***** Normal growth of the acetabulum depends on:**

1-Normal epiphyseal growth of the triradiate cartilage

2- The presence of the spherical femoral head within the acetabulum

*** At birth, the hips are lax, head of femurs are cartilaginous, the acetabulum has more cartilage than bone, and the **fibrocartilage labrum widened the acetabulum** to accommodate **50%** of head cover

***** The femoral head is >50% uncovered at birth, and this predisposes to subluxation/dislocation.**

*** DDH is a spectrum of: **Acetabular dysplasia** >> **instability** >> **subluxation** >> **dislocation**

*** **Acetabular dysplasia:** abnormally developed, shallow acetabulum

*** **Instability**: Ability to subluxate or dislocate the hip with passive manipulation

*** **Subluxation**: Incomplete loss of contact

*** **Dislocation**: complete loss of contact

*** To say that a hip dislocation is due to DDH the dislocation must be primary with no secondary underlying cause (**2ry hip dysplasia** >> Down syn. Ehler Danlos syn.) + must occur after birth (before birth >> **CDH**)

*** DDH is different than CDH which is **Congenital dislocation of the hip (CDH)** >> Antenatal dislocation in utero / usually stiff irreducible on neonatal examination (negative Ortolani test) / Pavlik harness should not be used in CDH

*** 20:1000 neonatal hip instability at birth

*** 80% of affected children are **females**

*** The **left hip** is more commonly involved (60%) / 20% bilateral / 20% right

*** 60% of newborns with hip instability become stable by age 1w, and **90% become stable by age of 6-8 weeks** , leaving only 10% of them with residual hip instability.

***** Risk factors (F):**

A- **Frank breech presentation** (30 - 50% risk).

B- **Female**

C- **Firstborn**

D-**Family history** is a strong risk factor. → One child has DDH, risk of another child **6%**
At least one parent involved: **12%** risk.
Parent and sibling involved: **36%** risk.

E- Fluid abnormality (**oligohydramnios**)

F- Feet Deformity (Metatarsus adductus)

G- Fetal anomalies

H- Faulty Habits (Swaddling) esp. with ligament laxity

I- Facial asymmetry (Torticollis).

* Note: prematurity is a protective factor.

***** DDH contains both Bone changes and Soft tissue changes:**

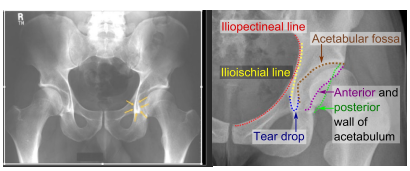
- Bone changes : Acetabulum and Femur
- Soft tissue changes: intra-articular and extra-articular

> Acetabulum :

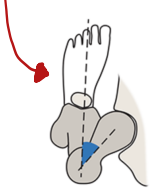
- Shallow, dysplastic.
- Anteverted **deficient anterolaterally**
- Delay in teardrop development.
- Maybe deficient posteriorly.
- New false acetabulum.

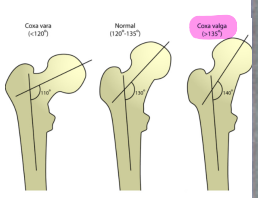
> Femur :

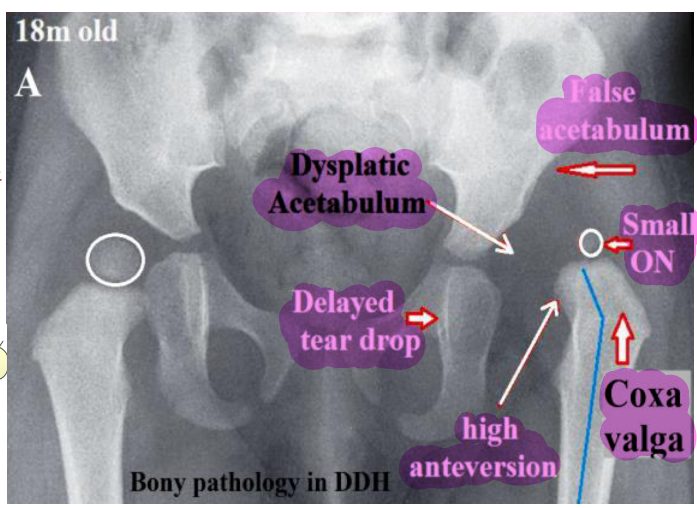
- Delayed ossific nucleus → small ON
- Coxa valgus
- Anteversion of the proximal femur → femur head faces more Anterior → causes in-toe gait
- Deformed shape of the head.



Tear drop \ Normal X-ray





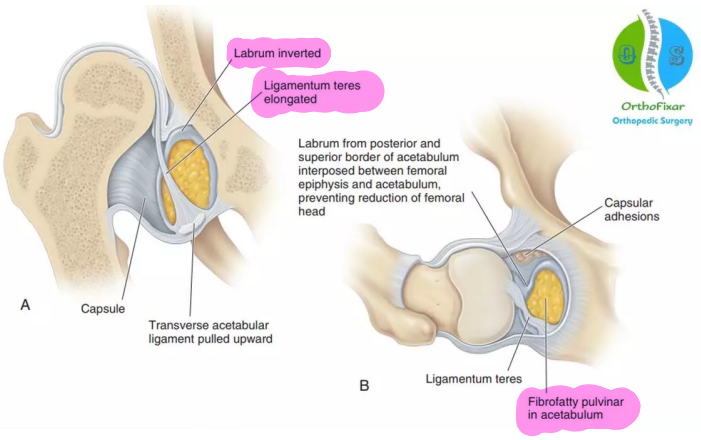


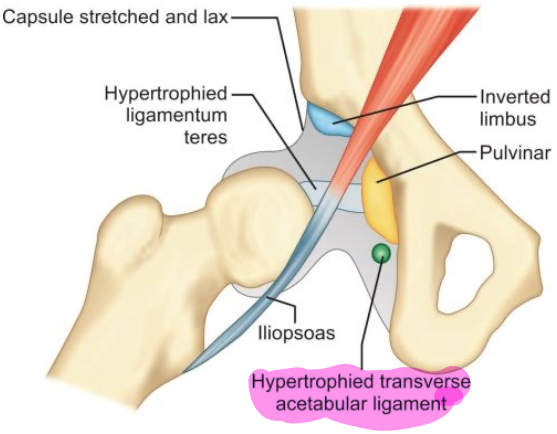
> Intra-articular

- Wide lax redundant capsule
- **Pulvinar** (fibro-fatty tissue) muscles
- Thick elongated ligamentum teres
- Infolded thick labrum inside (**Inverted limbus**)
- Thick transverse acetabular ligament.
- Narrow inferior capsule by the **Psoas**. → hip capsule is constricted by iliopsoas tendon causing hourglass deformity of the capsule

> Extra-articular

- Tight adductor
- Short abductors
- Tight psoas tendon





*** Clinical features :

- Maybe Asymptomatic as in acetabular dysplasia only
- limitation of abduction while changing nappy. (Angle more than 20º) >>> **most sensitive test for DDH**
- Abnormal deep long **groin** crease (**Not thigh**).
- Apparent limb shortening in unilateral DDH >> positive **Galeazzi (or Allis) test** only for **unilateral dislocation** in children usually **above six months** of age.
- Wide perineum in bilateral DDH (mostly seen above 3 yrs)
- Post walking: limping, **tiptoe gait** (in unilateral DDH), **waddling gait** (in bilateral DDH).
- Positive **Ortolani test** >> Ortolani test is not for dysplastic or subluxated hips, **only for completely dislocated ones** thus it has very low sensitivity (only 2%) . So **negative Ortolani test does not mean no DDH** it means only you need further evaluation for risky newborns by other methods. / It's called "**reduction test**" as you try reducing the dislocated hip by **traction and abduction** / negative in CDH (irreducible) /best tested **before 3 months of age**.
- DON'T do **Barlow test** → you induce dislocation by adduction

Age	Clinical features [3]
< 6 months	• **Asymptomatic** • **Barlow sign**: a palpable clunk caused by hip dislocation when the hip is flexed and adducted with application of downward pressure • **Ortolani sign**: a palpable clunk caused by hip reduction when the hip is flexed and abducted while applying upward pressure • Possibly Galeazzi sign
6–18 months	• Inability to **abduct** the hip • Barlow and Ortolani sign disappear • Prominent **Galeazzi sign**: unequal knee height and apparent shorter femur when child lies supine with hips and knees flexed • **Asymmetrical gluteal folds** may be present.
> 18 months	• **Hip pain**, and/or pain referred from the hip to the knee and/or anterior thigh • Possibly a hip deformity (e.g., coxa vara) • Waddling or Trendelenburg gait • Leg length discrepancy and toe walking to compensate for the difference in leg length • Possibly lumbar lordosis

ⓘ A positive Barlow sign shows that the reduced hip is subluxatable or dislocatable. A positive Ortolani sign shows that a dislocated hip is reducible.

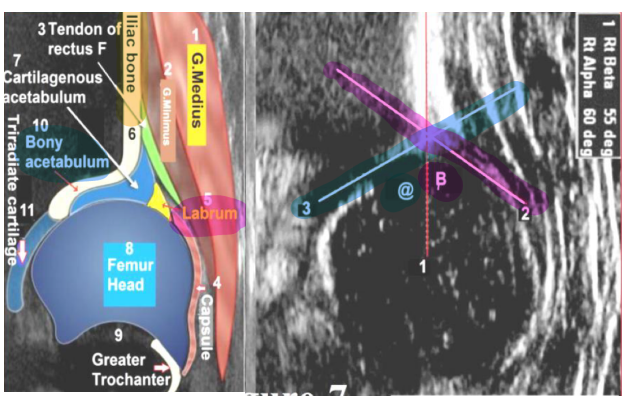
ⓘ Leg length discrepancy, Galeazzi sign, and/or asymmetrical gluteal folds may be absent in patients with **bilateral** DDH.

*** Confirmatory tests:

- Done for high risk patients (Risk factors)
- **Ultrasound** at **6 weeks** (Not before this to give a chance to neonatal unstable hips to become mature and stable (85-90%) in order not to over treat) if not found do **X-ray** at **3 months** (Not before this as >> The ossific nucleus of the femoral head is usually present around 12 weeks of age) >>> So **presentation before 3 months do US**
- On US we look at >> **alpha and beta angles**

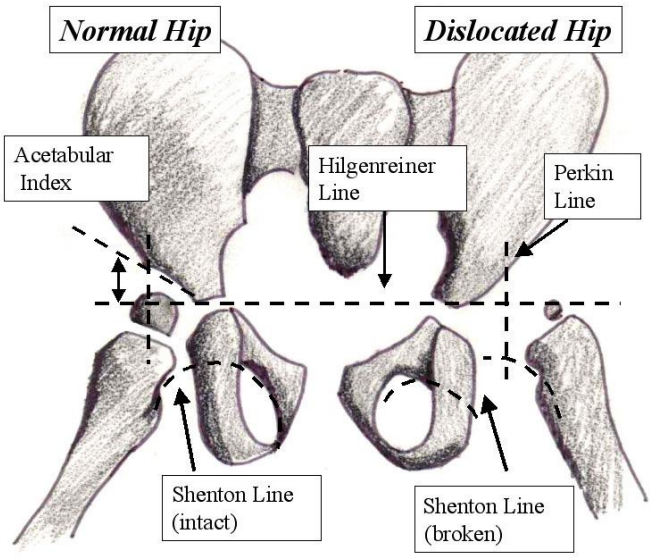
>>> Normal α angle is **>60º**. (Acetabular roof angle).

>>> Normal β angle is **<55º**. (Labral cartilage roof angle).

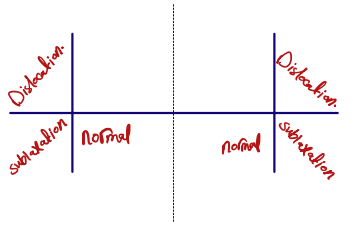


- On X-ray >> **we draw 4 lines**
- **Hilgenreiner line** >> drawn horizontally through each triradiate cartilage
- **Perkin line** >> Perpendicular line to the Hilgenreiner line at the lateral edge of the acetabulum.

>>>>This will divide the hip region into four quadrants, (the **normally** ossific nucleus of the head in the **inner lower quadrant**, in subluxation it is in the outer lower quadrant, and in a dislocation in the upper outer quadrant).



- **Shenton line** >> continuous arch drawn along the **medial** border of the femoral neck and the **superior border** of the obturator foramen / positive if disturbed >>> False positive in young children with high femoral anteversion, further more it is intact in acetabular dysplasia .
- **Acetabular index angle (AIA)** (Mirror of DDH) The angle formed by an oblique line (through the outer edge of the acetabulum and triradiate cartilage) and the Hilgenreiner line. >>> In the infant < 3 months, a normal value < **30°** / By 6 months of age, the acetabular index decreases to 25°.



>>> Radiographic finding in acetabular dysplasia

* Increased obliquity of the acetabulum (AIA >30°). * Loss of acetabular concavity. * Intact Shenton line.

***** Management** :

- reduction if dislocated or sublaxed
- Manage the acetabular dysplasia : → dynamic splint → flexion and abduction.
- if less than 6 months by **Pavlik harness** (hips are flexed at 90-100° with 45-60° abduction , duration: 8-12 weeks, until the AIA <30° / success rate >90%)

>>>> **Excessive hip flexion** > risk of femoral nerve palsy. /// **Excessive hip abduction** > increased risk of osteonecrosis

- if larger child >>> Spica casting
- **follow up** till skeletal maturity (14 for females / 16 for males) >>> recurrence rate of hip problems in the future is 10-20%

***** Complications of DDH:**

1-Joint stiffness after open surgery

2-Residual acetabular dysplasia, subluxation, and /or re-dislocation despite adequate treatment. (residual subluxation is ~20%) >> FU till maturity.

3-Early osteoarthritis in the hip joint(the 30s) / and the spine (In a dislocated hip the affected leg will become shortened, and this will put pressure on the back, increasing the risk of osteoarthritis to the spine.)

4-Leg length discrepancy >> back pain, functional scoliosis, and knee pain

5- Genu valgum: Unilateral hip dislocations >> **fixed adduction** deformity in the hip >> increased medially directed stress on the knee joint.

6- Trochanteric overgrowth > abnormal gluteus function

6-Avascular necrosis (AVN) of the femoral epiphysis : 0-73%. Extreme abduction, especially when combined with extension and internal rotation, results in a higher rate of avascular necrosis.

The potential sequel of avascular necrosis include:- Femoral head deformity, acetabular dysplasia, lateral subluxation of the femoral head, relative overgrowth of the greater trochanter, and limb length inequalities, osteoarthritis is a common late complication.

***** Prognosis** : Children with DDH who receive early treatment are generally good.