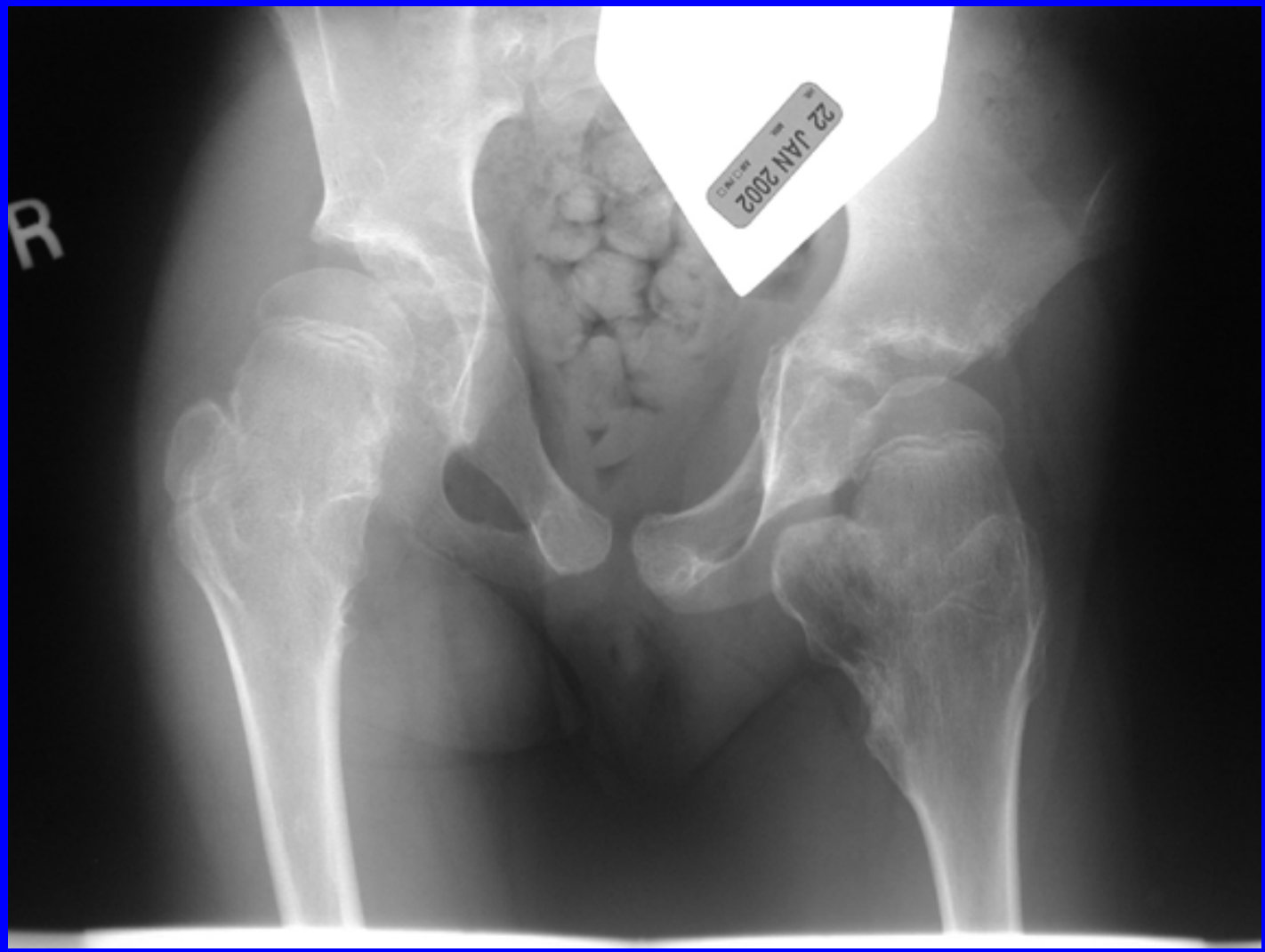

Greater Trochanter
Anterior Hip Capsule
Blood supply
Trochanteric Base
GMED
G MIN
C
PI

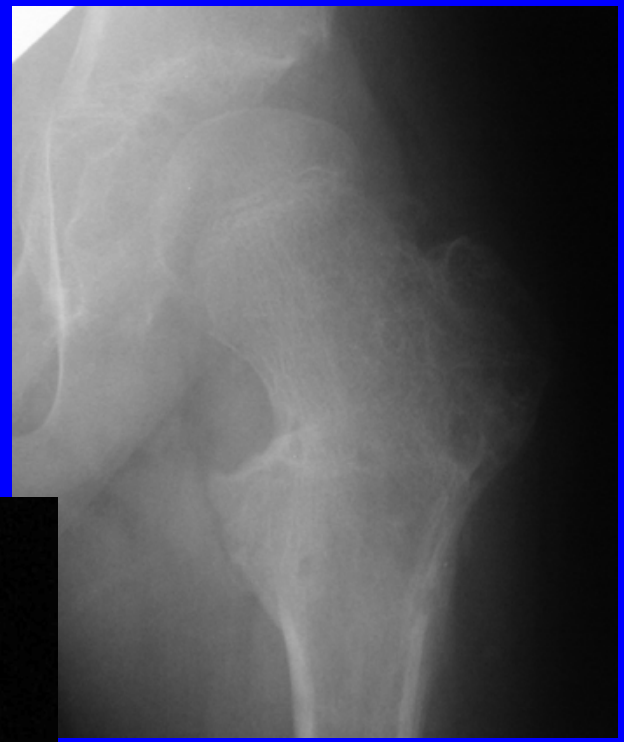

Femoral Head
Acetabulum

Potential Uses for the Surgical Dislocation Approach

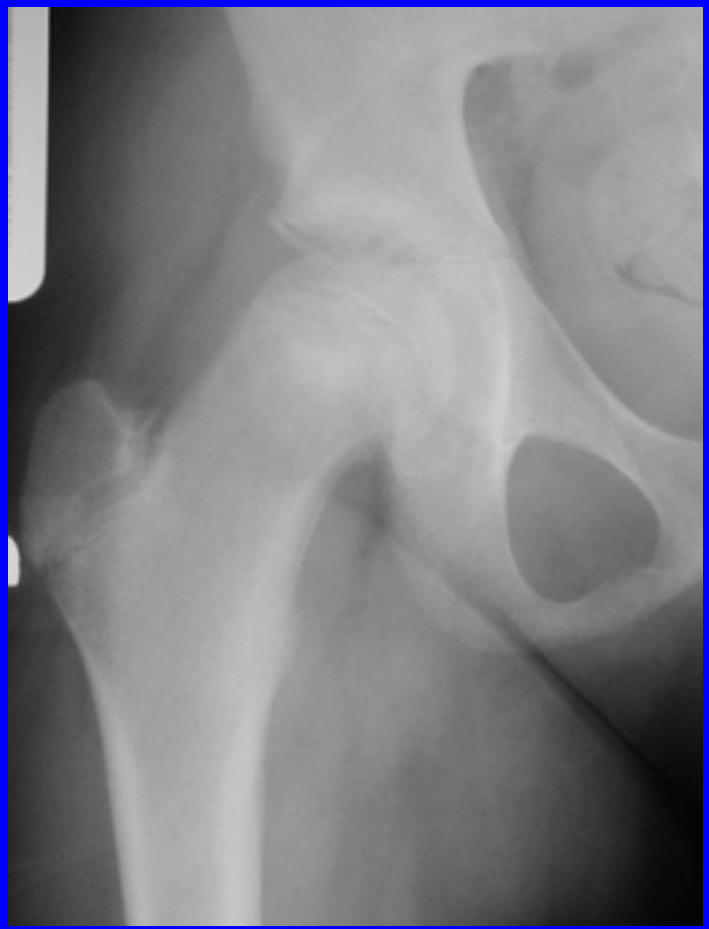
- Post-traumatic problems
  - Pipkin fractures of the femoral head
  - Incompletely reduced hip dislocations with incarcerated soft tissue or loose bodies
  - Acetabular fractures of the posterior wall
- All types of FAI
- SCFE: femoral neck osteoplasty OR Dunn/cuneiform osteotomy of neck

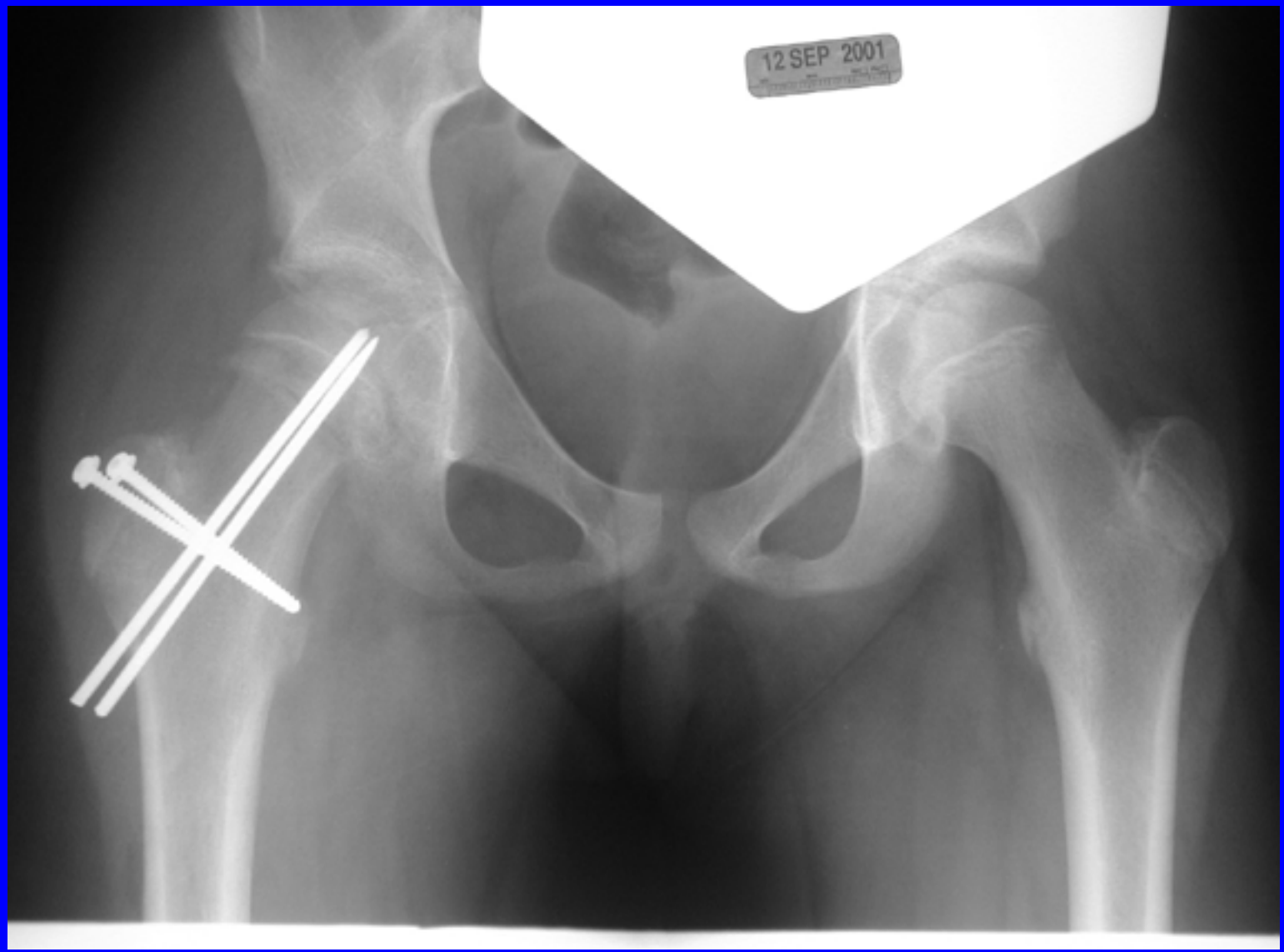
Improved Access





Improved Safety ?



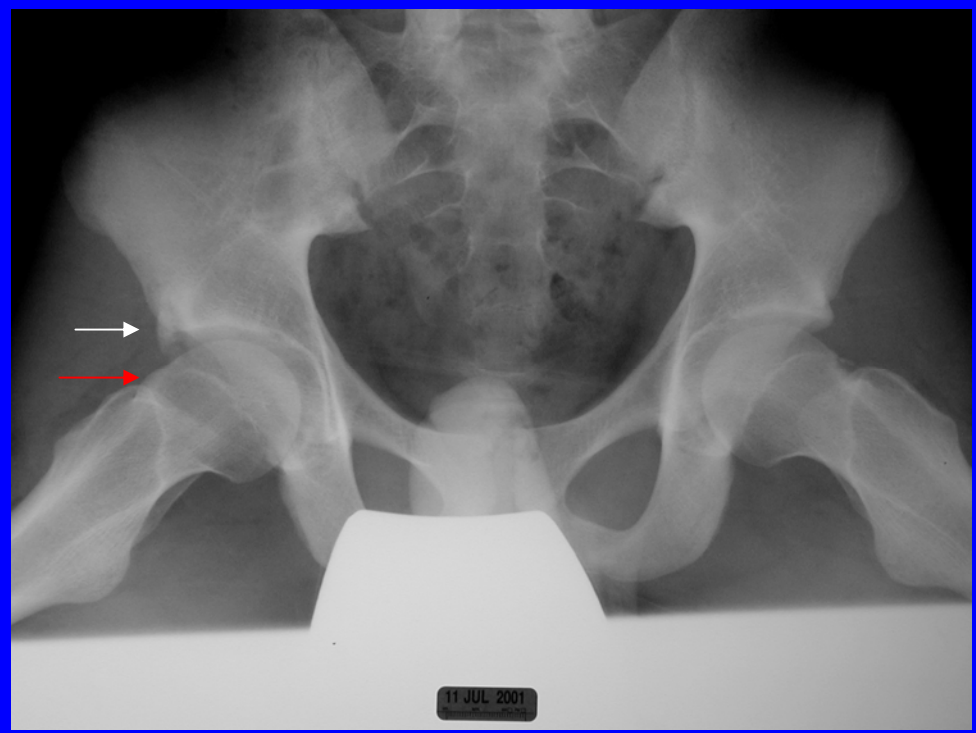

12 SEP 2001

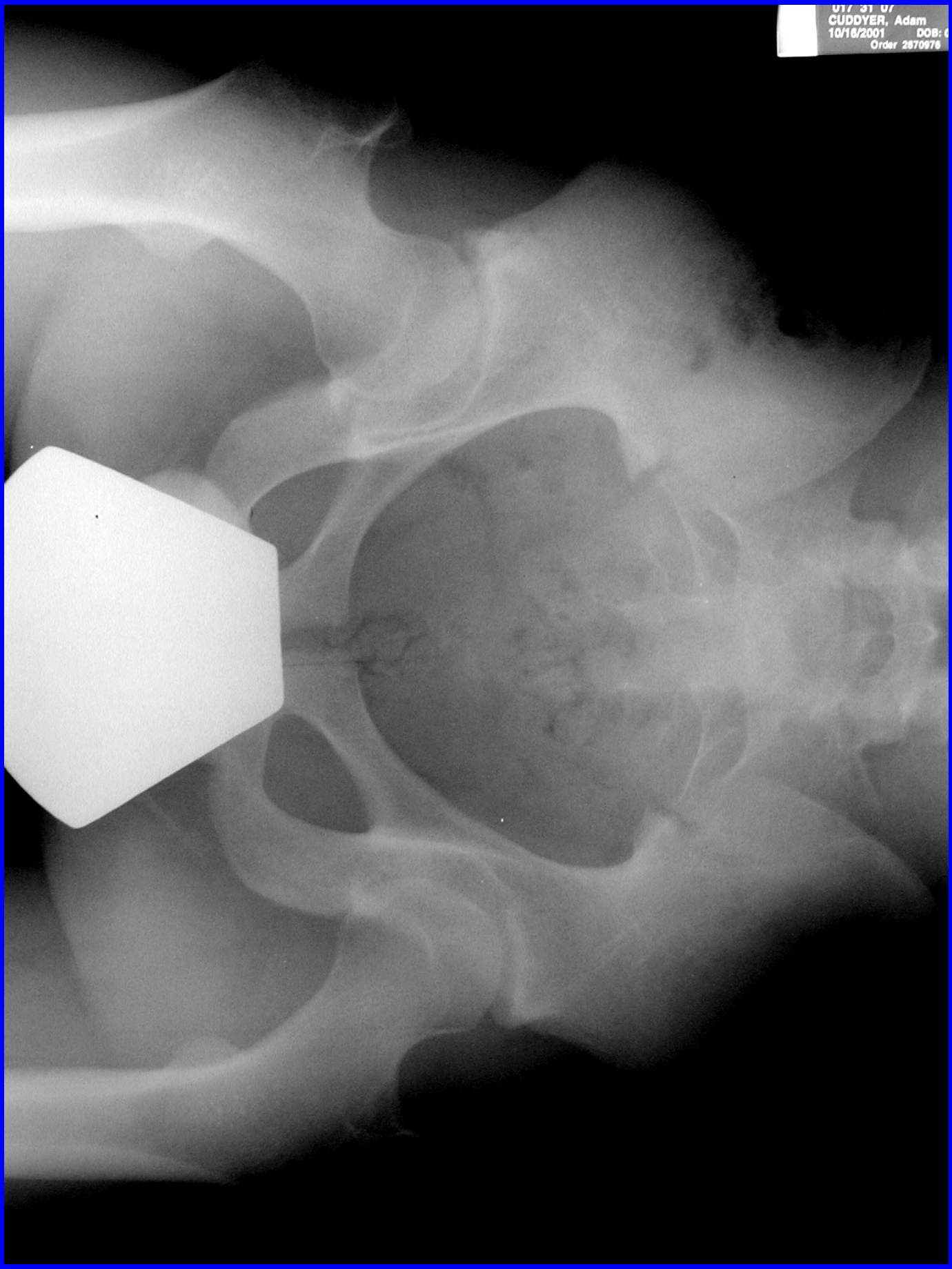
Early Harvard Experience with Surgical Hip Dislocation

- 300+ dislocations, 60+ subluxations since 8/01
  Followup: 1 to 5 years on 85 hips
- Age at surgery: 8-48 years (mean 24)
- Variety of mechanical disorders treated
- AVN only in 4 complex cases (details to follow)

Insufficient Head-Neck Offset

- 18 yoTae Kwan Do participant with R groin pain.
  - Right is his main kicking leg.
  - Groin ache with sitting.
  - Positive anterior impingement test

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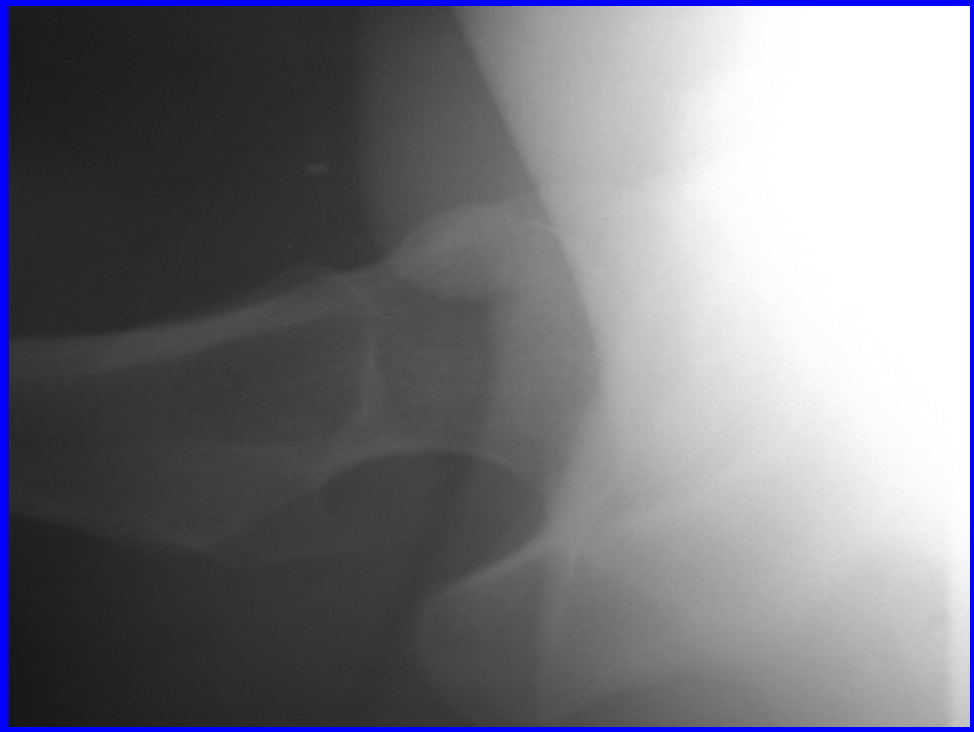
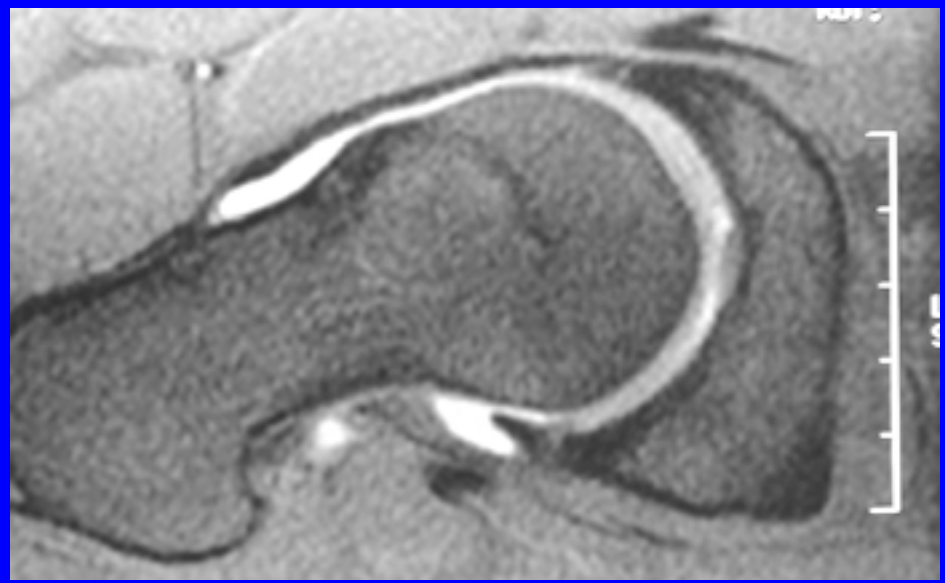
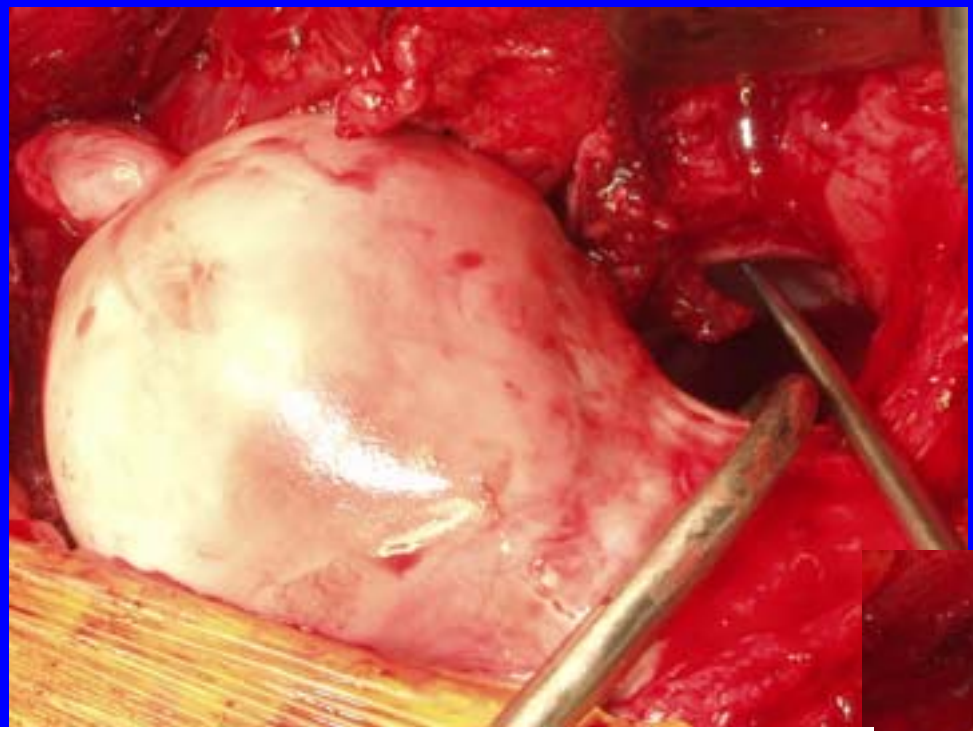
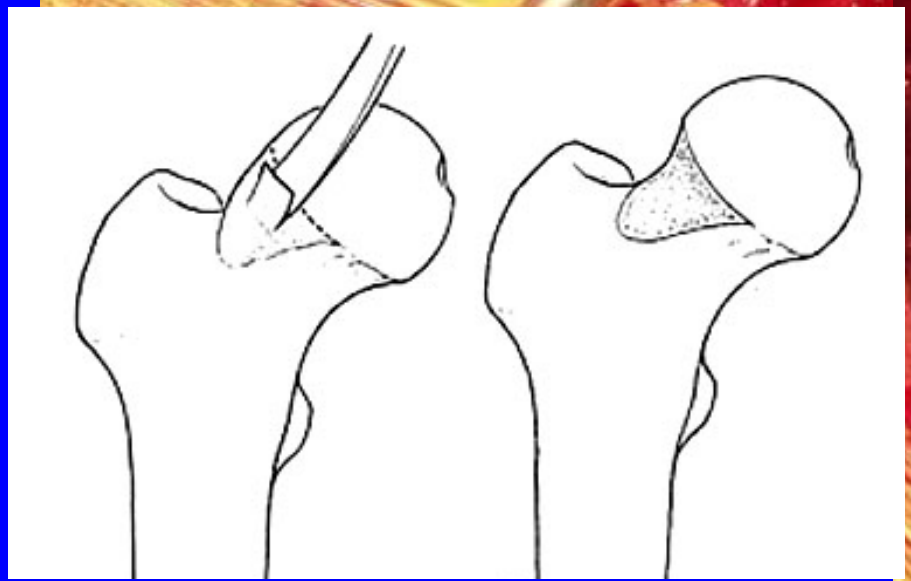
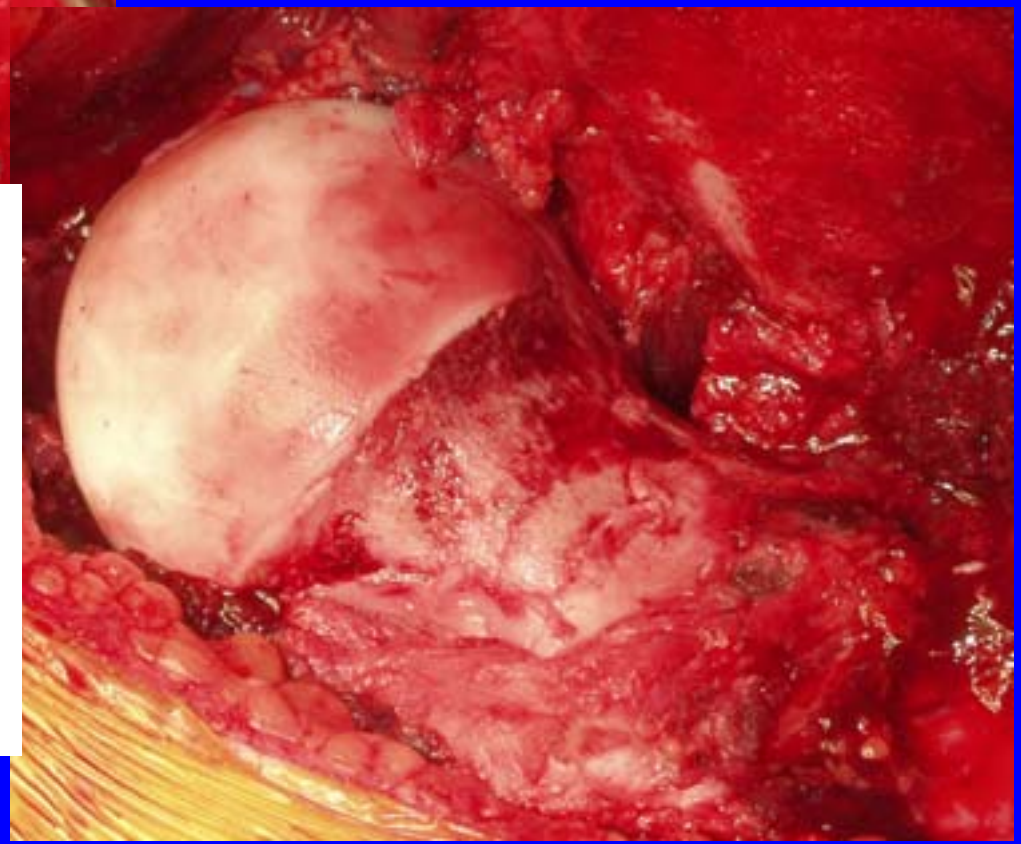
10/16/2001
Order 2670976



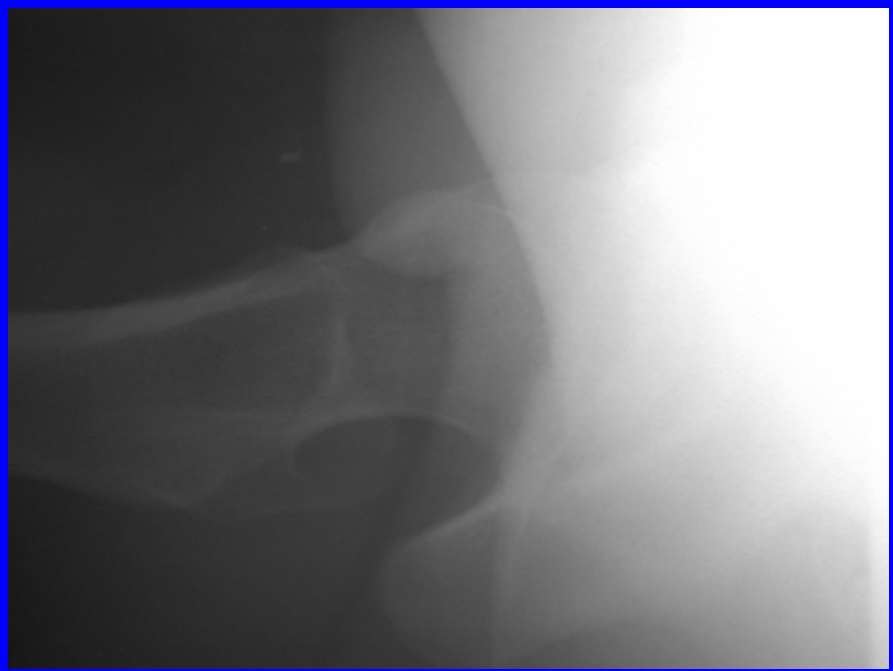




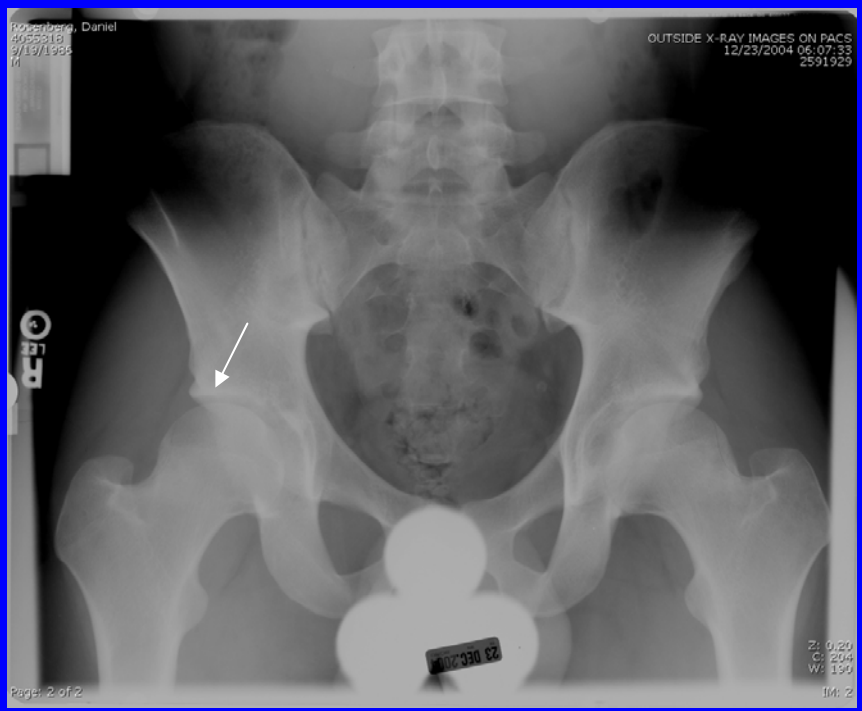


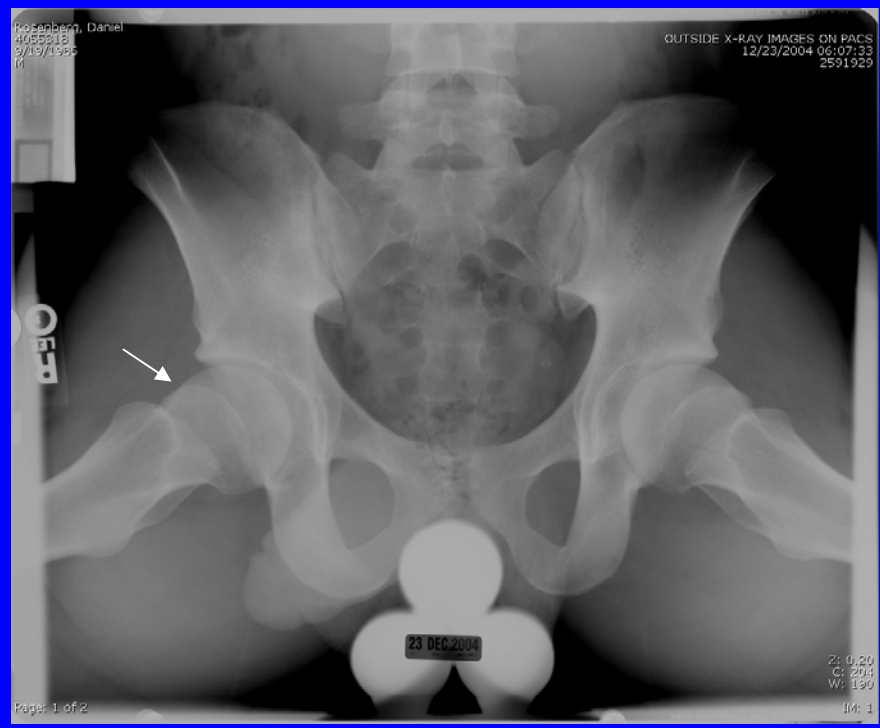


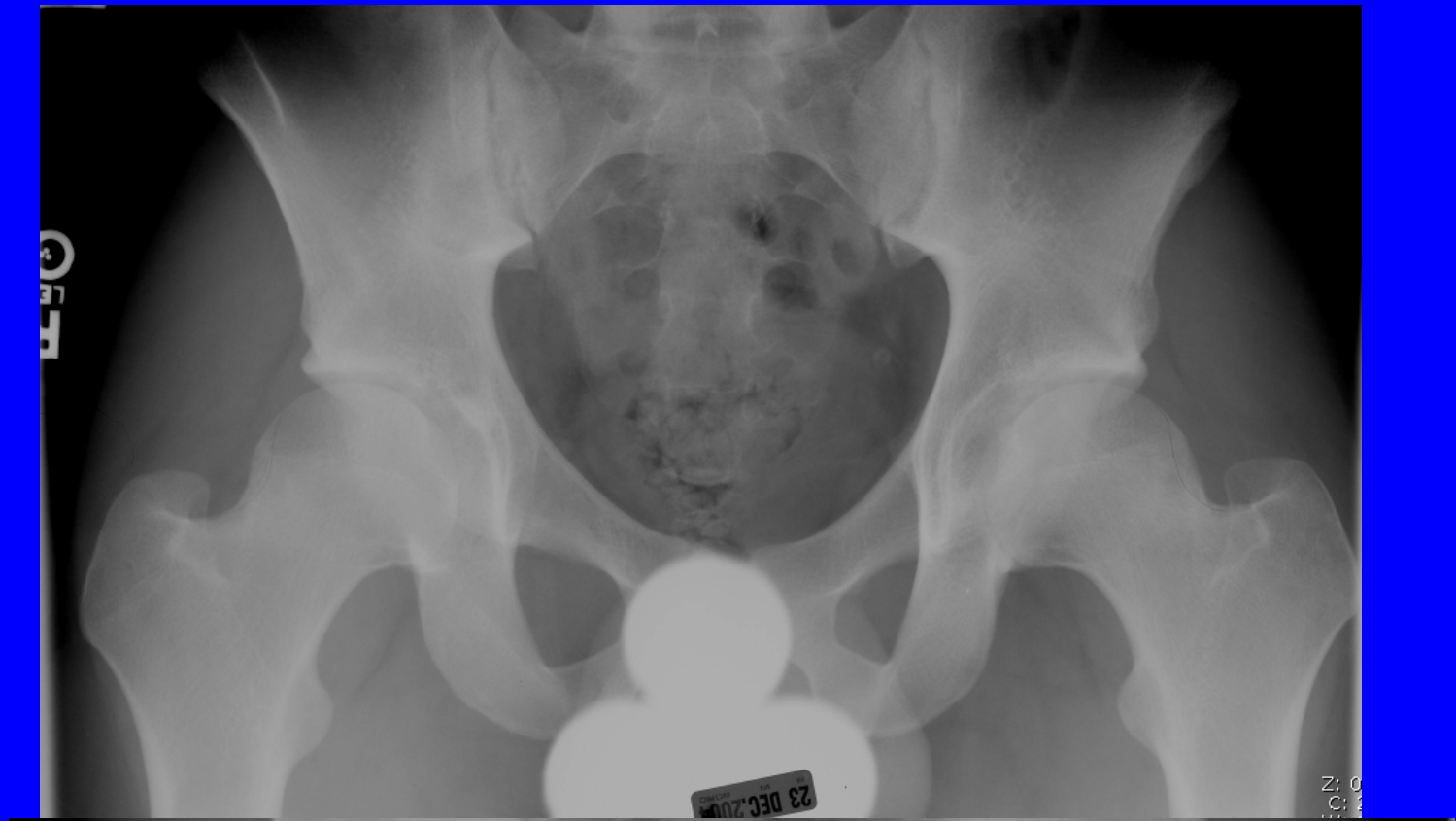
Pre-op, postop offset creation by neck osteoplasty



- 20 yo hockey goalie; 5 yr hx groin pain sitting; increasing groin pain with sports
- Flexion 90 degrees; IR 0 degrees
- XR: crossover sign **and** neck "bump"



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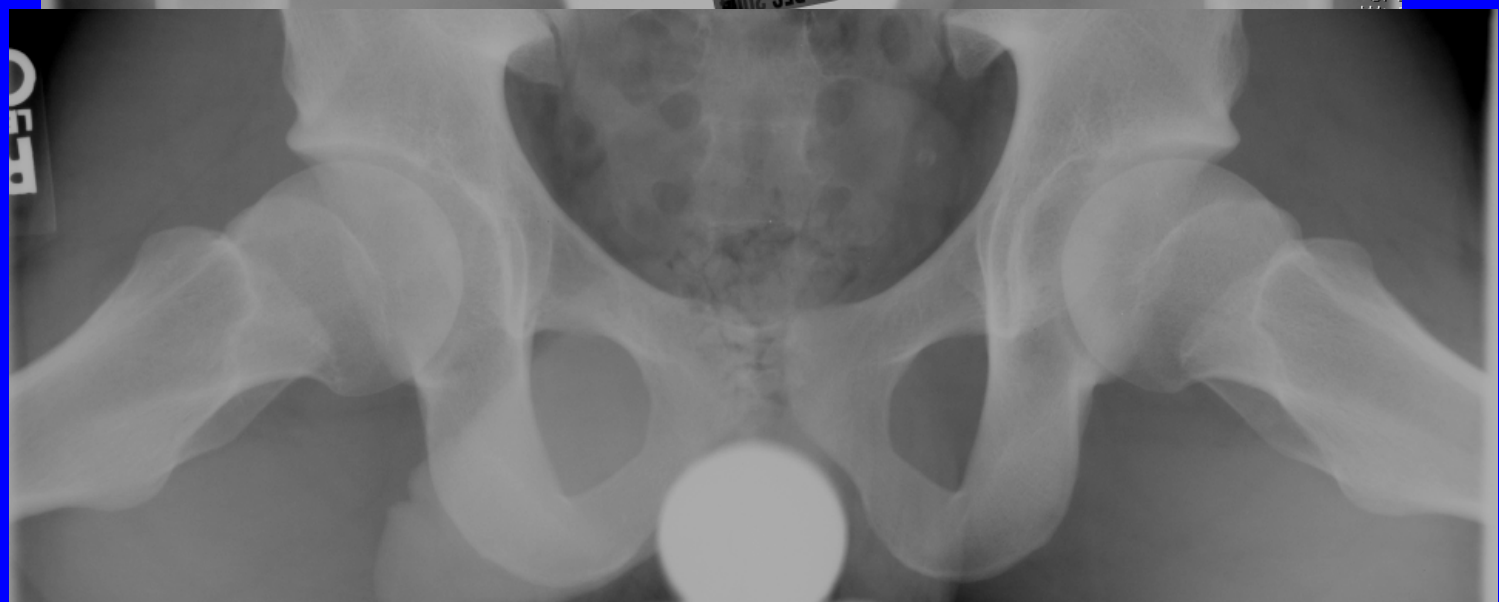
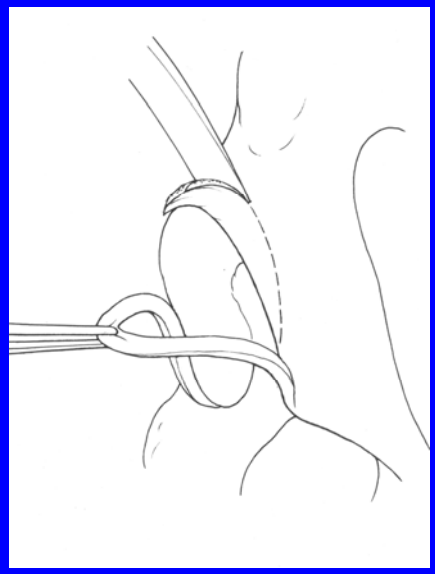
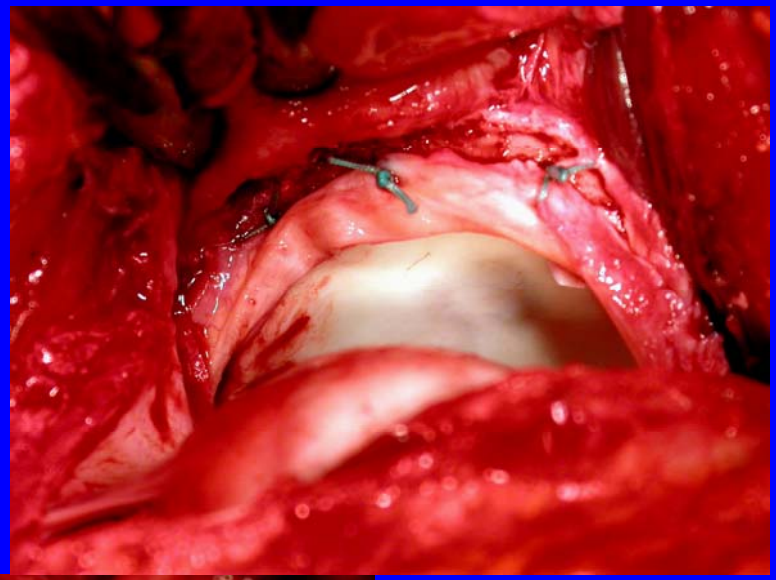
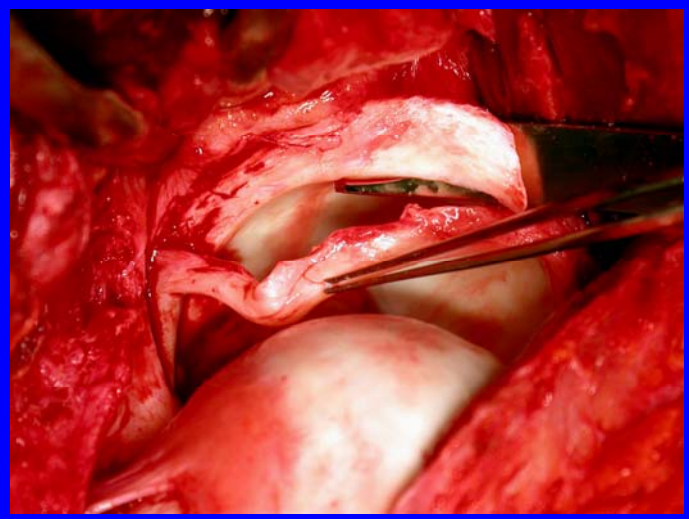
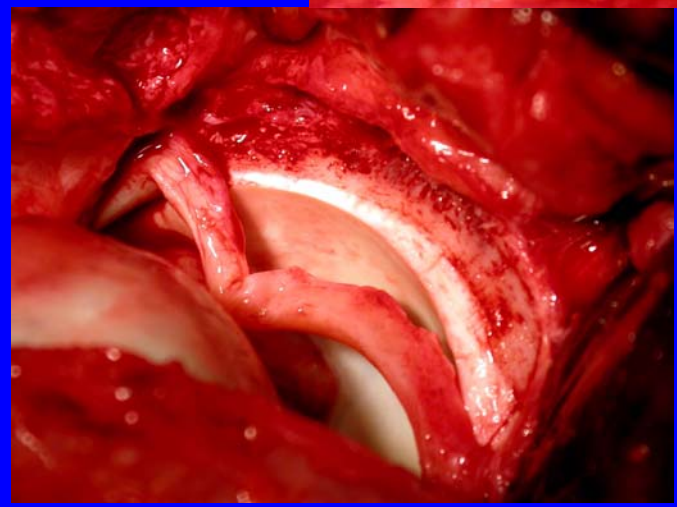


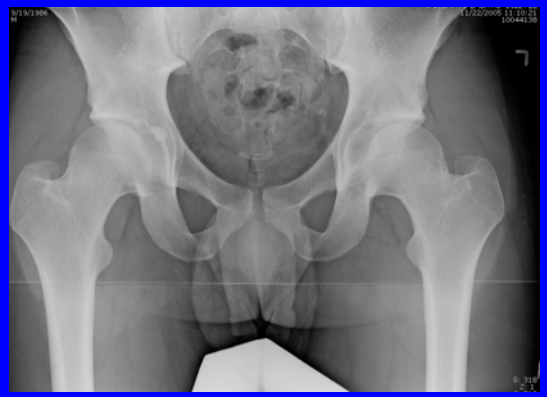


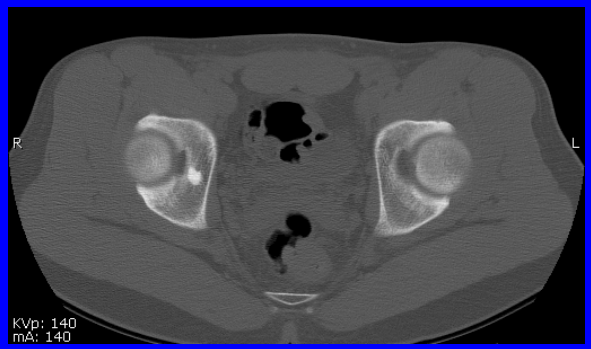






- Acknowledgement to Professor R.Ganz for inspiration, guidance, and intraop photos

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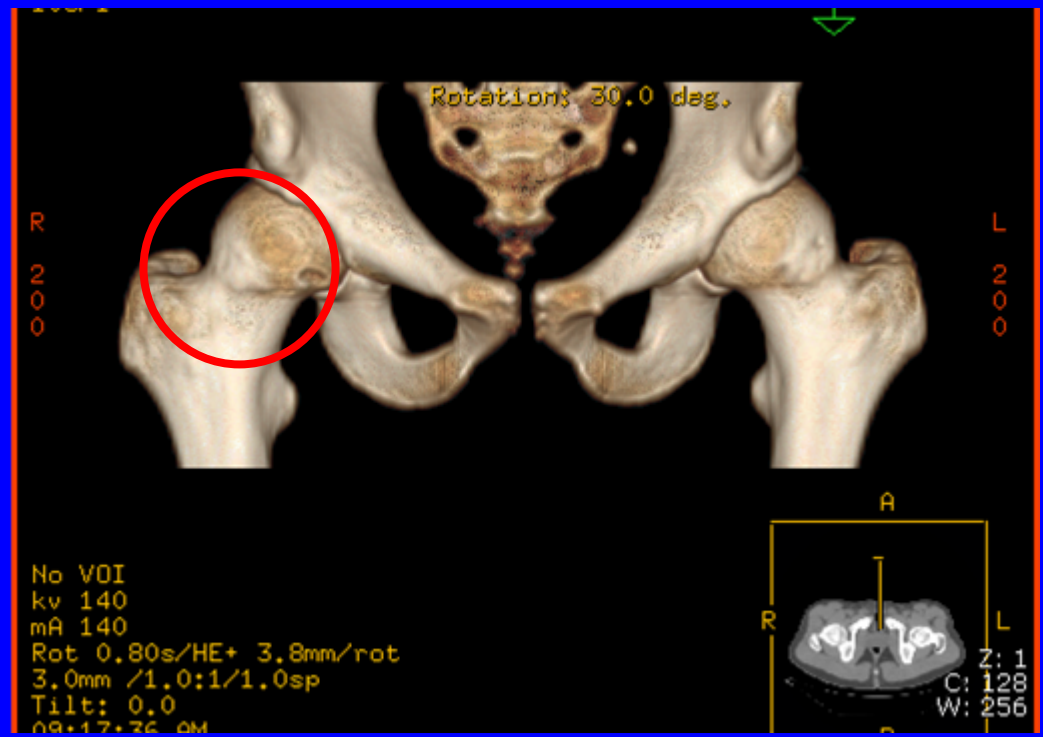
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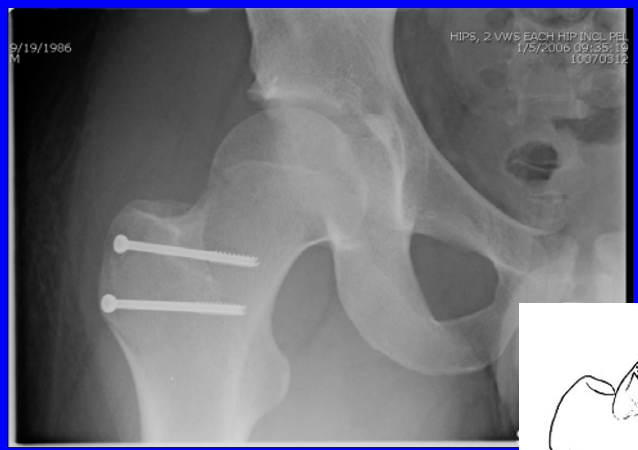
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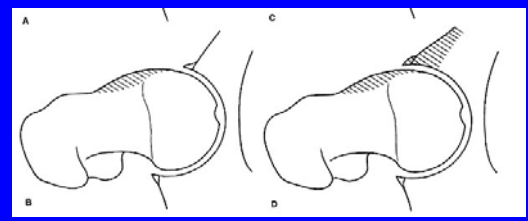
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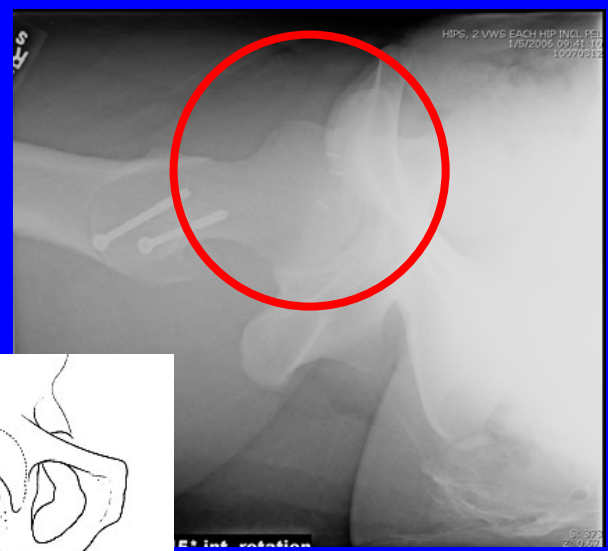
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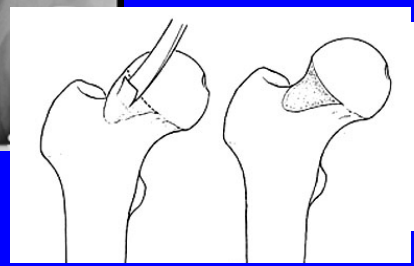
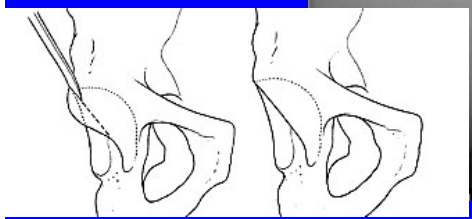
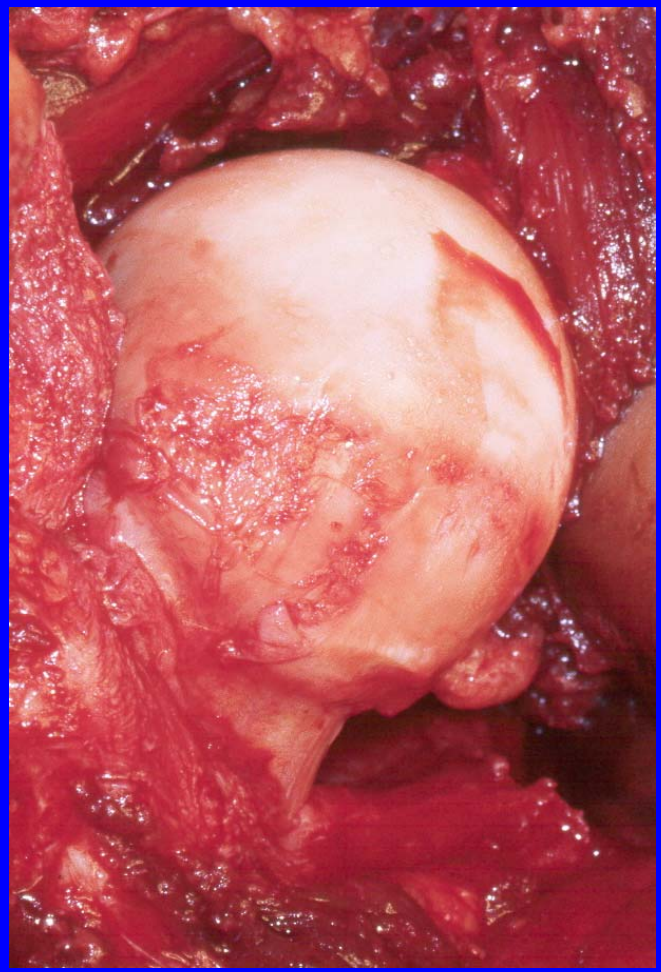
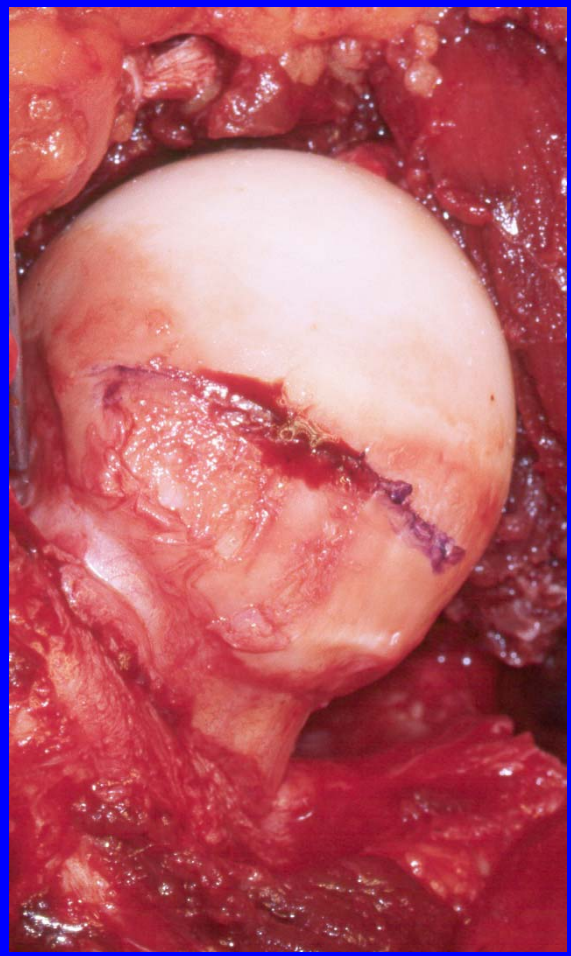
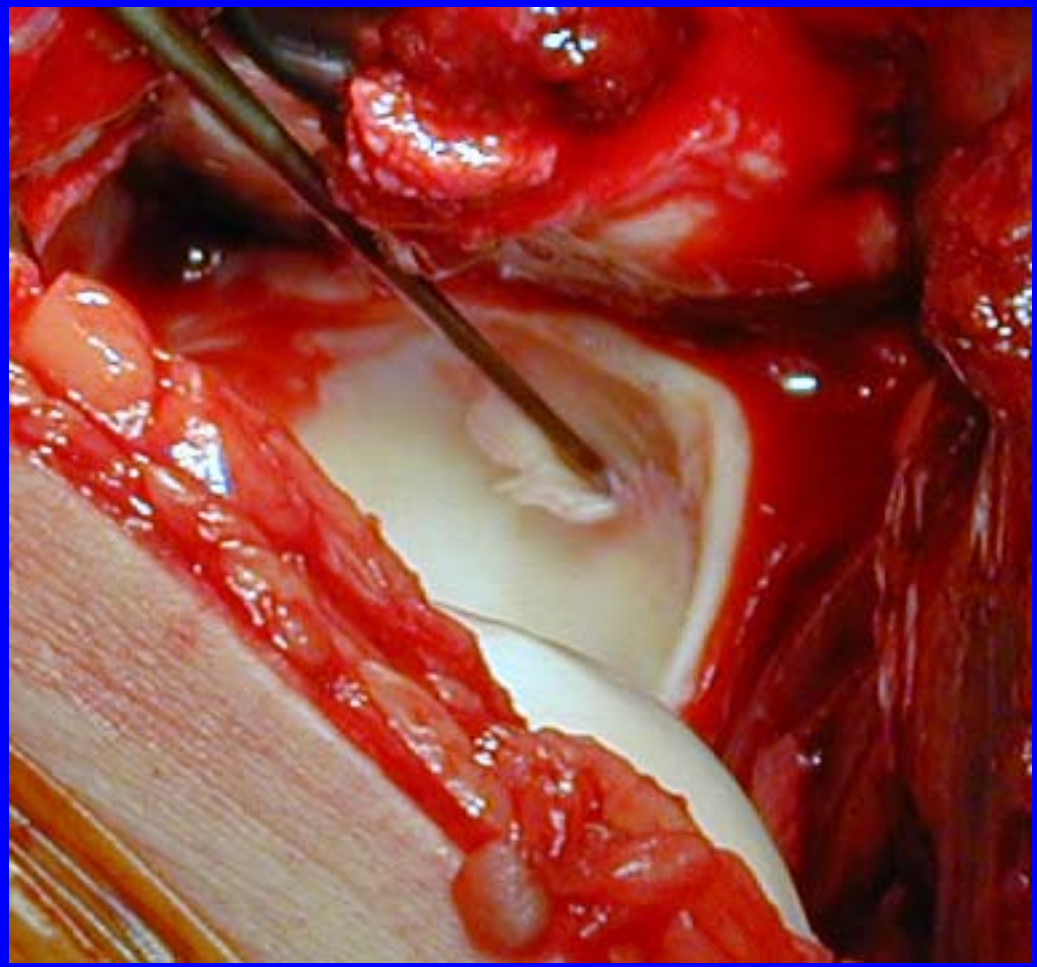




SCFE - osteoplasty


Cartilage Delamination due to Impingement

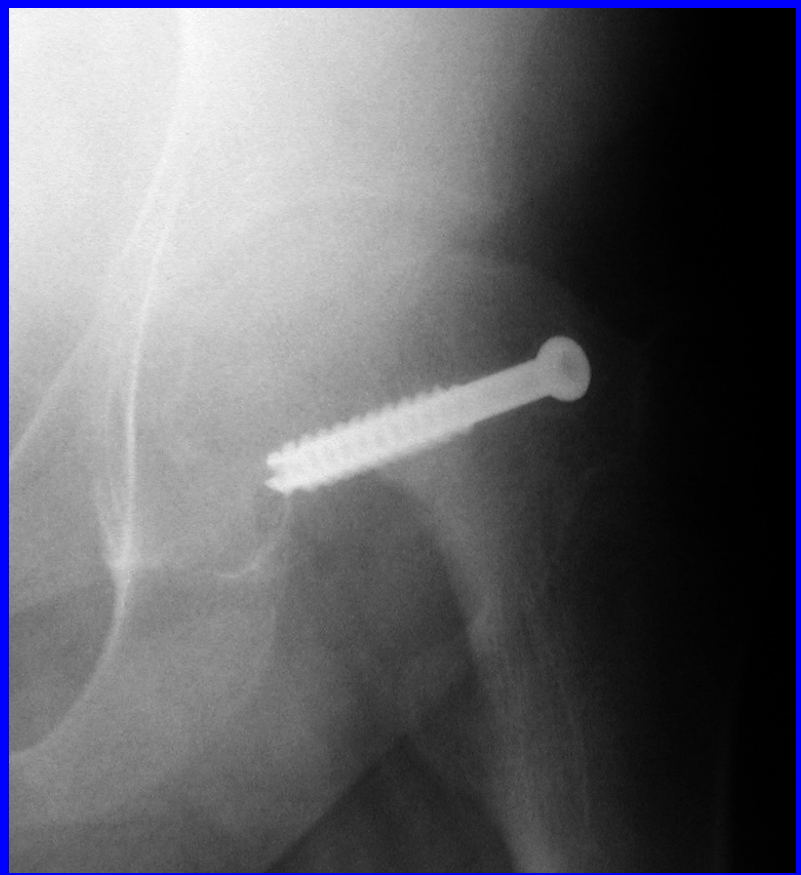


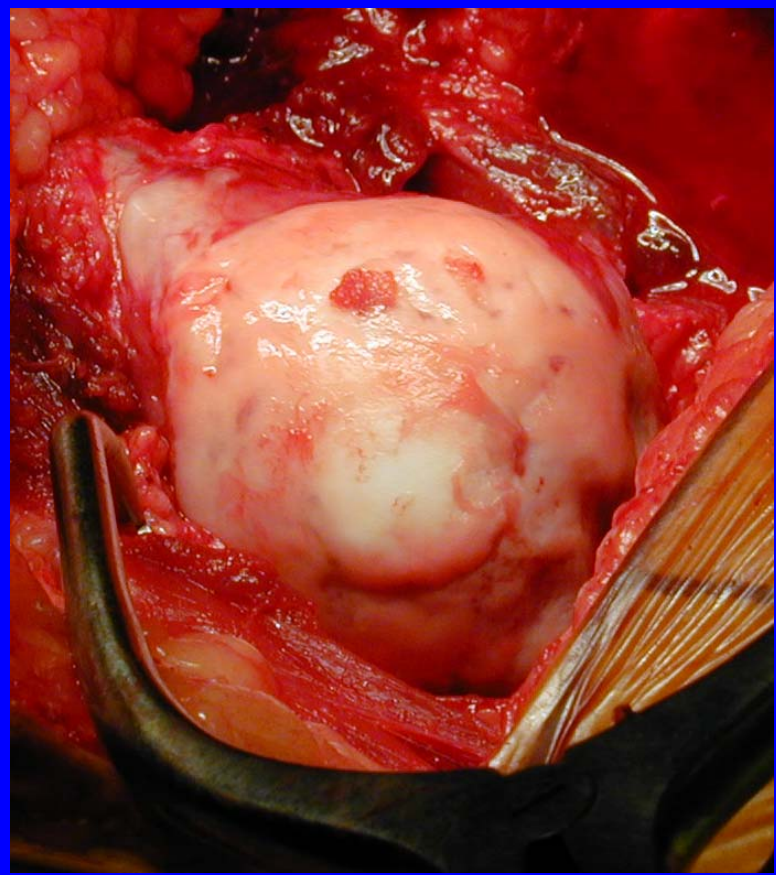
Points on Femoro-Acetabular Impingement

- FAI is common, but commonly MISSED!!
- Cam and pincer combination is **much** more common than either alone!!

  (Beck et al: JBJS 87-B: 1012-1018, 7/2005)
- Late treatment and undertreatment seem the commonest causes of treatment failure

Outcome depends on pre-existing damage in joint!



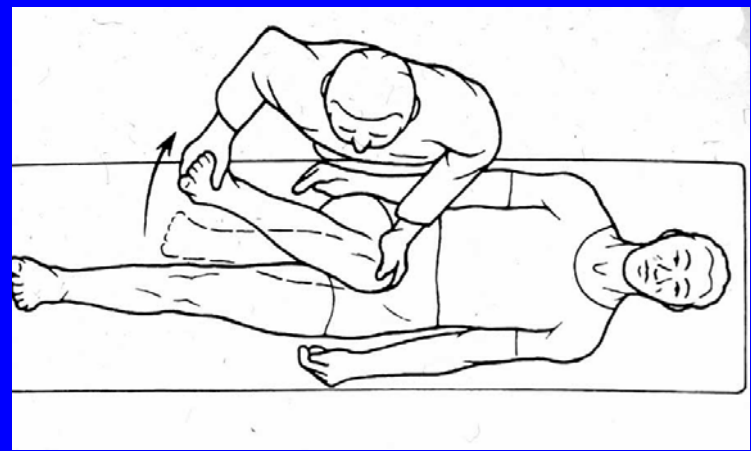


Clinical Evaluation for Femoro-Acetabular Impingement

- History: Groin ache worse with flexion
* Physical Exam
  * **1. Limited flexion**>lim int rot>lim abd

    OFTEN<90°!!
  * **2. Passive ER>>IR!!!**
  * 3. Anterior Impingement Test

    (pain on passive F/Add/IR)



Hip Joint-Preserving Techniques

Extra-articular

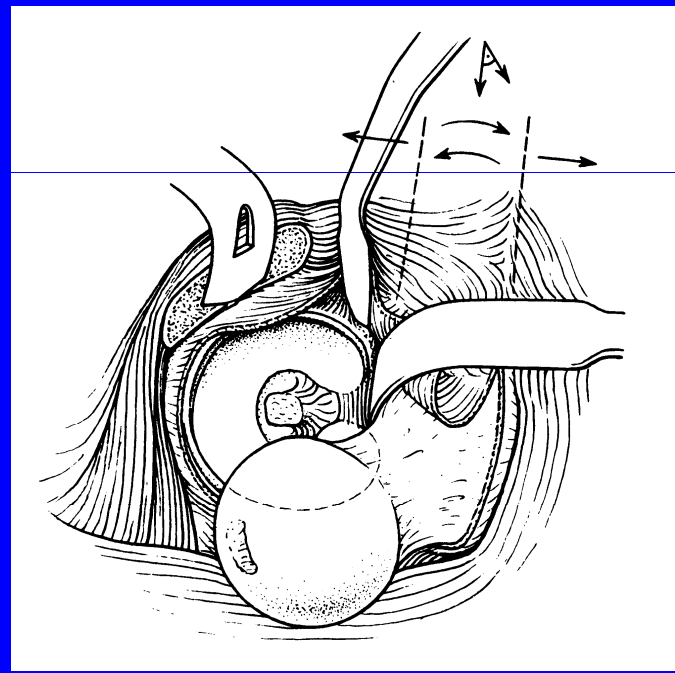
- Classic Osteotomy
  - Prox. Femoral (ITO)
  - Pelvic (PAO, etc.)

Intra-articular

- Arthroscopy
- Anterior Arthrotomy
- Surgical Dislocation

Points on Surgical Dislocation Approach

- Is an approach rather than a specific procedure
* Allows extensive **dynamic** intraarticular assesment
* Full dislocation **not** mandatory
* Associated ITO possible
* Vascularity to femoral head is reliable and easily protected
* Results depend on primary problem

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Hip Arthroscopy

- What it IS: A surgical approach to the hip joint, with special(evolving!) instrumentation, which allows “closed but visible”intra-articular surgery
- What it is NOT:

  NON-invasive/atraumatic

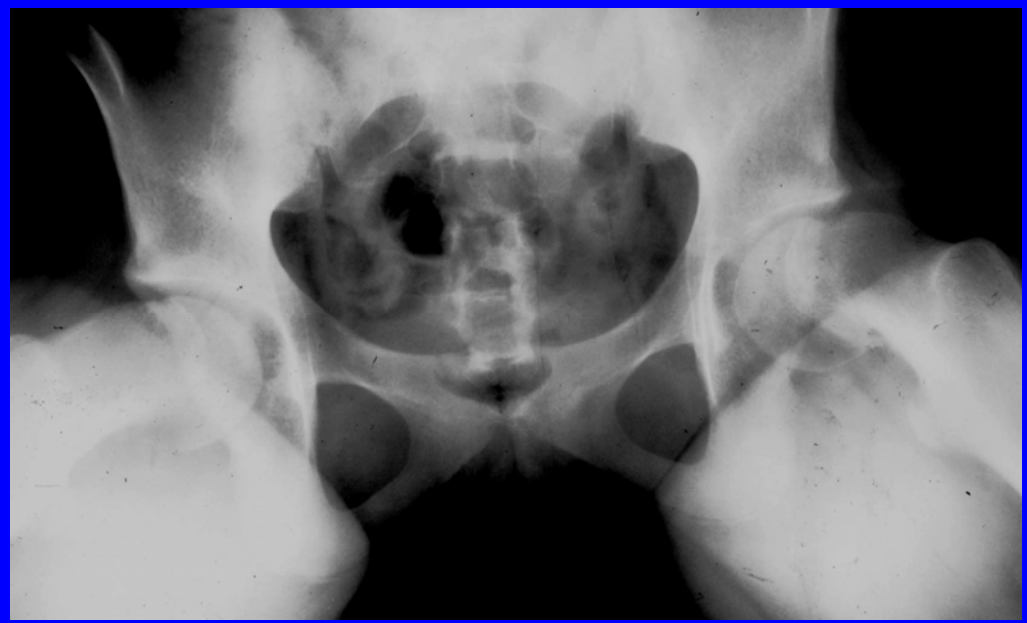
  Technically easy/user-friendly

  Useful for malalignment problems

  Magic

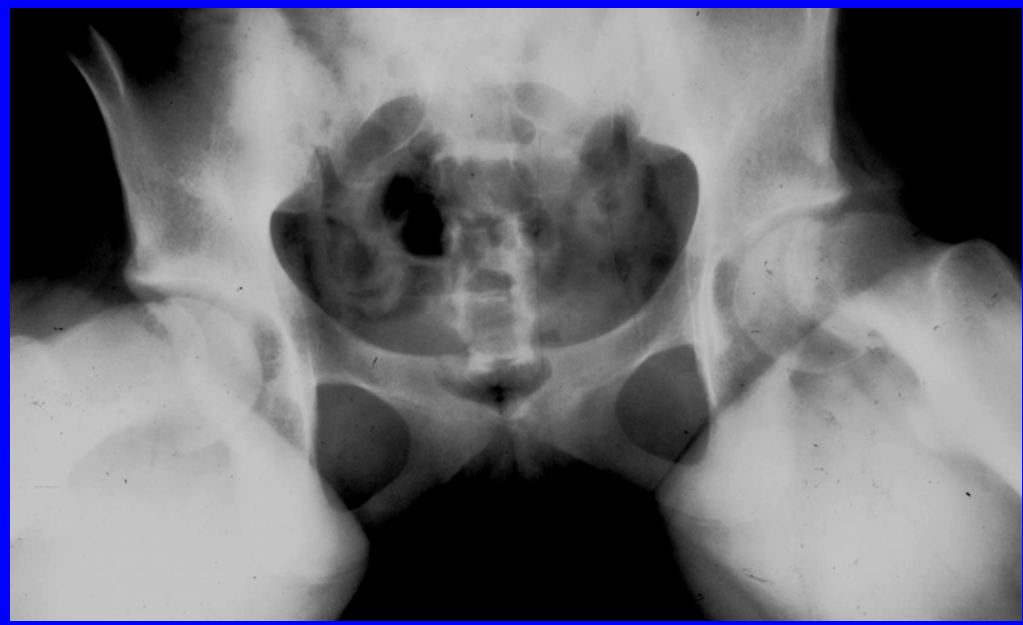
Extra-articular Impingement Relief for SCFE by ITO

- Severe impingement in flexion from neck bump and posterior head tilt; can't sit well
- Rim changes on XR; risk for arthrosis



Slipped Capital Femoral Epiphysis

- 14 yo F with L>>R groin pain with sitting; <80° L hip flexion, no IR; 90° R hip flexion
  - XR: healed slip R; nearly healed slip L



Slipped capital femoral epiphysis

Early mechanical damage to the acetabular cartilage by a prominent femoral metaphysis

Michael Leunig[1], Mark M Casillas[1], Marc Hamlet[1], Othmar Hersche[1], Hubert Nötzli, Theddy Slongo[2] and Reinhold Ganz[1]

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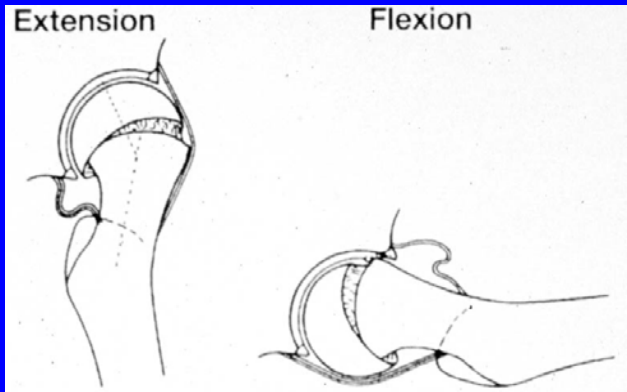
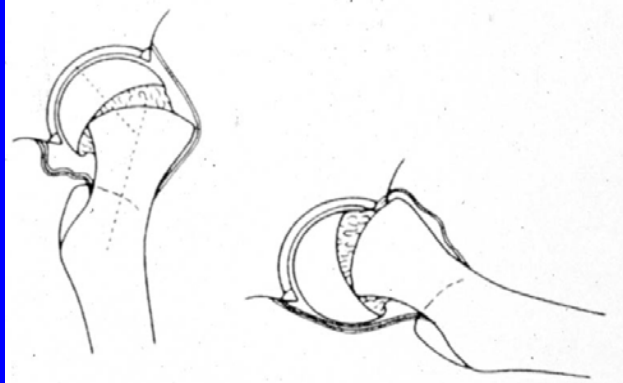
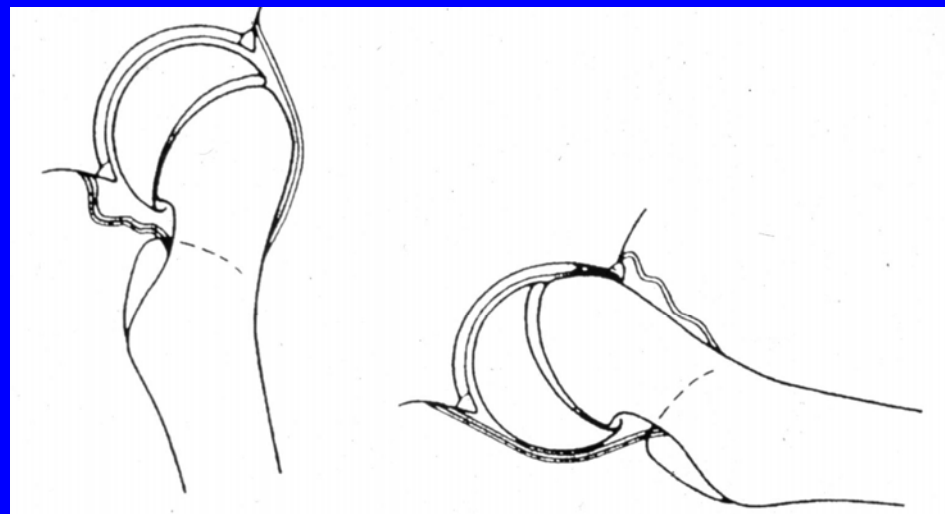
Submitted 99-04-09. Accepted 00-03-07



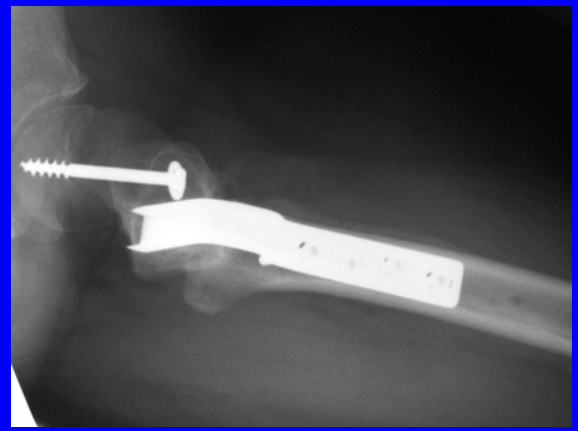
Mild-to-moderate SCFE causes jamming of the femoral metaphysis against the acetabular cartilage in flexion.

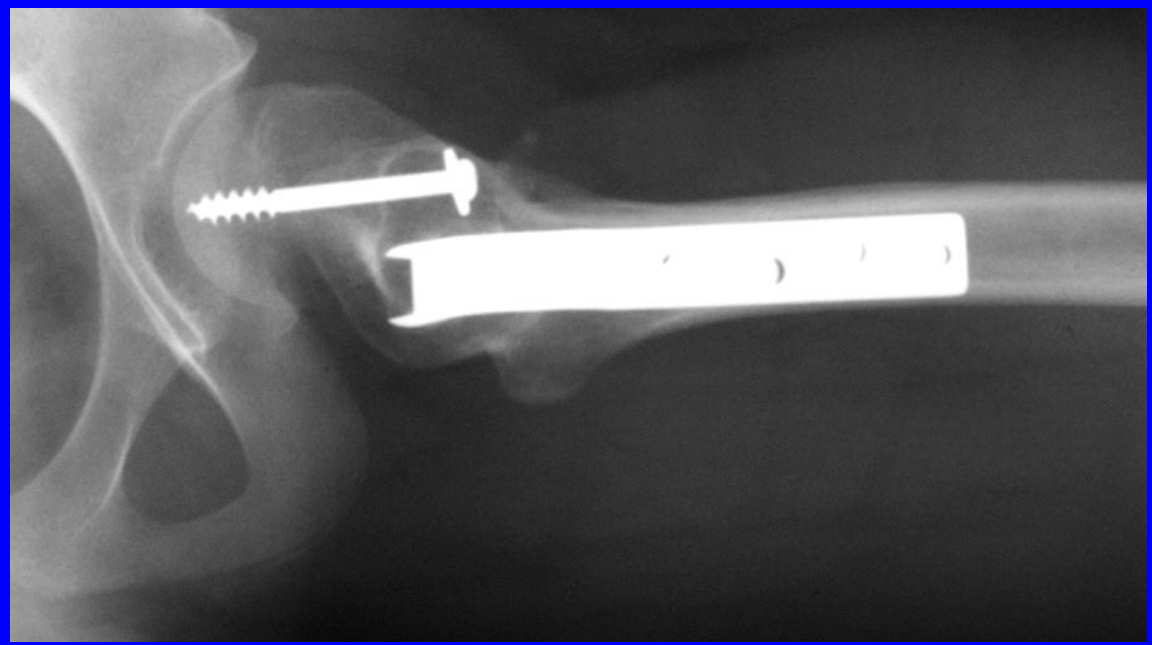


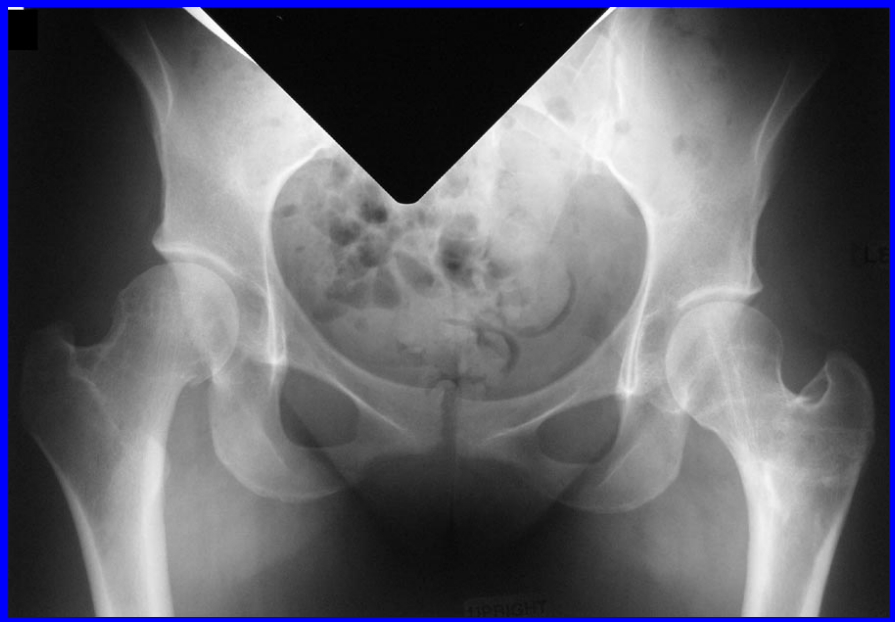
Severe SCFE with an impingment of the femoral neck against the acetabular rim in flexion.

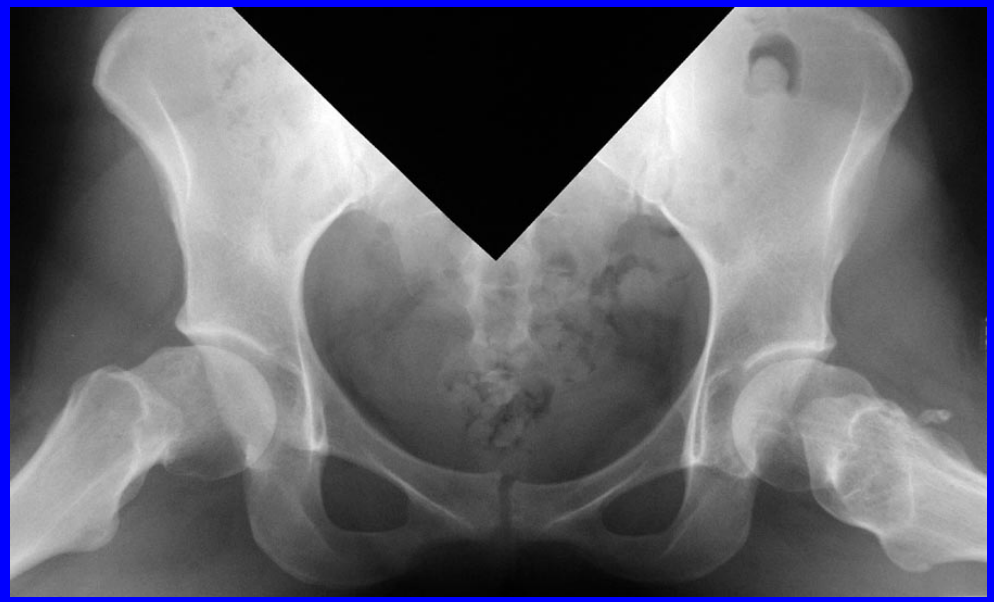


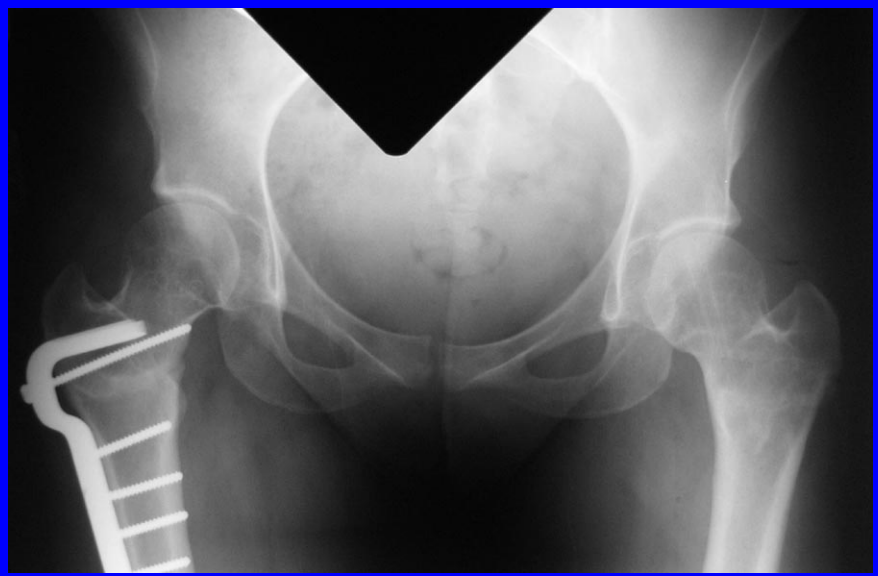
Severe SCFE after remodeling showing reappearence of jamming in the constrained hip joint.



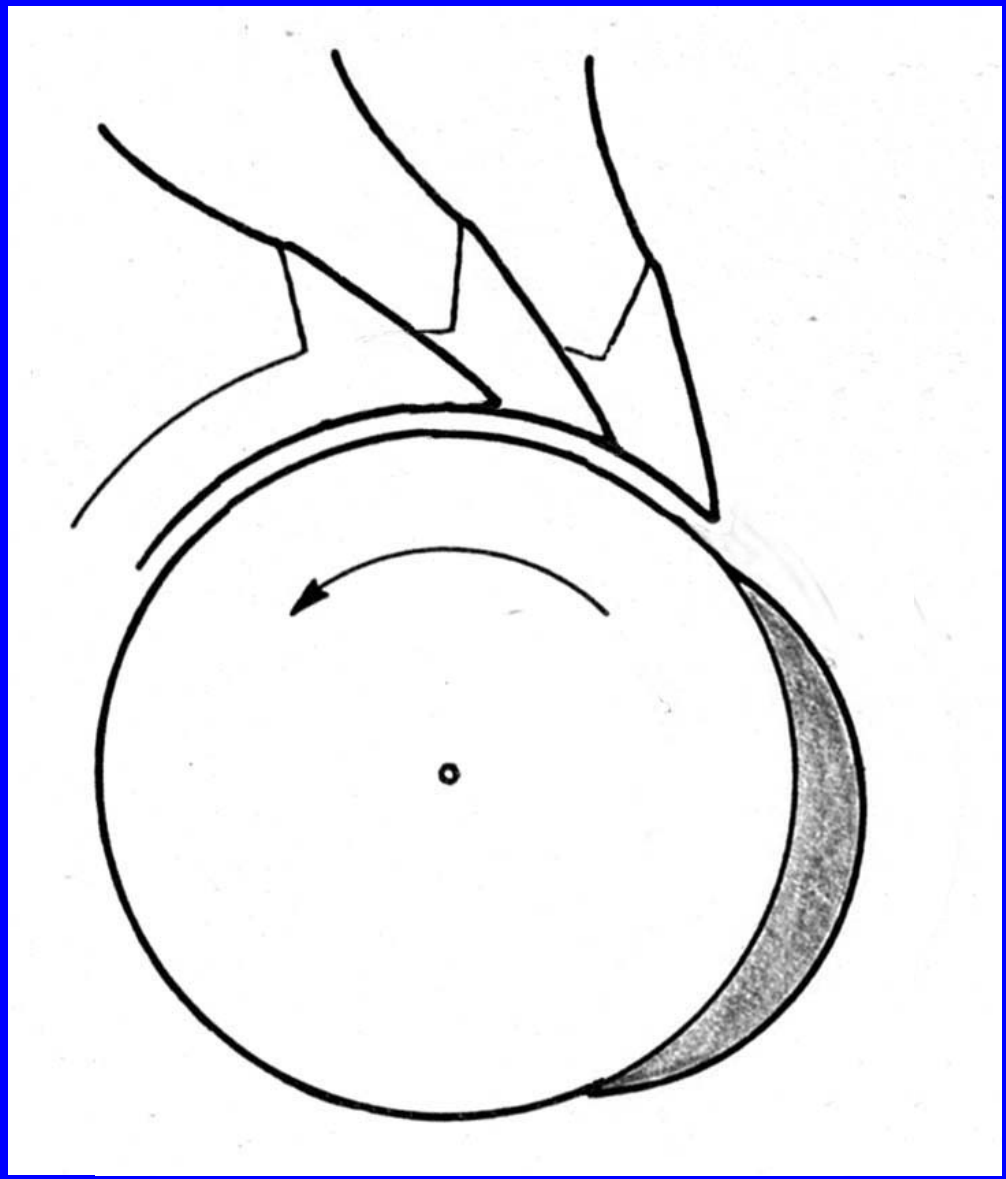








Anterior femoro-acetabular impingement



Acetabulum

Overcoverage with retroversion

Deep acetabulum

Femur

Non-spherical head

Malalignment of head-neck


YOU ARE
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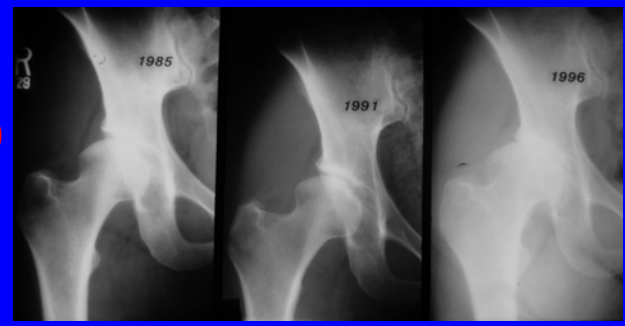
Etiologies of Hip OA in North America-UPDATED



* ***Dysplasia*** ***43%***

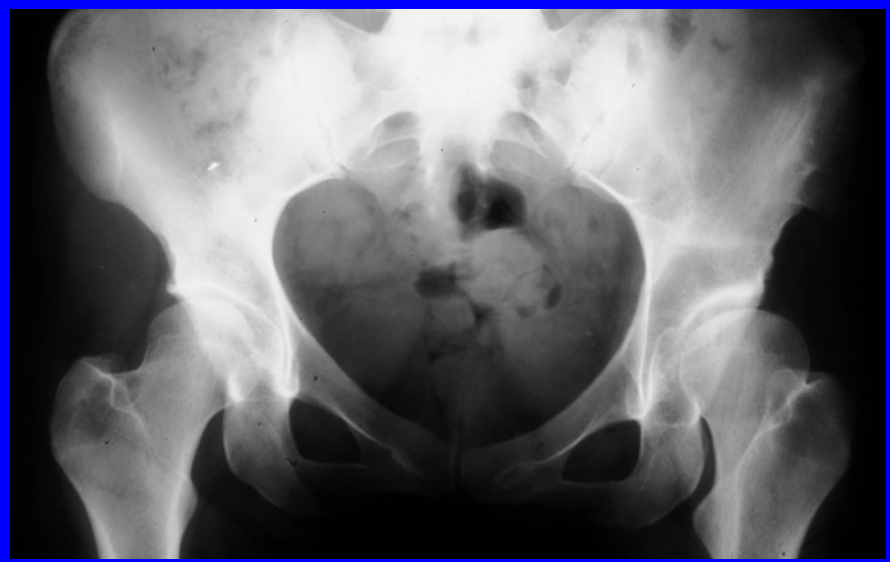
- Perthes-Impingement 22%
- SCFE-Impingement 11%
- Non-Perthes, non-SCFE FAI >10%?
  "Impingement-related" 43%?

- Idiopathic + Other 16%

(modified from Aronson, 1986)

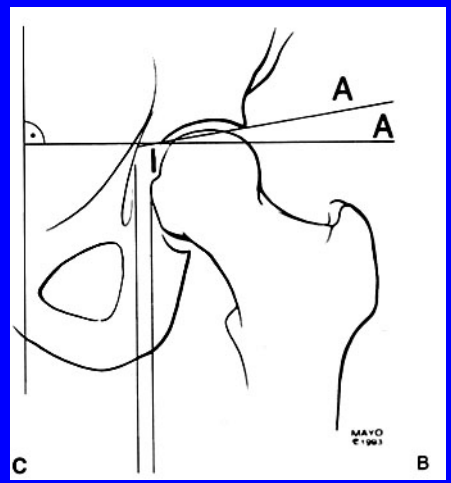
Major Points about Hip Dysplasia

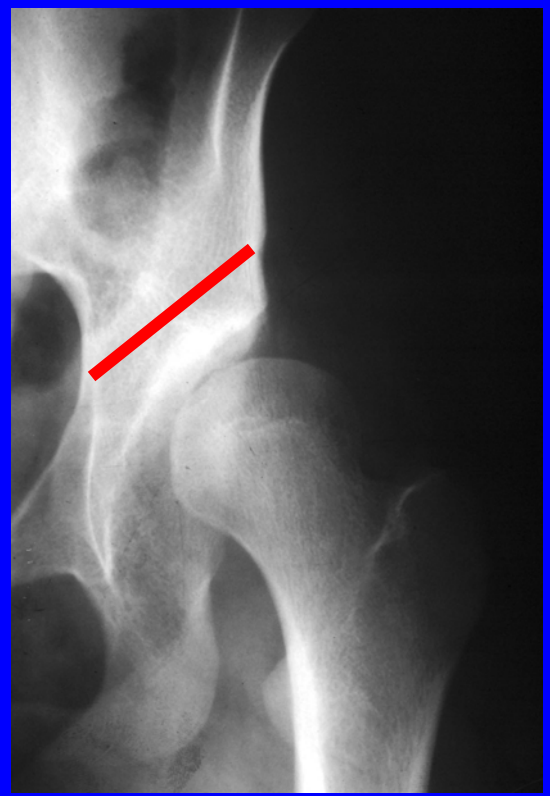
- DDH is commonest etiology of hip OA in the Western World and Japan
- DDH commonly 1st presents in adulthood
- Instability is a major mechanical lesion DDH
- Acetabular rim syndromes reflect intra-articular pathomorphology
- Intraarticular surgery has a place in DDH treatment



DDH: Primary Anatomic Characteristics

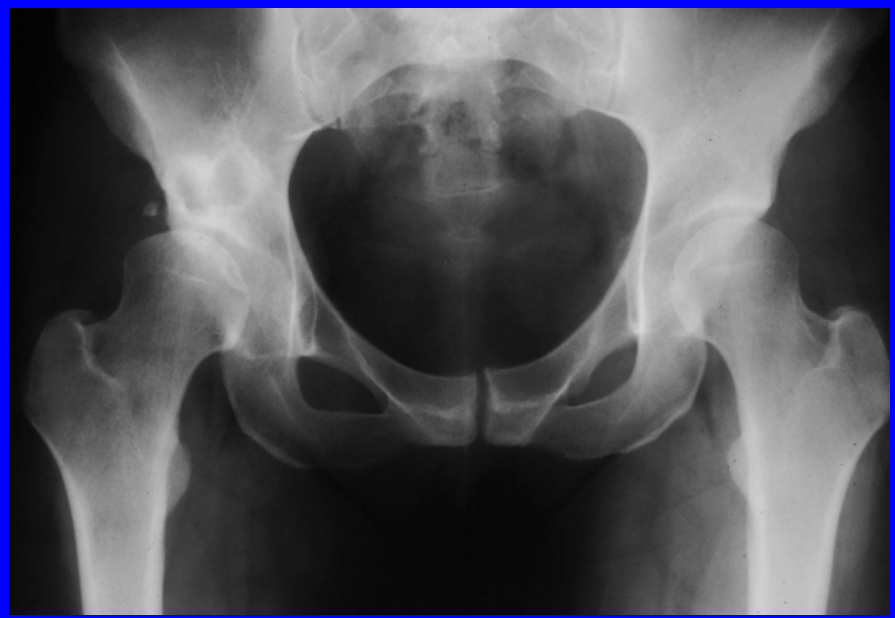
- Acetabular dysplasia
  - * Obliquity of the weight –bearing zone (sourcil)
    - NB: **Normal sourcil tilt is <10°**

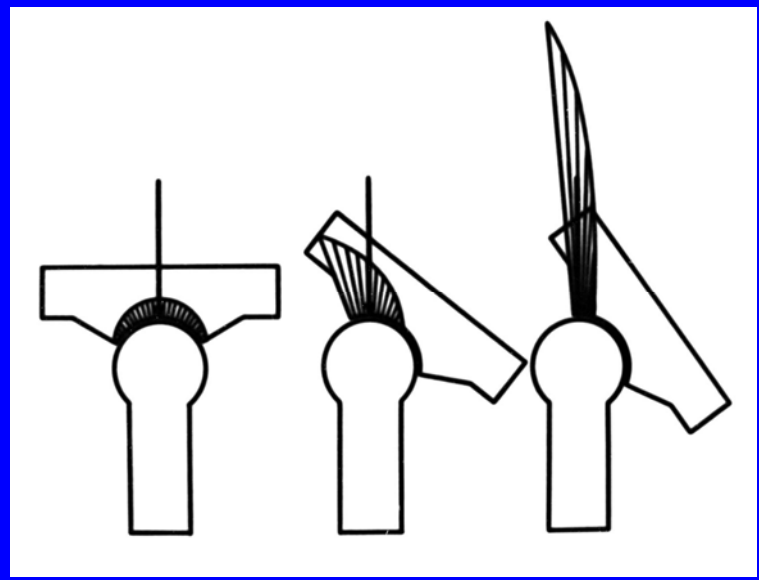




MechanicalCharacteristics of DDH

* Static overload of rim: local stress concentration
* Dynamic instability: shear forces



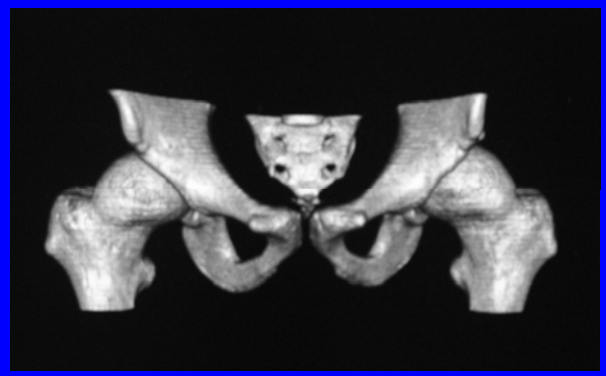


Clinical Evaluation of the Patient with Hip Instability

- History/Sx: early--**trochanteric ache or limp**
  - Groin ache is a later symptom of rim overload
  - Acetabular rim syndrome: sharp pain, instability
* Other dysplasia symptoms are from anterior instability and are often worst when hip is extended or externally rotated
* NB: Most impinging hips are most symptomatic in flexion.

Imaging Possibilities

- Plain radiography
- CT
- MRI



Plain Radiography: The Gold Standard

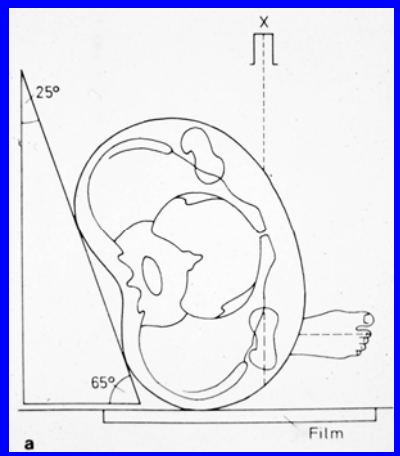
- AP View: coverage, congruity, subluxation, rims
  - Roof Angle/Tilt of sourcil (Tönnis angle): Normal is 0 to 10 degrees of valgus
  - Lateral center-edge angle: Normal > 25°
- Faux profil view
  - Anterior coverage: anterior C-E angle: Normal > 20°
- Functional views
  - Simulate surgical correction; look for possible impingement

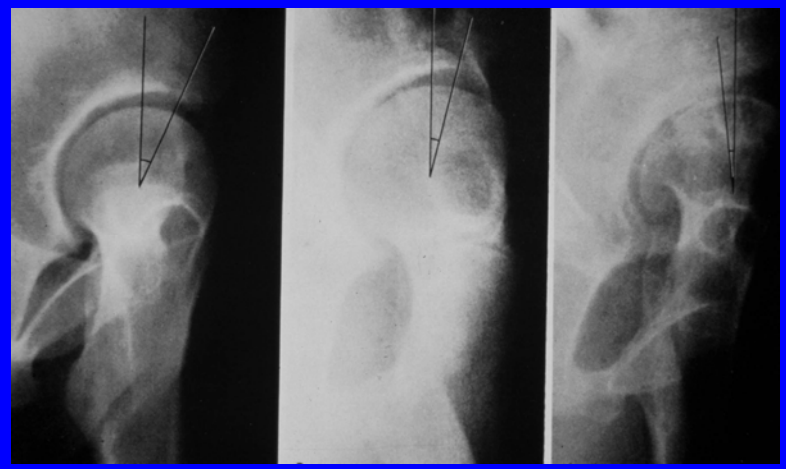
Imaging for Hip Dysplasia

- The <u>faux profil view</u>:

  a true lateral view of acetabulum; taken standing 25° off full lateral; shows any anterior uncovering and anterior subluxation (Lequesne; Tönnis, 1987)

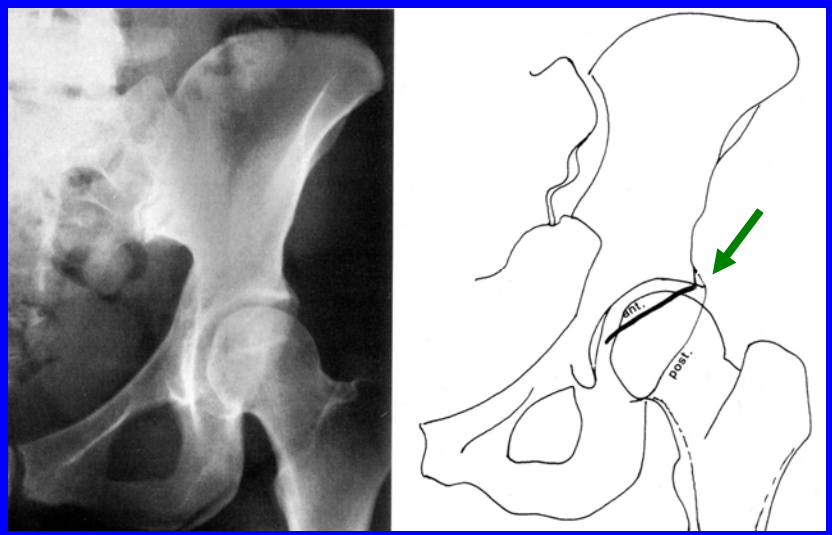
<u>Normal Anterior C-E angle>20°</u>

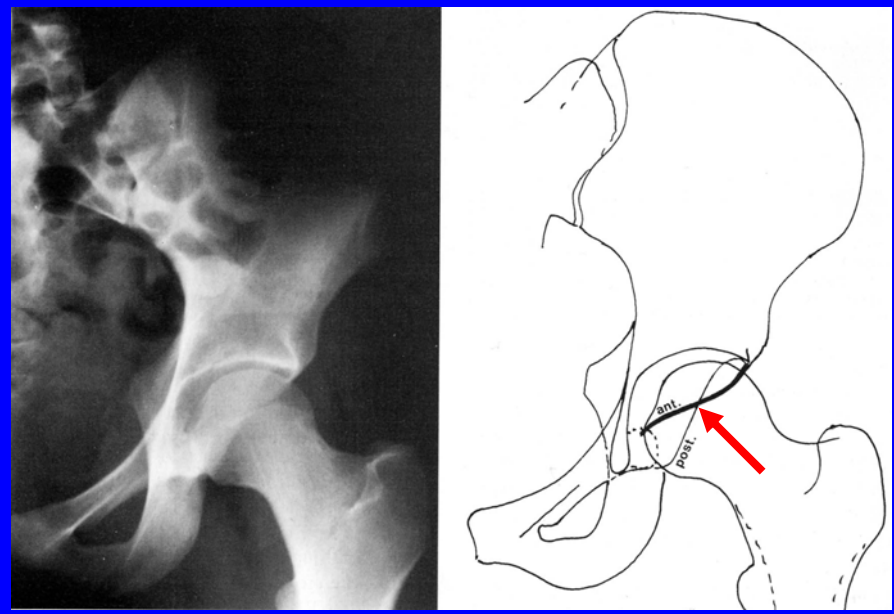




Acetabular depth and version

- Anterior and posterior rims: usually meet at lateral rim of acetabulum
* Crossover sign in retroversion: rims cross over one another
- Posterior wall: usually passes lateral to center of head
* Posterior wall sign in retroversion: posterior wall passes medial to center of head





Imaging for Hip Dysplasia

- Plain X-ray
- CT Scan: with distal femoral cuts, can determine femoral and acetabular version
* MRI: dGEMRIC with IV gadolinium; shows labrum; **assess GAG in articular cartilage**

YJ Kim et al: JBJS 85A:1987, 2003).

Indications for Joint-Preserving Therapy in the Mature Dysplastic Hip

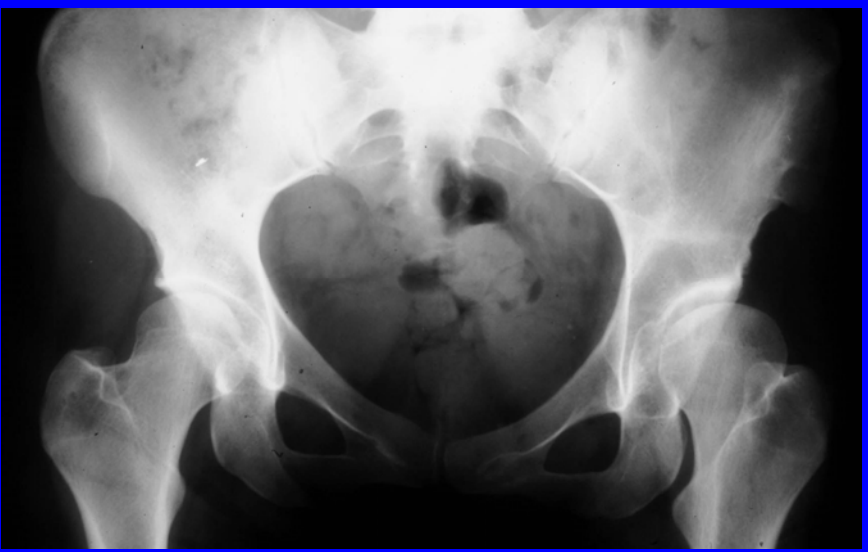
- Symptoms likely to be relieved
- Prognosis likely to be improved
- Joint preservation preferred over THR

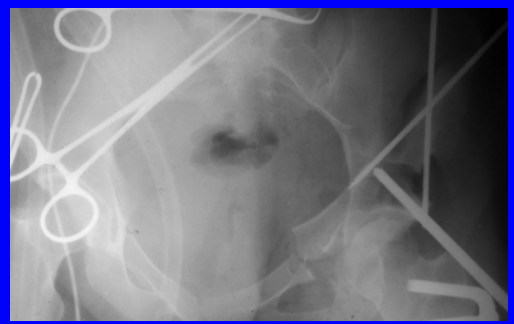
Treatment Goals in DDH:

- ✓ Create joint stability: Sourcil~horizontal
- * Avoid impingement: Preserve~90° flexion
- * Note: Balancing these goals may be difficult!

Site(s) of Correction

- Willy Sutton's Rule:
  "Go where the money is!"
  (Usually the acetabulum)





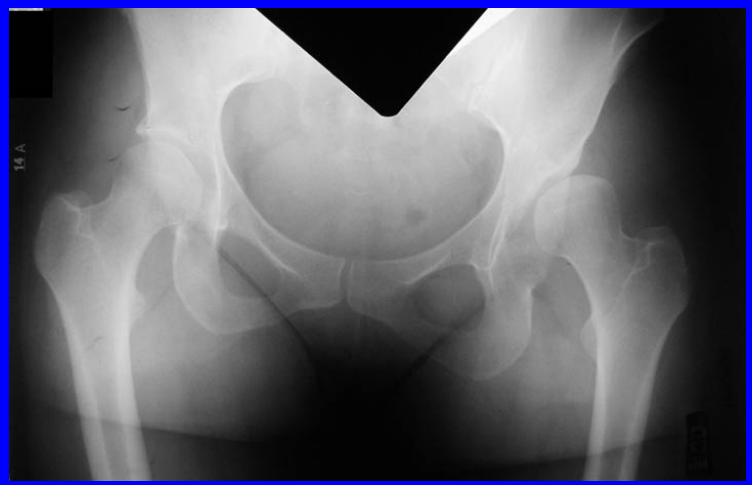
Surgical Rules for DDH

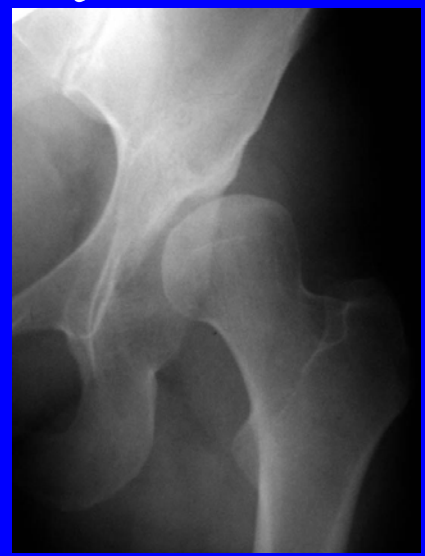
- Congruence is more important than coverage.
- Congruence is more important than coverage.
- Congruence is more important than coverage.
  (Impingement is worse than instability!)
- Think dynamically.
- Think in 3 dimensions.

* Balanced correction is the goal!

Acetabular Redirectional Osteotomy for Congruous Dysplasia

- Reorientation of hyaline cartilage: usual
  - Direction and amount individualized
- Medialization: IF joint is lateralized
- Augmentation: not usual
- Osteotomy type: many choices





Joint-PreservingTreatment of Congruous Dysplasia in the Adult

- Indications

  Pain

  C-E angle<20 degrees

  Arthrosis gr. 0-1; good ROM

  "Young", active patient

- Program

  Acetabular osteotomy

  +/- arthrotomy

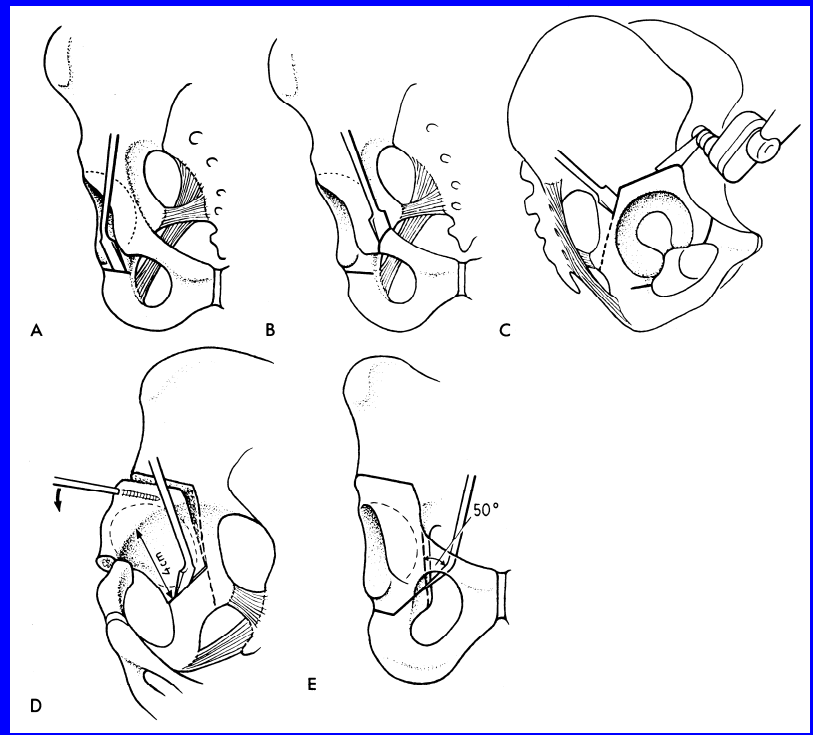
  * + **ITO:** Done along with acetabular osteotomy IF severe coxa valga or persisting subluxation after acetabular osteotomy

Bernese Periacetabular Osteotomy

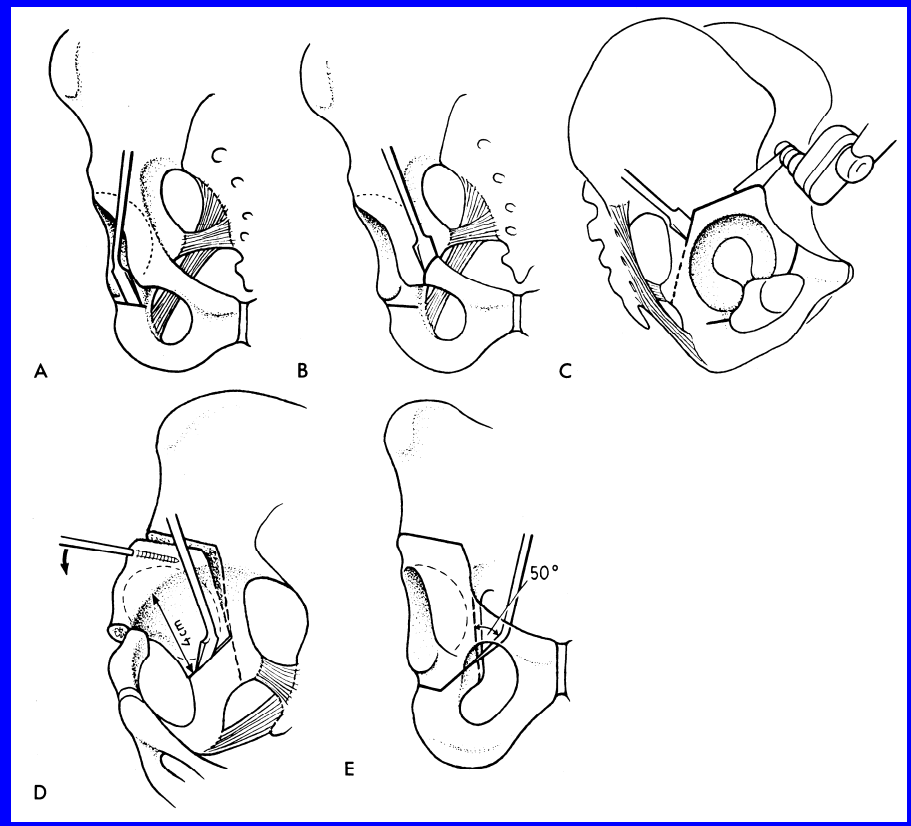
- Single incision; supine
- Abductor-sparing approaches
- Major multidirectional corrections possible
- Stable fixation/ early postop function

  (Ganz et al, CORR 232: 26-36, 1988;

  Siebenrock et al, JBJS 83-A: 449-455, 2001)



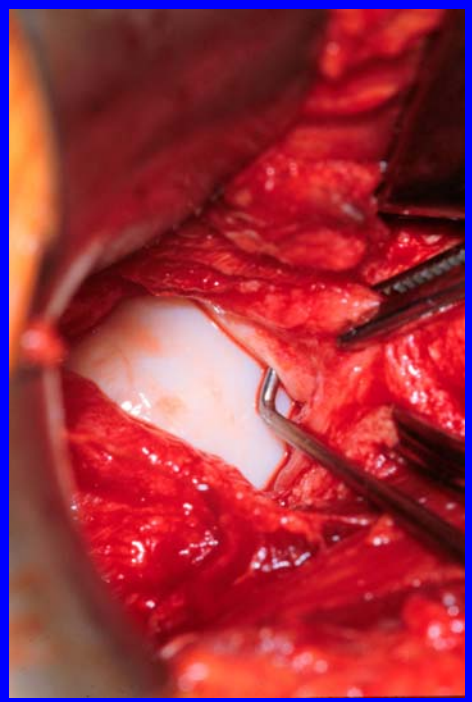
PAO

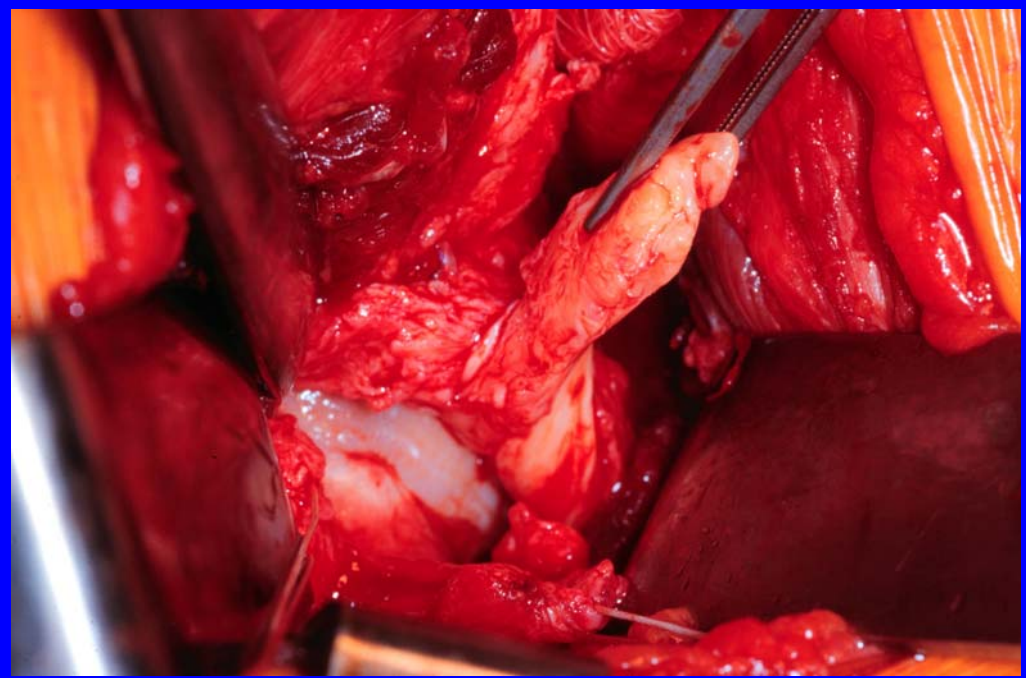


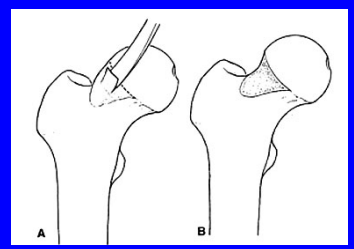
- Patient selection
- Preop
- Intraop
  - Approach
  * +/- **Arthrotomy**
  - Osteotomies
    ischium; SPR; ilium; post. column; post. ischium
  * **Positioning of fragment**
  - Internal fixation, soft tissue repair/closure
- Postop

Arthrotomy

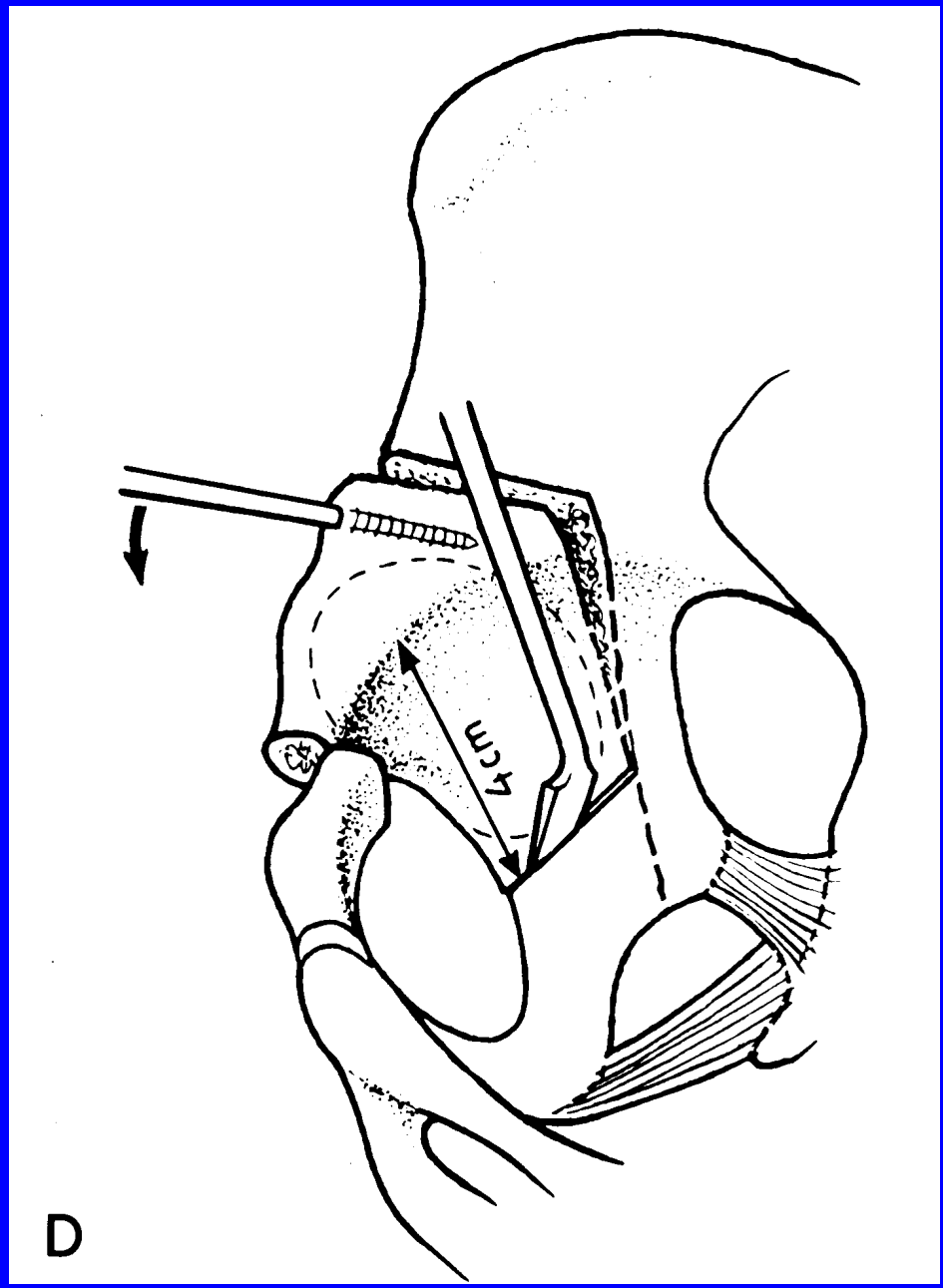
- Useful if labral sx, and to assess impingement
- Much less of a view than with surg dislocation
- Can see labrum and neck but not acetabulum
- Can easily do head-neck osteoplasty if needed







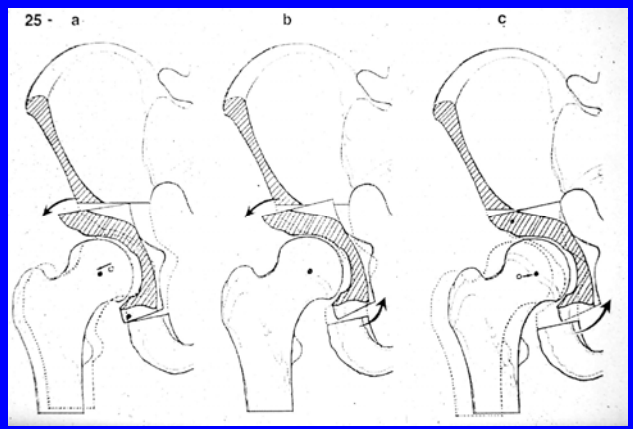

5
4
3
2
1
CM

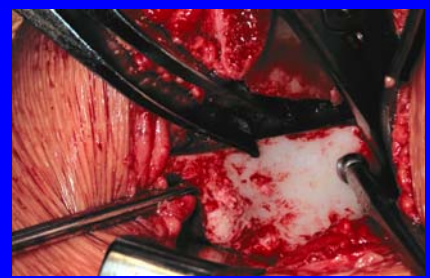

4 cm
D

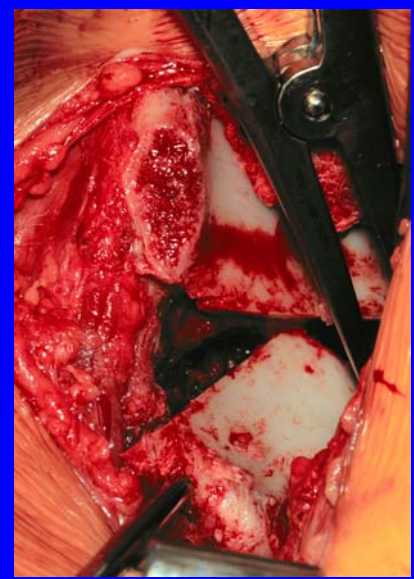
Correction/Acetabular Reorientation

- Schanz screw as joy stick to rotate acetabulum forward, increasing anterior coverage
- Bone spreaders, Weber bone clamp for control
- Rotate/adduct fragment as needed to further increase lateral coverage

* Avoid retroversion and lateralization

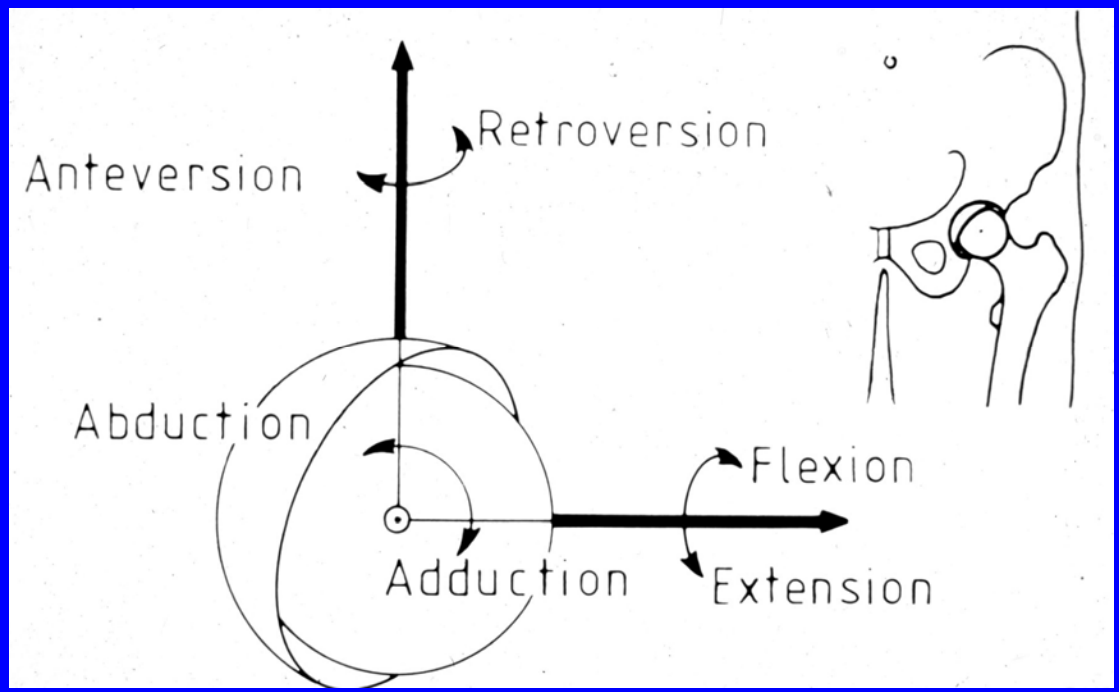


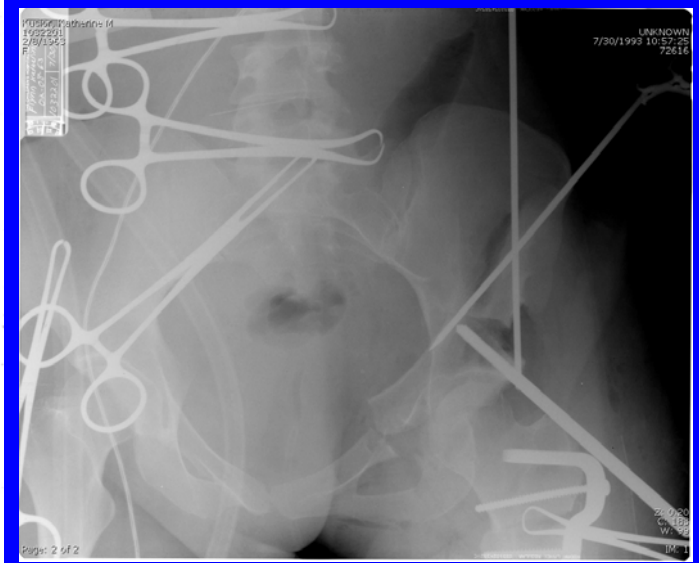




Positioning of the osteotomized fragment

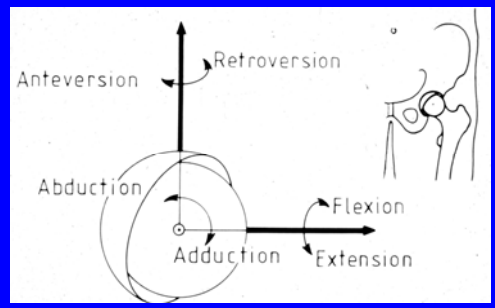
- **<u>This is the most important part of procedure</u>**
- Iatrogenic impingement must be avoided
  - Overcoverage/retroversion/offset issues

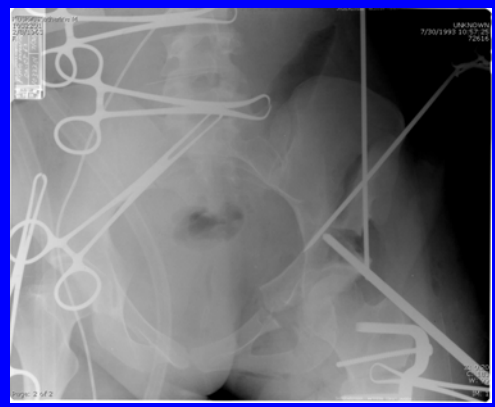


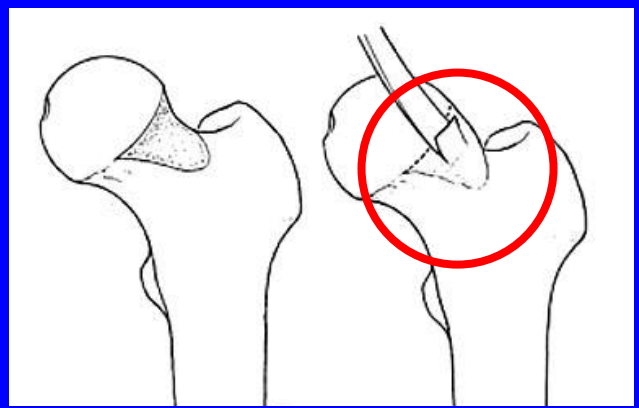


Positioning of the osteotomized fragment

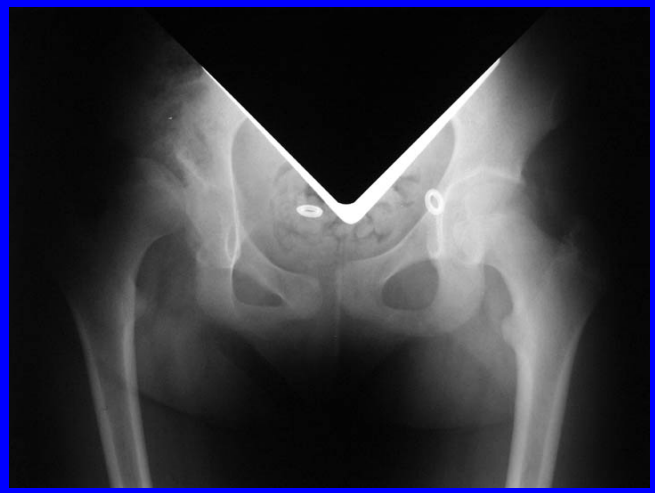
- **<u>This is the most important part of procedure</u>**
- Iatrogenic impingement must be avoided
  - Overcoverage/retroversion/offset issues
* After provisional fixation: confirm no impingement in 90 degrees of flexion !
* IF impingement, reduce correction or increase offset

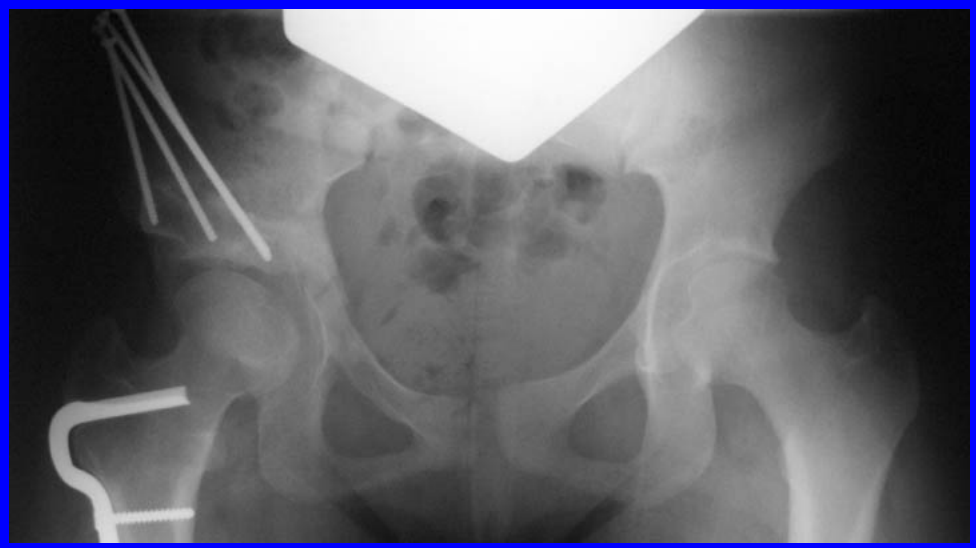




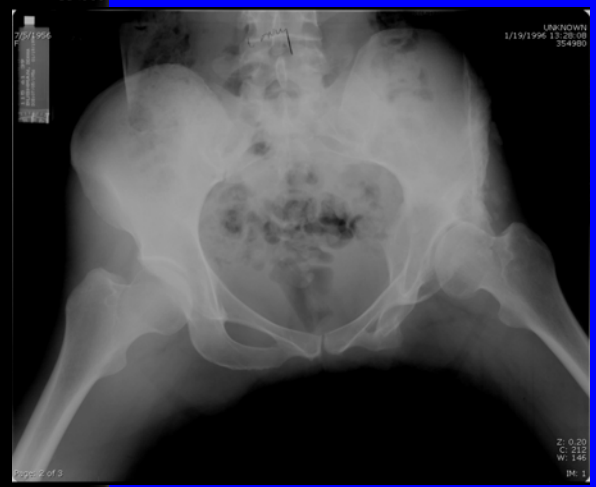


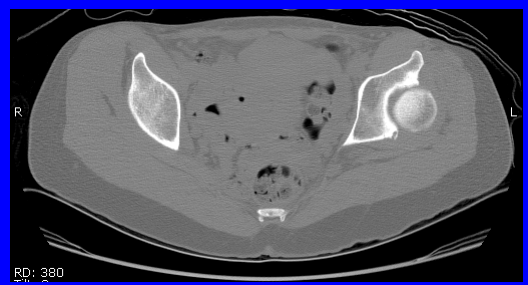
14 yo F 1 yr hx limp



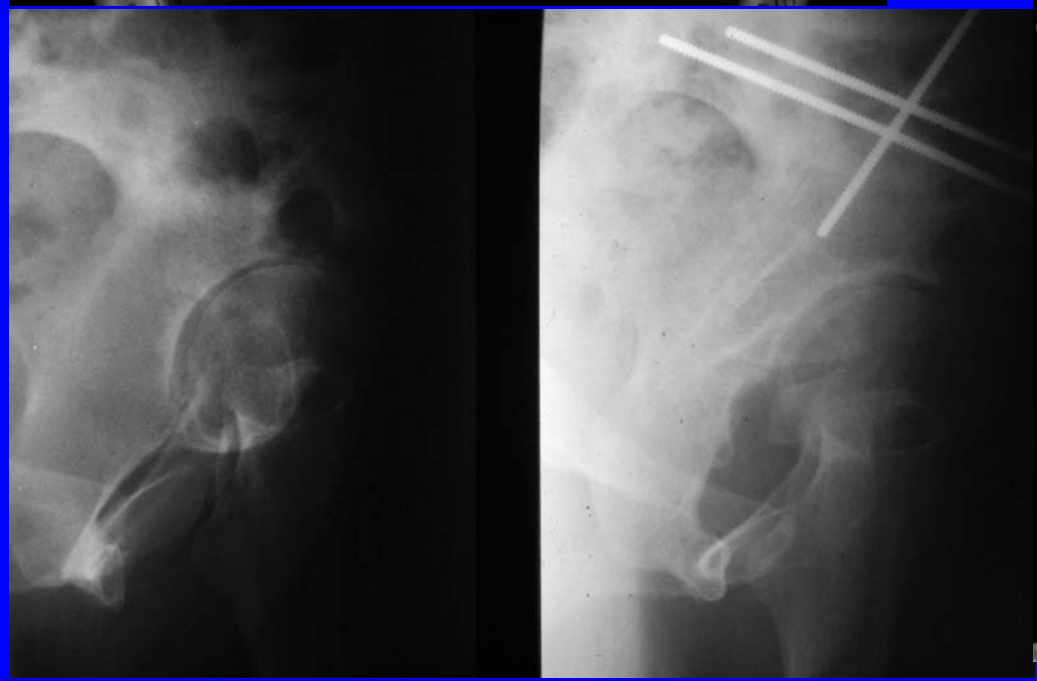


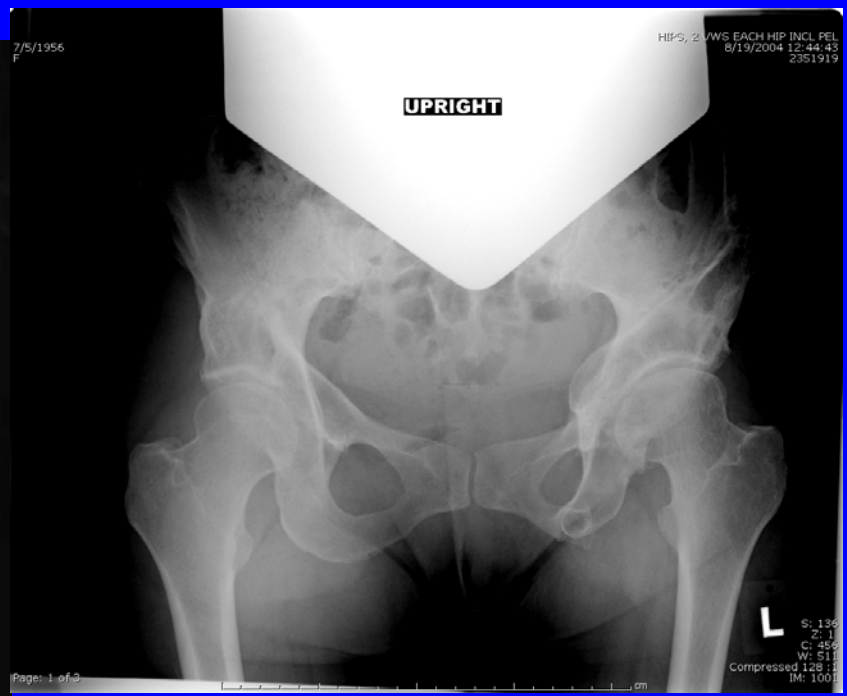
- 38 yo nurse 13 y post left Steel osteotomy; left retroverted, uncovered. Now with labral sx, left>right groin pain. Good motion but anterior impingement sign, left hip ER>IR



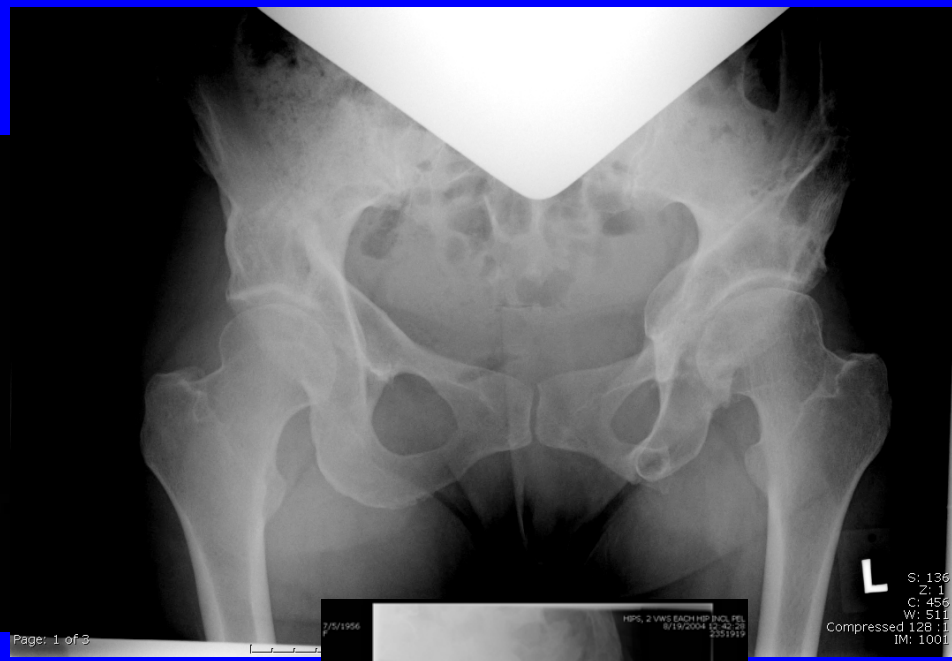



R
FC




7/5/1956
F
HIPS, 2 VWS EACH HIP INCL PEL
8/19/2004 12:44:43
2351919
UPRIGHT
L
Page: 1 of 2

Now 49 yo; 11.5 y after PAO; no symptoms; jogs; skis

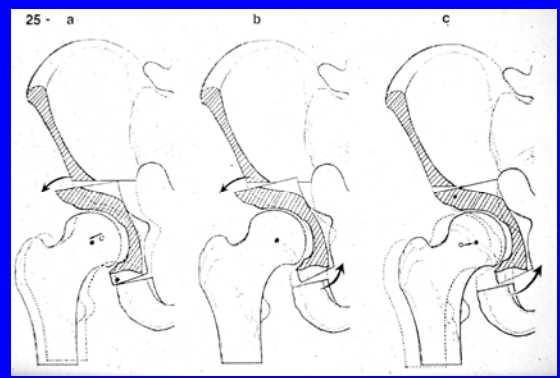


Our post-PAO Program

- Epidural for 2-3 days; home on day 6
- Gentle ROM exercises begin on postop day 1
- Coumadin for 6 weeks
- Crutches till osteotomy stable(6-12 wks);
  extra time if arthrosis

CH PAO Numbers

- >1100 hips (1991-2010)
- 9/1 F/M
- Age at op: 9-55 (mean 24+); all had closed triradiate
- 40+ →THR (all gr 2-3 arthrosis preop)
- Deep infection 2 (pre-direct ant. approach)
- Permanent neurapraxia 5 (3 partial peroneal; 2 ? complete motor sciatic)
- Osteonecrosis 0
- Iliac nonunion 0



Middle-Term Results of PAO: Bern and Boston

- Hip still preserved in 84% at 10+ yrs
- Pain relief excellent in most
- Mild loss of flexion in most
- CE angles improved from ~5 to~30 degrees
* Best results if OA 0 or grade 1 preop and no labral tear
- ~50% reoperation rate at 5 y if OA gr. 2-3
- Conversion to THR straightforward

5-15 yr Boston PAO Followup: Matheney, Kim, and Millis (JBJS, 9/09)

- 161/189 of 1991-1998 PAO's (MBM) located.
- All had pain preop. Preop CE angle in most <10 degrees
- Mean FU: 9.3y Mean age at op 24y (9-48)
- 141still functioning (88%)
  - Mean WOMAC score 4 (minimal to mild pain)
- 20 THR (12%): THR at mean 7.6y after PAO
- 10 yr Kaplan-Meyer survivorship>83%

* **Important prognostic factors for outcome after PAO**

Important prognostic factors after PAO

- Preoperative arthrosis
- Congruity
- Age (<35 yo do better statistically)
- (Labral tear)

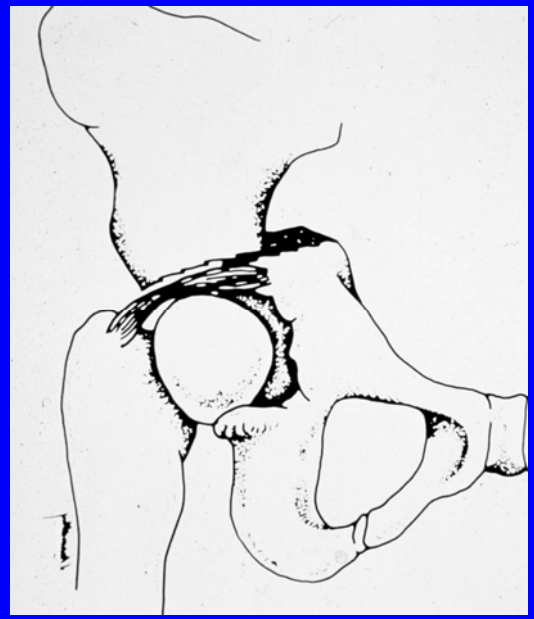
For example :

<35yo/nl congruity/no OA:
<1% failure risk

>35yo/poor congruity/mod OA:
>90% failure risk!!!

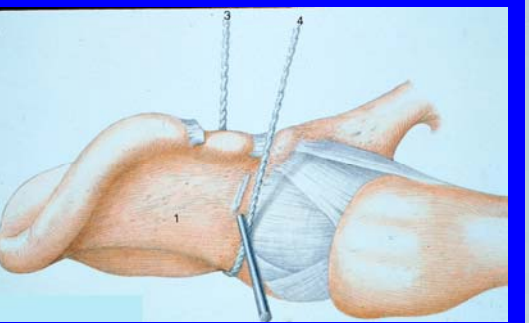
“Salvage” Joint-Preserving Procedures

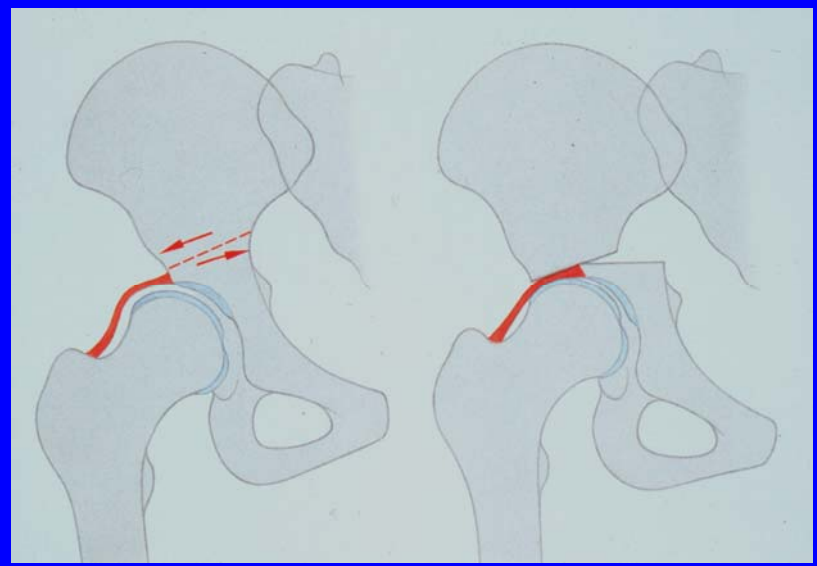
- Proximal femur
* Pelvis: Chiari Osteotomy/ Shelf Procedures

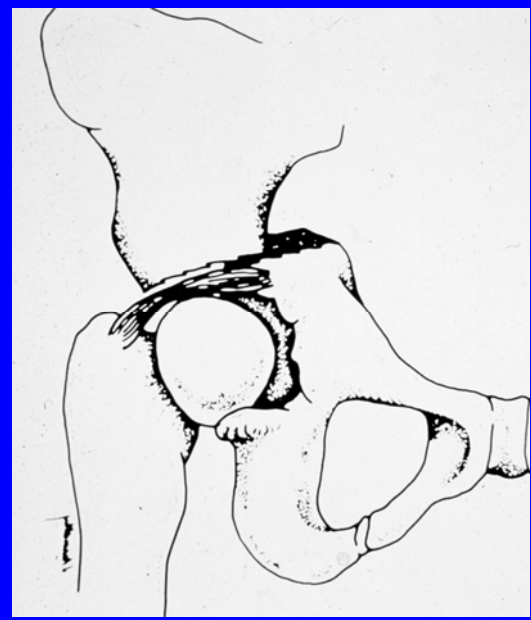


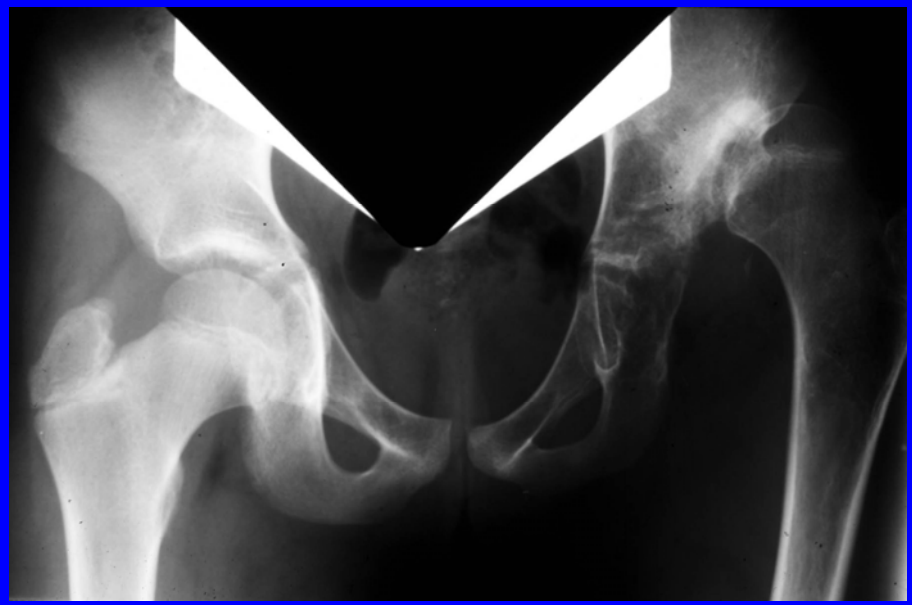
Chiari Osteotomy

- Salvage procedure for dysplastic impingement
- Sliding iliac shelf with capsular interposition arthroplasty
- "Reverse Salter" effect: abducts joint through symphysis hinge

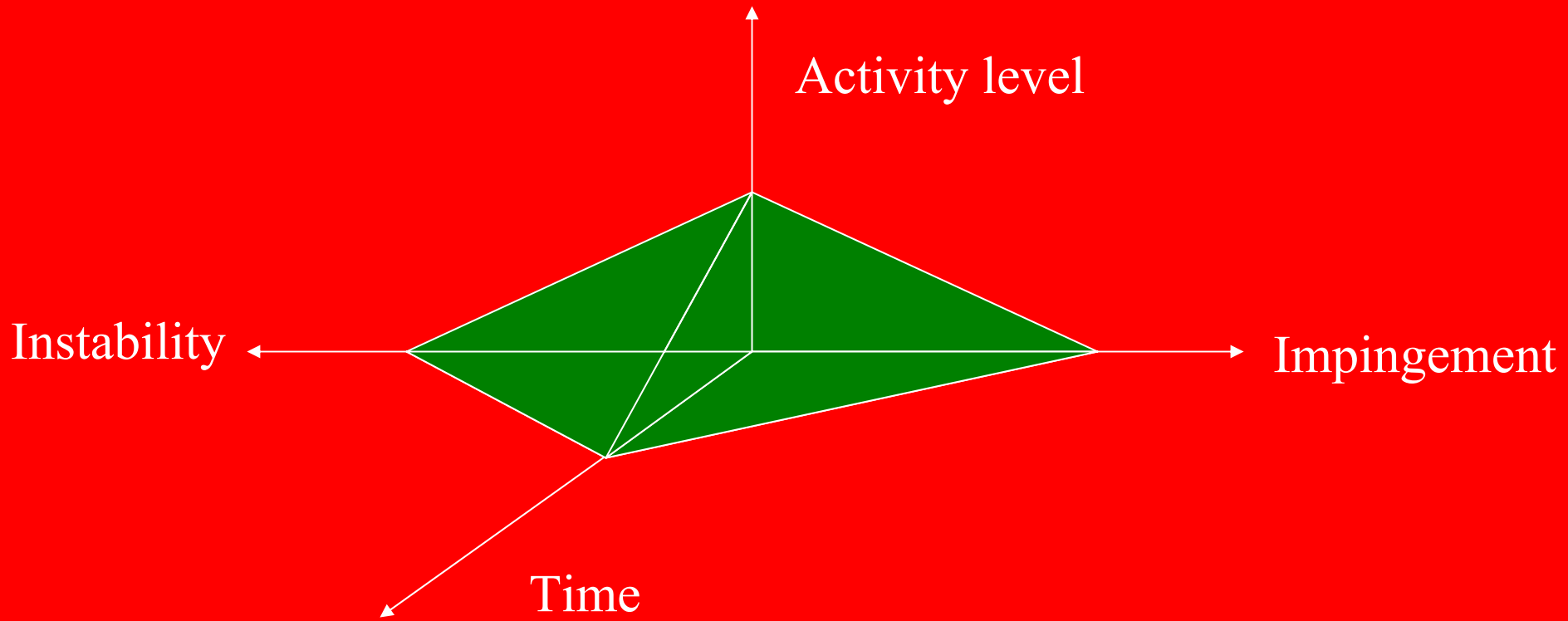






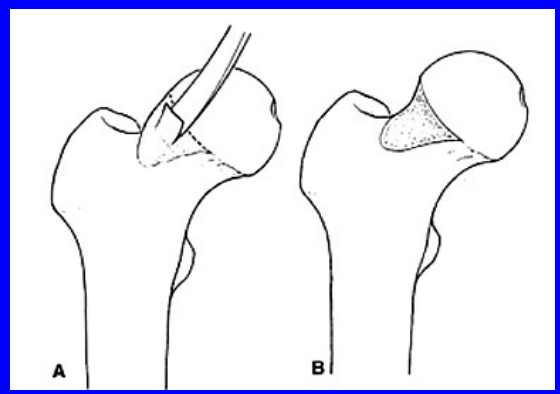


Diarthrodial Joint Function



The Bottom Line/The END!!

- Most OA in the hip has a mechanical etiology
- **Impingement and instability** are the bad actors
  - Different presentations
- Developmental deformity patterns are common causes of pathomechanics
- Early surgery limits cartilage damage
- Both Intra-articular AND extraarticular surgery ARE effective



Summary Thoughts on Osteotomy and Related Procedures

- Joint-preserving procedures work IF they solve the mechanical problem, which is often abnormal loading of the rim from impingement or dysplasia.
- Best treatment may require intraarticular work: surgical dislocation is a powerful tool.
- **Timely treatment prior to arthrosis is best**.