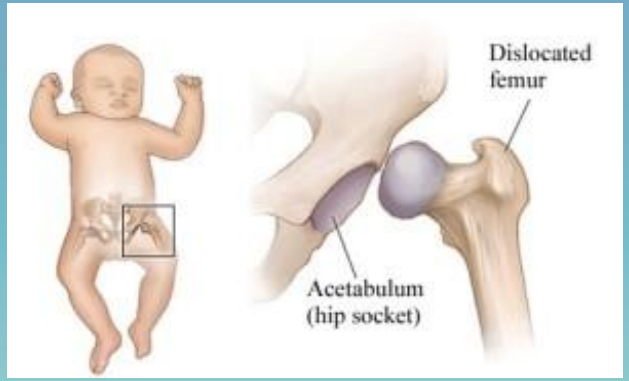
# Sonographic Evaluation of the Pediatric Hip

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# Developmental Dysplasia of the Hip

- Abnormal relationship of femoral head to the acetabulum
- Formerly known as congenital hip dislocation
- Believed to be developmental

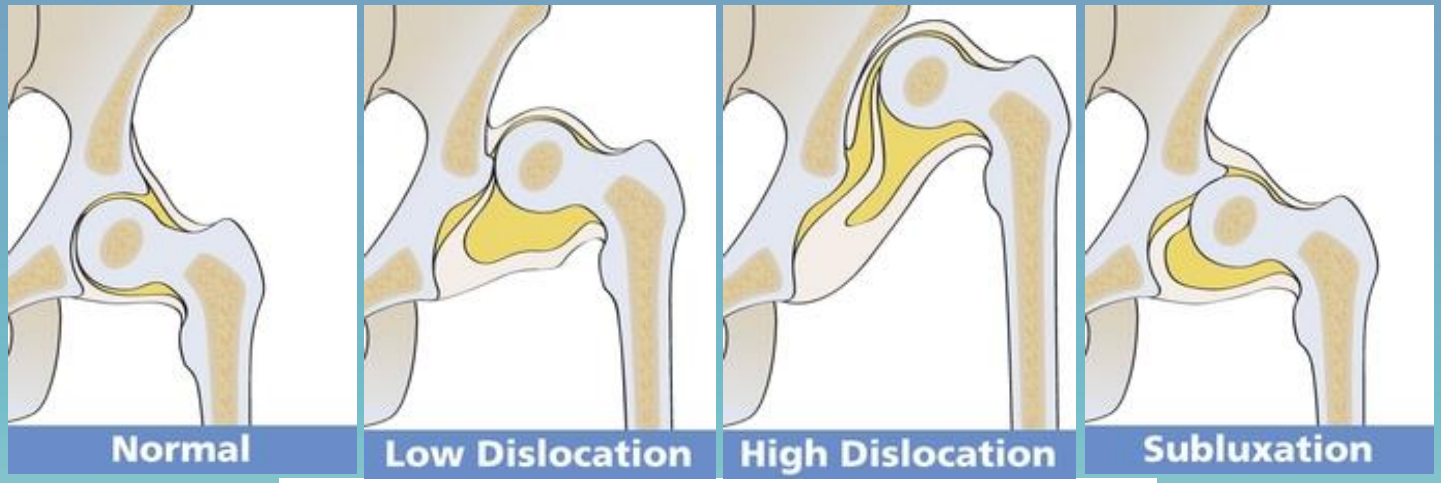
**Most dislocations are evident at births**

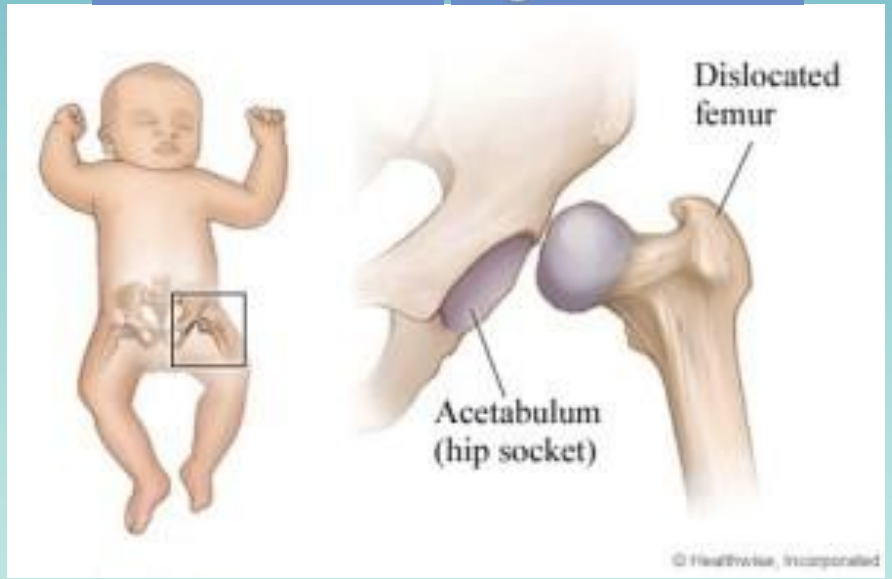
**Some develop later in infancy**

For this reason, it is now called developmental dysplasia of the hip

# Developmental Dysplasia of the Hip (DDH)

- General term encompassing a wide range of disorders of the hip
  - Dislocation
  - Subluxation
  - Instability/inadequate acetabular development
  - Reducible subluxed or dislocated hips
  - Irreducible hips and dislocations resulting from teratologic etiologies


Normal
Low Dislocation
High Dislocation
Subluxation


Dislocated femur
Acetabulum (hip socket)

# Terminology Encountered

- Hip dysplasia
- Developmental dysplasia of hip (DDH)
- Developmental dislocation of hip (DDH)
- Hip dislocation
- Congenital dislocation of hip (CDH)
- Acetabular dysplasia

The severity and time of occurrence determines the name

# DDH Incidence

- Incidence 5-7 per 1000 cases
  - Can be higher if taken into account the minority of adults who undergo hip replacement for osteoarthritis have a background of previously undetected and asymptomatic hip dysplasia
    - 1.5-20 per 1000
- Usually unilateral (80% of cases) and on the left
- Different than immature hips which resolve within 2-8 weeks
- Higher in Caucasian/Native-American populations
- Females (8x higher)

# Causes/Risk Factors

Multifactorial

- Previous family history
- Firstborn Children
- Oligohydramnios
- Breech position
- Abnormal laxity of ligaments and hip capsule
- Teratologic

# Causes/Risk Factors

If a child has DDH, the risk of another child having it is 6% ( 1 in 17 )

If a parent has DDH, the risk of a child having it is 12% ( 1 in 8 )

If a parent and a child have DDH, the risk of a subsequent child having DDH is 36% ( 1 in 3 )

Lack of space & restriction of movement in utero

Extreme hip flexion with knee extension

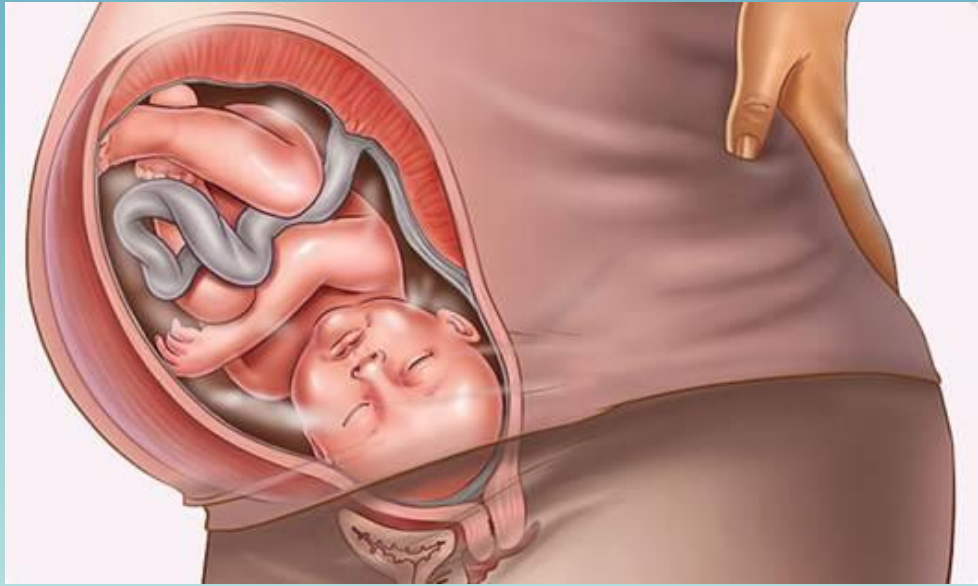
Due to hormones secreted by mothers to lax the ligaments (stretch easier) to allow easier vaginal delivery

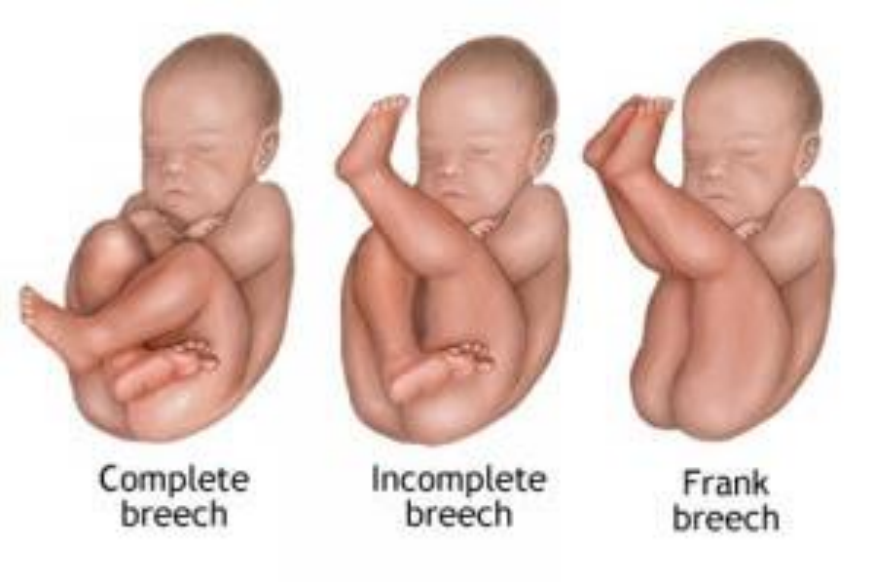
- Girls have more laxity than boys

Occur during fetal development and associated with other abnormalities

- Arthrogryposis, spina bifida, foot deformities, torticollis

# Fetal Positions



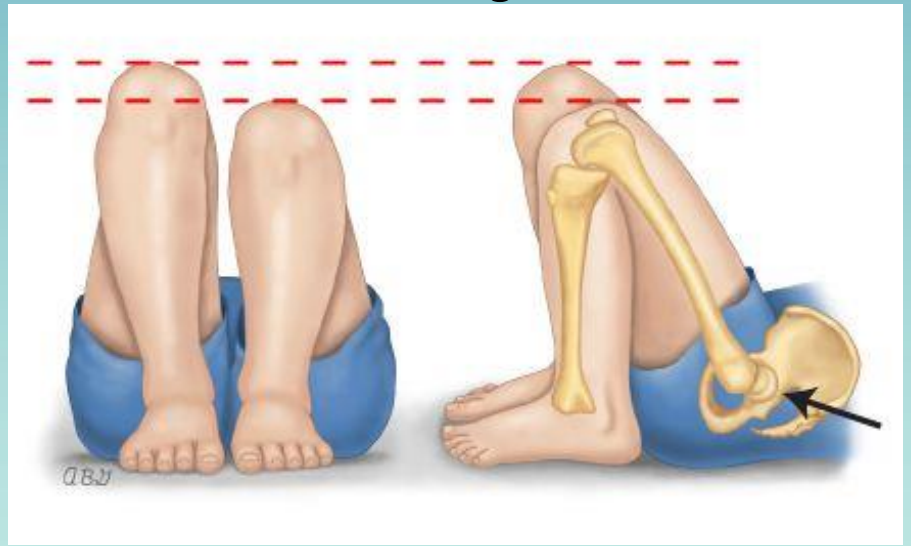


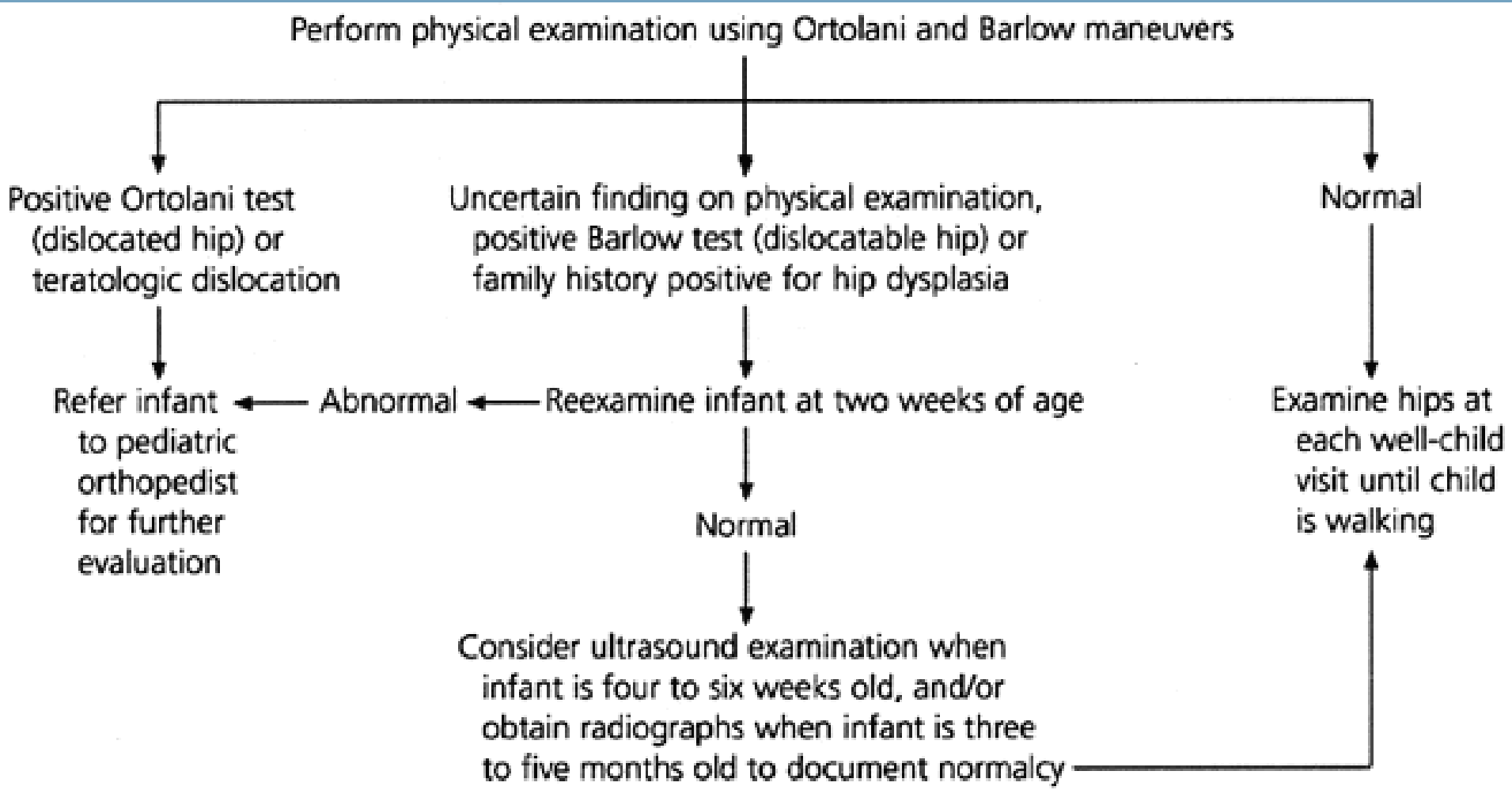
# Signs & Symptoms

- Asymmetrical gluteal creases
- Asymmetrical thigh creases
- Asymmetrical legs
- Hip clicks/pops (different than snapping)
  - Not all babies

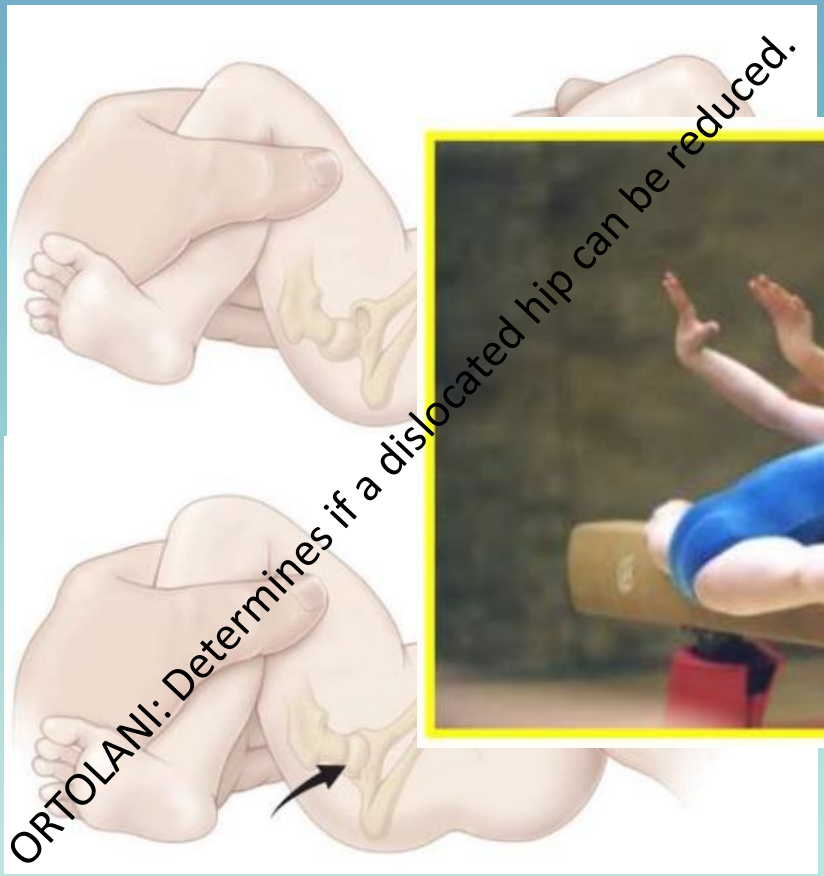
# Asymmetric Gluteal, Thigh and Labial Folds

Galeazzi Test/knee height difference



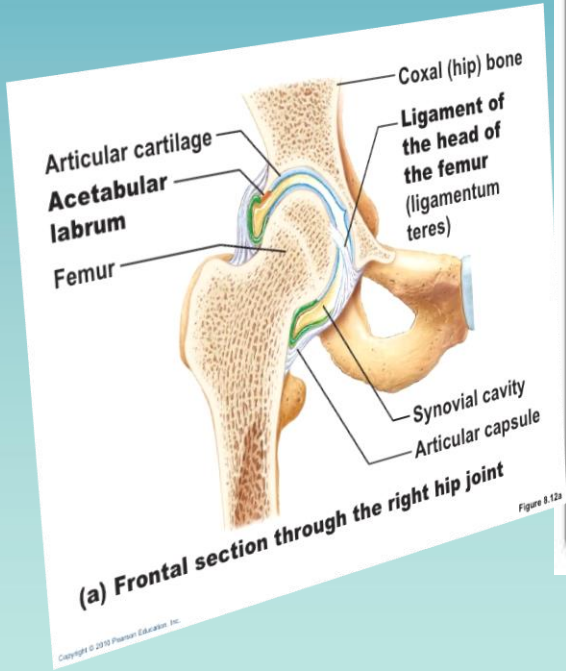

Perform physical examination using Ortolani and Barlow maneuvers
Positive Ortolani test (dislocated hip) or teratologic dislocation
Uncertain finding on physical examination, positive Barlow test (dislocatable hip) or family history positive for hip dysplasia
Normal
Refer infant to pediatric orthopedist for further evaluation
Abnormal
Reexamine infant at two weeks of age
Examine hips at each well-child visit until child is walking
Normal
Consider ultrasound examination when infant is four to six weeks old, and/or obtain radiographs when infant is three to five months old to document normalcy

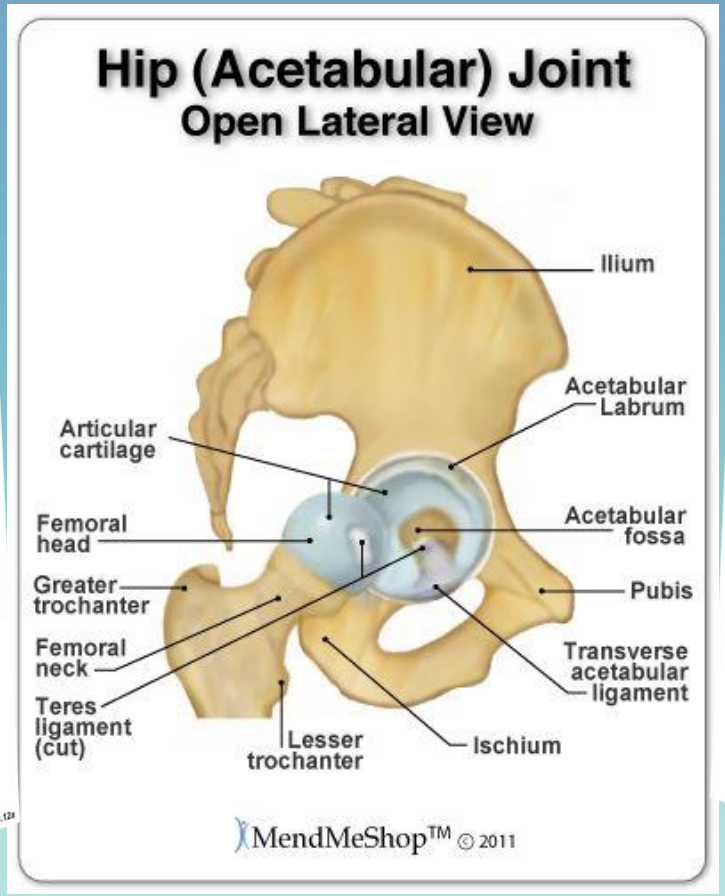
# The Ortolani and Barlow maneuvers have been the standard techniques for detecting hip instability in newborns

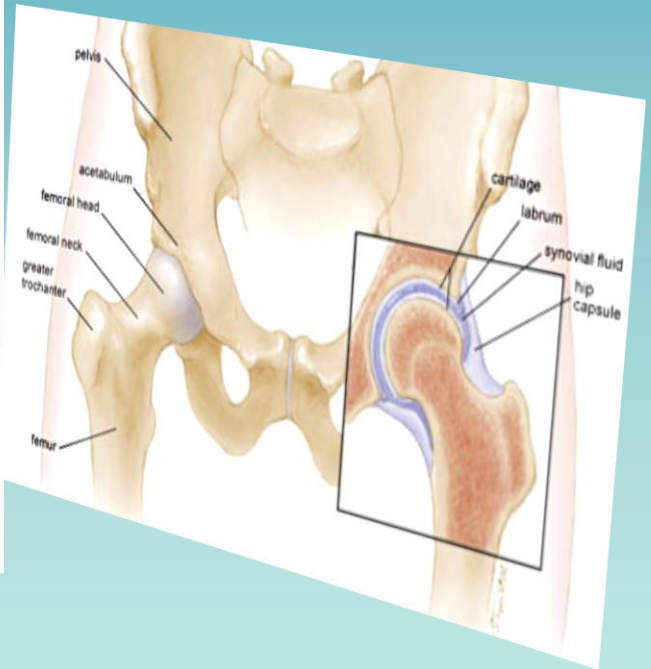


ORTOLANI: Determines if a dislocated hip can be reduced.

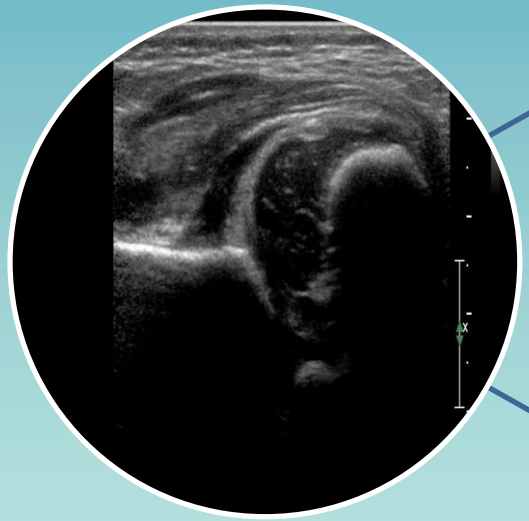
BARLOW: Determines whether a hip can be dislocated.


Coxal (hip) bone
Articular cartilage
Acetabular labrum
Ligament of the head of the femur (ligamentum teres)
Femur
Synovial cavity
Articular capsule
(a) Frontal section through the right hip joint
Figure 8.12a


Hip (Acetabular) Joint
Open Lateral View
Ilium
Acetabular Labrum
Articular cartilage
Femoral head
Acetabular fossa
Greater trochanter
Pubis
Femoral neck
Transverse acetabular ligament
Teres ligament (cut)
Lesser trochanter
Ischium
MendMeShop™ © 2011


pelvis
acetabulum
femoral head
femoral neck
greater trochanter
femur
cartilage
labrum
synovial fluid
hip capsule

# Sonographic Methods



Static

Proposed by Graf
Coronal images: to assess anatomy and morphology

Dynamic

- Real-time assessment of hip in a transverse plane
- Proposed by Harcke

# Graf Sonographic Anatomic Classification

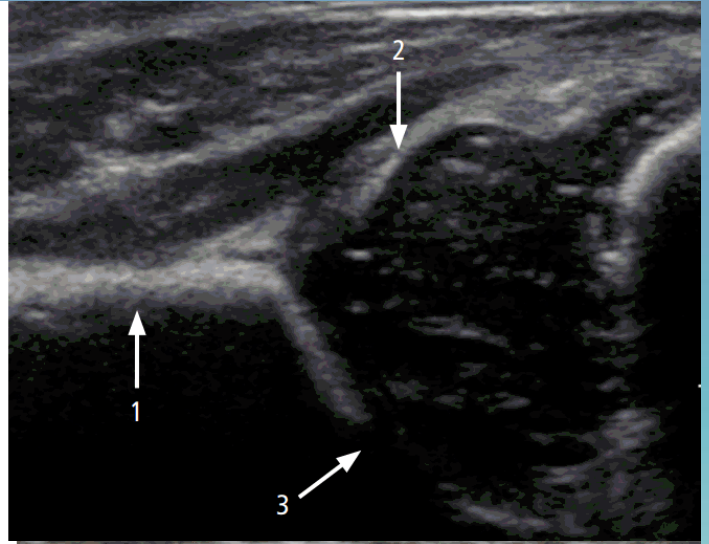
| GRAF SONOGRAPHIC HIP TYPE | | BONY ROOF | OSSIFIC RIM | CARTILAGE ROOF | ALPHA ANGLE |
|---|---|---|---|---|---|
| Ia | Mature | Good | Sharp | Long and narrow, extends far over femoral head | >60° |
| Ib | Mature | Good | Usually blunt | Short and broad but covers femoral head | >60° |
| IIa | Physiological delay in ossification <3 months | Deficient | Rounded | Covers femoral head | 50–59° |
| IIb | Physiological delay in ossification >3 months | Deficient | Rounded | Covers femoral head | 50–59° |
| IIc | | Deficient | Rounded/ flat | Covers femoral head | 43–49° |
| D | On point of dislocation | Severely deficient | Rounded/ flat | Compressed | 43–49° |
| IIIa | Dislocated | Poor | Flat | Displaced upward and echo-poor | <43° |
| IIIb | Dislocated | Poor | Flat | Displaced upward and more reflective than femoral head | <43° |
| IV | Dislocated | Poor | Flat | Interposed | <43° |

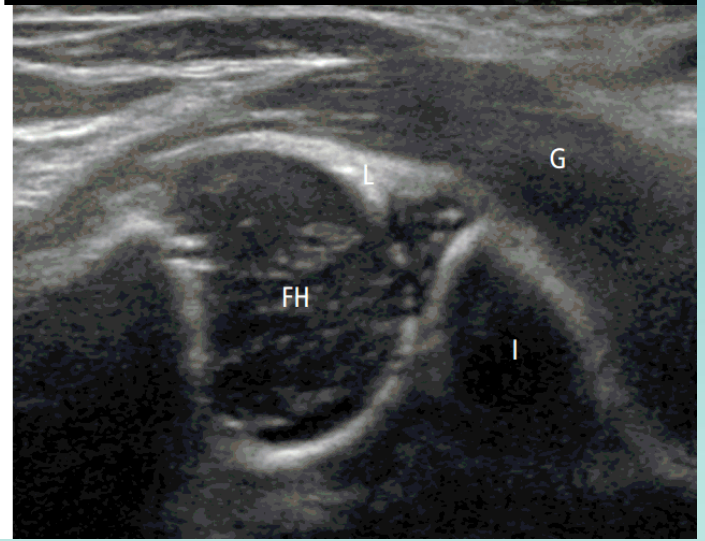
# Static Evaluation of Hip

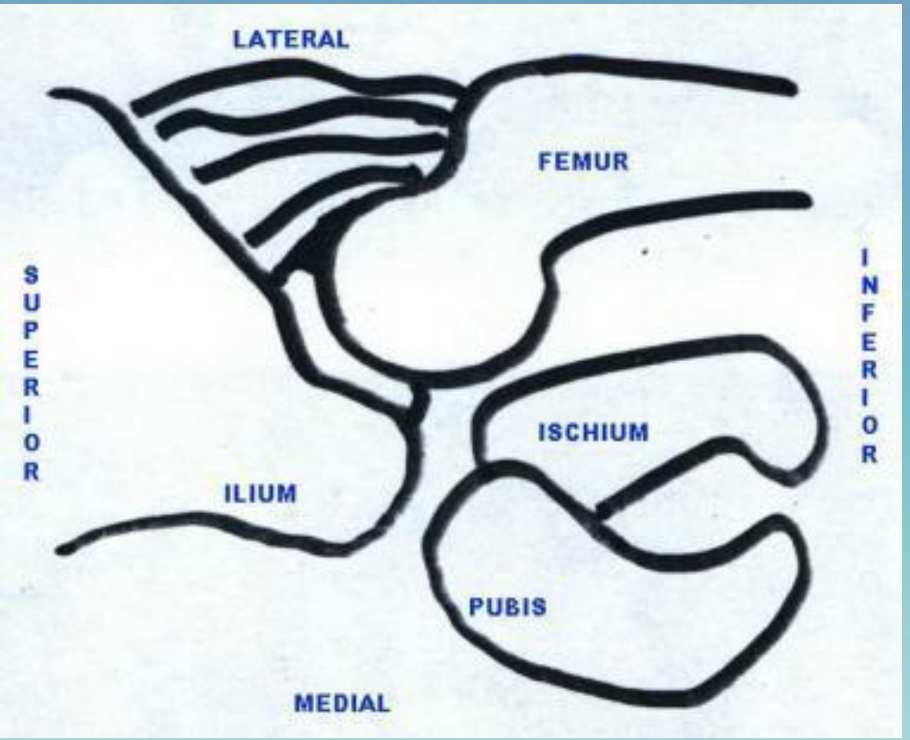
- Measurements
  - Alpha angle: formed by the acetabular roof to the vertical cortex of the ilium
    - > 60 is considered normal
    - Between 43-60 mild dysplasia
    - < 43 severe dysplasia
- Beta angle: formed by the vertical cortex of the ilium and the triangular labral fibrocartilage (echogenic triangle)
  - Normally < 77 degrees
- Bony coverage
  - The percentage of the femoral epiphysis covered by the acetabular roof. A value of >50% is considered normal

# Sonographic Techniques

- High-frequency Linear-array transducer (dependent on baby's body habitus)
  - 5-9 MHz
- Place baby in a supine position
  - Others recommend RPO or LPO
  - Place a folded towel or wedge to support baby
  - An oblique position enables the examiner to maintain the planes of interest through movements of adduction and abduction.
  - Research also suggests examining the infant with its feet toward the examiner. (if possible, I know it is hard)
- When examining the right hip, hold the transducer in the left hand while the right hand guides the positions and movements.
- When examining the left hip, the right hand holds the transducer while the left hand guides the positions.
- Place transducer on lateral or posterolateral aspect of hip joint

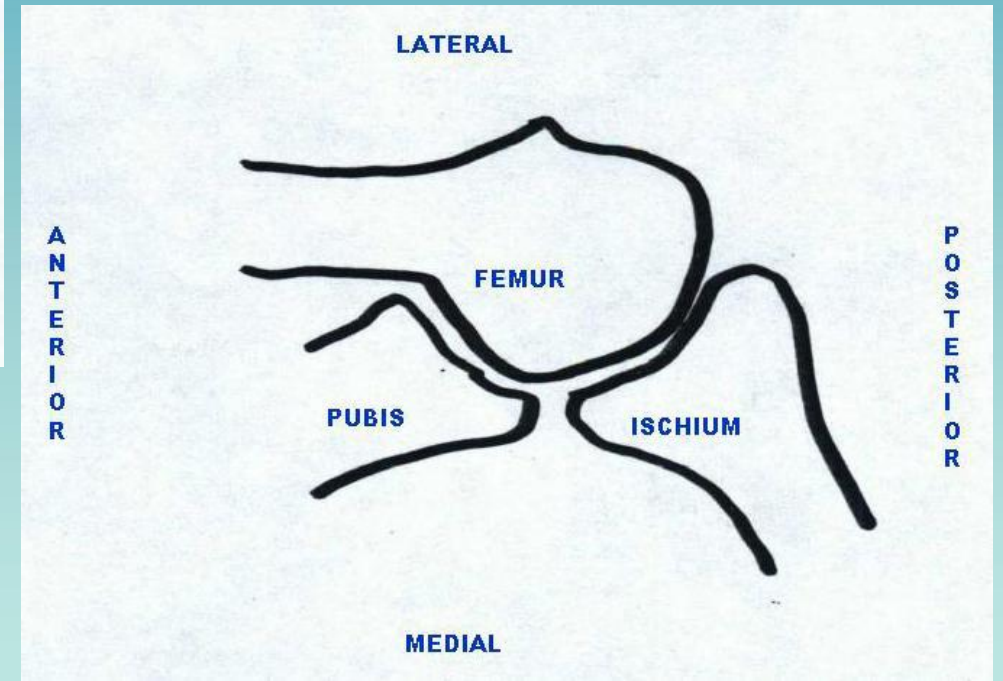

2
1
3


L
G
FH
I

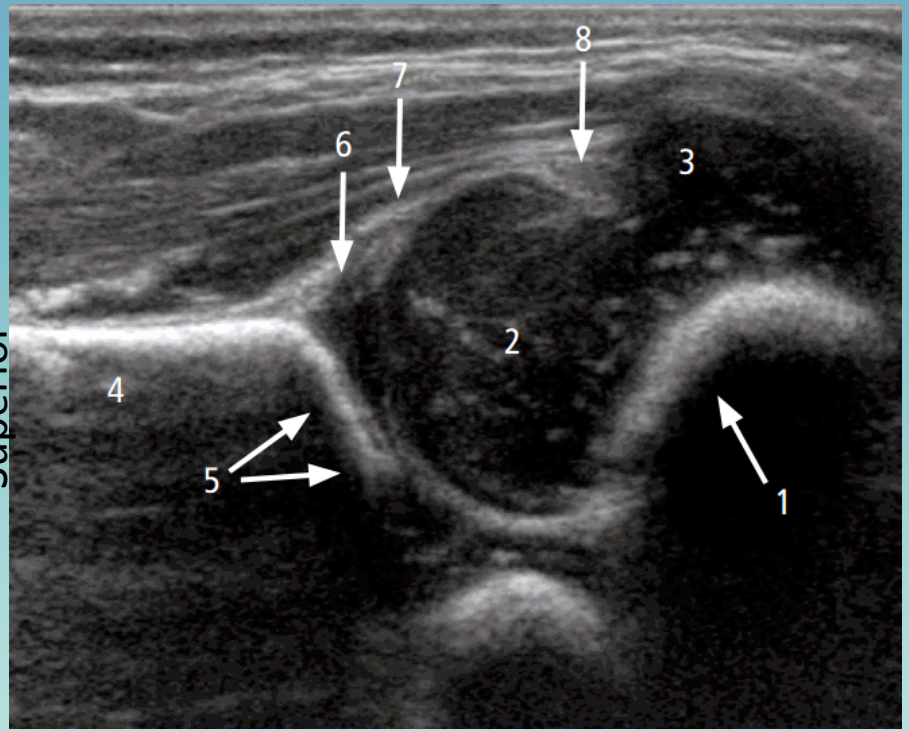



Coronal

Transverse



# Sonographic Appearance

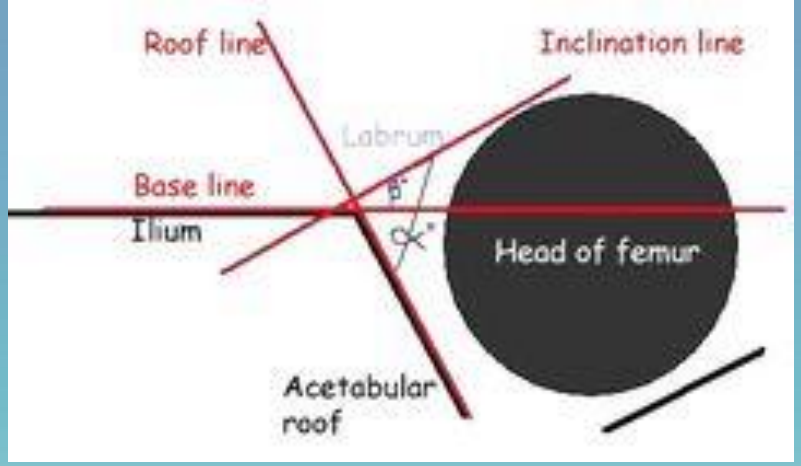


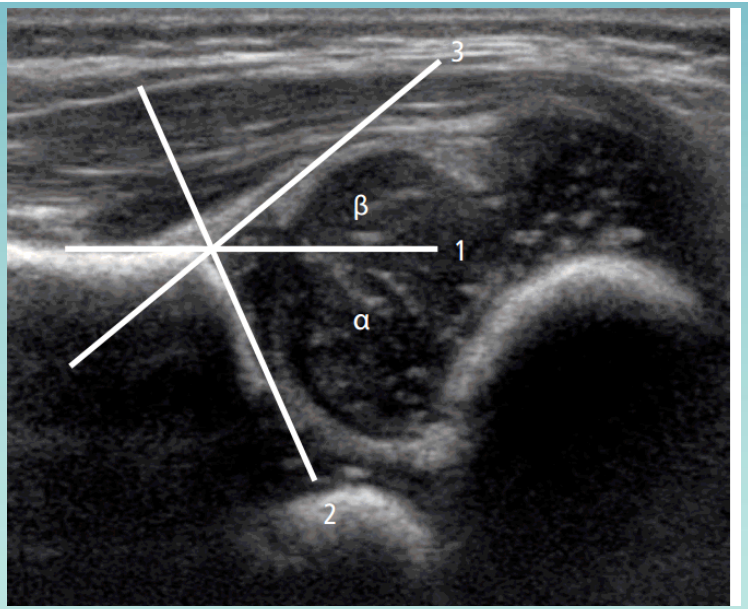

Egg-in-a-spoon in a coronal plane

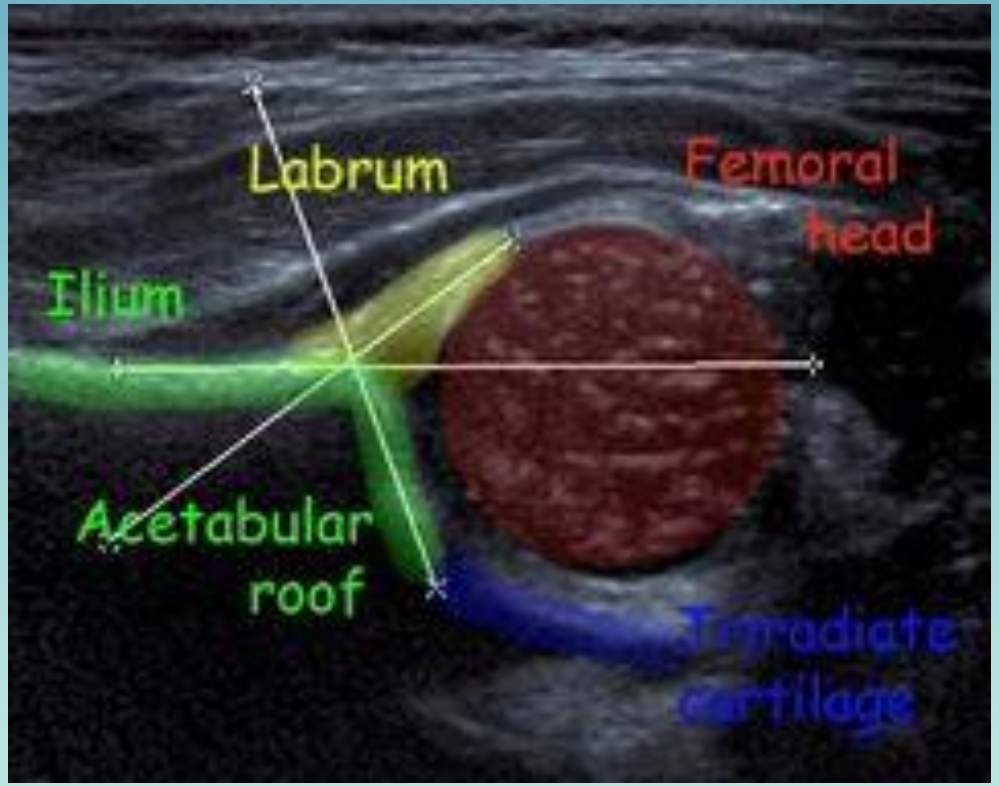
Inferior

1, chondro-osseous junction between the bony part and the cartilaginous part of the femoral neck; 2, cartilaginous part of the femoral head (hyaline cartilage); 3, greater trochanter; 4, iliac bone; 5, lower limb of the ilium and bony acetabular roof; 6, cartilaginous acetabular roof; 7, acetabular labrum; 8, synovial fold.

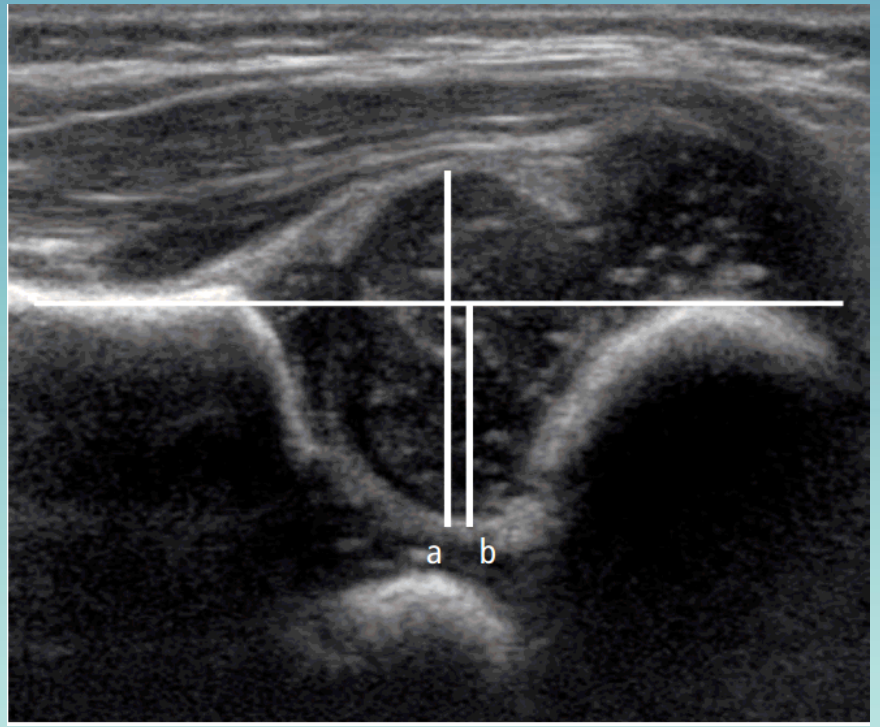
# Angles

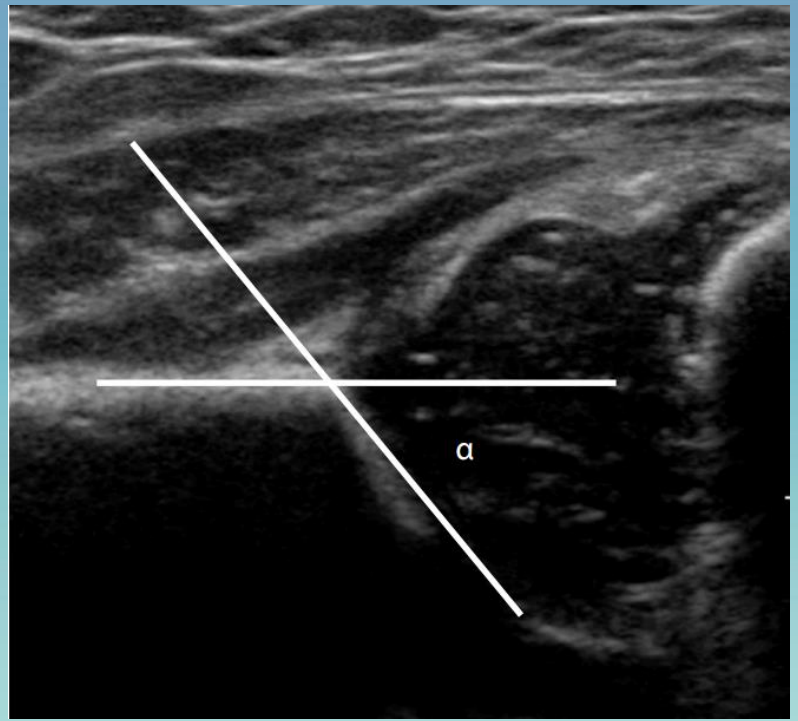

Roof line
Inclination line
Labrum
Base line
Ilium
β
α
Head of femur
Acetabular roof

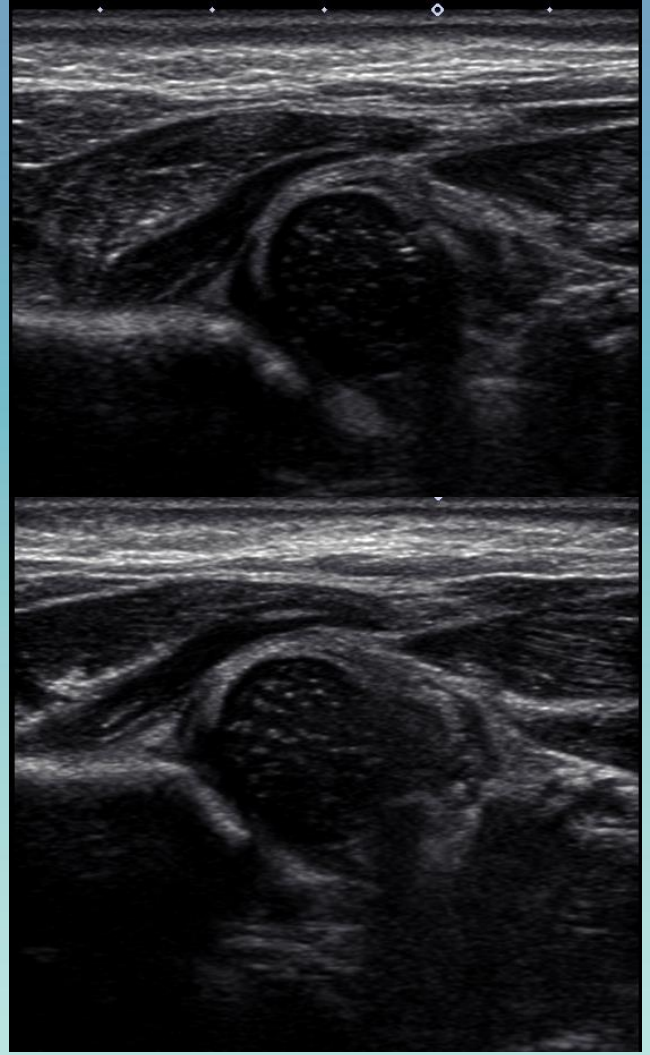

3
β
1
α
2


Labrum
Femoral head
Ilium
Acetabular roof
Triradiate cartilage

# Bony Coverage

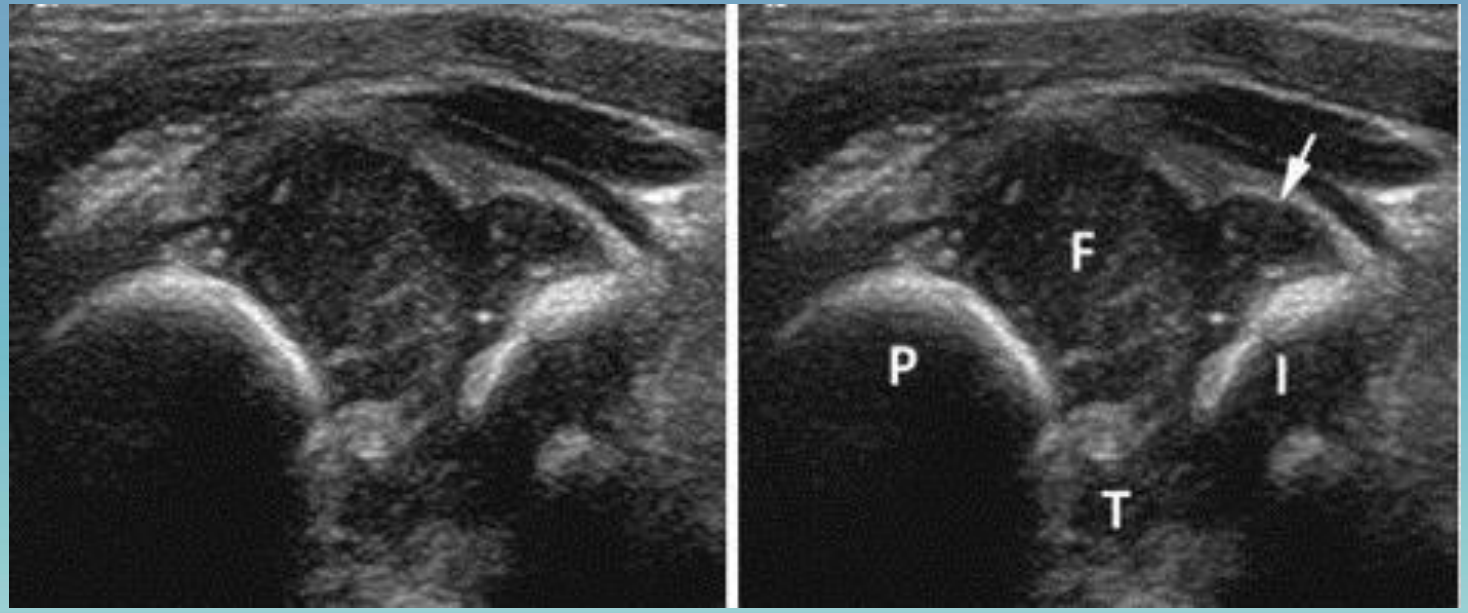




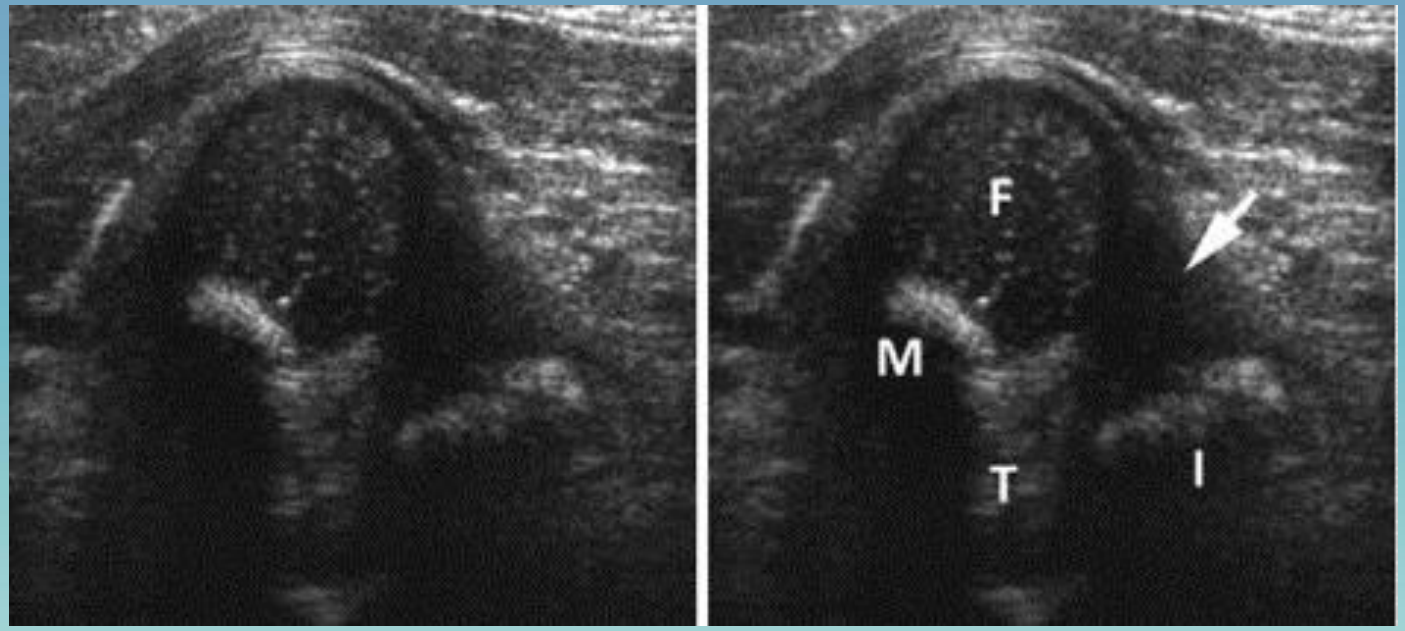
Ultrasonography of a 2-month-old girl shows that the α angle is abnormal, measuring 56°

1




Normal Transverse showing cup-like appearance formed by metaphysis & ischium

*F*= femoral head
*M*=femoral metaphysis
*I*= ischium
*T*= triradiate cartilage
*Arrow*= cartilaginous labrum




Abnormal hip: Transverse view of hip with stress showing subluxation of femoral head from its normal position and disruption of cup-like configuration. This hip was reducible.

# Treatment

- Pavlik Harness
  - usually for younger patients (less than six months of age)

# I can’t Look Anymore…….

Thank YOU so much for your kind attention
Rochester Institute of Technology