AIUM Practice Parameter for the Performance of the Ultrasound Examination for Detection and Assessment of Developmental Dysplasia of the Hip

Received January 26, 2024. Manuscript accepted for publication January 27, 2024.

doi:10.1002/jum.16431

The American Institute of Ultrasound in Medicine (AIUM) is a multidisciplinary association dedicated to advancing the safe and effective use of ultrasound in medicine through professional and public education, research, development of clinical practice parameters, and accreditation of practices performing ultrasound examinations.

The AIUM Practice Parameter for the Performance of the Ultrasound Examination for Detection and Assessment of Developmental Dysplasia of the Hip was revised by the AIUM in collaboration with other organizations whose members use ultrasound for performing this examination(s) (see "Acknowledgments"). Recommendations for personnel requirements, the request for the examination, documentation, quality assurance, and safety may vary among the organizations and may be addressed by each separately.

This Practice Parameter is intended to provide the medical ultrasound community with recommendations for the performance and recording of high-quality ultrasound examinations. The parameters reflect what the AIUM considers the appropriate criteria for this type of ultrasound examination but are not intended to establish a legal standard of care. Examinations performed in this specialty area are expected to follow the Parameter with recognition that deviations may occur depending on the clinical situation.

This practice parameter is intended to assist practitioners performing sonographic studies for detection and assessment of developmental dysplasia of the hip (DDH). Adherence to the following recommendations will maximize the probability of detecting most of the abnormalities that relate to acetabular morphology, position of the femoral head, and stability.

Selective screening is currently performed in the United States. The strongest risk factors for DDH are female sex, history of a parent and/or a sibling with DDH, birth weight >4000 g, abnormal physical exam,[1–3] and breech presentation.[4]

Ultrasound is the preferred method for diagnostic imaging of the infant hip.[5,6] It affords direct visualization of the cartilaginous

and other components of the hip joint and permits a dynamic examination that can be used to assess hip stability. The value of ultrasound diminishes as the femoral head ossifies.[2,7] When the relationship between the femoral head and the triradiate cartilage cannot be adequately visualized, radiographs of the hips are indicated.[3,4]

There are no absolute contraindications to ultrasound of the infant hip for DDH. Because of the presence of physiologic laxity, hip sonography is usually not performed on patients younger than 6 weeks of age, unless indicated based on an abnormal finding on physical examination.[8]

Indications

A. Common indications for ultrasound of the infant hip include, but are not limited to:
   1. Abnormal or equivocal findings of hip instability on physical examination
   2. Any family history of DDH
   3. Breech presentation at birth
   4. Neuromuscular conditions
   5. Monitoring infants with DDH undergoing treatment

B. Relative indications for ultrasound of the infant hip include, but are not limited to:
   1. Oligohydramnios
   2. Other intrauterine causes of postural molding
   3. Leg length discrepancy
   4. Asymmetric thigh creases

Qualifications and Responsibilities of Personnel

Physicians interpreting or performing this type of ultrasound examination should meet the specified AIUM Training Guidelines[9] in accordance with AIUM accreditation policies.[10]

Sonographers performing the ultrasound examination should be appropriately credentialed[11] in the specialty area in accordance with AIUM accreditation policies.[10]

Physicians not personally performing the examination must provide supervision, as defined by the Centers for Medicare and Medicaid Services Code of Federal Regulations 42 CFR §410.32,[12] which is available from the U.S. Government Publishing Office.

Request for the Examination

The written or electronic request for an ultrasound examination must originate from a physician or other appropriately licensed healthcare provider or under the provider's direction. The clinical information provided should allow for the performance and interpretation of the appropriate ultrasound examination and should be consistent with relevant legal and local healthcare facility requirements.

Specification of the Examination

Both hips should be examined. The diagnostic examination for DDH incorporates two orthogonal planes: a coronal view in the standard plane in neutral position and a transverse view of the flexed hip with and without stress, as defined below. This enables an assessment of hip position, acetabular morphology, and stability.

If position, acetabular morphology, and/or stability cannot be assessed when attempting to perform a complete examination, the report should note the portion not performed. It is acceptable to perform the examination with the infant in each lateral decubitus position.

For the complete examination, morphology is assessed with the hip flexed without and with stress. The stress maneuver (posterior push maneuver) is performed to evaluate for hip instability with the hip and knee flexed and the thigh adducted (Barlow maneuver). If the femoral head is subluxated, subluxable, dislocated, or dislocatable, reducibility can be assessed by abducting and externally rotating the hip (Ortolani maneuver). It is important that the infant be relaxed when hips are assessed for instability. To increase comfort and cooperation, it is suggested that the infant be kept nothing by mouth (NPO) for 3 hours before the sonogram so that the baby may be fed during the examination to maximize relaxation unless it is

clear that the hip is normally aligned after which gentle stress maneuvers may be applied.[13]

Coronal View

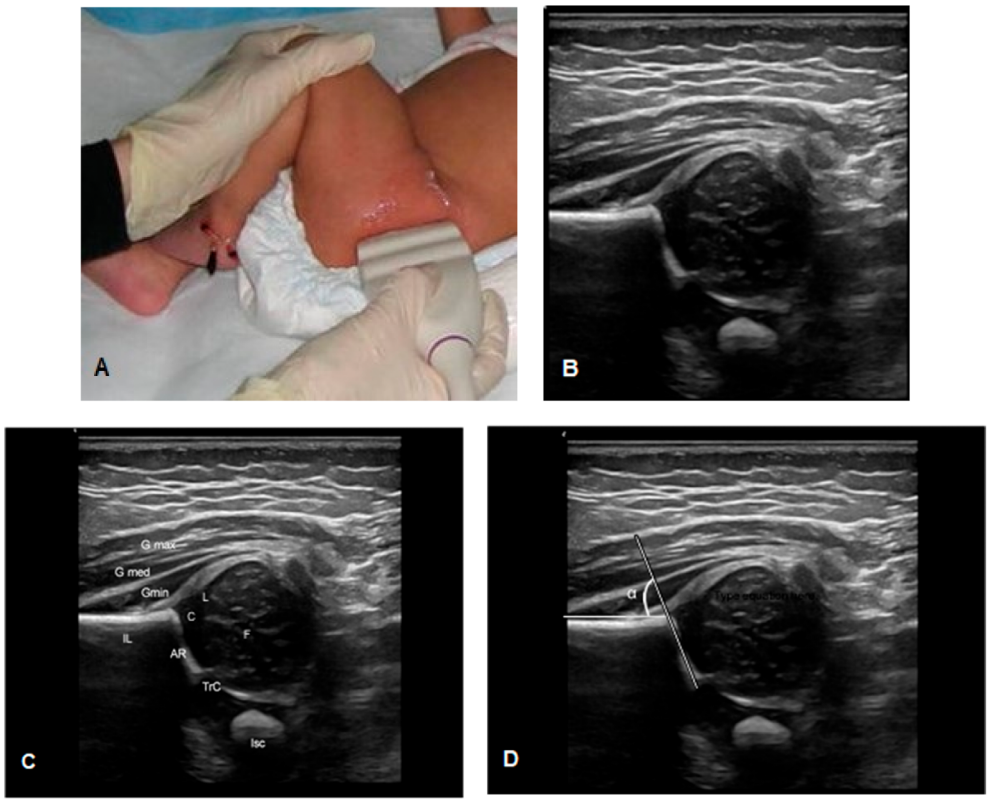
The anatomic coronal plane is approximately parallel to the infant's body. If the superior edge of the transducer is rotated 10° to 15° (usually posteriorly) into an oblique coronal plane, the ilium will appear straight. After adjustment to assure that the imaging plane extends through the deepest part of the acetabulum (including visualization of the triradiate cartilage and the ischium), the resulting image will be a coronal view in the standard plane.

The standard plane is defined by identifying a straight iliac line, the tip of the acetabular labrum, and the transition from the os ilium to the triradiate cartilage (see Figure 1). The coronal view in the standard plane can be obtained with the hip in the physiologic neutral position (15- to 20-degree flexion). Femoral head position and acetabular morphology are assessed, and the alpha angle (normally ≥60 degrees) is measured.[14,15] Performance of stress in this plane may be helpful.

Transverse Flexion View

The examination is performed with the hip flexed at 90°. The transverse plane is the anatomic transverse or axial plane with respect to the body, similar to the plane of an axial computed tomography (CT) image (Figure 2). With the transducer nearly parallel to the femoral shaft, the femoral shaft is seen anteriorly, terminating in the femoral head, which rests on the ischium. The transducer is placed in a posterolateral position, parallel to the femoral shaft without stress. Next, gentle stress is applied to assess stability (Barlow maneuver). The Ortolani maneuver can be performed to test

Figure 1. A, For the coronal view, the ultrasound transducer is placed parallel to the lateral aspect of the baby's hip. **B**, A coronal ultrasound image of a normal hip. **C**, A labeled coronal ultrasound image of a normal hip. **D**, coronal ultrasound image of an alpha angle measurement. F indicates femoral head; Gmax, gluteus maximus; Gmed, gluteus medius; Gmin, gluteus minimus; L, labrum; IL, iliac; AR, acetabular roof; Isc, ischium; TrC, triradiate cartilage.



reducibility. Stress views are omitted when hips are being examined in a Pavlik harness or splint device.

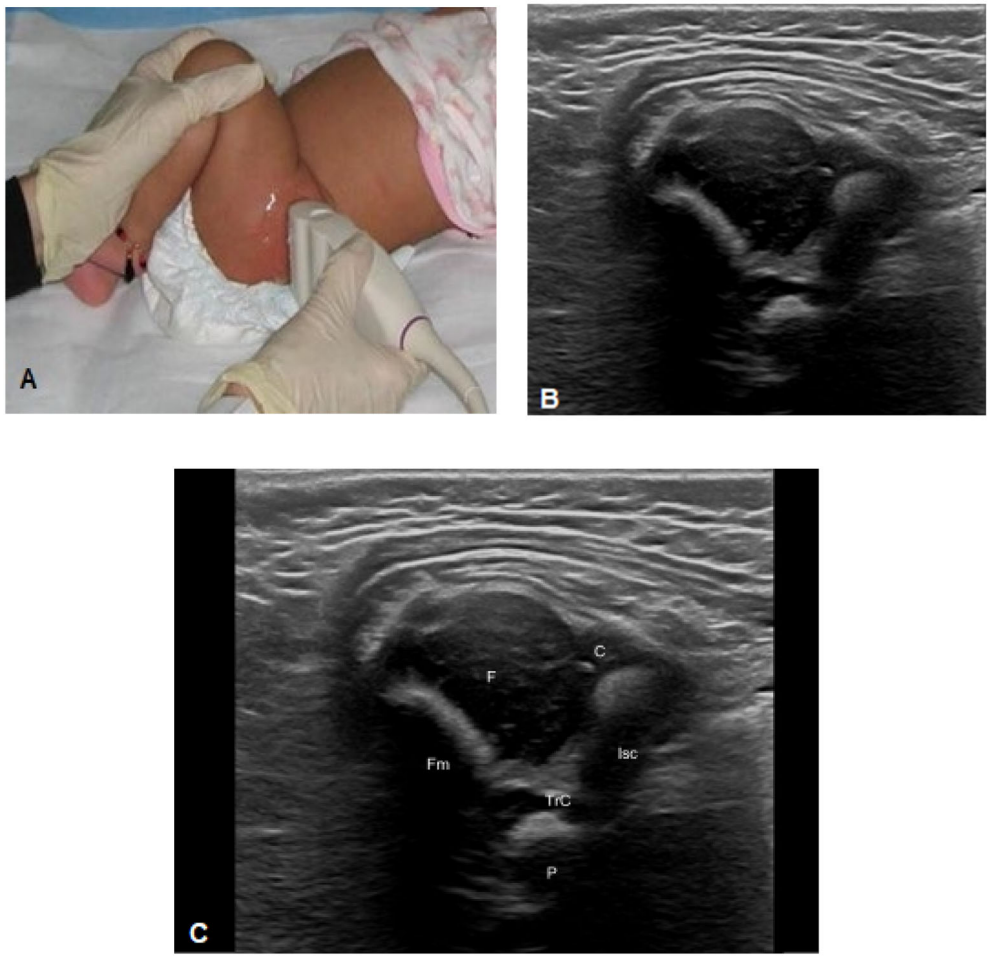
Documentation

Accurate and complete documentation is essential for high-quality patient care. Written reports and ultrasound images/video clips that contain diagnostic information should be obtained and archived, with recommendations for follow-up studies if clinically applicable, in accordance with the AIUM Practice Parameter for Documentation of an Ultrasound Examination.[16]

The Graf alpha angle should be measured because it is important for therapeutic decision making by orthopedic surgeons. Images should include patient identification, facility identification, examination date, hip being imaged, image orientation, and whether stress is being applied. An official interpretation (final report) of the ultrasound examination should be included in the patient's medical record, indicating acetabular morphology, position of femoral head, and stability.[9]

Retention of the ultrasound examination images should be consistent both with clinical need and with relevant legal and local health care facility requirements.

Figure 2. A, Transverse flexion view: the hip and knee are flexed 90°, and the ultrasound transducer is placed perpendicular to the lateral aspect of the baby's hip nearly parallel to the femoral shaft. **B**, A normal transverse ultrasound view. **C**, A labeled normal transverse ultrasound image. F, femoral head; Fm, femoral metaphysis; C, acetabular cartilage; P, pubis; Isc, ischium; TrC, triradiate cartilage.



Equipment Specification

Equipment performance monitoring should be in accordance with the AIUM Routine Quality Assurance of Clinical Ultrasound Equipment.[17]

Hip ultrasound for detecting DDH should be performed with a high-frequency linear transducer that permits penetration of the soft tissues. Total ultrasound exposure should be kept as low as reasonably achievable while optimizing diagnostic information.

Quality and Safety

Policies and procedures related to quality assurance and improvement, safety, infection control, and equipment-performance monitoring should be developed and implemented in accordance with the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices.[10]

ALARA (As Low as Reasonably Achievable) Principle

The potential benefits and risks of each examination should be considered. The ALARA principle[18] should be observed for factors that affect the acoustical output and by considering transducer dwell time and total scanning time. Further details on ALARA may be found in the current version of the AIUM publication *Medical Ultrasound Safety*.[19]

Infection Control

Transducer preparation, cleaning, and disinfection should follow manufacturer recommendations and be consistent with the AIUM's Guidelines for Cleaning and Preparing External- and Internal-Use Ultrasound Transducers Between Patients, Safe Handling, and Use of Ultrasound Coupling Gel.[20]

Equipment Performance Monitoring

Monitoring protocols for equipment performance should be developed and implemented in accordance with the AIUM Standards and Guidelines for the Accreditation of Ultrasound Practice.[10]

Acknowledgments

This parameter was developed by the AIUM in collaboration with the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Radiologists in Ultrasound (SRU). We are indebted to the many volunteers who contributed their time, knowledge, and energy to developing this document.

Collaborative Subcommittees

AIUM
Susan J. Back, MD
Brian Douglas Coley, MD, FAIUM, FSRU, FACR, FAAP
ACR
Sandra Allison, MD, FACR, FSRU, FAIUM, Co-Chair
Lynn A. Fordham, MD, FACR, FAIUM, FAAWR, Co-Chair
John Amodio, MD
Henrietta K. Rosenberg, MD, FACR
Arash R. Zandieh, MD
SPR
Patricia T. Acharya, MD, FAAP
Monica Epelman, MD
Judy Estroff, MD
SRU
Cassandra M. Sams, MD
Judy H. Squires, MD

AIUM Expert Advisory Group

AIUM Clinical Standards Committee

Rachel Bo-ming Liu, MD, FACEP, FAIUM, chair
Margarita V. Revzin, MD, MS, FSRU, FAIUM, vice chair
Tracy Anton, BS, RDMS, RDCS, FAIUM
Creagh T. Boulger, MD, FAIUM
John R. Eisenbrey, PhD, FAIUM
Rob Goodman, MB, BChir, FAIUM
Ethan J. Halpern, MD, FAIUM
Oliver Daniel Kripfgans, PhD, FAIUM
Juliana Gevaerd Martins, MD
John Stephen Pellerito, MD, FACR, FAIUM, FSRU
James M. Shwayder, MD, JD, FAIUM

Jean Lea Spitz, MPH, CAE, RDMS, FAIUM, FSDMS

Approved 1998; Revised 2003, 2006, 2008, 2013, 2014, 2018, 2023

References

1. Bache CE, Clegg J, Herron M. Risk factors for developmental dysplasia of the hip: ultrasonographic findings in the neonatal period. *J Pediatr Orthop B* 2002; 11:212–218.
2. Schaeffer EK, Study Group I, Mulpuri K. Developmental dysplasia of the hip: addressing evidence gaps with a multicentre prospective international study. *Med J Aust* 2018; 208:359–364.
3. Roposch A, Protopapa E, Malaga-Shaw O, et al. Predicting developmental dysplasia of the hip in at-risk newborns. *BMC Musculoskelet Disord* 2020; 21:442.
4. Oh EJ, Min JJ, Kwon S-S, et al. Breech presentation in twins as a risk factor for developmental dysplasia of the hip. *J Pediatr Orthop* 2022; 42:e55–e58.
5. Roposch A, Wright JG. Increased diagnostic information and understanding disease: uncertainty in the diagnosis of developmental hip dysplasia. *Radiology* 2007; 242:355–359.
6. Smergel E, Losik SB, Rosenberg HK. Sonography of hip dysplasia. *Ultrasound Q* 2004; 20:201–216.
7. Atalar H, Gunay C, Turanli S, Koktener A. Discrepancy between ultrasonographic and radiographic findings in patients treated for developmental dysplasia of the hip; hip maturation on ultrasonography may not be consistent with radiographic hip maturation. *J Pediatr Orthop B* 2020; 29:228–234.
8. Mulpuri K, Song KM, Gross RH, et al. The American Academy of Orthopaedic surgeons evidence-based guideline on detection and nonoperative management of pediatric developmental dysplasia of the hip in infants up to six months of age. *J Bone Joint Surg Am* 2015; 97:1717–1718.
9. Training Guidelines. American Institute of Ultrasound in Medicine website. https://www.aium.org/resources/training-guidelines Accessed August 18, 2023.
10. Standards and Guidelines for the Accreditation of Ultrasound Practices. American Institute of Ultrasound in Medicine website. https://www.aium.org/resources/official-statements/view/standards-and-guidelines-for-the-accreditation-of-ultrasound-practices Accessed August 18, 2023.
11. Employment of Credentialed Sonographers. American Institute of Ultrasound in Medicine website. https://www.aium.org/resources/official-statements/view/employment-of-credentialed-sonographers Accessed August 18, 2023.
12. 42 CFR § 410.32 - Diagnostic x-ray tests, diagnostic laboratory tests, and other diagnostic tests: Conditions. U.S. Government Publishing Office website. https://www.govinfo.gov/app/details/CFR-2021-title42-vol2/CFR-2021-title42-vol2-sec410-32/summary Accessed April 24, 2023.
13. Grissom LE, Harcke HT, Kumar SJ, Bassett GS, MacEwen GD. Ultrasound evaluation of hip position in the Pavlik harness. *J Ultrasound Med* 1988; 7:1–6.
14. Harcke HT, Pruszczynski B. Hip ultrasound for developmental dysplasia: the 50% rule. *Pediatr Radiol* 2017; 47:817–821.
15. Graf R. Hip sonography: background; technique and common mistakes; results; debate and politics; challenges. *Hip Int* 2017; 27:215–219.
16. AIUM practice parameter for documentation of an ultrasound examination. *J Ultrasound Med* 2019; 39:E1–E4. https://doi.org/10.1002/jum.15187.
17. *AIUM Routine Quality Assurance of Clinical Ultrasound Equipment*, version 2. American Institute of Ultrasound in Medicine website. https://www.aium.org/docs/default-source/aium-publications/rqa2.pdf Accessed August 18, 2003.
18. AIUM Official Statement: As Low As Reasonably Achievable (ALARA) Principle. American Institute of Ultrasound in Medicine website. https://www.aium.org/resources/official-statements/view/as-low-as-reasonably-achievable-(alara)-principle Accessed August 18, 2023.
19. *Medical Ultrasound Safety*. 4th ed. Laurel, MD: American Institute of Ultrasound in Medicine; 2020. https://www.aium.org/docs/default-source/aium-publications/mus4.pdf. Accessed August 18, 2023.
20. Guidelines for Cleaning and Preparing External- and Internal-Use Ultrasound Transducers and Equipment Between Patients as well as Safe Handling and Use of Ultrasound Coupling Gel. American Institute of Ultrasound in Medicine website. https://www.aium.org/resources/official-statements/view/guidelines-for-cleaning-and-preparing-external--and-internal-use-ultrasound-transducers-and-equipment-between-patients-as-well-as-safe-handling-and-use-of-ultrasound-coupling-gel. Accessed August 18, 2023.