

# AIUM–ACR–ACOG–SMFM–SRU Practice Parameter for the Performance of Standard Diagnostic Obstetric Ultrasound Examinations

## Preamble

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 parameters, and accreditation.

The AIUM represents the entire range of clinical and basic science interests in medical diagnostic ultrasound, and, with hundreds of volunteers, the AIUM has promoted the safe and effective use of ultrasound in clinical medicine since 1952. This document and others like it will continue to advance this mission.

Practice parameters of the AIUM are intended to provide the medical ultrasound community with parameters for the performance and recording of high-quality ultrasound examinations. The parameters reflect what the AIUM considers the minimum criteria for a complete examination in each area but are not intended to establish a legal standard of care. AIUM-accredited practices are expected to generally follow the parameters with recognition that deviations from these parameters will be needed in some cases, depending on patient needs and available equipment. Practices are encouraged to go beyond the parameters to provide additional service and information as needed.

## Introduction

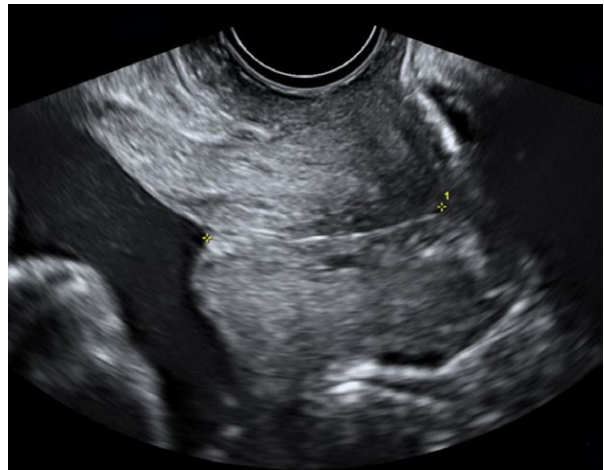
The clinical aspects contained in specific sections of this practice parameter (Introduction, Classification of Fetal Ultrasound Examinations, Specifications of the Examination, Equipment Specifications, and Fetal Safety) were revised collaboratively by the AIUM, the American College of Radiology (ACR), the American College of Obstetricians and Gynecologists (ACOG), the Society for Maternal-Fetal Medicine (SMFM), and the Society of Radiologists in Ultrasound (SRU). Recommendations for Qualifications and Responsibilities of Personnel; Written Request for the Examination; Documentation; and Quality Control and Improvement, Safety, Infection Control, and

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**Figure 1.** Ultrasound image of NT measurement.



**Figure 3.** Transvaginal cervical length measurement.



Patient Education vary among the organizations and are addressed by each separately.

This practice parameter has been developed for use by practitioners performing obstetric ultrasound studies. Obstetric ultrasound examinations should be performed only when there is a valid medical reason, and the lowest possible ultrasonic exposure settings should be used to gain the necessary diagnostic information.<sup>1-3</sup>

While 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 anomalies.<sup>4</sup> In some cases, other imaging may be necessary as well.

While it is not possible to detect all structural congenital anomalies with diagnostic ultrasound, adherence

to the following practice parameter will increase the likelihood of detecting many fetal abnormalities.

## Classification of Fetal Ultrasound Examinations

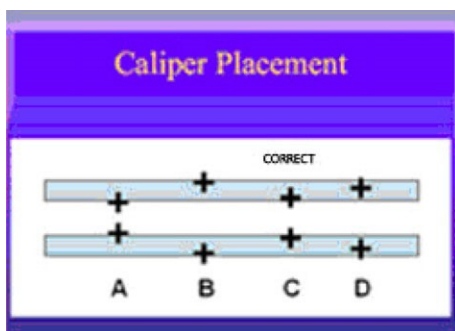
### **Standard First-Trimester Ultrasound Examination**

A standard obstetric ultrasound examination in the first trimester includes evaluation of the presence, size, location, and number of gestational sacs. The gestational sac is examined for the presence of a yolk sac and embryo/fetus (a fetus is generally defined as  $\geq 10$  weeks' gestational age).<sup>5</sup> When an embryo/fetus is detected, it should be measured, and the cardiac activity should be recorded by a 2-dimensional video clip or M-mode. The routine use of pulsed Doppler ultrasound to either document or “listen” to embryonic/fetal cardiac activity is discouraged.<sup>6,7</sup> The uterus, cervix, adnexa, and cul-de-sac region should be examined.

### **Standard Second- or Third-Trimester Ultrasound Examination**

An obstetric ultrasound examination in the second or third trimester includes an evaluation of the fetal number, cardiac activity, presentation, amniotic fluid volume, placental position, fetal biometry, and an anatomic survey. The maternal cervix and adnexa should be examined.

**Figure 2.** Diagram for the NT measurement.



**Table 1.** Criteria for cervical length measurement

Criteria
Bladder empty; transvaginal scan.
Cervix fills up 75% of available image space.
Anterior and posterior cervixes are of equal thickness.
Internal and external cervical os are seen.
Endocervical canal is seen throughout.
Calipers placed at the internal and external os where the anterior and posterior walls of the cervix meet. If the endocervical canal curves, 2 or more linear measurements should be used and added together to obtain the cervical length. The shortest best measurement should be reported.
Dynamic cervical shortening; examination time, 3–5 minutes and/or suprapubic/fundal pressure.
Report shortest best measurement.

### 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 examination impractical or unnecessary. If a limited obstetric ultrasound examination is performed on a woman who has not previously had a standard or detailed ultrasound examination, a subsequent standard or detailed ultrasound examination should be obtained where appropriate. In patients who require serial ultrasound examinations 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.<sup>8</sup>

### Specialized Ultrasound Examination

A detailed anatomic examination is performed for women at risk for fetal anatomic or karyotypic abnormalities (advanced maternal age, maternal medical complications of pregnancy, or pregnancy after assisted reproductive technology) or when an anomaly is suspected on the basis of the history, abnormal biochemical markers, or the results of either the limited or standard scan.<sup>4</sup>

Other specialized ultrasound scans may include a fetal echocardiogram, biophysical profile, and fetal Doppler ultrasound or additional biometric measurements, including nuchal translucency (NT) and cervical length.<sup>9–14</sup>

## Qualifications and Responsibilities of Personnel

See [www.aium.org](http://www.aium.org) for AIUM Official Statements, including *Standards and Guidelines for the Accreditation of Ultrasound Practices* and relevant *Physician Training Guidelines*.<sup>15</sup>

## Written Request for the Examination

The written or electronic request for an ultrasound examination should provide sufficient information to allow for the appropriate performance and interpretation of the examination. The request for the examination must be originated by a physician or another appropriately licensed health care provider or under the physician's or provider's direction. The accompanying clinical information should be provided by a physician or other appropriate health care provider familiar with the patient's clinical situation and should be consistent with relevant legal and local health care facility requirements.

## Specifications of the Examination

### Standard First-Trimester Ultrasound Examination

1. Indications for first-trimester<sup>1</sup> ultrasound examinations include but are not limited to:

- a. Confirmation of the presence of an intrauterine pregnancy<sup>16,17</sup>;
- b. Confirmation of cardiac activity<sup>18–22</sup>;
- c. Estimation of gestational age<sup>23–25</sup>;
- d. Diagnosis or evaluation of multiple gestations, including determination of chorionicity<sup>26–28</sup>;
- e. Evaluation of a suspected ectopic pregnancy<sup>29,30</sup>;
- f. Evaluation of the cause of vaginal bleeding;
- g. Evaluation of pelvic pain;
- h. Evaluation of suspected gestational trophoblastic disease;

<sup>1</sup>For the purpose of this document, first trimester represents 1 week to 13 weeks 6 days.

- i. Assessment for certain fetal anomalies, such as anencephaly<sup>31-35</sup>;
- j. Measurement of the NT<sup>11,12,36-38</sup> when part of a screening program for fetal aneuploidy;
- k. Imaging as an adjunct to chorionic villus sampling, embryo transfer, and localization and removal of an intrauterine device; and
- l. Evaluation of maternal pelvic masses and/or uterine abnormalities.

## 2. Imaging parameters

Scanning in the first trimester may be performed either transabdominally or transvaginally. If a transabdominal examination is not definitive, a transvaginal or transperineal 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, its location should be documented. The gestational sac should be evaluated for the presence or absence of a yolk sac or embryo/fetus, and the crown-rump length should be recorded, when possible.<sup>17,23-25</sup>

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 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 maternal serum human chorionic gonadotropin levels are appropriate in pregnancies of undetermined location to avoid inappropriate intervention in a potentially viable early pregnancy.<sup>16,19,20</sup>

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 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. Presence or absence of cardiac activity should be documented with a 2-dimensional video clip or M-mode.<sup>7</sup>

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.<sup>18-22</sup>

- c. Fetal number should be documented. Amnionicity and chorionicity should be documented for all multiple gestations.<sup>26-28</sup>
- d. Appropriate fetal anatomy for the first trimester should be assessed and include the calvarium, fetal abdominal cord insertion, and presence of limbs when the fetus is of sufficient size.<sup>31-35</sup>
- e. The nuchal region should be imaged, and abnormalities such as cystic hygroma should be documented.

For those patients desiring to assess their individual risk of fetal aneuploidy, a very specific measurement of the NT during a specific age interval is necessary (as determined by the laboratory used). See the guidelines for this measurement below.

Nuchal translucency measurements should be used (in conjunction with serum biochemistry) to determine the risk for having a fetus with aneuploidy or other abnormalities.<sup>36-41</sup>

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.<sup>11,12</sup>

Guidelines for NT measurement:

- 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 screen 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.
  - 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<sup>17</sup>**

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<sup>42-46</sup>;
  - b. Evaluation of fetal anatomy<sup>47-56</sup>;
  - c. Estimation of gestational age<sup>42</sup>;
  - d. Evaluation of suspected multiple gestation;
  - e. Evaluation of cervical length<sup>13,14,57-61</sup>;
  - f. Evaluation of fetal growth<sup>62-65</sup>;
  - g. Evaluation of a significant discrepancy between uterine size and clinical dates;
  - h. Determination of fetal presentation;
  - i. Evaluation of fetal well-being;
  - j. Suspected amniotic fluid abnormalities<sup>66-68</sup>;
  - 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;
  - q. Evaluation/follow-up of placental appearance and location, including suspected placenta

- previa, vasa previa, and abnormally adherent placenta;
- r. Adjunct to amniocentesis or other procedure;
- s. Adjunct to external cephalic version;
- t. Evaluation of suspected gestational trophoblastic disease;
- u. Evaluation of a pelvic mass; and
- v. Suspected uterine anomalies.

In certain clinical circumstances, a more detailed examination of fetal anatomy may be indicated.<sup>4</sup>

2. Imaging parameters for a standard fetal examination

- a. Fetal cardiac activity (by video clip or M-mode), fetal number, and presentation should be documented.

An abnormal heart rate and/or rhythm should be documented.

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-diameter pocket). In assessing oligohydramnios, the deepest vertical pocket (<2 cm) is preferred over AFI ( $\leq 5$  cm) because it results in fewer obstetric interventions without a significant difference in the perinatal outcome, and the single deepest pocket should be at least 1 cm wide.<sup>66-69</sup> Polyhydramnios (deepest vertical pocket  $\geq 8$  cm or AFI  $\geq 24$  cm) may be associated with other pregnancy complications.<sup>69</sup>
- c. The placental location, appearance, and relationship with the internal cervical os should be documented. 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.<sup>70,71</sup>

It is recognized that the apparent placental position early in pregnancy may not

correlate well with its location at the time of delivery.

A transvaginal or transperineal ultrasound examination should be performed if the relationship between the cervix and the placenta cannot be assessed.

A velamentous (also called membranous) placental cord insertion that crosses the internal os of the cervix is suspicious for a vasa previa, a condition that has a high risk of fetal mortality if not diagnosed prior to labor.<sup>72-74</sup> Color and pulsed Doppler ultrasound should be used to assess vasa previa or abnormal placental cord insertion.<sup>75</sup>

### **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.<sup>76,77</sup> 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.<sup>62-65</sup>

The pregnancy should not be redated after an accurate earlier scan has been performed and is available for comparison.<sup>78,79</sup>

- i. The biparietal diameter is measured at the level of the thalami and cavum septi pellucidi.<sup>80</sup> The cerebellar hemispheres should not be visible in this scanning plane. The measurement is typically taken 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 the biparietal diameter for estimating gestational age.

- ii. The 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. The 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. The 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.

### **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.<sup>81,82</sup> Results from various prediction models can be subsequently compared to fetal weight percentiles from published nomograms.<sup>62-65,83,84</sup>

If previous studies have been performed, appropriateness of growth should also be documented. Scans for growth evaluation can typically be performed at least 3 weeks apart. A shorter scan interval may result in confusion as to whether measurement changes are truly due to growth as opposed to variations in the technique itself.<sup>85,86</sup>

Currently, even the best fetal weight prediction methods can yield errors as high as  $\pm 15\%$ .<sup>87</sup>

### **Maternal 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 maternal ovaries during the second and third trimesters.

If the cervix appears abnormal (shortened or funneled) or is not adequately visualized during the transabdominal ultrasound examination, a transvaginal or transperineal scan is recommended when evaluation of the cervix is needed.<sup>13,14,59,88</sup>

If a referring health provider desires a precise cervical length measurement, a transvaginal measurement of the cervix should be performed.<sup>13,14,57-61</sup>

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.

### ***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, and increased maternal abdominal wall thickness.<sup>89-92</sup> 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; and
  - Upper lip.

A measurement of the nuchal fold may be helpful during a specific age interval (approximately 16 to 20 weeks' gestational age) to assess the risk of aneuploidy.<sup>93</sup>

- ii. Chest:
  - Heart<sup>94</sup>
  - Four-chamber view, heart size, and position;
  - Left ventricular outflow tract;
  - Right ventricular outflow tract; and

Three-vessel view and 3-vessel trachea view, if technically feasible.<sup>51-56</sup>

- iii. Abdomen:
  - Stomach (presence, size, and situs);
  - Kidneys;
  - Urinary bladder;

- Umbilical cord insertion site into the fetal abdomen; and
- Umbilical cord vessel number.

- iv. Spine:
  - Cervical, thoracic, lumbar, and sacral spine.
- v. Extremities:
  - Presence of legs and arms; and
  - Presence of hands and feet.
- vi. External genitalia:
  - In multiple gestations and when medically indicated.

## Documentation

Adequate documentation is essential for high-quality patient care. There should be a permanent record of the ultrasound examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded. Variations from normal size should be accompanied by measurements. Images should be labeled with the patient identification, facility identification, examination date, and side (right or left) of the anatomic site imaged. An official interpretation (final report) of the ultrasound findings should be included in the patient's medical record. Retention of the ultrasound examination should be consistent both with clinical needs and with relevant legal and local health care facility requirements.<sup>95</sup>

Reporting should be in accordance with the *AIUM Practice Parameter for Documentation of an Ultrasound Examination*.<sup>96</sup>

## Equipment Specifications

These studies should be conducted with real-time scanners, using a transabdominal and/or transvaginal approach. A transducer of appropriate frequency should be used. Real-time ultrasound is necessary to confirm the presence of fetal life through observation of cardiac activity and active movement.

The choice of transducer frequency is a trade-off between beam penetration and resolution. With modern equipment,  $\geq 3$ -MHz abdominal transducers allow sufficient penetration in most patients while providing adequate resolution. During early pregnancy,

transvaginal ultrasound may provide superior resolution while still allowing adequate penetration.

## Fetal Safety

Diagnostic ultrasound studies of the fetus are generally considered safe during pregnancy.<sup>1,2,97-100</sup> This diagnostic procedure should be performed only when there is a valid medical indication, and the lowest possible ultrasonic exposure setting should be used to gain the necessary diagnostic information under the as low as reasonably achievable (ALARA) principle.<sup>1-3,6,7,97-100</sup>

A thermal index for soft tissue (TIs) should be used at before 10 weeks' gestation, and a thermal index for bone (TIb) should be used at or after 10 weeks' gestation when bone ossification is evident.<sup>3</sup> In keeping with the ALARA principle, spectral Doppler ultrasound should not be used unless clinically indicated.<sup>6,101</sup>

The promotion, selling, or leasing of ultrasound equipment for making "keepsake fetal videos" is considered by the US Food and Drug Administration to be an unapproved use of a medical device.<sup>101-103</sup> Use of a diagnostic ultrasound system for these purposes, without a physician's order, may be in violation of state laws or regulations.<sup>102</sup>

## Quality Control and Improvement, Safety, Infection Control, and Patient Education

Policies and procedures related to quality control, patient education, infection control, and safety should be developed and implemented in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

Equipment performance monitoring should be in accordance with the *AIUM Standards and Guidelines for the Accreditation of Ultrasound Practices*.

## ALARA Principle

The potential benefits and risks of each examination should be considered. The ALARA principle should be observed with adjusting controls that affect the acoustic output and by considering transducer dwell

times. Further details on ALARA may be found in the AIUM publication *Medical Ultrasound Safety*, Third Edition.<sup>2</sup>

## Acknowledgments

This parameter was revised by the AIUM in collaboration with the ACR, ACOG, the SMFM, and the SRU according to the process described in the AIUM Clinical Standards Committee Manual.

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Members represent their societies in the initial and final revision of this practice parameter.

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