Lecture 9

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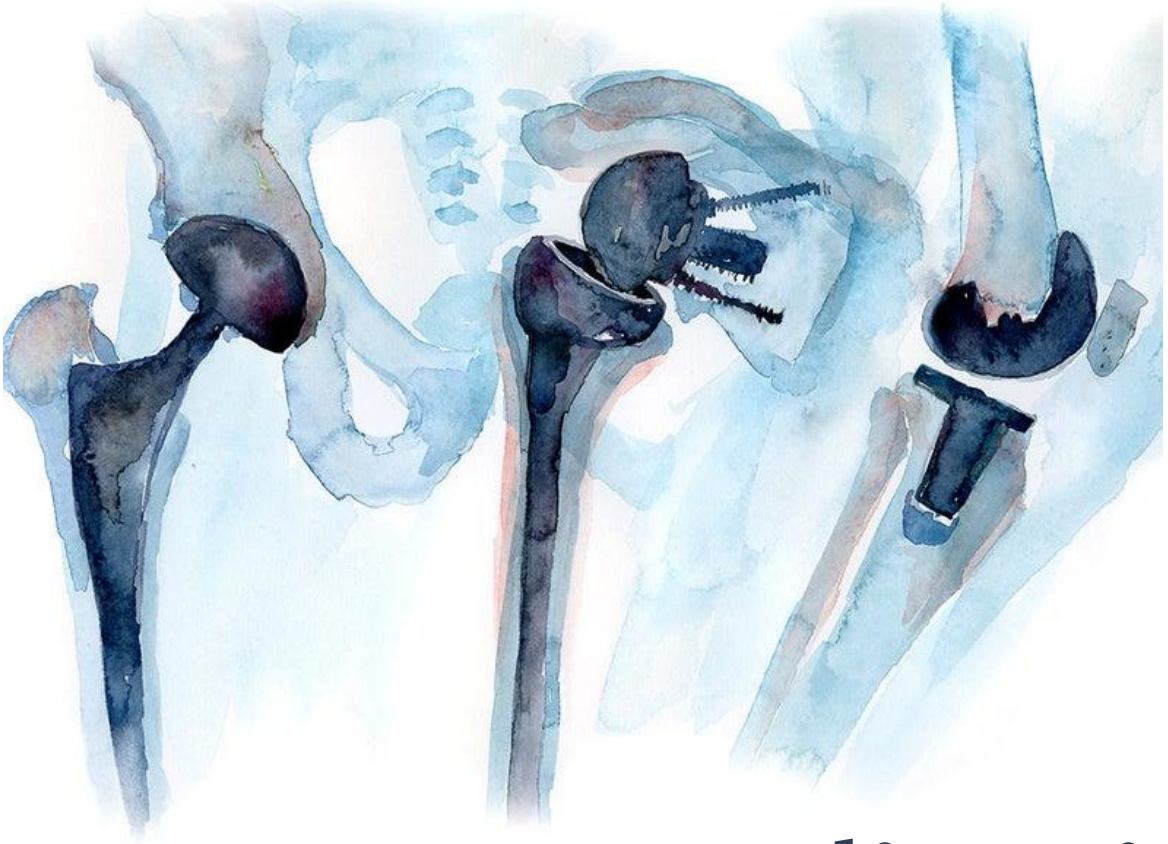

Common Pediatric Hip Disorders

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Objectives:

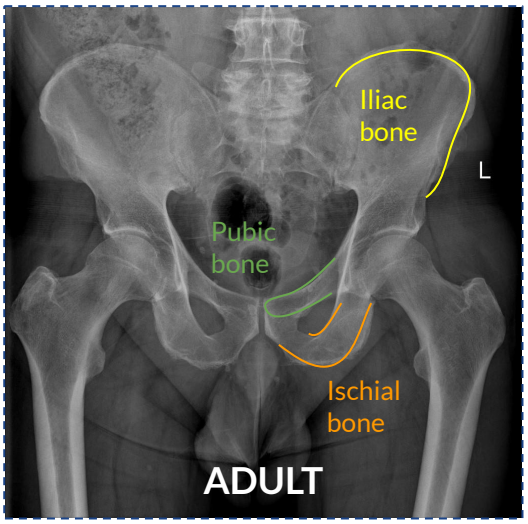
➔ No objectives were given

Color Index:

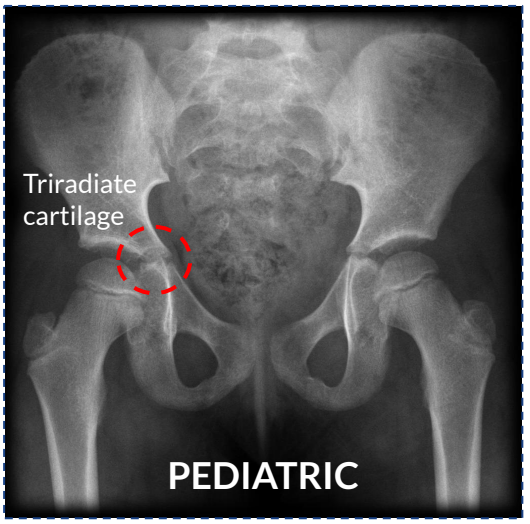
Original text | Doctor's notes | Text book
Important | Golden notes | Extra

Overview:

- In pediatrics the meeting area between the **ischium, pubic bone and iliac bone is called triradiate cartilage.** It is a transverse opening near to the top of the acetabulum.
- The femoral head is not present at the very early days (it is only cartilage), after a while the femoral head will start to be formed and the cartilage starts ossification and it will be called ossification center (ossification nucleus).
- Pediatrics have a growth plate, the greater trochanter is not yet formed.



A Child's Head and neck of femur are separated by the growth plate while in adults there's no separation.



Common Pediatric Hip Disorders

DDH (Developmental Dysplasia of the Hip)
The abnormality is between the head of the femur and the acetabulum.

SCFE (Slipped Capital Femoral Epiphysis)
The problem is between the head and the neck of the femur, growth plate between them becomes weak.

Legg-Calve-Perthes Disease (LCP)
The problem is at the femoral head. (Issue is decreased blood supply to the head of femur).

❖ What is the difference between DDH and CDH?

DDH (Developmental Dysplasia of the Hip):

This is the new name of the disease, why did they change it? Because it could happen with hip dislocation, subluxation, dislocatable, Acetabular dysplasia. It also could happen because of mechanical problems not only developmental problems (not only congenital).

CDH (Congenital Dislocation of the Hip):

This name means this disease will happen only during in utero development, and is limited only to hip dislocation. This term is no longer used because the disease can also be acquired later in life and can present with multiple presentations other than pure hip dislocation.

Developmental Dysplasia of the Hip:

⚠ The main problem is between the **head** of the femur and **acetabulum**.

Patterns of Developmental Dysplasia of the Hip (DDH)	
Completely Dislocated	• Completely separated; out of acetabulum. • There's a special test for dislocated hip & another one for dislocatable hip it's **very important** to differentiate between them.
Subluxated	• Partially separated.
Dislocatable	• Means unstable. Normally, when I want to push out the femoral head it won't dislocate; however in a patient with dislocatable DDH, it will dislocate and return back easily.
Acetabular Dysplasia (Acetabulum doesn't fit the head of femur)	• Normally the head of the femur is inside the acetabulum and both of them are surrounding each other so they will have their shape (the hemispherical shape). • If the femoral head is dislocated the acetabulum will not find anything to surround, so it will become shallow. Or sometimes the acetabulum is formed as shallow shape with no femoral head dislocation, but bc the acetabulum is shallow the head can't go in. The acetabulum takes its shape when the femoral head is attached to it, but if the femoral head is not attached and not inside the acetabulum, it will become flat rather than hemispheric. Evenmore sometimes the baby is born with a flat acetabulum but the femoral head is normal with no pathology but cannot attach to the acetabulum. • What is the X-Ray finding? ➔ The angle between the acetabulum and horizontal line is increased.

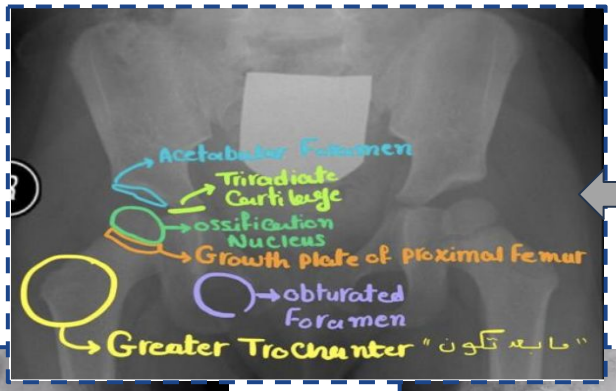
Causes:

The exact cause is **unknown**, But may be due to:

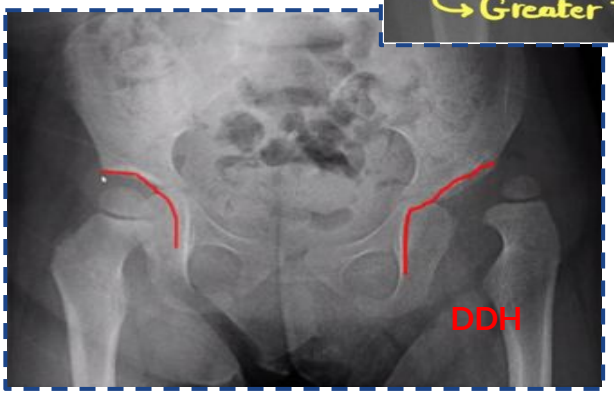
Causes	**Hormonal**	• Oxytocin and Relaxin	
	Familial	• Familial ligament laxity diseases	
	Genetic	• Females are affected 4-6 times males • Twins (40%)	
	Mechanical [1]	Prenatal	• Breech presentation[2], oligohydramnios[3], primigravida[4], twins, torticollis[5], metatarsus adductus and C-section
		Postnatal	• Swaddling (المهاد) and strapping (both causes adduction)

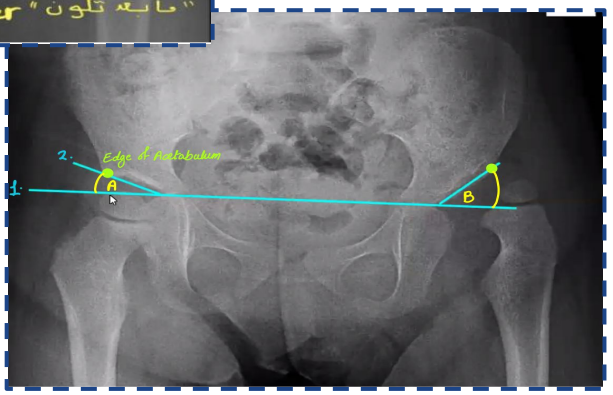
1- Anything that causes adduction of the hip might be a predisposing factor of DDH.
2- Breech presentation is when the fetus is lying longitudinally and its buttocks, foot or feet are presenting instead of its head.
3- Oligohydramnios refers to amniotic fluid volume that is less than expected for gestational age which might pressure the baby.
4- Primigravida is a woman who is pregnant for the first time.
5- Torticollis, also known as wryneck, is a twisting of the neck that causes the head to rotate and tilt at an odd angle.

Radiological Overview



Normal X ray of a child





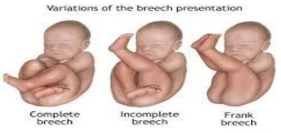
On Right side:
1. Head is inside the hip joint.
2. Acetabulum is covering the head of femur

Left side shows:
1. Head of femur is smaller
2. Lateralization (going out); of femur head
3. Acetabulum is not covering completely; (Shallow or Acetabular Dysplasia)

1. Draw straight line between the two Triradiate Cartilages. (horizontal line)
2. Draw line from the Edge of Acetabulum to the Triradiate Cartilage. Notice that the angle B is wider than A indicating DDH

Infants at Risk:

-**breech birth:** is when a baby is born bottom first instead of head first.



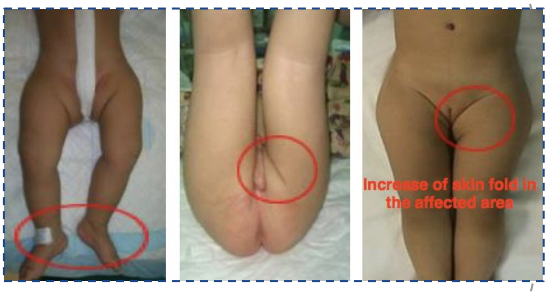
-**Torticollis:** defined by an abnormal, asymmetrical head or neck position

1. Positive family history: 10X
2. A baby girl: 4-6 X
3. Breech presentation: 5-10 X
4. Torticollis: CDH in 10-20% of cases
5. Foot deformities: Calcaneo-valgus and metatarsus adductus
6. Knee deformities: hyperextension and dislocation.

- When risk factors are present? the infant should be reviewed clinically and radiologically. If there are no risk factors one visit with negative findings should be enough to rule out DDH. If there are risk factors, **there must be at least two visits** with negative findings plus radiological confirmation to rule out DDH.
- DDH is increased by adduction and decreased by abduction, so anything that increases the stress on the head causing adduction might be predisposing factors.
- OSCE: History Taking of DDH patient. (the most important thing is to ask about the risk factors that are mentioned above)!

Clinical Examination

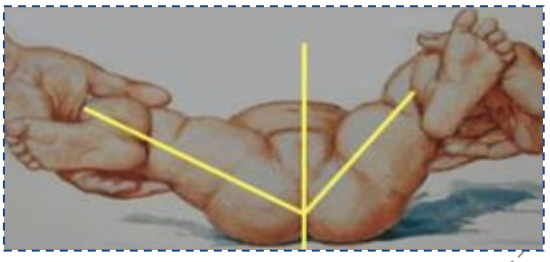
Look



These features are always found until treated

- External Rotation
- Lateralized Contour
- Asymmetric skin folds (anterior and posterior)
- Shortening
  - Of dislocated limb, which moves up leading to formation of skin folds in the affected limb.

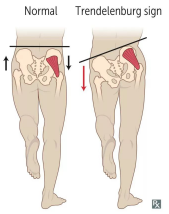
Move

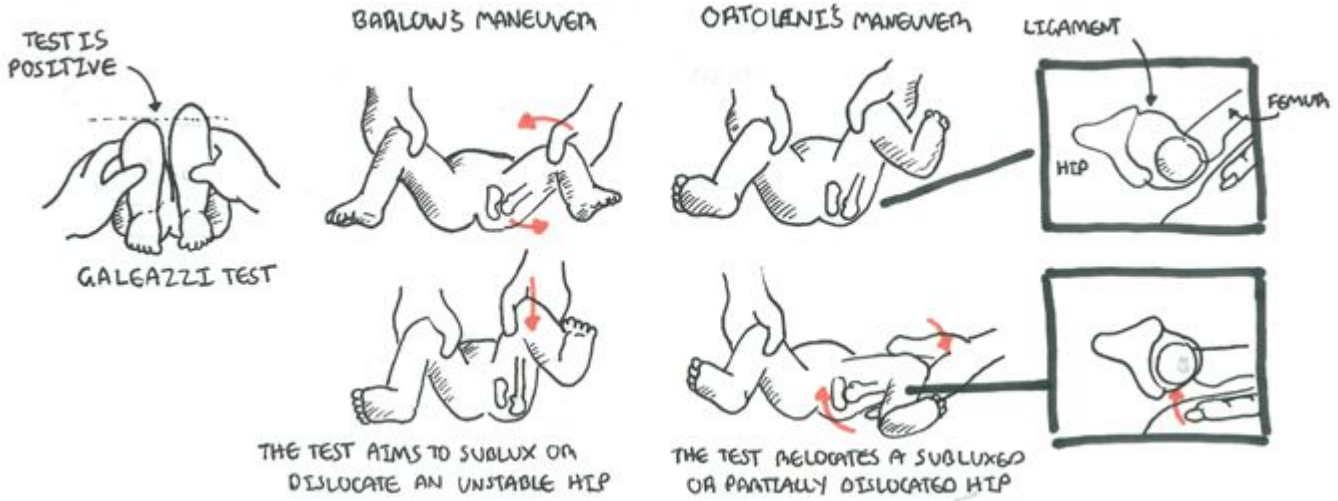


- Limited hip abduction: Because there is dislocation of the hip, that is why there is restricted abduction.
- It is present from birth, the mother will notice it while she's changing the diaper.

Special Tests

- Galeazzi (Older than 8 months)
- **Ortolani Test** (The most sensitive in Reducible DDH)
  - ➔ This Examination is performed for pediatrics <6 months.
  - ➔ Flex the hip and pull it then abduct it gently, if you pop it back into place or hear a click it is a positive test which means the baby is for sure has DDH.
- Barlow test
  - ➔ This test is helpful in dislocatable hip, done only for baby <6 months.
  - ➔ You will do adduction and move the femur out a little bit, if you feel the femur moved out that means unstable hip (dislocatable hip)
- Trendelenburg sign (used for late presentations >2 years when the child starts to walk)
  - ➔ Becomes waddling gait if bilateral
- Painless limping

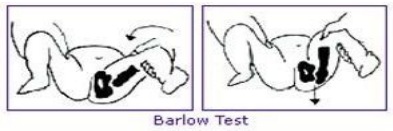




Barlow test

(Used for dislocatable pattern of DDH)

The test will dislocate the hip

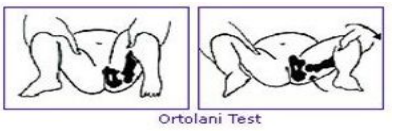


Barlow & Ortolani signs for hip dislocation

Ortolani Test

(Used for dislocated pattern of DDH)

The test will reduce the hip



Both these tests are the most important screening tests

Important Notes ❗

★ If you have an 8 months old patient with DDH what is the best test to use?
- The answer is **limited abduction,** key? 8 months.Ortolani and Barlow is for babies less than 6 months & Trendelenburg is for babies after 2y.

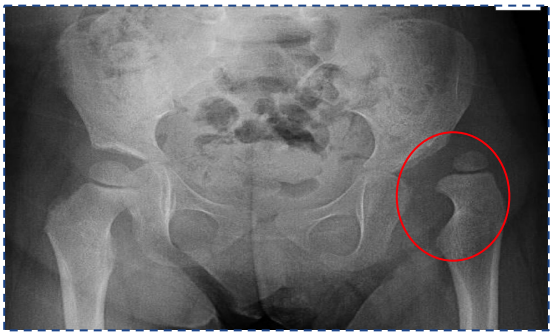
★ If you have a baby older than 6 months, what will you find in the examination which suggest DDH?
- Limited abduction, shortening, increase skin fold, limping when the baby starts to walk.

Investigations:

- 0-3 months: U/S (bc the head of the femur is not yet formed(it is as cartilage), so X-ray is useless)
- > 3 months: X-ray pelvis AP + abduction + inferolateral position.
- After 6 months: reliable (the best option for baby 6 months or older is x-ray).

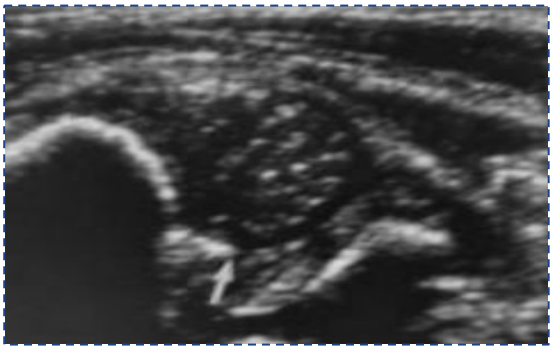
In the EXAM:

★ If the baby is **less than 6 months old do US, 6 month or older do X-ray**".

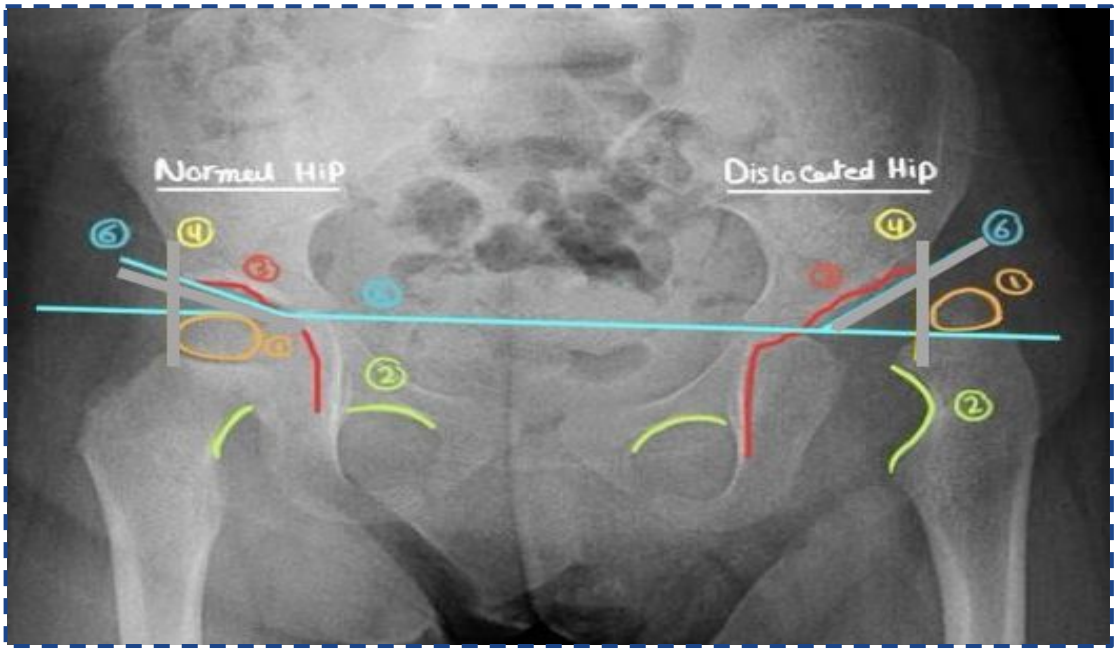


DDH on X-ray

(Very Important!)



Investigations:



The image shows left sided DDH

First you need to know some radiological terms found in pediatric hip:

1. Shows the ossification center (nucleus) of the femoral head\
2. Shows "Shenton's line" which runs across the upper border of the obturator foramen to the neck of the femur
3. Acetabulum
4. Shows two perpendicular "Perkin's" lines between the edge of acetabulum and the horizontal line (making an angle). **Normally** the femoral head should be medial to the perpendicular line.

6 Shows a horizontal line "Hilgenreiner's Line" between the two triradiate cartilages.

- **Normally** the femoral head should be **below** horizontal line.

❖ What are the signs of DDH on an X ray? **Important !**

- Head of the femur (ossification nucleus \ center) is **small.**
- Disrupted **Shenton's line.** In DDH the obturator foramen in seperated from the neck of femur.
- Acetabulum is opened and we call it "**Shallow Acetabulum**". The problem happened in the relationship b\w the head of femur and the acetabulum **that's why it's DDH.**
- Head of the femur (ossification nucleus \ center) is **lateral** to the perpendicular line.
- Head of the femur (ossification nucleus \ center) is **above** the horizontal line.

Note: From base to the tip of the acetabulum: the normal angle is between **18-22 degree**, in **DDH** it's **30, 40 degree and more.**

Treatment: (very important in MCQs)

Treatment of DDH

- Our aim in the treatment is to:
  1. **REDUCE**: obtain concentric reduction
  2. **STABILIZE**: maintain concentric reduction
  3. **SAFELY**: in a non-traumatic fashion [1]
  4. **WAY**: refer to pediatric orthopedics

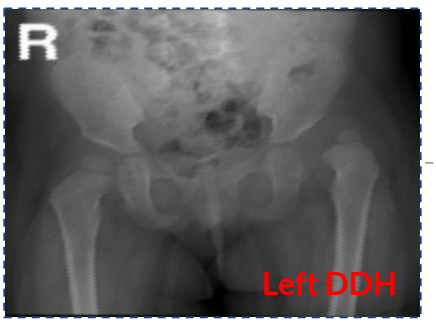

Pavlik Harness

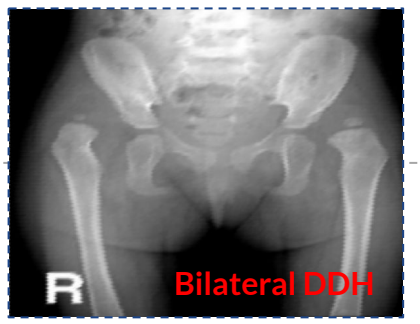

Short Leg Hip Spica Cast

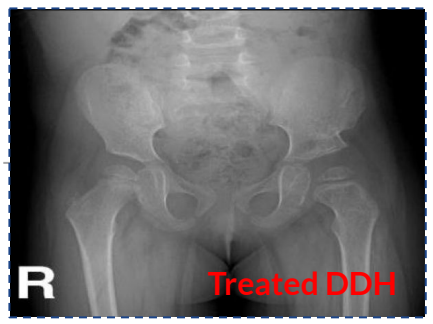
Important points

- ➔ Method depends on age.
- ➔ The earlier started the easier and better the results.
- ➔ Should be detected EARLY.
- ➔ Could be surgical or non-surgical if you detected early the surgical management is less likely

Birth – 6 m	**Reduce** + **maintain** with Pavlik harness or hip spica (H.S) in the OR . in the clinic and pt is awake, you do ortolani then if it works stabilize the hip. First 6 weeks with Pavlik harness then abduction splint for 3 months then we follow up the patient.
6-12 m	**GA** (general anesthesia) + **Closed reduction** + **maintain** with hip spica • If it fails, we remove fibrous tissues and do an open reduction • Why we give GA? because we have to do arthrogram (check presence of fibers) • If the arthrogram showed presence of fibers we might do an open reduction We do not use pavlik harness because the family can release it and we need to repeat the process and give the child GA again
12 - 18 m	**GA** + **Open** reduction (due to fibers presence) + **maintain** with hip spica
18 – 24 m	**GA** + **Open** reduction (ORIF) + **Acetabuloplasty** + maintain with hip spica
2 - 8 years	**GA** + **Open** reduction + **Acetabuloplasty** + **femoral shortening** [2] + **H.S** (hip spica)
Above 8 years	**GA** +**Open** reduction + **Acetabuloplasty** (advanced) + **femoral shortening** + **H.S** • Some hospitals and countries don't treat DDH after 8 years bc there will be erosions and abnormal acetabulum so even if you correct the femur the rate of success is very low. The patient will have to wait to do total hip replacement





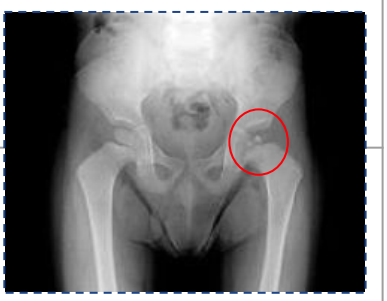
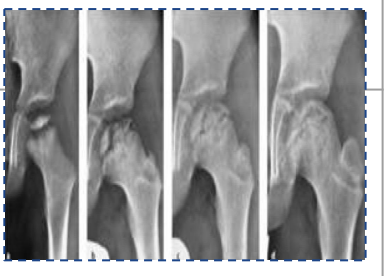


1- So if you try to reduce and it was tight don't try very hard or you will cause AVN
2- At this age the patient start walking, and with walking the femur will move up more and more, so you need to put it back to its place and shorten it

Complications: Important !

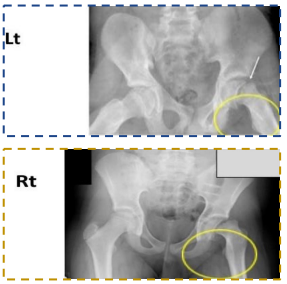
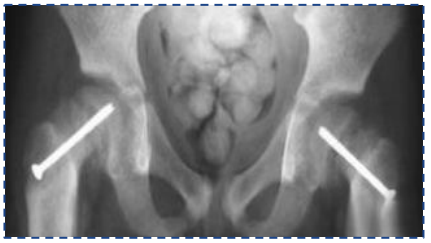
1. Severe pain
2. Early arthritis
3. Leg Length Discrepancy
4. Pelvic Inequality
5. Early lumbar spine degeneration

Legg-Calvé Perthes Disease

Legg-Calvé Perthes Disease	
Where?	At the level of head of the femur.
Why?	↓ Vascularity of head of the femur (avascular necrosis)
Causes	Unknown (it's ischemia due to unknown cause that will resupply the tissue however it will be too late)
Risk factors	• 4-8 years • Males • Obesity
Severity	Depends on the amount of femoral head involvement (determinant of prognosis)
History	• Hip pain • Knee pain • Minor trauma or no trauma • Painful limping
Clinical Examination	• Inability for weight bearing • Decrease internal rotation (IR) • Decrease Abduction • Usually painful ROM 
Investigations	X ray early X ray might not show anything • Pelvis (decreased and irregularly shaped femoral head) • Knee (normal) MRI • Used if X ray is not showing anything (early case)
Treatment Controversial	Refer to orthopedic as an **urgent** case • Control pain until the body heals the lesion by itself [1] • Maintain ROM to maintain the circular shape of the femoral head • Hip containment inside the acetabulum ➔ If outside we need to do surgery 
Late Complications	• Early arthritis • Leg Length Discrepancy (LLD) • Pelvic inequality • Early Lumbar spine degeneration

1- The blood supply will decrease → some cells will die → the body try to create new blood vessels → the blood supply will return → the dead cells will be reabsorbed → new cell will be formed → the femoral head will go back to its normal shape by remodeling. This process will take up to 4 years. (We need to control it by keeping the hip maintained & reduced + good ROM)

Slipped Capital Femoral Epiphysis:

Slipped Capital Femoral Epiphysis	
Where?	At the level of the growth plate (Between head and neck of femur)
Causes	• Hormonal • Metabolic • Obesity • Mechanical • Trauma • Unknown (most common)
Risk factors	• 8-12 years • Males • Obesity • Black • If other side is affected
History	• Hip pain • Referred knee pain • Minor trauma or no trauma • Painful limping
Clinical Examination	• Inability for weight bearing • Hip in ER (external rotation) • Decrease internal rotation (IR) • Decrease Abduction • Usually painful ROM
Investigations	X ray [1] • Pelvis ➔ **Early**: Normal or increased growth plate (preslip phase) ➔ **Late**: positive slippage • Knee (normal) [2] MRI • Used if X ray is normal or doubtful • If the Hx and PE suggest SCFE and X-ray is normal we do MRI (early cases) 
Treatment	Refer to orthopedic as an **emergency** case • In situ pinning – to prevent further damage to the vascularity - Might affect growth slightly (but very crucial) • Protected weight bearing for 3-4 weeks then full weight bearing • No sport for 6 months
Late Complications	• Femoral Acetabular Impingement (FAI) • Early arthritis • Leg Length Discrepancy (LLD) • Pelvic inequality • Chondrolysis • Early Lumbar spine degeneration 

1- On the Lt side, there is widening of growth plate (pre-slipped stage) → needs MRI. The Rt one is worse (there is slippage) which increases the risk of early arthritis

2- If the pt comes complaining of knee pain (referred) and I did an X-ray and it was normal, what is the next step? pelvic X-ray

Extra:

Developmental Dysplasia of the Hip

Definition
- abnormal development of hip, resulting in shallow acetabulum (dysplasia), displacement with some remaining contact between the articular surfaces (subluxation), or complete displacement of the joint (dislocation)
- most common orthopaedic disorder in newborns

Etiology
- due to ligamentous laxity, muscular underdevelopment, and abnormal shallow slope of acetabular roof
- spectrum of conditions
  - dislocated femoral head completely out of acetabulum
  - dislocatable head in socket
  - head subluxates out of joint when provoked
  - dysplastic acetabulum, more shallow and more vertical than normal

Physical Exam
- diagnosis is clinical
  - limited abduction of the flexed hip (<60°)
  - affected leg shortening results in asymmetry in skin folds and gluteal muscles, wide perineum
  - Barlow's test checks if hips are dislocatable
    - flex hips and knees to 90° and grasp thigh
    - fully adduct hips, push posteriorly to try to dislocate hips, feeling for a distinct clunk
  - Ortolani's test checks if hips are reducible
    - initial position as above but try to reduce hip with fingertips during abduction
    - positive test: palpable clunk is felt (not heard) if hip is reduced
  - Trendelenburg test and gait useful if older (>2 yr)
  - Galeazzi's sign
    - knees at unequal heights when hips and knees flexed
    - appearance of a shorter femur (lower knee) on affected side
    - difficult test if child <1 yr

Investigations
- U/S in first few months to view cartilage (bone is not calcified in newborns until 4-6 mo)
- follow-up radiograph after 3 mo
- x-ray signs (at 4-6 mo): false acetabulum, acetabular index >25°, broken Shenton's line, femoral neck above Hilgenreiner's line (horizontal line through right and left triradiate cartilage), ossification centre outside of inner lower quadrant (quadrants formed by intersection of Hilgenreiner's and Perkin's lines)

Treatment
- 0-6 mo: reduce hip using Pavlik harness to maintain abduction and flexion
- 6-18 mo: reduction under GA, hip spica cast x 2-3 mo (if Pavlik harness fails)
- 18 mo-2 yr: open reduction with spica casting
- >2 yr: pelvic and/or femoral osteotomy

Complications
- redislocation, inadequate reduction, stiffness
- AVN of femoral head may be seen at any point in treatment; due to impingement of medial circumflex femoral artery with severe abduction and flexion for prolonged time while in Pavlik harness or spica cast

Slipped Capital Femoral Epiphysis
- most common adolescent hip disorder, peak incidence at pubertal growth spurt

Definition
- type I Salter-Harris epiphyseal injury at proximal hip with anterosuperior displacement of the metaphysis relative to the epiphysis (remains in the acetabulum)

Etiology
- multifactorial
  - genetic: autosomal dominant, Black children at highest risk
  - cartilaginous physis hypertrophies too rapidly under growth hormone effects
  - sex hormone secretion, which stabilizes physis, has not yet begun
  - overweight: mechanical stress
  - trauma: causes acute slip
- risk factors: obesity (#1 factor), male, hypothyroid (risk of bilateral involvement), growth hormone deficiency, previous radiation to hip region, renal osteodystrophy

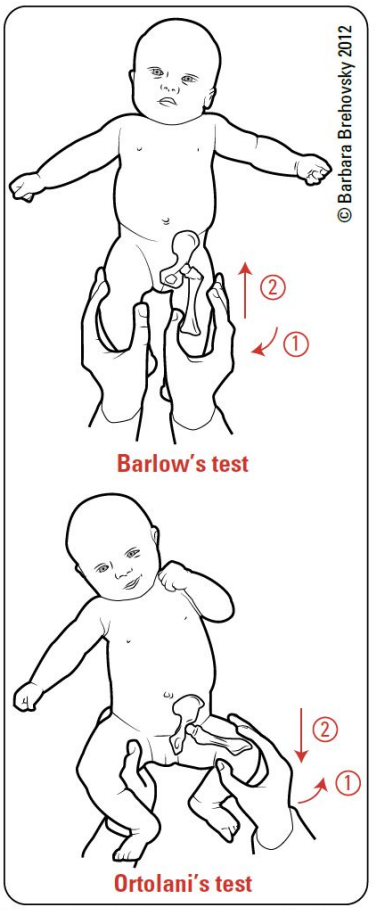


Figure 52. Barlow's test and Ortolani's test

5 Fs that Predispose to Developmental Dysplasia of the Hip
Family history
Female
Frank breech
First born
Le**F**t hip

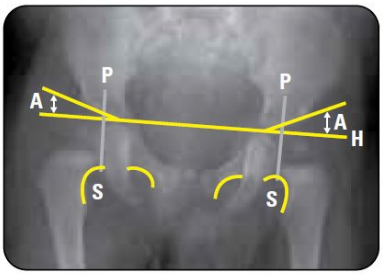


Figure 53. Pelvic x-ray and reference lines and angles for assessment of DDH

Triradiate Cartilage
y-shaped epiphyseal plate at junction of ilium, ischium and pubis

Hilgenreiner's Line
Line running between triradiate cartilages

Perkin's Line
Line through lateral margin of acetabulum, perpendicular to Hilgenreiner's Line

Shenton's Line
Arced line along inferior border of femoral neck and superior margin of obturator foramen

Acetabular Index
Angle between Hilgenreiner's Line and line from triradiate cartilage to point on lateral margin of acetabulum

Extra:

Clinical Features
- acute: sudden, severe pain with limp, less than 3 weeks duration
- chronic: typically groin and anterior thigh pain, may present with knee pain
  - positive Trendelenburg sign on affected side, due to weakened gluteal muscles
- can be associated with knee pain due to activation of the medial obturator nerve
- restricted internal rotation, abduction, flexion
  - Drehmann sign: obligatory external rotation during passive flexion of hip
- Loder classification: stable vs. unstable (provides prognostic information)
  - stable = able to bear weight, with or without crutches (risk of osteonecrosis <10%)
  - unstable = unable to ambulate even with crutches (high-risk of osteonecrosis, between 24-47%)

Bilateral involvement occurs in about 25%

Investigations
- x-ray: AP, frog-leg lateral radiographs both hips
  - posterior and medial slip of epiphysis
  - disruption of Klein's line
  - AP view may be normal or show widened/lucent growth plate compared with opposite side

Klein's Line
On AP view, line drawn along supero-lateral border of femoral neck should cross at least a portion of the femoral epiphysis. If it does not, suspect SCFE

Treatment
- operative: percutaneous in-situ fixation without reduction
- consider prophylactic fixation of contralateral hip in high-risk patients

Complications
- AVN, chondrolysis (loss of articular cartilage, resulting in narrowing of joint space), pin penetration, premature OA, loss of ROM, contralateral SCFE

Legg-Calvé-Perthes Disease (Coxa Plana)

Definition
- idiopathic AVN of femoral head, presents at 4-8 yr of age
- 12% bilateral, M:F=5:1, 1/1200
- associations
  - family history
  - low birth weight
  - abnormal pregnancy/delivery
  - ADHD in 33% of cases, delayed bone age in 89%
  - second-hand smoke exposure
- key features
  - AVN of proximal femoral epiphysis, abnormal growth of the physis, and eventual remodelling of regenerated bone

Most common in adolescent athletes, especially jumping/sprinting sports

Children diagnosed with coxa plana <6 yr of age have improved prognosis

Clinical Features
- child with antalgic or Trendelenburg gait ± pain
- intermittent knee, hip, groin, or thigh pain
- flexion contracture (stiff hip): decreased internal rotation and abduction of hip
- limb length discrepancy (late)

Investigations
- x-ray: AP pelvis, frog leg lateral
- initially, may be negative; if high index of suspicion, obtain bone scan or MRI
- eventually, collapse of femoral head will be seen (diagnostic)

Treatment
- goal is to preserve ROM and keep femoral head contained in acetabulum
- non-operative
  - physiotherapy: ROM exercises
  - restricted weight bearing
- operative
  - femoral or pelvic osteotomy (>8 yr of age or severe)
    - prognosis better in males, <6 yr, <50% of femoral head involved, abduction >30°
- 60% of involved hips do not require operative intervention
- natural history is early onset OA and decreased ROM

Quiz

MCQ

Q1: Which of the following is a proven risk factor for DDH?

A. Oligohydramnios
B. Negative family history
C. 3rd child
D. Baby male

Q2: What is the most sensitive test in a 4-months-old child with suspicion of reducible DDH?

A. Limited abduction
B. Ortolani
C. Barlow
D. Galeazzi

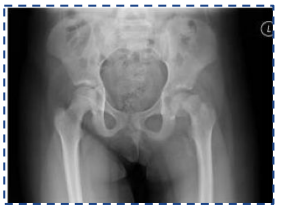
Q3: An 8-months-old child brought by his parents because of painless limping that was noticed recently. Which one of the following tests will be positive?

A. Galeazzi
B. Ortolani
C. Barlow
D. Thompson

Q4: A 16-months-old baby has DDH, which one of the following is a suitable management plan?

A. Pavlik harness
B. ORIF
C. open reduction w/ acetabuloplasty
D. open reduction w/o acetabuloplasty

Q5: An 8-year-old child came to the ER with painful limping, limited abduction and painful ROM. An X ray was done (shown in the image). Which of the following is the most likely diagnosis?



A. Perthes disease
B. DDH.
C. SCFE.
D. Septic arthritis.

SAQs

1. Mention 4 risk factors for DDH
   Page 4
2. What are the radiological signs found on an X ray of a child with DDH?
   Page 7

Answers

Q1	Q2	Q3	Q4	Q5
A	B	A	B	C

THANK YOU

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