

INFANT AND PEDIATRIC HIP CHAPTER 28

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- OBJECTIVES:**
- UPON COMPLETION OF THIS PRESENTATION, STUDENTS WILL BE ABLE TO:
 - ✓ DESCRIBE THE EMBRYOLOGY AND ANATOMY OF THE NEONATAL HIP.
 - ✓ IDENTIFY THE NORMAL HIP MOVEMENTS.
 - ✓ DEMONSTRATE THE NORMAL PROTOCOL AND SONOGRAPHIC APPEARANCES OF ULTRASOUND EVALUATION OF THE NEONATAL HIP.
 - ✓ DISCUSS THE MANEUVERS USED IN EVALUATING NEONATAL/PEDIATRIC HIPS.
 - ✓ DIFFERENTIATE BETWEEN NORMAL AND ABNORMAL NEONATAL/PEDIATRIC HIPS.

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- ## INDICATIONS FOR SONOGRAPHY
- RULE OUT DEVELOPMENTAL DISPLACEMENT OF THE HIP
 - SEPTIC ARTHRITIS/JOINT EFFUSION
 - PROXIMAL FOCAL FEMORAL DEFICIENCY

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ANATOMY

- UPPER LEG COMPOSED OF MANY PARTS TO INCLUDE BONES AND JOINTS, NERVES, ARTERIES, SUPERFICIAL VEINS, AND MUSCLES
- ANTERIOR SURFACE OF THIGH IS CONTINUOUS WITH INGUINAL REGION OF ABDOMEN
- POSTERIOR SURFACE OF THIGH IS INFERIOR TO THE GLUTEAL REGION
 - ❖ BACK OF THE PELVIS AND HIP JOINT

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BONES AND JOINTS

- SACROILIAC JOINTS UNITE TWO HIP BONES WITH SACRAL PART OF VERTEBRAL COLUMN
- PUBIC SYMPHYSIS IS WHERE TWO HIP BONES UNITE WITH EACH OTHER ANTERIORLY
- HIP BONES ARE FUSION OF THREE SEPARATE BONE
 - ❖ ILIUM, ISCHIUM, AND PUBIS
 - TOGETHER THESE FORM PELVIC GIRDLE

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HIP JOINT

- ARTICULATION OF HEAD OF FEMUR WITH ACETABULUM OF HIP BONE
- JOINT IS NOT DIRECTLY PALPABLE BECAUSE IT IS SURROUNDED AND PROTECTED BY MUSCLES OF UPPER THIGH
- GREATER TROCHANTER OF FEMUR FORMS A PALPABLE KNOB AT SIDE

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HIP JOINT (CONT'D)

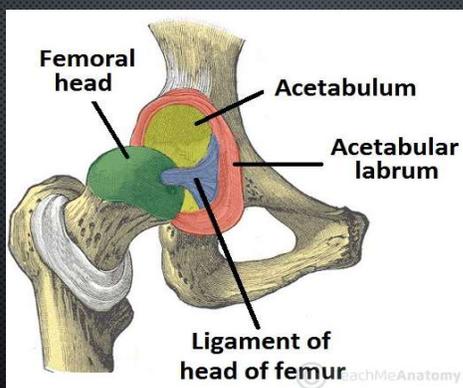
- PSOAS TENDON CROSSES CENTER HIP JOINT JUST INFERIOR TO INGUINAL LIGAMENT AT TOP OF FEMORAL TRIANGLE
- PECTINEUS MUSCLE IS MEDIAL TO TENDON
- LATERAL TO TENDON IS ILIACUS MUSCLE
- GLUTEUS MINIMUS MUSCLE IS IMMEDIATE COVER FOR UPPER PART OF HIP JOINT
- PIRIFORMIS MUSCLE IS IMMEDIATELY POSTERIOR TO JOINT

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BONES

- ROUNDED SHAPE OF FEMUR AND CUP SHAPE OF ACETABULUM FORM "BALL-AND-SOCKET" HIP JOINT
- ACETABULUM IS MADE DEEPER BY A RIM OF FIBROCARILAGE
 - ❖ "ACETABULAR LABRUM"
- BONY DEFICIENCY AT LOWER PART OF ACETABULUM (ACETABULAR NOTCH) COVERED BY BAND OF FIBROUS TISSUE
 - ❖ "TRANSVERSE LIGAMENT"

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MOVEMENTS OF HIP

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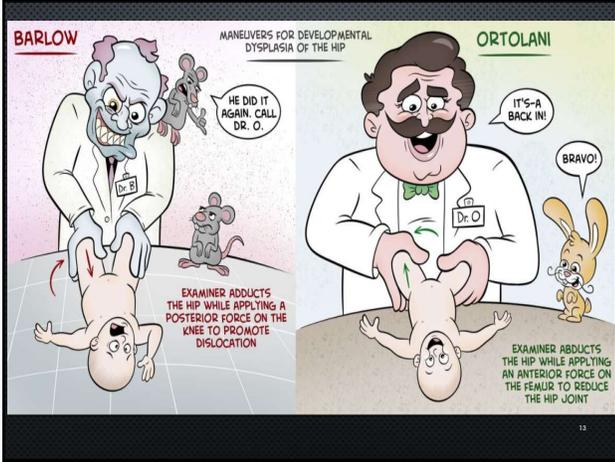
- SOMEWHAT LIMITED IN RANGE FROM TIGHT FIT BETWEEN FEMUR AND ACETABULUM AND HIP BONE IS IMMOBILE
- FUNCTIONS/MOVEMENTS:
 - ❖ FLEXION: BENDING FORWARD
 - ❖ EXTENSION: BENDING BACKWARD
 - ❖ ABDUCTION: MOVING SIDWAYS OUTWARD
 - ❖ ADDUCTION: MOVING SIDWAYS INWARD
 - ❖ MEDIAL ROTATION
 - ❖ LATERAL ROTATION

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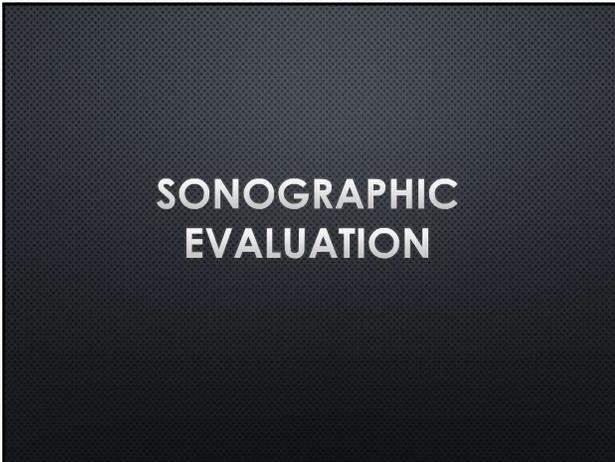
MANEUVERS

- BARLOW: HIP FLEXED, AND ADDUCTED, DOWNWARD AND OUTWARD PRESSURE APPLIED
 - ❖ IF DDH- HIP "POPS" OUT
- ORTOLANI: HIP FLEXED AND ABDUCTED
 - ❖ IF DDH- HIP "CLUNKS" BACK IN

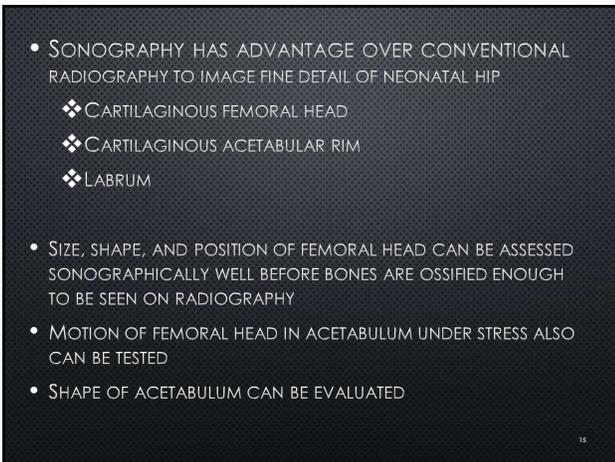
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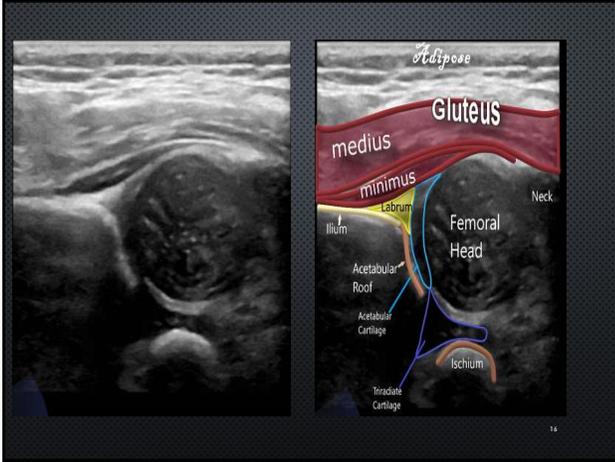
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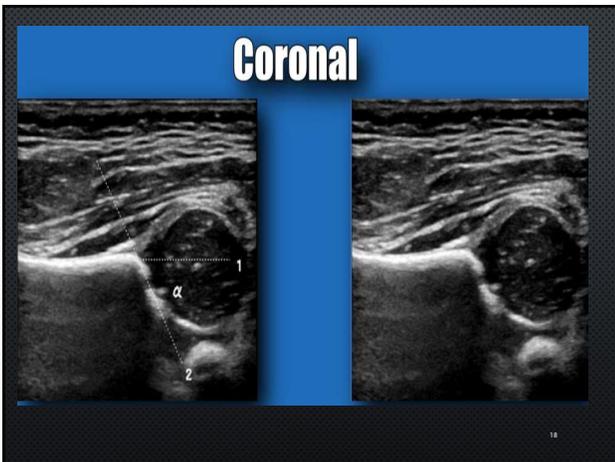
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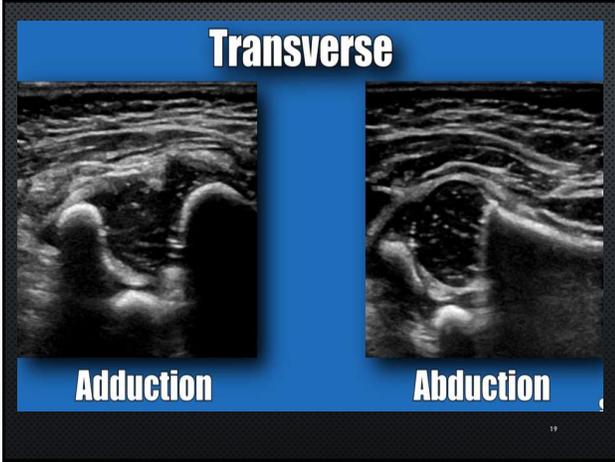
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- SONOGRAPHY CAN BE PERFORMED UNTIL FEMORAL HEAD OSSIFIES
- OSSIFICATION OF FEMORAL HEAD BEGINS BETWEEN 2 AND 8 MONTHS
 - ❖ OCCURS EARLIER IN GIRLS THAN BOYS
 - ❖ OFTEN COMPLETE BY 1 YEAR
- ONCE FEMORAL HEAD IS COMPLETELY OSSIFIED
 - ❖ DIFFICULT TO OBTAIN ADEQUATE SONOGRAPHIC IMAGES - ARTIFACT

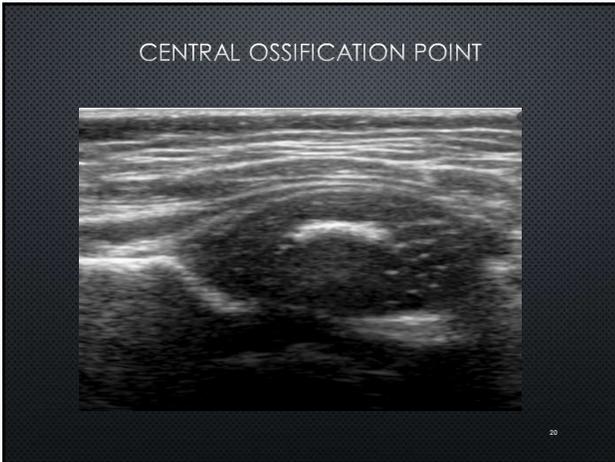
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- LINEAR ARRAY TRANSDUCER
- FOR AVERAGE WEIGHT NEONATES UP TO THREE MONTHS
 - ❖ 7.5 – 9.0 MHz TRANSDUCER
- INFANTS TO AGE 7 MONTHS
 - ❖ 5 – 7.5 MHz TRANSDUCER
- AFTER 7 MONTHS
 - ❖ 3-MHz TRANSDUCER
- PREMATURE INFANT
 - ❖ 12 – 15 MHz TRANSDUCER

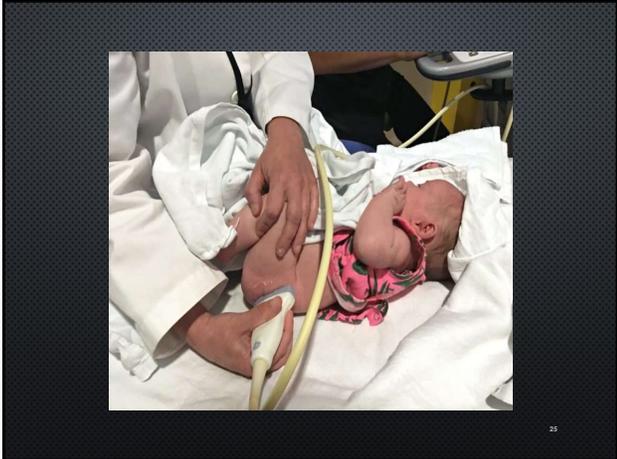
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SONOGRAPHIC PROTOCOL

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- BASIC HIP ANATOMY IS IMAGED IN FOUR DIFFERENT VIEWS:
 1. CORONAL/NEUTRAL
 2. CORONAL/FLEXION
 3. TRANSVERSE/FLEXION
 4. TRANSVERSE/NEUTRAL

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GRAF'S ALPHA AND BETA ANGLES

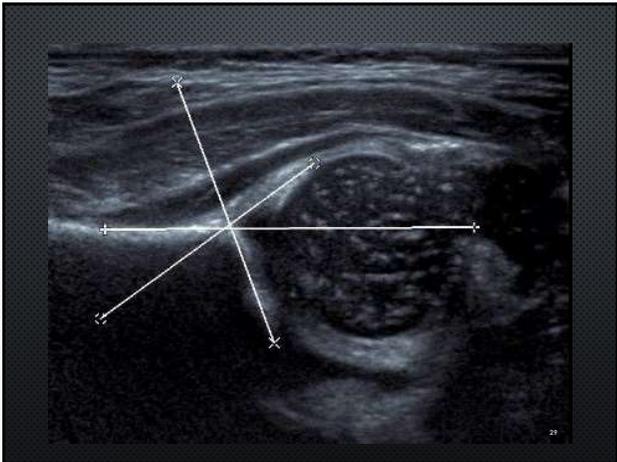
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- **GRAF USED A SERIES OF LINES AND ANGLE MEASUREMENTS TO EVALUATE MORPHOLOGY OF ACETABULUM:**
 - ❖ **BASELINE CONNECTS OSSEOUS ACETABULAR CONVEXITY TO POINT WHERE JOINT CAPSULE AND PERICHONDRIUM UNITE**
 - ❖ **INCLINATION LINE CONNECTS OSSEOUS ACETABULAR CONVEXITY TO LABRUM**
 - ❖ **ACETABULAR ROOF LINE CONNECTS LOWER EDGE OF MEDIAL ACETABULAR ROOF TO OSSEOUS ACETABULAR CONVEXITY**

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- ALPHA AND BETA ANGLES ARE MEASURED BASED ON PRECEDING LINES
- ALPHA ANGLE IS ANGLE BETWEEN BASELINE AND ACETABULAR ROOF LINE AND REPRESENTS OSSEOUS ACETABULUM
- ALPHA ANGLE IS NORMALLY GREATER THAN 60 DEGREES
- BETA ANGLE IS ANGLE BETWEEN BASELINE AND INCLINATION LINE

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- BETA ANGLE EVALUATES FORMATION AND SIZE OF CARTILAGINOUS ACETABULUM
 - ❖ NORMALLY LESS THAN 55 DEGREES
- ALPHA ANGLE REFLECTS CHANGES IN OSSEOUS PORTION OF ACETABULUM
 - ❖ OCCURS GRADUALLY
- BETA ANGLE REFLECTS CHANGES IN CARTILAGINOUS ACETABULUM
 - ❖ OCCURS MORE QUICKLY THAN CHANGES IN OSSEOUS ACETABULUM
 - ❖ MAY BE MORE SENSITIVE THAN ALPHA ANGLE

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CORONAL/NEUTRAL VIEW

- PERFORMED WITH INFANT IN SUPINE POSITION FROM LATERAL ASPECT OF HIP JOINT
 - ❖ PLANE OF TRANSDUCER ORIENTED CORONALLY WITH RESPECT TO HIP JOINT
- FEMUR IS STABILIZED WITH A FLEXION
- ALPHA AND BETA ANGLES MAY BE MEASURED FROM THIS VIEW
- A STABILITY TEST CAN BE PERFORMED IN THIS VIEW BY GENTLY PUSHING AND PULLING THE INFANT'S LEG

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CORONAL/NEUTRAL VIEW (CONT'D)

- NORMAL CORONAL/NEUTRAL VIEW
 - ❖ FEMORAL HEAD IS RESTING AGAINST BONY ACETABULUM
- WHEN HIP BECOMES SUBLUXED OR DISLOCATED
 - ❖ FEMORAL HEAD GRADUALLY MIGRATES Laterally AND SUPERIORLY WITH PROGRESSIVELY DECREASED COVERAGE OF FEMORAL HEAD

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HIP DYSPLASIA

- ACETABULAR ROOF IS IRREGULAR AND ANGLED
- LABRUM IS DEFECTED SUPERIORLY AND BECOMES ECHOGENIC AND THICKENED
- HIP IS FRANKLY DISLOCATED
 - ❖ LABRUM MAY BE DEFORMED
- COMBINATION OF DEFORMED LABRUM AND FIBROFATTY TISSUE PREVENTS HIP FROM BEING REDUCED

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CORONAL/FLEXION VIEW

- TRANSDUCER MAINTAINED IN LATERAL POSITION WHILE HIP IS MOVED INTO A 90-DEGREE ANGLE OF FLEXION
- CURVILINEAR MARGIN OF FEMORAL SHAFT BODY IS IDENTIFIED ANTERIOR TO FEMORAL HEAD
- IN MIDPORTION OF ACETABULUM, FEMORAL HEAD IS SURROUNDED BY ECHOES FROM BONY ACETABULAR COMPONENTS

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CORONAL/FLEXION VIEW (CONT'D)

- SUPERIORLY LATERAL MARGIN OF ILIAC BONE IS SEEN AND TRANSDUCER POSITION SHOULD BE ADJUSTED SO THAT IT BECOMES A STRAIGHT HORIZONTAL LINE ON MONITOR
- NORMAL HIP GIVES APPEARANCE OF A BALL-ON-A-SPOON IN THE MID ACETABULUM
 - ❖ FEMORAL HEAD IS THE BALL
 - ❖ ACETABULUM FORMS THE SPOON
 - ❖ ILIAC LINE IS HANDLE

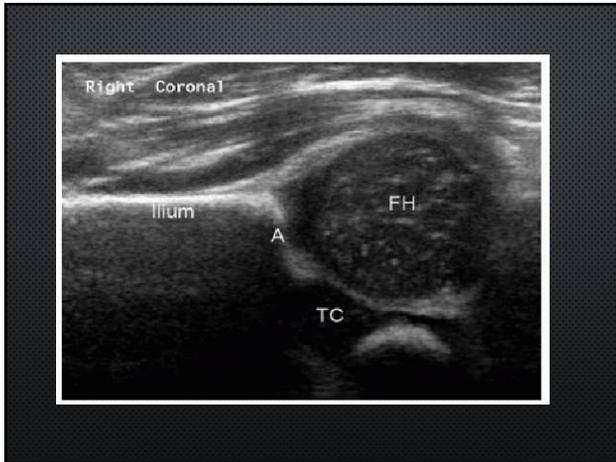
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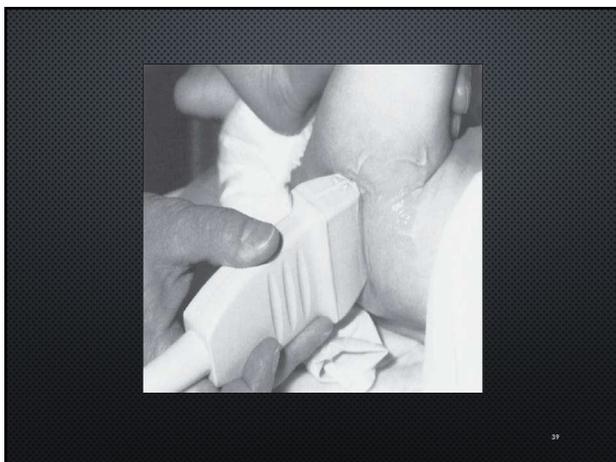


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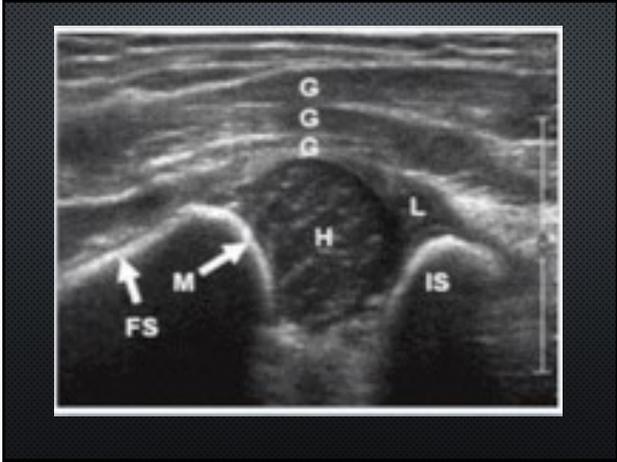
TRANSVERSE/FLEXION VIEW

- TRANSVERSE IS ROTATED 90 DEGREES AND MOVED POSTERIORLY INTO A POSTEROLATERAL POSITION OVER HIP
- ECHOES FROM BONY ACETABULUM APPEAR POSTERIORLY TO FEMORAL HEAD
- NORMAL HIP
 - U CONFIGURATION IS PRODUCED

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TRANSVERSE/NEUTRAL VIEW

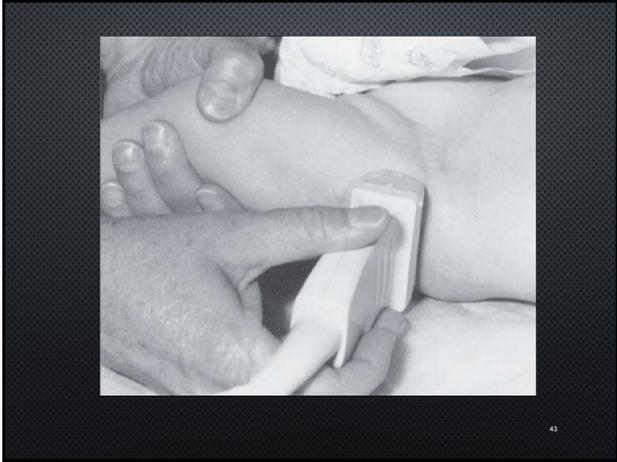
- LEG IN A NEUTRAL POSITION
- TRANSDUCER IS NOW HORIZONTAL TO ACETABULUM FROM LATERAL ASPECT OF HIP
- PLANE PASSES THROUGH FEMORAL HEAD INTO ACETABULUM AT CENTER OF CARTILAGE

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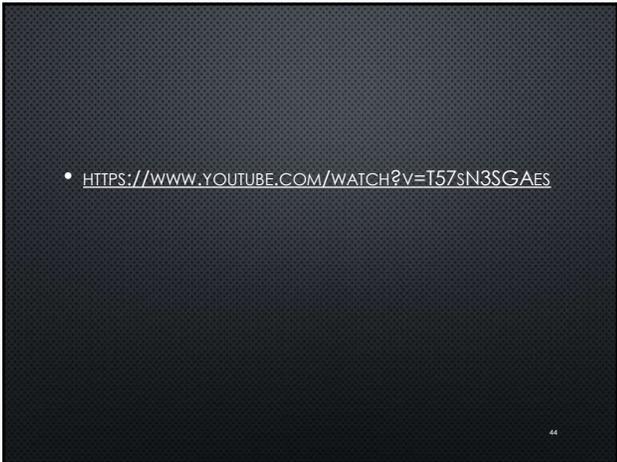
TRANSVERSE/NEUTRAL VIEW (CONT'D)

- IMAGES REPRESENT PARTS OF A FLOWER:
 - ❖ FEMORAL HEAD – FLOWER
 - ❖ ECHOES FROM ISCHIUM POSTERIORLY AND PUBIS ANTERIORLY – LEAVES AT ITS BASE
 - ❖ ECHOES THAT PASS THROUGH CARTILAGE INTO AREA OF ACOUSTIC SHADOWING CREATED BY OSSEOUS STRUCTURES – STEM

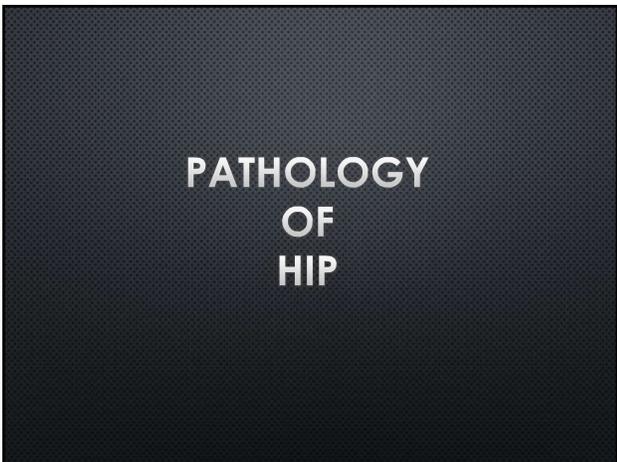
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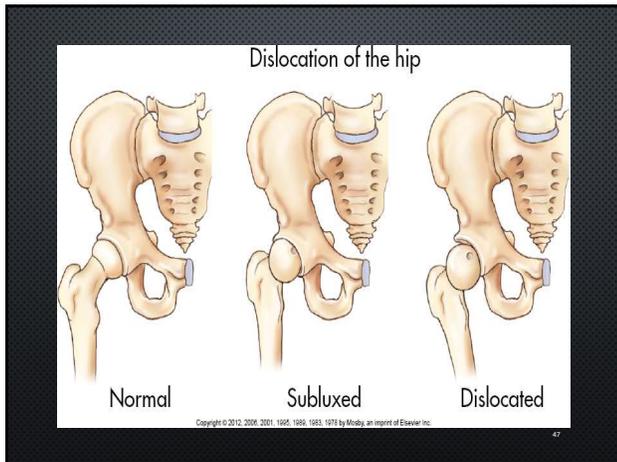
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DEVELOPMENTAL DYSPLASIA OF THE HIP (DDH)

- AKA. DEVELOPMENTAL DISPLACEMENT OF THE HIP
- ENCOMPASSES A SPECTRUM OF PATHOLOGIES:
 - SUBLUXATED
 - DYSPLASTIC
 - DISLOCATABLE
 - DISLOCATED HIP

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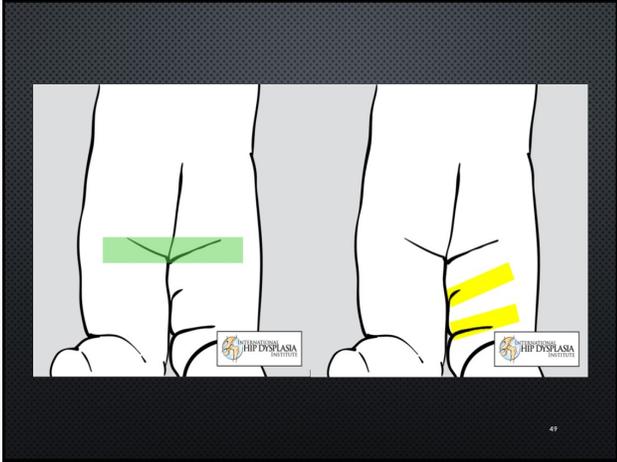
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CLINICAL EXAMINATION

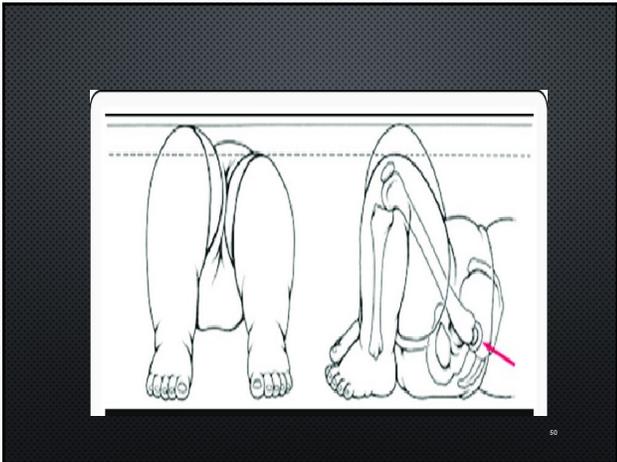
- WITH VISUAL INSPECTION, THE DISLOCATED HIP SHOWS ASYMMETRIC SKIN FOLDS AND SHORTENING OF THE AFFECTED THIGH.
- THE KNEE IS LOWER IN POSITION ON THE AFFECTED SIDE WHEN THE PATIENT IS SUPINE AND THE KNEES ARE FLEXED, KNOWN AS THE **GALEAZZI SIGN**.

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CLINICAL EXAMINATION (CONT'D)

- HIP INSTABILITY MAY RESOLVE AFTER 4-6 WEEKS, DUE TO WANING MATERNAL HORMONES.
- NEONATES WITH A SLIGHTLY POSITIVE OR INCONCLUSIVE PHYSICAL EXAM, AND NEWBORNS WITH A RISK FACTOR FOR DDH SHOULD BE EXAMINED WITH SONOGRAPHY AFTER THIS PERIOD TO REDUCE FALSE-POSITIVE RESULTS.

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DISLOCATION

- NEONATAL HIP DISLOCATION CAN BE DUE TO:
 - ACQUIRED
 - TRAUMA
 - NEUROMUSCULAR DISEASES
 - TERATOGENIC
 - ❖ OCCUR IN UTERO – ASSOCIATED WITH NEUROMUSCULAR DISORDERS
 - DEVELOPMENTAL
 - ❖ WAS FORMERLY KNOWN AS CONGENITAL HIP DYSPLASIA
 - ❖ REPLACED BY DEVELOPMENTAL DISPLACEMENT OF THE HIP (DDH)

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DISPLACEMENT

- RELATIVELY COMMON CONGENITAL ABNORMALITY
- BEFORE SONOGRAPHY, PLAIN FILM RADIOGRAPHS WERE USED TO CONFIRM DIAGNOSIS OF A DYSPLASTIC HIP
- SONOGRAPHY HAS NOW REPLACED RADIOGRAPHY IN THAT IT:
 - ❖ DOES NOT REQUIRE NEONATE TO BE SEDATED
 - ❖ IONIZING RADIATION IS NOT USED
 - ❖ SOFT TISSUES ARE WELL DEFINED

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DISPLACEMENT - DDH (CONT'D)

- MULTIPLE RISK FACTORS MAY CONTRIBUTE
 - ❖ FIRSTBORN CHILD
(FEMALES > MALES)
 - ❖ LEFT HIP MOST COMMONLY AFFECTED
 - ❖ BREECH BIRTH
 - ❖ LOW BIRTH WEIGHT
 - ❖ FAMILY HISTORY
 - ❖ INTRAUTERINE CONDITIONS

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DISPLACEMENT- DDH (CONT'D)

- OTHER RISK FACTORS:
 - ❖ MATERNAL HYPERTENSION
 - ❖ FETAL GROWTH RESTRICTION
 - ❖ OLIGOHYDRAMNIOS
 - ❖ PREMATURE RUPTURE OF MEMBRANES
 - ❖ PROLONGED GESTATION
 - ❖ INCREASED BIRTH WEIGHT
 - ❖ POTTER'S SYNDROME
 - ❖ NEONATAL INTENSIVE CARE

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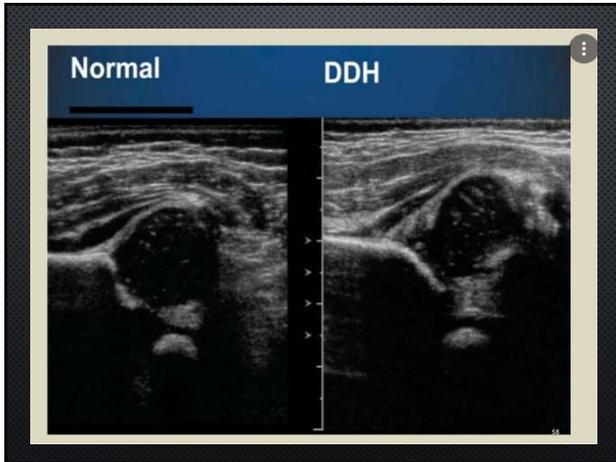
SONOGRAPHIC TECHNIQUE FOR DEVELOPMENTAL DISPLACEMENT OF HIP

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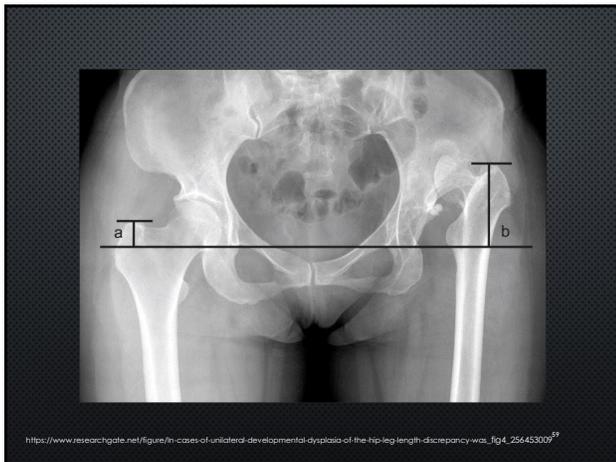
- TWO SONOGRAPHIC TECHNIQUES:
 1. STATIC (MORPHOLOGIC)
 2. DYNAMIC
 - ❖ MORE COMMONLY USED AND PREFERRED
- STATIC OR MORPHOLOGIC TECHNIQUE:
 - ❖ IMAGE IS ACQUIRED IN CORONAL PLANE AT MID ACETABULAR LEVEL
 - INCLUDES FEMORAL HEAD, ACETABULUM, LABRUM, AND ILIAC BONE AS IT MEETS TRIRADIATE CARTILAGE
 - PRODUCES A CORONAL IMAGE WHICH HAS A CONFIGURATION OF A LAZY Y

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GRAF'S CLASSIFICATION OF NEONATAL HIPS

- ACCORDING TO GRAF (FOUR TYPES OF DISPLACEMENTS).
- CLASSIFIED ACCORDING TO ITS ALPHA AND BETA ANGLES:
 - TYPE I HIP
 - ❖ NORMAL HIP
 - ❖ HAS AN ALPHA ANGLE OF GREATER THAN 60 DEGREES
 - TYPE II HIP
 - ❖ HAS AN ALPHA ANGLE BETWEEN 43 AND 60 DEGREES
 - TYPE III HIP
 - ❖ HAS AN ALPHA ANGLE OF < 43 DEGREES AND A BETA ANGLE >77 DEGREES
 - TYPE IV HIP
 - ❖ HAS AN ALPHA ANGLE < 43 DEGREES AND THE BETA ANGLE IS IMMEASURABLE

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DYNAMIC TECHNIQUE

- CURRENTLY USED IN MOST CLINICAL SITUATIONS TODAY
- ALL SCANNING IS PERFORMED FROM LATERAL OR POSTEROLATERAL ASPECT OF HIP
- HIP IS IMAGED IN ORTHOGONAL PLANES:
 - ❖ CORONAL (LONGITUDINAL)
 - ❖ TRANSVERSE (AXIAL)
- WITH THE HIP FLEXED, THE FEMUR IS MOVED THROUGH A RANGE OF ABDUCTION AND ADDUCTION, WITH STRESS VIEWS PERFORMED IN THE FLEXED POSITION

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TREATMENT OF DDH

- THE INITIAL TREATMENT OF UNCOMPLICATED DDH IS CLOSED REDUCTION
 - ❖ ACCOMPLISHED EITHER BY PLACING TWO DIAPERS ON THE NEONATE OR BY USING A SPICA CAST, BRACE, OR PAVLIK HARNESS.
- THE HIP SHOULD BE POSITIONED IN FLEXION, WITH ABDUCTION AND EXTERNAL ROTATION.

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PAVLIK HARNESS



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ANY QUESTIONS???



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