AIUM Practice Parameter for the Performance of Standard Diagnostic Obstetric Ultrasound

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 Standard Diagnostic Obstetric Ultrasound 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.

Obstetric ultrasound should be performed only when there is a valid medical reason, and the lowest possible acoustic output settings should be used to gain the necessary diagnostic information.[1–3]

Although this practice parameter describes the key elements of standard ultrasound examinations in the first, second, and third trimesters of pregnancy, a more detailed fetal anatomic examination may be necessary in some cases, such as when an abnormality is found or suspected on the standard examination or in pregnancies at high risk for fetal anomaly.[4] In some cases, other imaging may be necessary as well.

Although it is not possible to detect all structural congenital anomalies with diagnostic ultrasound, adherence to the following practice parameters will increase the likelihood of detecting many fetal abnormalities.

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Classification of Fetal Ultrasound Examinations

Standard First-Trimester Ultrasound Examination

A standard obstetric ultrasound examination in the first trimester includes evaluation of the presence, size, location, and number of gestational sac(s). The gestational sac is examined for the presence of yolk sac and embryo/fetus (a fetus is generally defined as greater than or equal to 10 weeks' gestational age).[5] When an embryo/fetus is detected, the crown rump length should be measured, and the presence or absence of cardiac activity should be recorded by cine clip or M-mode. The routine use of pulsed Doppler ultrasound to either document or "listen" to embryonic/fetal cardiac activity is discouraged.[6] The uterus, cervix, adnexa, and cul-de-sac region should be examined.

Standard Second- or Third-Trimester Ultrasound Examination

An obstetric ultrasound in the second or third trimester includes an evaluation of fetal number, cardiac activity, presentation, amniotic fluid volume, placental position, placental cord insertion site, fetal biometry, anatomic survey, and growth. The patient's cervix, uterus, and adnexa should be examined.

Limited Ultrasound Examination

A limited obstetric ultrasound examination is performed to answer a specific, acute clinical question when an immediate impact on management is anticipated and when time or other constraints make performance of a standard ultrasound impractical or unnecessary. If a limited obstetric ultrasound is performed on a patient who has not previously had a standard or detailed ultrasound examination, a subsequent standard or detailed ultrasound should be obtained where appropriate. In patients who require serial ultrasounds and have already had a standard or detailed scan, some will only need limited scans, whereas others will require standard or detailed follow-up examinations. Clinical judgement should be used to determine the proper type of ultrasound examination to perform and the appropriate frequency for follow-up ultrasound examinations.[7]

Specialized Ultrasound Examination

A detailed anatomic examination is performed for patients at risk for fetal anatomic or karyotypic abnormalities (including, but not limited to, advanced patient age, medical complications of pregnancy, or pregnancy after assisted reproductive technology) or when an anomaly is suspected on the basis of history, abnormal biochemical markers, cell-free DNA screening, or the results of either the limited or standard scan.[4]

Other specialized ultrasound scans may include fetal echocardiogram, biophysical profile and fetal Doppler ultrasound, or additional biometric measurements including nuchal translucency (NT) and cervical length.[8–14]

Qualifications and Responsibilities of Personnel

Physicians interpreting or performing this type of ultrasound examination should meet the specified AIUM Training Guidelines[15] in accordance with AIUM accreditation policies.[16]

Sonographers performing the ultrasound examination should be appropriately credentialed[17] in the specialty area in accordance with AIUM accreditation policies.[16]

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,[18] 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 health care 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 health care facility requirements.

Specification of the Examination

The written or electronic request for an obstetric ultrasound examination should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation[19] that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state's scope of practice requirements.

Standard First-Trimester Ultrasound Examination

1. Indications for first-trimester (for the purpose of this document, the first trimester represents 1 week – 13 weeks + 6 days) ultrasound examinations include, but are not limited to:
   a. Confirmation of the presence of an intrauterine pregnancy[20–22]
   b. Confirmation of cardiac activity[23–27]
   c. Estimation of gestational age[28–30]
   d. Diagnosis or evaluation of multiple gestations including determination of chorionicity and amnionicity[31,32]
   e. Evaluation of a suspected ectopic or abnormally implanted pregnancy[33,34]
   f. Evaluating the cause of vaginal bleeding
   g. Evaluation of pelvic pain
   h. Evaluation of suspected gestational trophoblastic disease[35]
   i. Measuring the NT and nasal bone when part of a screening program for fetal aneuploidy
   j. Assessing for fetal anomalies detectable in the first trimester, such as anencephaly[9,10,36–44]
   k. Imaging as an adjunct to chorionic villus sampling, embryo transfer, and localization and removal of an intrauterine device
   l. Evaluation of pelvic masses and/or uterine abnormalities
2. Imaging Parameters
   Scanning in the first trimester may be performed transabdominally, transvaginally, or a combination of both. If a transabdominal examination is not definitive, a transvaginal scan is recommended.
   a. The uterus (including the cervix) and adnexa should be evaluated for the presence of a gestational sac. If a gestational sac is seen, the location, size, and shape should be documented. The gestational sac should be evaluated for the presence or absence of a yolk sac and embryo/fetus. If an embryo/fetus is identified, the crown-rump length should be measured.[20,28–30,45]
      A definitive diagnosis of intrauterine pregnancy can be made when an intrauterine gestational sac containing a yolk sac or embryo/fetus with or without cardiac activity is visualized. In a very early intrauterine pregnancy, a small, eccentric intrauterine fluid collection with an echogenic rim can be seen before the yolk sac and embryo. In the absence of sonographic signs of ectopic pregnancy, the fluid collection is highly likely to represent an intrauterine gestational sac. Follow-up ultrasound and/or serial determination of patient serum beta–human chorionic gonadotropin levels are appropriate in pregnancies of undetermined location to avoid inappropriate intervention in a potentially viable early pregnancy.[20,24,25]
      Caution should be used in making the presumptive diagnosis of a gestational sac in the absence of a definite yolk sac or embryo. If the embryo is not identified, the mean sac diameter may be useful for determining the timing of ultrasound follow-up. However, the crown-rump length is a more accurate indicator of gestational age than the mean gestational sac diameter.
   b. The presence or absence of cardiac activity should be documented with a cine clip or M-mode.[6]

With transvaginal scans, cardiac motion is usually observed when the embryo is 2 mm or greater in length; if an embryo less than 7 mm in length is seen without cardiac activity, a subsequent scan in 1 week is recommended to ensure that the pregnancy is nonviable.[23–27]

c. Fetal number should be documented.
Amnionicity and chorionicity should be documented for all multiple gestations.[31]

d. In the later first trimester, fetal anatomy should be assessed and include the cranium, midline falx, choroid plexus, profile including nasal bone, lungs, stomach, situs, abdominal umbilical cord insertion, and the presence of limbs. A 4-chamber view should be evaluated if technically feasible.[36–40,46–48]

e. The nuchal region should be imaged, and abnormalities such as cystic hygroma should be documented.
A precise NT measurements should be obtained in these scenarios:

i. If a measurement is required as part of aneuploidy risk calculation (in conjunction with serum analytes). In this setting, it is important that the practitioner measure the NT according to established guidelines. A quality assessment program is recommended to ensure that false-positive and false-negative results are kept to a minimum.[9,10]

ii. If the NT appears subjectively enlarged. In practices in which cell-free DNA is used primarily for aneuploidy screening, an enlarged NT may be considered a sonographic marker of structural, genetic, or syndromic abnormalities.

Guidelines for NT measurement (Figure 1):

i. The margins of the NT edges must be clear with the angle of insonation perpendicular to the NT line.

ii. The fetus must be in the midsagittal plane. The tip of the nose, palate, and diencephalon should be seen.

iii. The image must be magnified so that it is filled by the fetal head, neck, and upper thorax.

iv. The fetal neck must be in a neutral position, with the head in line with the spine, not flexed and not hyperextended.

v. The amnion must be seen as separate from the NT line.

vi. The (+) calipers on the ultrasound must be used to perform the NT measurement.

vii. Electronic calipers must be placed on the inner borders of the nuchal line with none of the horizontal crossbar itself protruding into the space (Figure 2).

viii. The calipers must be placed perpendicular to the long axis of the fetus.

ix. The measurement must be obtained at the widest space of the NT.

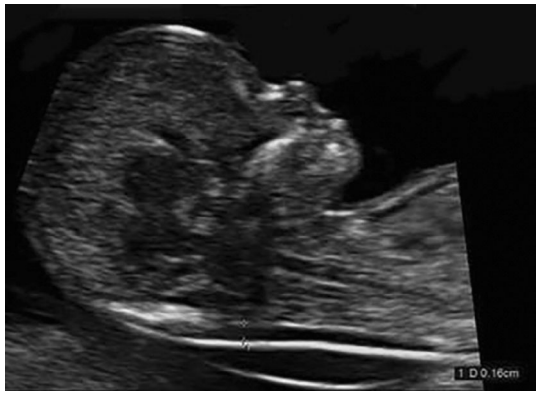
f. The uterus, including the cervix, adnexal structures, and cul-de-sac, should be evaluated. Abnormalities should be imaged and documented.

The presence, location, appearance, and size of adnexal masses should be documented. The presence and number of leiomyomata should be documented. The measurements of the largest or any potentially clinically significant leiomyomata should be documented. The cul-de-sac should be evaluated for the presence or absence of fluid. Uterine anomalies should be documented.

Standard Second- and Third-Trimester Ultrasound Examination[21]

1. These examinations are commonly performed to assess fetal anatomy and biometry. Other indications include but are not limited to:
   a. Screening for fetal anomalies[49–54]
   b. Evaluation of fetal anatomy[55–64]
   c. Estimation of gestational age[49]

Figure 1. Ultrasound image of NT measurement.



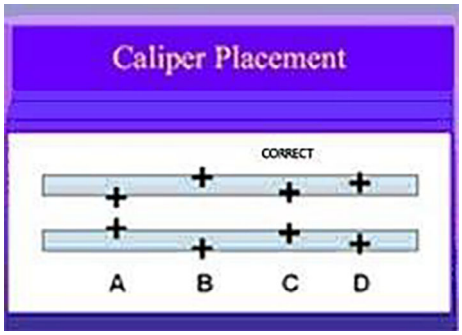
d. Evaluation of suspected multiple gestation
e. Evaluation of cervical length[11–13,65–69]
f. Evaluation of fetal growth[70–73]
g. Evaluation of significant discrepancy between uterine size and clinical dates
h. Determination of fetal presentation
i. Evaluation of fetal well-being[47]
j. Suspected amniotic fluid abnormalities[74–76]
k. Evaluation of premature rupture of membranes and/or premature labor
l. Evaluation of vaginal bleeding
m. Evaluation of abdominal or pelvic pain
n. Suspected placental abruption
o. Suspected fetal death
p. Follow-up evaluation of a fetal anomaly[77]
q. Evaluation/follow-up of placental appearance and location. Includes suspected placenta previa, vasa previa, and evaluation of placenta accreta spectrum[78]
r. Adjunct to amniocentesis or other procedure
s. Adjunct to external cephalic version
t. Evaluation of suspected gestational trophoblastic disease
u. Evaluation of pelvic mass
v. Suspected uterine anomalies

In certain clinical circumstances, a more detailed examination of fetal anatomy may be indicated.[79]

2. Imaging parameters for a standard fetal examination
   a. Fetal cardiac activity (by cine clip or M-mode), fetal number, and presentation should be documented.

      Abnormal heart rate and/or rhythm should be documented.

Figure 2. Diagram for the NT measurement.



Multiple gestations require the documentation of additional information: chorionicity, amnionicity, comparison of fetal sizes, evaluation of amniotic fluid volume in each gestational sac, and fetal genitalia (when visualized).

b. A qualitative or semiquantitative estimate of amniotic fluid volume should be documented.

   Although it is acceptable for experienced examiners to qualitatively estimate amniotic fluid volume, semiquantitative methods have also been described for this purpose (eg, amniotic fluid index [AFI], single deepest pocket, and 2-dimensional pocket). In assessing oligohydramnios, the deepest vertical pocket (<2 cm) is preferred over AFI (≤5 cm) because it results in fewer obstetric interventions without a significant difference in perinatal outcome, and single deepest pocket should be at least 1 cm wide.[74–76,80,81] Polyhydramnios (deepest vertical pocket ≥8 cm or AFI ≥24 cm) may be associated with other pregnancy complications.[80]

c. The placental location, appearance, and relationship to the internal cervical os should be documented. In patients who have had one or more prior cesarean deliveries, a detailed evaluation of the placental location and attachment in the lower uterine segment should be performed looking for signs of placenta accreta spectrum. The umbilical cord should be imaged, and the number of vessels in the cord documented. The placental cord insertion site should be documented when technically possible.[82,83]

   It is recognized that apparent placental position early in pregnancy may not correlate well with its location at the time of delivery.

   Transvaginal ultrasound should be performed if the relationship between the cervix and the placenta cannot be assessed.

   Vasa previa, defined as fetal vessels in close proximity to the cervix (typically within 2 cm of the internal cervical os), is associated with a high risk of fetal morbidity and mortality if not diagnosed prior to labor.[84–86] Risk factors for vasa previa include resolving low-lying/placenta previa, bilobed/succenturiate lobe of the placenta, velamentous cord insertion, multiple

gestations, and in vitro fertilization.[87] Transvaginal ultrasound with color and pulsed Doppler (to document fetal vessels) should be performed in scenarios in which vasa previa is suspected.[88]

d. Gestational age assessment

First-trimester crown-rump measurement is the most accurate means for sonographic dating of pregnancy. Beyond this period, a variety of sonographic parameters such as biparietal diameter, abdominal circumference, and femoral diaphysis length can be used to estimate gestational age. It should be noted that abdominal circumference is the least reliable of these measurements for estimating gestational age.[89,90] The variability of gestational age estimation, however, increases with advancing pregnancy. Significant discrepancies between gestational age and fetal measurements may suggest the possibility of a fetal growth abnormality.[70–73]

Gestational age assessment by ultrasound in the early second trimester (between 14 0/7 weeks' and 21 6/7 weeks' gestation) is based on a composite of fetal biometric measurements and has an accuracy of ±7–10 days.[91]

The pregnancy should NOT be redated after an accurate earlier scan has been performed and is available for comparison.[92,93]

i. Biparietal diameter is measured at the level of the thalami and cavum septi pellucidi.[94] The cerebellar hemispheres should not be visible in this scanning plane. The measurement is typically measured from the outer edge of the proximal skull to the inner edge of the distal skull.

The head shape may be elongated (dolichocephaly) or rounded (brachycephaly) as a normal variant. Under these circumstances, certain variants of normal fetal head development may make measurement of the head circumference more reliable than biparietal diameter for estimating gestational age.

ii. Head circumference is measured at the same level as the biparietal diameter, around the outer perimeter of the bony calvarium, excluding subcutaneous tissues of the skull. This measurement is not affected by head shape.

iii. Femoral diaphysis length can be reliably used after 14 weeks' gestational age. The long axis of the femoral shaft is most accurately measured with the beam of insonation being perpendicular to the shaft, excluding the distal femoral epiphysis.

iv. Abdominal circumference or average abdominal diameter should be determined at the skin line on a true transverse view at the level of the junction of the umbilical vein, portal sinus, and fetal stomach when visible.

e. Fetal weight estimation

Fetal weight can be estimated from measurements such as the biparietal diameter, head circumference, abdominal circumference or average abdominal diameter, and femoral diaphysis length.[95,96] Results from various prediction models can be subsequently compared to fetal weight percentiles from published nomograms.[70–73,97–99]

If previous studies have been performed, appropriateness of growth should also be documented. Scans for growth evaluation should be performed no more frequently than 2-week intervals. A shorter scan interval may result in confusion as to whether measurement changes are truly due to growth as opposed to technical variations.[100–103]

Currently, even the best fetal weight prediction methods can yield errors as high as ±15%.[104]

f. Patient anatomy

Evaluation of the uterus, adnexal structures, and cervix should be performed.

The presence, location, and size of adnexal masses and the presence of at least the largest and potentially clinically significant leiomyomata should be documented. It is not always possible to image the normal ovaries during the second and third trimesters.

If the cervix appears abnormal (shortened or funneled) or is not adequately visualized during the transabdominal ultrasound, a transvaginal scan is recommended.[11,12,67,105]

If a referring health provider desires a precise cervical-length measurement, a transvaginal measurement of the cervix should be performed (Table 1 and Figures 1 and 3).[11,12,65–69]

A midline lower uterine segment contraction may obscure the internal os, giving the false impression of a longer endocervical canal. Excessive manual pressure with the ultrasound transducer may also falsely elongate the cervix.

g. Fetal anatomic survey
Fetal anatomy, as described in this document, may be adequately assessed by ultrasound after approximately 18 weeks gestational age. It may be possible to document normal structures before this time, although some structures can be difficult to visualize because of fetal size, position, movement, abdominal scars, or increased patient body mass index.[106–109] A second- or third-trimester scan may pose technical limitations for an anatomic evaluation due to imaging artifacts from acoustic shadowing. When this occurs, the report of the ultrasound examination should document the nature of this technical limitation. A follow-up examination may be helpful.
The following areas of assessment represent the minimal elements of a standard examination of fetal anatomy. A more detailed fetal anatomic examination may be necessary if an abnormality or suspected abnormality is found on the standard examination.
   i. Head, face, and neck
      Lateral cerebral ventricles choroid plexus
      Midline falx
      Cavum septi pellucidi cerebellum
      Cisterna magna upper lip
      Profile (including nasal bone)
      A measurement of the nuchal fold may be helpful during a specific age interval (approximately 16–20 weeks gestational age) to assess the risk of aneuploidy.[110]
   ii. Chest
      Heart[111]
      Four-chamber view
      Heart size, position, and situs
      Left ventricular outflow tract
      Right ventricular outflow tract
      Three-vessel view and three-vessel trachea view, if technically feasible[59–64]
   iii. Abdomen
      Stomach (presence, size, and situs)
      Bowel
      Kidneys
      Urinary bladder
      Umbilical cord insertion site into the fetal abdomen
      Umbilical cord vessel number
   iv. Spine
      Cervical, thoracic, lumbar, and sacral spine
   v. Extremities
      Presence of legs and arms
      Presence of hands and feet
   vi. External Genitalia
      If medically indicated or the patient wants to know

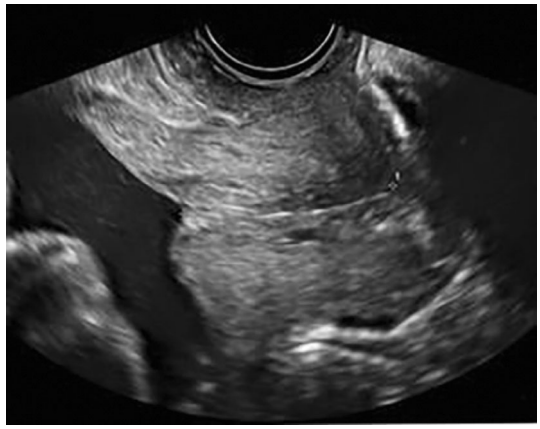
Table 1. Criteria for Cervical-Length Measurement

Criteria
Bladder empty
Transvaginal scan
Cervix occupies 75% of available image space
Calipers placed at the internal and external os where the anterior and posterior walls of the cervix meet. If the endocervical canal curves, two or more linear measurements may be used and added together to obtain the cervical length.
Shortest, best of 3 measurements is reported
Dynamic cervical shortening—examination time 3 minutes and/or suprapubic/fundal pressure

Documentation

Accurate and complete documentation is essential for high-quality patient care. Written reports and ultrasound

Figure 3. Transvaginal cervical-length measurement.



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.[19]

There should be a permanent record of the ultrasound examination and its interpretation. Comparison with prior relevant imaging studies may prove helpful. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should generally be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, image orientation, and anatomic structure recorded. An official interpretation (final report) of the ultrasound examination should be included in the patient's medical record. Retention of the ultrasound examination images should be consistent both with clinical need and with relevant legal and local health care facility requirements.[99]

Equipment Specification

Equipment monitoring should be in accordance with the *AIUM Routine Quality Assurance of Clinical Ultrasound Equipment*.[112]

Obstetric ultrasound examinations should be conducted with modern imaging systems, using a transabdominal and/or transvaginal approach. The choice of transducer frequency is a tradeoff between beam penetration and resolution. In most patients, an abdominal transducer of ≥3 MHz allows sufficient penetration while providing adequate resolution. During early pregnancy, transvaginal ultrasound may provide superior resolution while still allowing adequate penetration.

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.[16]

Fetal Safety

Diagnostic ultrasound studies of the embryo/fetus are generally considered to be safe during pregnancy.[1,2,113–116] This diagnostic procedure should be performed only when there is a valid medical indication, and the lowest possible acoustic output setting should be used to gain the necessary diagnostic information under the "as low as reasonably achievable" (ALARA) principle.[1–3,6,113–116]

A thermal index for soft tissue (TIs) should be used at <10 weeks' gestation and a thermal index for bone should be used at ≥10 weeks' gestation when bone ossification is evident.[3,117] A TI ratio of 0.7 or less should be used for obstetric scanning. Higher acoustic outputs should only be used if needed to obtain diagnostic-quality images. In keeping with the ALARA principle, spectral Doppler ultrasound should not be used unless clinically indicated.[6,105]

The promotion, selling, or leasing of ultrasound equipment for making "keepsake fetal videos" is considered by the U.S. Food and Drug Administration (FDA) to be an unapproved use of a medical device.[118–120] Use of a diagnostic ultrasound system for these purposes, without a physician's order, may be in violation of state laws or regulations.[106]

ALARA (As Low As Reasonably Achievable) Principle

The potential benefits and risks of each examination should be considered. The ALARA principle[121] 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*.[2]

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.[122]

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.[16]

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