Developmental Dysplasia of the Hip:

what do Radiologists Need to Know?

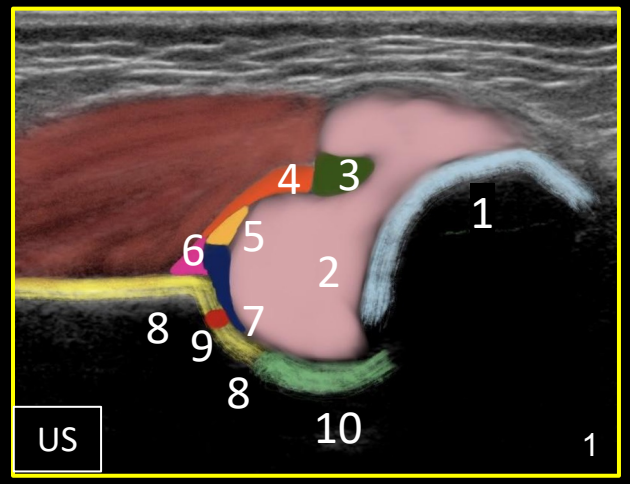
IMAGING METHODS

Imaging Method	Description	Advantages	Disadvantages	Indications
Ultrasonography (US)	Real-time imaging using sound waves to visualize the hip joint.	Non-invasive and safe for infants.	Limited visualization of bony structures.	Screen for DDH in newborns and young infants.
X-ray (Radiography)	2D imaging using ionizing radiation to assess bone anatomy.	Provides detailed visualization of bony abnormalities.	Limited assessment of soft tissues.	Confirm DDH diagnosis in older infants and children.
Magnetic Resonance Imaging (MRI)	Non-ionizing, multiplanar imaging to visualize soft tissues and bony structures.	Excellent visualization of soft tissue structures.	Expensive and may require sedation in young children.	Assess complex or atypical DDH cases.
Computed Tomography (CT)	3D imaging using ionizing radiation to visualize bone anatomy.	Precise assessment of bone morphology.	Higher radiation exposure compared to X-ray.	Rarely used in DDH diagnosis due to radiation risks.

Table 1. Key aspects of imaging methods in the diagnosis and management of DDH.

All authors have disclosed no financial relationships.

INFANT HIP ANATOMY



Legend of figures 1 and 2.

1.Chondro-osseous border
2. Femoral head
3. Synovial fold
4. Hip joint capsule
5. Labrum
6. Rectus femoris tendon
7. Cartilage
8. Bony roof
9. Bony rim
10. Triradiate cartilage

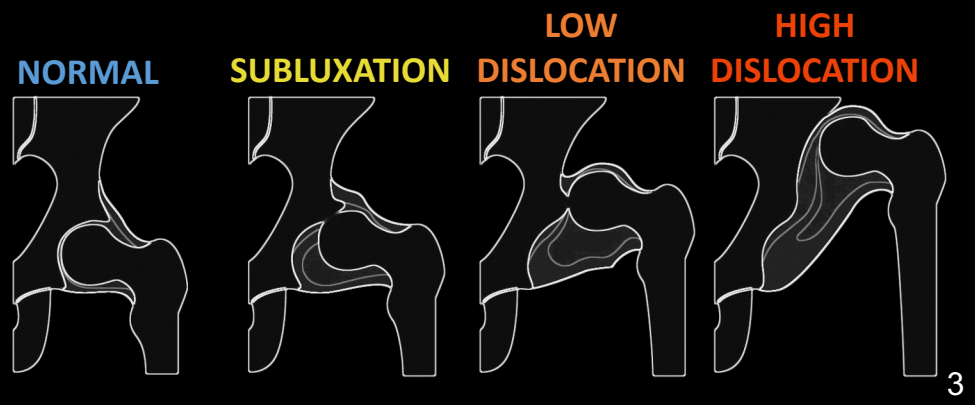


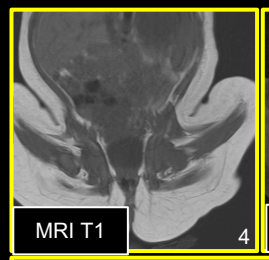
Figure 3. Illustrations of a normal, subluxated, low dislocation and high dislocation hip.

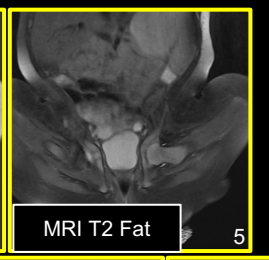
MRI FAST PROTOCOL

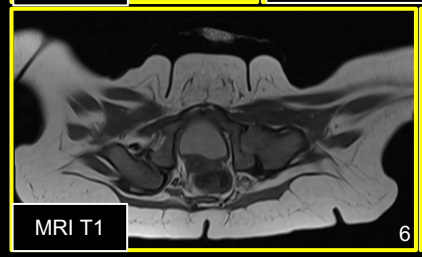
✓ The fast protocol is designed to shorten the scan time while still providing high-quality images. This is achieved by using specific imaging sequences that focus on the essential structures of the hip joint and omitting unnecessary sequences.

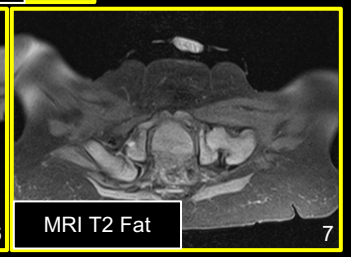
Protocol Sequences	Slice Thickness and Gap	FOV (mm)	Matrix (mm)
Axial T2	3.0 mm/0.6 mm	220	240 x 320
Axial T2 Fatsat	3.0 mm/0.6 mm	220	240 x 320
Coronal T1	4.0 mm/0.4 mm	200	240 x 320
Coronal T2	4.0 mm/0.4 mm	200	240 x 320
Coronal T2 Fatsat	4.0 mm/0.4 mm	200	240 x 320

Table 2. Our suggestion for a fast protocol for the assessment of the hips.



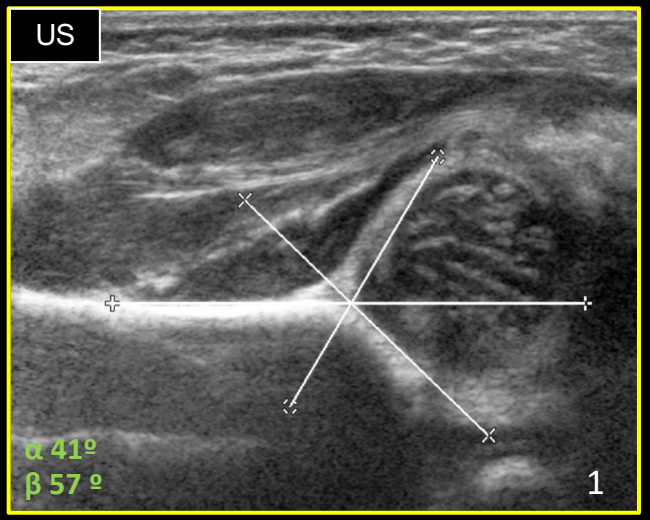


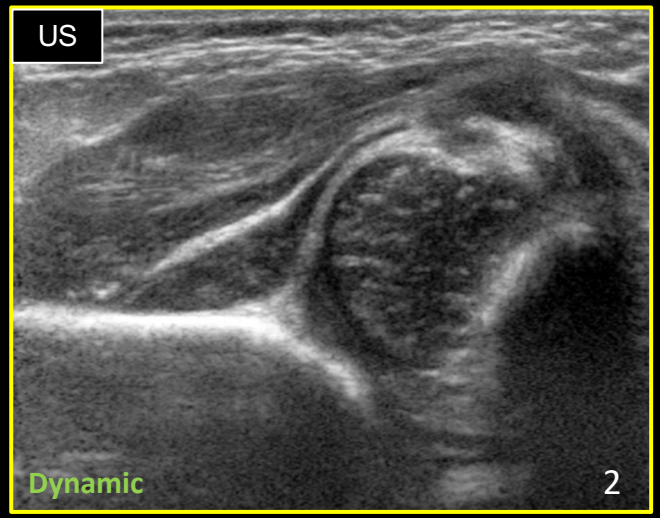




Figures 4-7. Male, one year and ten months old, with bilateral hip dysplasia, with posterior dislocation of the right femoral head, undergoing preoperative assessment with a rapid MRI protocol. Preoperative examination performed with external immobilization device. Femoral head dislocation with marked dysplasia of the right acetabulum was noted, with thickening of the labrum, joint capsule and iliofemoral ligament.

GRAF & HARCKE METHOD

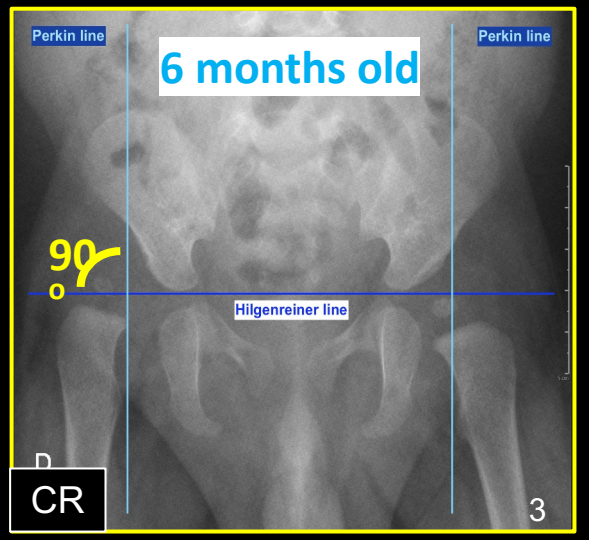




Figures 1 and 2. Patient with Graf type III hip, presenting subluxation of the femoral head during dynamic maneuvers. The dynamic maneuvers will be demonstrated below (Video 1), including the Ortolani's Maneuver, which detects posterior slippage of the hip into the acetabulum, and the Barlow Maneuver, which detects slippage of the hip out of the acetabulum.

Each thigh is examined separately. Both maneuvers begin with the infant in the supine position and the thighs and knees flexed to 90° (the feet will be off the bed). To perform Ortolani's Maneuver, the thigh of the hip under examination is abducted and gently pulled anteriorly. Instability is indicated by palpation, sometimes an audible click of the femoral head moving over the posterior arch of the acetabulum and repositioning in the socket. Next, in the Barlow Maneuver, the hip is returned to the starting position and then slightly abducted (i.e. the knee is pulled over the body) and the hip is moved posteriorly. A click indicates that the femoral head is moving out of the acetabulum.

RADIOGRAPHIC FEATURES



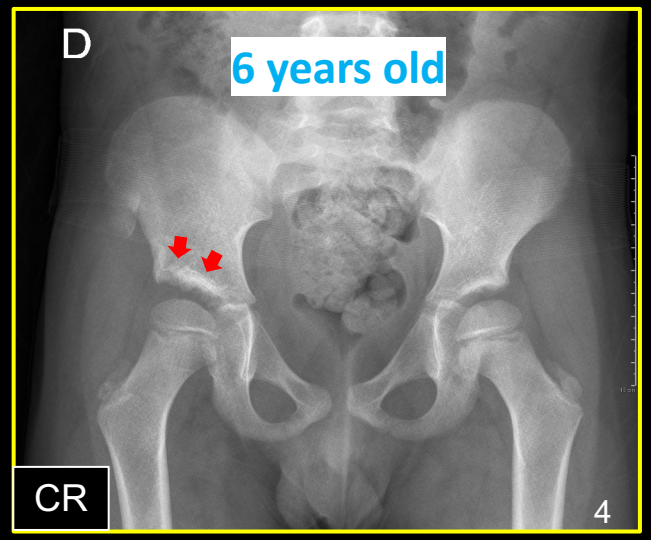


Figure 3. Female, 6 months old, with lateral dislocation of the right femoral head, located in the superolateral quadrant of the intersection between **Hilgenreiner's and Perkin's lines.**

Figure 4. Same patient in Figure 25, 6 years old, postoperative control of osteotomy of the right acetabular roof, noting sclerosis and cortical irregularities (arrows). Symmetrical nuclei of ossifications of the femoral heads.

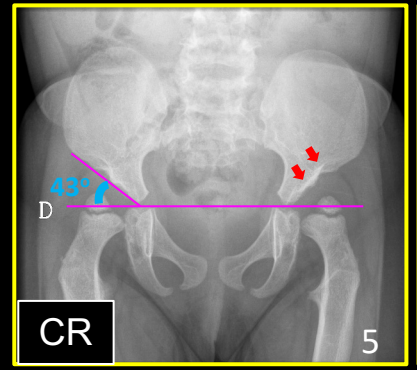
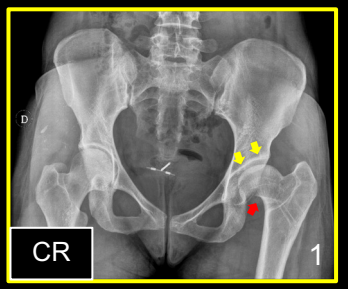


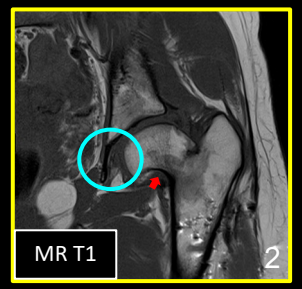
Figure 5. Female, 3 years old, presenting shallow acetabular cavities, mainly on the left (arrows), associated with superolateral dislocation of the femoral heads and verticalization of the femoral necks.

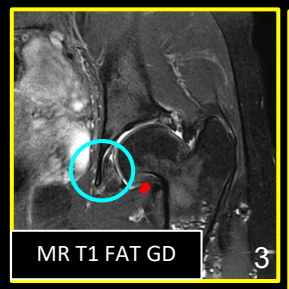
The acetabular angle using the Hilgenreiner line should be <28° at birth ref. The angle should become progressively shallower with age and should measure <22° at and beyond 1 year of age.

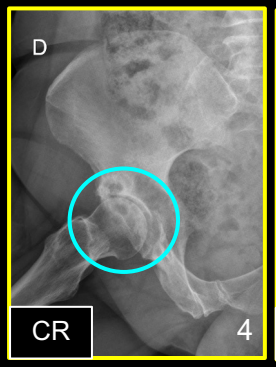
COMPLICATIONS

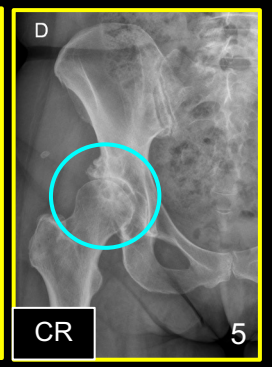
- ✓ Hip Dysplasia;
- ✓ Hip Dislocation;
- ✓ Femoral Acetabular Impingement (FAI);
- ✓ Osteoarthritis of the Hip;
- ✓ Functional limitations;
- ✓ Leg Length Discrepancy.

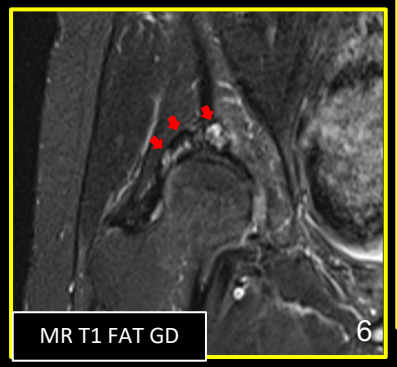








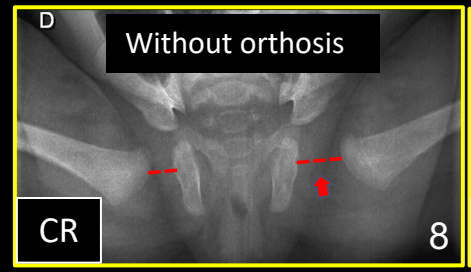


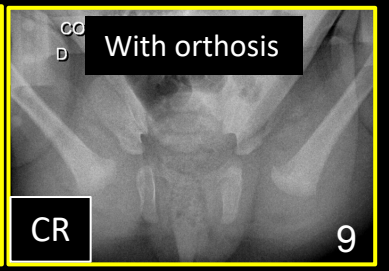


Figures 1-3. Female, 33 yo. Sequelae of developmental dysplasia of the left hip with deficit of acetabular coverage, shallow acetabulum (arrows), sequelae deformity of the femoral head and varus deviation (arrows). It is associated with chondral fissures and degeneration of the acetabular labrum, in addition to mild synovitis (circles).

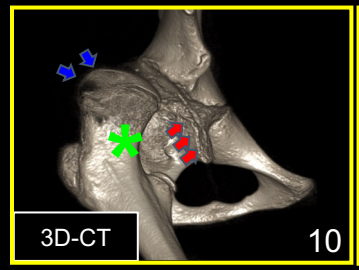
Figures 4-6. Female, 30 yo. Dysplastic right acetabulum with hypertrophy and partial ossification of the acetabular labrum (circle), associated with intra and perilabral cystic degeneration. Right hip arthrosis is associated with marginal osteophytes, irregular chondral thinning, cysts and subchondral edema in the acetabular roof (arrow). Small joint effusion in the right hip, with thickening and synovial enhancement (synovitis).

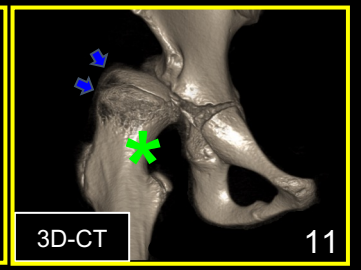
TREATMENT

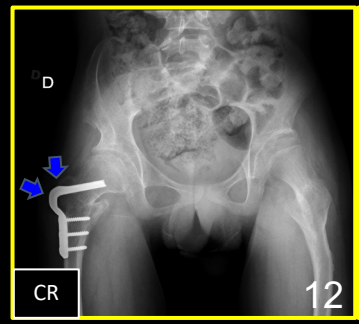


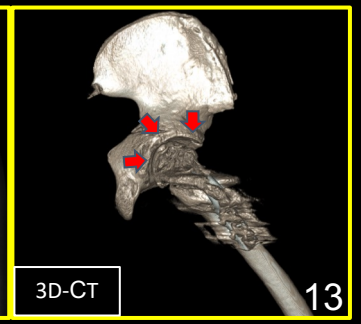


Figures 7 and 9. Patient with Pavlik harness and control X-ray during conservative treatment of developmental dysplasia of the hip.









Figures 10 and 11. Fem, 11 yo, with dysplastic aspect of the acetabular cavity (arrow). Cranial and lateral dislocation of the femoral head, which presents a slight volumetric reduction and rectification of its superomedial contour (arrow). Verticalization of the femoral neck (*).

Figures 12 and 13. The same patient as before. Metallic fixation of the right proximal femur, with plates and screws (arrows) with no signs of loosening. Signs of right acetabuloplasty, with increased coverage area of the femoral head (arrows).

FUTURE PERSPECTIVES

- ✓ **Hip Preservation Techniques:** Minimally invasive arthroscopic procedures and new surgical approaches are being explored to treat intra-articular hip conditions while preserving joint integrity[3].
- ✓ **Regenerative Therapies:** Regenerative medicine approaches, such as stem cell therapy and platelet-rich plasma (PRP) injections, are being investigated for their potential in promoting tissue repair and regeneration in DDH patients[1].
- ✓ **Patient-Specific Implants:** Advancements in 3D printing technology have enabled the development of patient-specific implants for complex hip dysplasia cases[2].
- ✓ **Personalized Treatment Algorithms:** With the growing recognition of the heterogeneity of DDH presentations, researchers are working towards developing personalized treatment algorithms to tailor the most appropriate and effective management strategy[5].
- ✓ **Long-Term Outcome Studies:** Researchers are increasingly focusing on long-term outcome studies to assess the efficacy and durability of various DDH treatments[4].

TAKE HOME

Aspect	Description
Definition	A condition affecting the hip joint in infants and young children, characterized by abnormal development or displacement.
Causes	Multifactorial, including genetic predisposition, breech presentation, and intrauterine positioning.
Risk Factors	Female gender, family history of hip problems, firstborn status, breech presentation, and oligohydramnios.
Screening & Detection	Newborn physical examination; Ultrasonography (US) for infants up to 6 months; X-ray and MRI for older infants/children.
Signs & Symptoms	Asymmetry in hip abduction, hip click, limited range of motion, and leg length discrepancy.
Long-term Complications	Early-onset hip osteoarthritis; Hip joint instability; Leg length discrepancy; Increased risk of hip re-dislocation.
Treatment Options	Non-surgical interventions: Pavlik harness, abduction splints; Closed reduction and hip spica casting.
	Open reduction with surgical stabilization; Osteotomies for complex cases.
Post-Treatment Management	Regular follow-up and monitoring; Physical therapy and rehabilitation; Long-term outcomes assessment.
Preventive Measures	Maternal and neonatal risk factor awareness; Proper swaddling and carrying techniques; Education for healthcare providers.
Future Perspectives	Regenerative therapies and tissue engineering; Personalized treatment algorithms; Minimally invasive procedures.