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SPECIAL CONTRIBUTION

AIUM/IUGA practice parameter for the performance of Urogynecological ultrasound examinations

Developed in collaboration with the ACR, the AUGS, the AUA, and the SRU

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Introduction

The clinical aspects of this parameter were developed by the AIUM/IUGA Collaborative Committee in collaboration with other organizations whose members use ultrasound for performing pelvic floor examinations (see "Acknowledgments"). Recommendations for practitioner requirements, the written request for the examination, procedure documentation, and quality control vary among the organizations and are addressed by each separately.An ultrasound examination is a proven and useful procedure for evaluating the pelvic floor, including the urethra, bladder, vagina, uterus if possible, anorectum, and levator ani muscle. Pelvic floor ultrasound (PFUS) examinations should be performed only when there is a valid medical reason. The lowest possible ultrasonic exposure settings should be used to gain the necessary diagnostic information. Although it is not possible to detect all pelvic floor pathology, adherence to the following practice parameter will maximize the possibility of detecting many conditions.

Indications/contraindications

Indications include, but may not be limited to, evaluation of:

1. Urinary incontinence;
2. Recurrent urinary tract infections;
3. Persistent dysuria;
4. Symptoms of voiding dysfunction;
5. Symptoms of pelvic organ prolapse;
6. Obstructed defecation;
7. Anal incontinence;
8. Vaginal discharge or bleeding after pelvic floor surgery;
9. Pelvic or vaginal pain after pelvic floor surgery;
10. Dyspareunia;
11. A vaginal cyst or mass;
12. Synthetic implants (slings, meshes, and bulking agents);
13. Levator ani muscle assessment after childbirth;
14. Obstetric perineal injury;
15. Obstetric anal sphincter injury; and
16. A perineal cyst or mass.

There are no contraindications except where patients are unable to consent to the procedure and in situations that would breach infection control guidelines, such as the presence of an open wound or severe vulvovaginal pain and discomfort.

Qualifications and responsibilities of personnel

See www.aium.org for AIUM Official Statements, including *Standards and Guidelines for the Accreditation of Ultrasound Practices* and relevant Training Guidelines.

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.

A request for the examination must be originated by a physician or other appropriately licensed health care provider or under the provider's direction. The accompanying clinical information should be provided by a physician or 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

The basic structures relevant in a PFUS examination include the pubic symphysis, the urethra, the bladder, the vagina, the uterus if present, the anal canal (internal and external anal sphincter/mucosa), the levator plate, the integrity of the insertion of the levator ani on the os pubis, and the dimensions of the levator hiatus. More than 1 scanning approach may be necessary to identify all relevant structures.

General patient preparation

For all the modalities, the patient is asked to have a moderate amount of urine in the bladder without being uncomfortable and then to lie down in the lithotomy position, with heels adducted close to the buttocks and feet 30 cm apart. In some locations, it is preferred to have the patient in a lateral position. Any gas in the lower rectum may affect the ultrasound images.

Approaches to performing PFUS examinations

i. Perineal PFUS: An abdominal transducer (4-dimensional [4D] volume, mechanical, or matrix transducer) is placed on the perineum/vulva:

- Longitudinally (for bladder neck/urethra, prolapse, and levator assessment); and
- Transversely (for assessment of anal canal and sphincters).

ii. Introital PFUS: An endovaginal transducer is placed at the vaginal introitus/vulva or perineum:

- Oriented cranially to assess the pelvic floor structures (prolapse, levator ani muscle anatomy and function, and periurethral area); and
- Oriented posteriorly to assess the anal sphincter structures.

iii. Endovaginal ultrasound (EVUS): An endocavitary transducer is inserted into the vagina (linear array 3600 3-dimensional [3D] transducer or radial array 3600 3D transducer):

- Endovaginal (for bladder neck/urethra, levator ani muscle, anal canal, and sphincters).

iv. Endoanal ultrasound (EAUS): An endocavitary transducer is inserted into the anus (linear array 3600 3D transducer or radial array 3600 3D transducer):

- Endoanal (for the external anal sphincter [EAS] and internal anal sphincter [IAS]).

Examination steps

It is suggested that the examination be performed in the following steps.

A. **Perineal PFUS**
   1. Perform a 2-dimensional (2D) assessment of the pelvic floor [1].
      a. Determine residual urine [2] and detrusor wall thickness [3] on the bladder dome:
      Part the labia and place an abdominal transducer on the perineum. Obtain a midsagittal image containing the inferoposterior symphyseal margin and urethra in the front and the anal canal in the back (Fig. 1).
      Measure the two largest bladder diameters, perpendicular to each other, to determine residual urine. Measure the detrusor wall thickness (Fig. 2)
   2. Perform a dynamic assessment of the pelvic floor.
      a. Compare split-screen images to evaluate bladder neck descent, urethral rotation, and the retrovesical angle [4]:
      Produce a split-screen image with the patient at rest in the image on the left and during the maximal Valsalva maneuver in the image on the right. The image should include the bladder neck and the inferoposterior margin of the symphysis pubis (Fig. 3).
      b. Observe in real time to evaluate descent of the bladder, uterus, and rectal ampulla/ pouch of Douglas:
      As the patient performs a maximal Valsalva maneuver of at least 6 s' duration, document organ descent against a horizontal line placed through the inferior symphyseal margin (Fig. 4) [5]. Note: Care should be taken to avoid levator coactivation [6].
      While most examinations for pelvic organ descent can be carried out supine, persistent levator coactivation sometimes requires imaging in the standing position. However, ultrasound threshold values for "normal" organ descent are varied in the literature and have not been well established [7–9].
      If a true rectocele is present, assess the maximal rectocele depth [10]. A separate frame obtained during the submaximal Valsalva maneuver may be required.

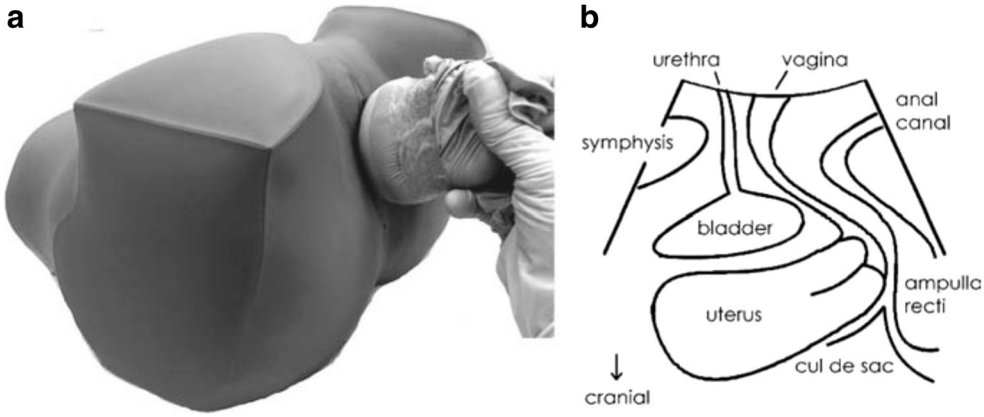

Fig. 1 Transducer placement for assessment of residual urine, detrusor wall thickness, organ descent, hiatal area, and levator ani integrity. From Dietz HP. The role of two- and three-dimensional dynamic ultrasonography in pelvic organ prolapse. *J Minim Invasive Gynecol* 2010; 17:282–294; with permission

In the same plane, it is possible to assess suburethral slings and other mesh implants, which appear as hyperechoic structures in the anterior or posterior vaginal wall [11, 12]. Hypoechoic or cystic structures, such as Gartner cysts or urethral diverticula, can also be observed in this plane and often become more prominent during the Valsalva maneuver [13].

3. Perform a 4D assessment of the pelvic floor [14].
   a. Assess the hiatal area for organ descent, hiatal ballooning, and levator integrity:

      Produce a split-screen image showing the midsagittal plane on the left and a 1- to 2-cm-thick rendered volume in the axial plane on the right [15].

      Freeze the image with the patient at the maximal Valsalva maneuver (at least 6 seconds' duration) with the region of interest adjusted to encompass the plane of minimal hiatal

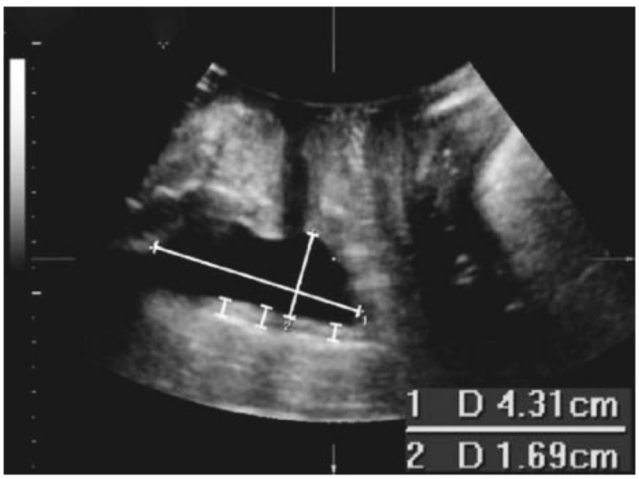

Fig. 2 B-mode single-screen image at rest for determination of residual urine (lines perpendicular to each other) and the detrusor wall thickness (3 short vertical measurements)

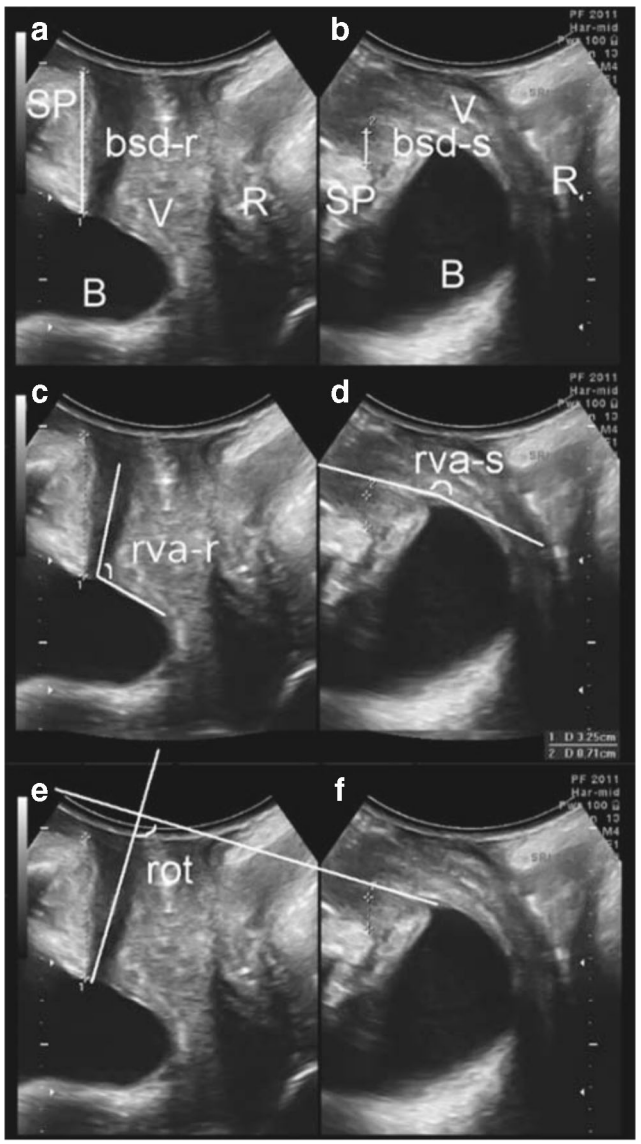

Fig. 3 Split-screen images for bladder neck descent, retrovesical angle, urethral rotation, and bladder descent. B indicates bladder; bsd, bladder neck–symphysis distance; r, at rest; R, rectum; rot, rotation angle; rva, retrovesical angle; s, on straining; SP, symphysis pubis; and V, vagina. From Dietz HP. Pelvic floor ultrasound in incontinence: what's in it for the surgeon? *Int Urogynecol J* 2011; 22:1085–1109; with permission

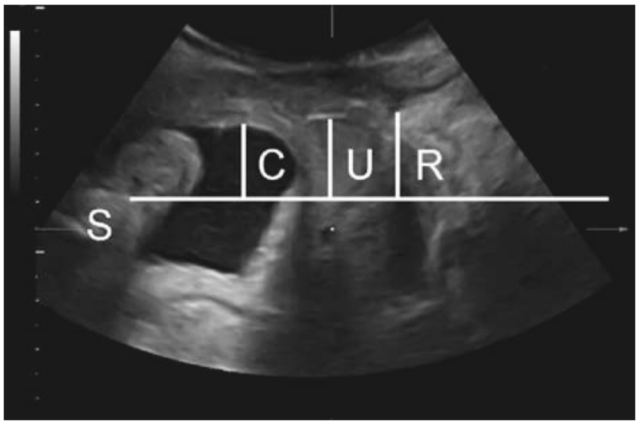

Fig. 4 Single screen at the maximum Valsalva maneuver (≥6 s) for organ descent. Descent measurements for the bladder (C), uterus (U), and rectal ampulla (R) are obtained against a horizontal reference line placed through the symphysis pubis (S)

dimensions between the posterior aspect of the symphysis pubis and the anterior aspect of the anorectal angle (Fig. 5).

To assess levator integrity, direct the patient to perform a pelvic floor muscle contraction, and identify the plane of minimal hiatal dimensions at maximal pelvic floor muscle contraction. Use this plane for tomographic ultrasound imaging (TUI) of the puborectalis component of the levator ani, with an interslice interval of 2.5 mm (Fig. 6) [17]. An avulsion is diagnosed when at least the 3 central slices show an abnormal insertion of the puborectalis muscle on the inferior pubic ramus [18]. In difficult cases, measurement of the levator-urethra gap may be of help [19].

4. Perform an evaluation of the anal sphincter [20, 21].
   a. Assess anal sphincter integrity, specifically the IAS and EAS. The anal canal includes the anal mucosa ("anal star"), IAS, EAS, as well as the puborectalis muscle.

      Position the transducer transversely (Fig. 7). Allow for a distance of 1 cm between skin and the EAS, regardless of the perineal depth. To achieve this distance, it may be necessary to part the labia and tilt the transducer to a more vertical rather than horizontal position.
   b. To assess the anal sphincter complex with TUI, acquire volumes at a 600 aperture and 700 acquisition angle, if possible, during a pelvic floor muscle contraction, with the volume showing optimal tissue discrimination used for evaluation. Identify the fascial plane between the EAS and levator ani in orthogonal planes, with the midsagittal plane in the B plane. Identify the extent of the EAS and adjust the interslice interval individually until the most cranial slice does not contain the EAS ventrally and the most dorsal slice does not contain the IAS (Fig. 8).

B. **Introital PFUS**

1. Perform a 2D assessment of the pelvic floor [23].
   a. Assess the pubic symphysis, urethra, bladder, vagina, and anorectum in a single image.

      For the pelvic floor assessment, place the transducer at the vaginal introitus/vulva or perineum (Fig. 9). Perform sagittal visualization of the pelvic floor hiatus by placing the transducer at the vaginal introitus and orienting it cranially along the vaginal canal.
   b. Perform a static assessment of the urethro- vesical junction and anorectal angle.

      Visualization of the cervix and uterus is not required for an adequate study; however, in

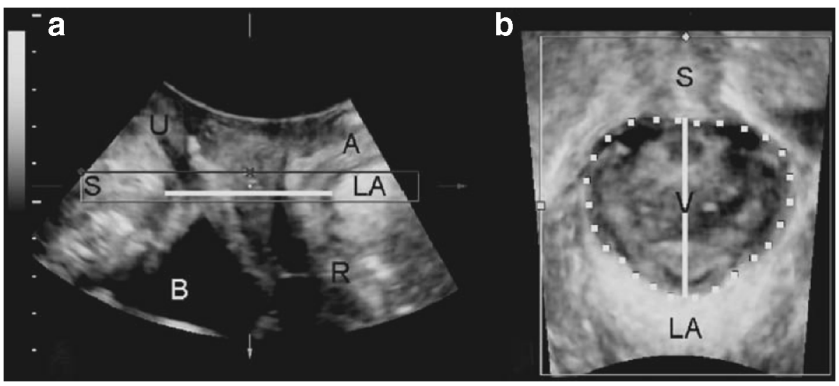

Fig. 5 Four-dimensional acquisition for organ descent and hiatal ballooning or overdistentibility[16] (850 acquisition angle). The region of interest (box in **a**) is set between the symphysis (S) on the left and the levator ani (LA) on the right. A indicates anal canal; B, bladder; R, rectal ampulla; U, urethra; and V, vagina. The dotted contour in **b** is the hiatus in the plane of minimal dimensions; the solid line in **a** and **b** is the minimal hiatal diameter in the midsagittal (anteroposterior) plane

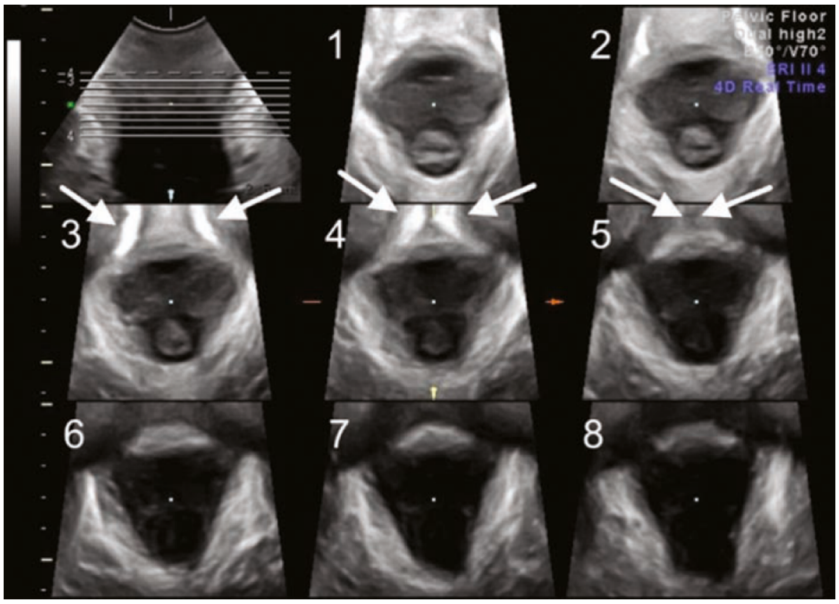

Fig. 6 Tomographic ultrasound imaging in the C (axial) plane for assessment of levator integrity. Slice 1 is the caudal slice; slice 8 is the most cranial slice. The arrows indicate the symphysis pubis

cases of uterine prolapse, the cervix and uterus are seen descended into the vaginal canal (Fig. 10).

2. Perform a dynamic assessment of the pelvic floor.
   a. Orient the transducer in a sagittal plane and instruct the patient to perform a pelvic floor contraction. Capture the dynamic movement using a cine loop and measure the pelvic floor contraction using the plane of minimal dimensions. Next, capture the dynamic movement as the patient performs a Valsalva maneuver. Measure the anterior, posterior, or apical pelvic floor descent.
3. Perform a 3D assessment of the levator hiatus and levator ani muscle integrity [24].
   a. Instruct the patient to remain still, with shallow breathing. With the 3D transducer in a sagittal plane and oriented cranially on the perineum, capture/obtain a 3D volume of the levator hiatus.
   b. Rotate the 3D volume. Perform measurements of hiatal size1 with the patient at rest [2], with a pelvic floor contraction, and [3] with the Valsalva maneuver (Fig. 11). Optimal hiatal imaging is assessed along the plane of minimal dimensions where the inferior border of the pubic symphysis is aligned with the anorectal angle. Additional assessments of this plane may include TUI through the hiatal structures to assess for levator ani muscle atrophy or avulsions.
4. Perform an evaluation of the anorectum.
   a. In the axial plane, assess the anal sphincter complex and levator ani muscles (Fig. 12).
   b. Assess the integrity of the anal sphincters, specifically noting the IAS and EAS. The anal sphincter complex may be assessed with TUI (Fig. 13).

C. **Endovaginal Ultrasound**

1. Perform a 2D assessment and dynamic assessment of the pelvic floor [25–28].
   a. Two-dimensional EVUS

      Further anterior and posterior dynamic imaging may be performed using EVUS. Introduce the transducer into the vagina until

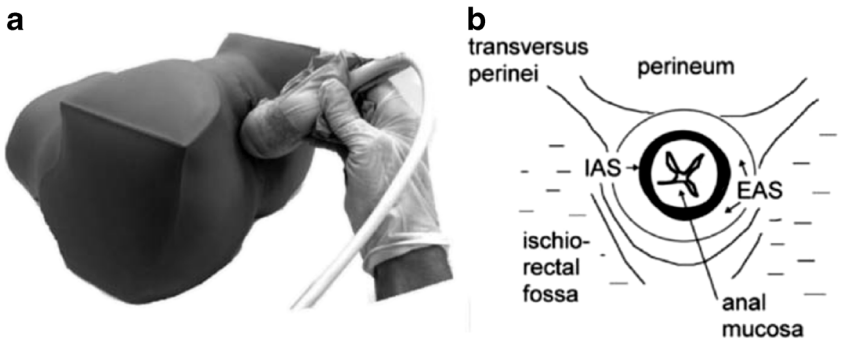

Fig. 7 Transducer placement for exoanal imaging of the anal sphincter

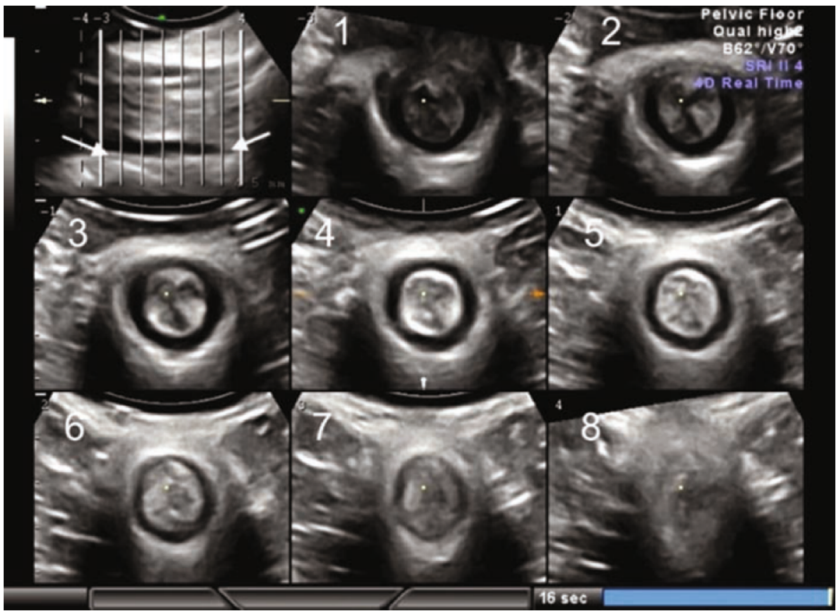

Fig. 8 Tomographic ultrasound imaging for assessment of the anal sphincter: asymptomatic nullipara. The top left image in the midsagittal plane shows placement of the 8 transverse slices, which encompass the entire EAS from slices 2 to 7, with the possible exception of the most superficial part of the subcutaneous EAS. A "residual defect" of the sphincter is diagnosed if 4 of 6 panels from 2 to 7 show a defect of greater than 30 degrees' circumference [21]. From Dietz HP. Exoanal imaging of the anal sphincters. *J Ultrasound Med* 2018; 37:263–280

the vesicourethral junction is visualized (Fig. 14).

During anterior compartment imaging, the details of the urethral anatomy [29, 30]. along with any sling or mesh present can be visualized [31–33]. Although the cough, Valsalva, and contract maneuvers can be performed, and bladder funneling can also be noted, these can be impeded by the presence of the transducer in the vagina (Fig. 15).

During posterior compartment imaging, any mesh present can be visualized [31]. Cough, Valsalva, and contraction maneuvers can be performed by the patient to improve visualization of high rectocele, enterocele, sigmoidocele, or intussusception. Visualization of a low recto- cele may be impeded by the presence of the transducer in the vagina [34].

Pelvic floor dyssynergia can also be noted during the maneuvers. Measure the distance from the transducer to the levator plate with the patient at rest. Then, direct the patient to contract her pelvic floor muscles, and measure the distance at maximal contraction of pelvic floor muscles (Fig. 16) [35]. The visualization of correct pelvic floor lift is an important clue to the patient's pelvic floor function [36]. This measurement has a good correlation with the Oxford scale in measuring pelvic floor lift. If the patient has defecatory dysfunction, she may, at this time, be asked to perform the Valsalva maneuver [37].

b. Three-Dimensional EVUS

Once the transducer is advanced to visualize the anterior compartment as in Fig. 15, the 3D volume is obtained. The scan starts from the vesicourethral junction and will

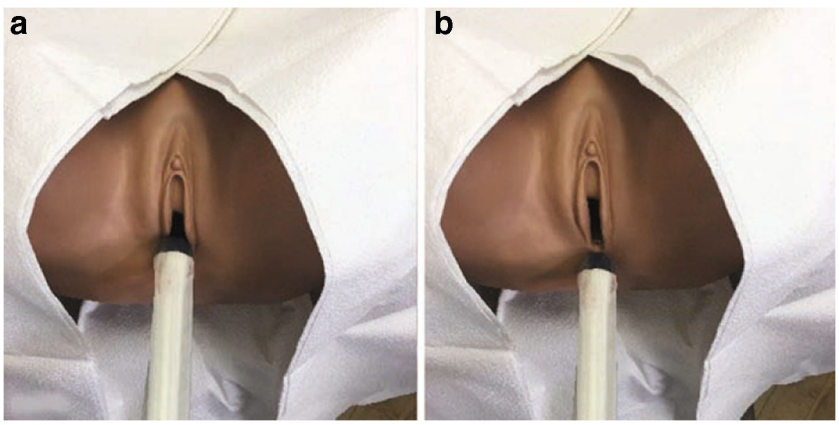

Fig. 9 The transducer can be applied to the introital (**a**) or perineal (**b**) region as necessary

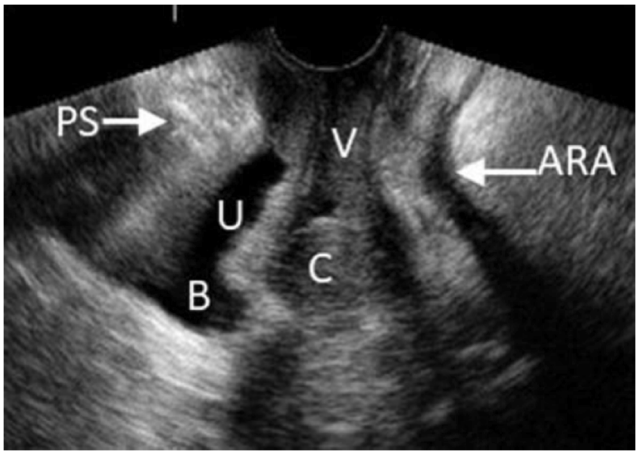

Fig. 10 Sagittal assessment of pelvic floor structures: pubic symphysis (PS), urethra (U), bladder (B), vagina (V), cervix (C), and anorectal angle (ARA)

Fig. 12 The transducer can be applied in a transverse manner at the introitus to visualize the perineal–anal sphincter complex

continue 6 cm caudal to include the perineal body [38]. The 3D volume is useful for visualization of the levator ani muscle subdivisions and defects, vaginal masses and cysts, slings, and mesh (Fig. 17) [25, 26, 39–41].

The levator ani muscle integrity, minimal levator hiatus area, anteroposterior diameter, urethral length, and sling and mesh position and dimensions, along with the levator plate descent angle, should be documented [35, 39, 40, 42].

D. **Endoanal Ultrasound**

a. Perform a 3D EAUS examination.

Endoanal ultrasound may be useful for evaluation of an anal sphincter defect or pathology [43–45]. To evaluate the anal sphincter, insert the transducer gently at a 450 angle until the levator plate comes into view posteriorly (Fig. 18). Some clinicians prefer to perform the test with the patient in the left lateral position [46–48].

In addition to obtaining detailed views of the

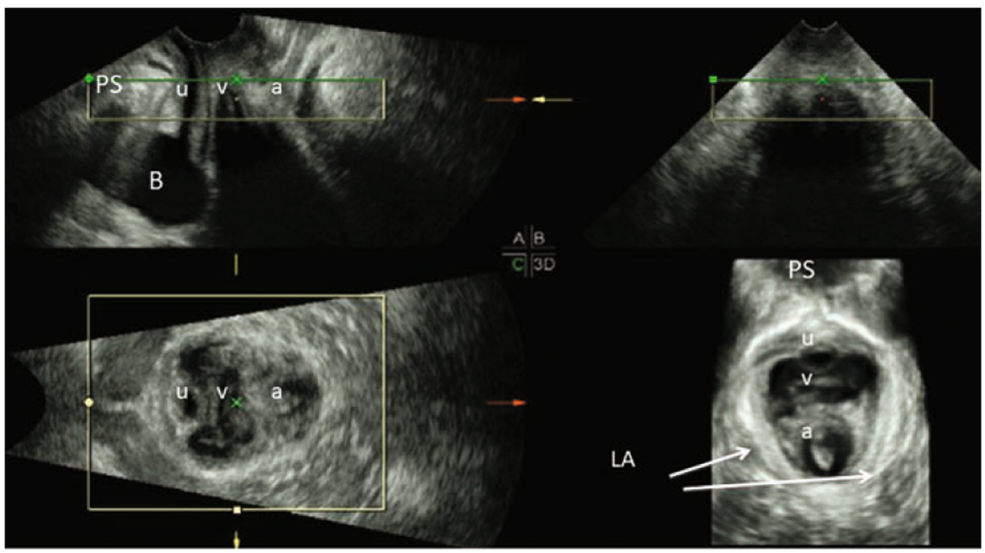

Fig. 11 Three-dimensional image of the pelvic floor hiatus presented in 3 orthogonal planes along with a rendered image. The acquisition plane is in panel A, sagittal plane; panel B represents the coronal plane; and panel C represents the transverse or axial plane. The rendered image represents the transverse or axial plane and the thick slice rendering acquired along the plane of minimal dimensions where the pubic symphysis (PS) is aligned with the anorectal angle. The cross sections of the urethra (u), vagina (v), and anus (a) are noted. In the rendered image, the levator ani muscles (LA) are seen

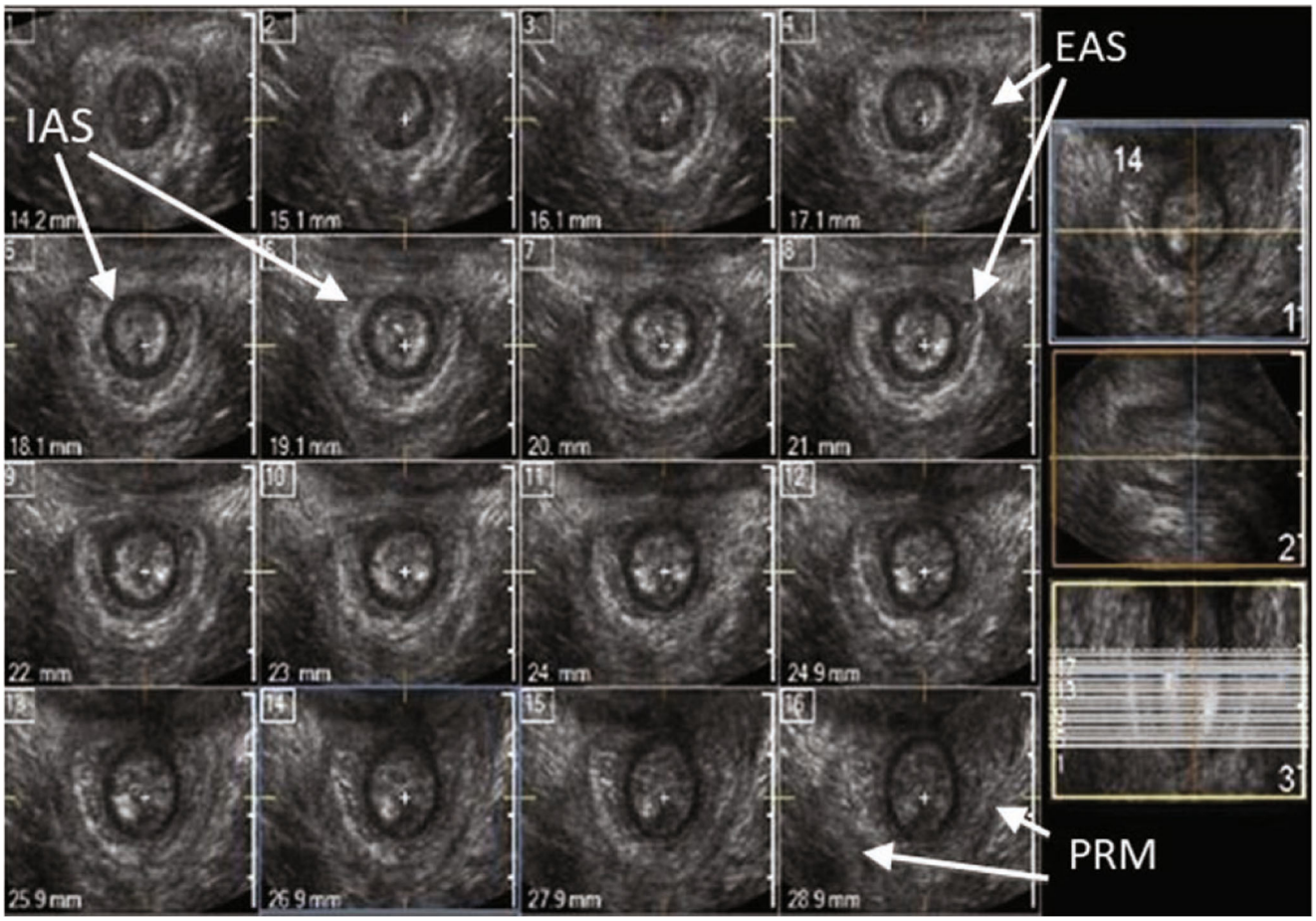

Fig. 13 Tomographic ultrasound imaging of the anal sphincter complex. The EAS has mixed echogenicity, whereas the IAS is hypoechoic. At the most proximal portion of the anal canal, the puborectalis muscle (PRM) surrounding the anorectum posteriorly is seen

anal sphincter complex, this method may be useful in imaging the pelvic anatomy of individuals with a short or absent vagina (Fig. 19). The anal sphincter complex consists of the IAS, made of smooth muscle, and the EAS made of striated muscle with the conjoint longitudinal muscle between the two. The

Fig. 14 The transducer is introduced into the vagina until the vesicourethral junction is visualized

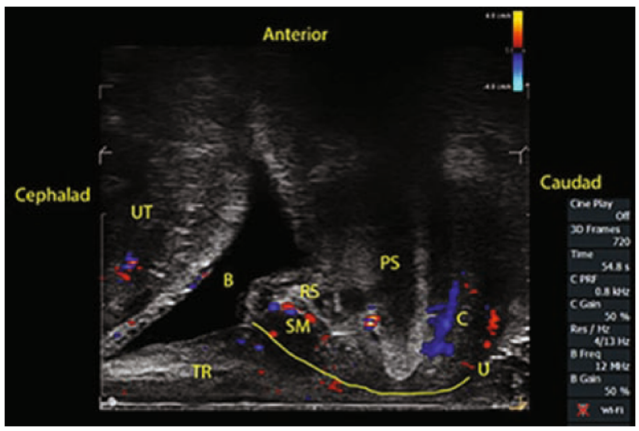

Fig. 15 Anterior compartment 2D Doppler flow view of the urethra and the bladder. B indicates bladder; C, clitoris; PS, pubic symphysis; RS, rhabdomyosphincter; SM, smooth muscle; TR, trigone; U, urethra (delineated by the yellow line); and UT, uterus (anterior edge of the uterus is seen cephalad to the bladder)

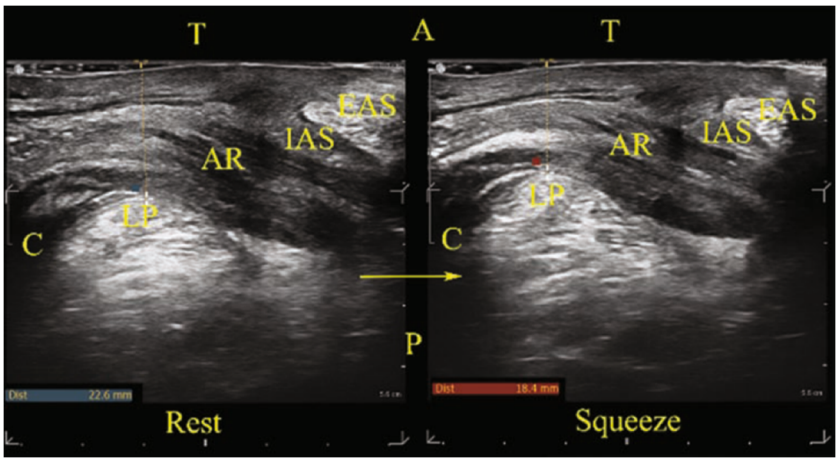

Fig. 16 Two-dimensional posterior imaging of the anorectum using a side-fire transducer at rest and contraction. A indicates anterior; AR, anorectum; C, cranial; LP, levator plate; P, posterior; and T, transducer

IAS is seen as a continuous hypoechoic ring, the EAS as a hyperechoic ring, whereas the conjoint longitudinal muscle is ofmixed echogenicity [49, 50].

Documentation

Adequate documentation is essential for high-quality patient care and should be in accordance with the *AIUM Practice Parameter for Documentation of an Ultrasound Examination*.

Equipment specifications

A 2D PFUS examination can be performed in the mid- sagittal or parasagittal plane by using a simple B-mode system. However, a 3- to 6-MHz 4D mechanical/matrix transducer or a 5- to 14-MHz or greater vaginal transducer may provide superior resolution while still allowing adequate penetration. When performing a perineal PFUS examination, access to the axial plane with a 3D/4D- capable system is required, preferably with harmonic and multislice imaging. Using a volume transducer suitable for abdominal or antenatal imaging, apertures should be at least 700 and acquisition angles 800 or higher. An introital PFUS examination is performed using an endocavitary micro-convex transducer (endovaginal transducer).

Quality control and improvement, safety, infection control, and patient education

Policies and procedures related to quality control, patient education, infection control, and safety, including equipment performance monitoring, should be developed

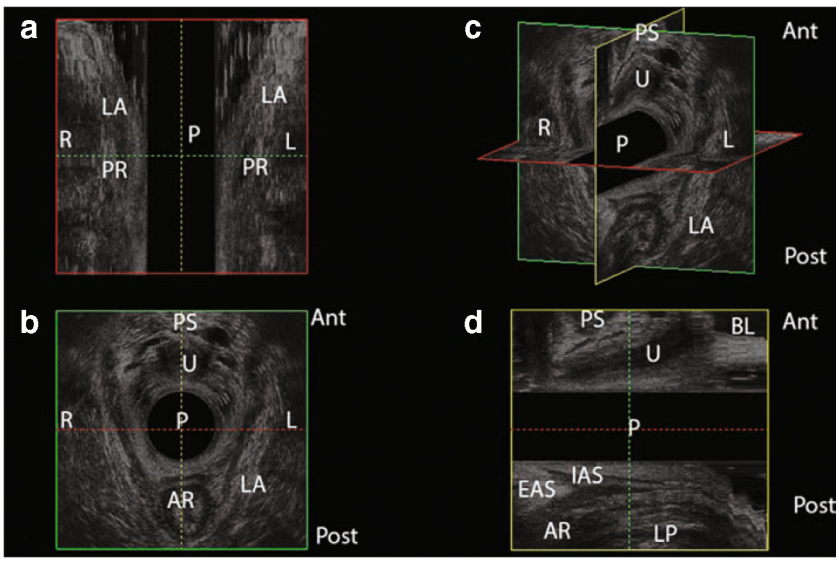

Fig. 17 Endovaginal 3D volume as seen on a workstation. A, in the red frame, is the 2D coronal view of the pelvic floor. B, in the green frame, is the axial view of the minimal levator hiatus. D, in the yellow frame, is the right midsagittal view of the pelvic floor. C is the 3D volume with all 3 planes in yellow, red, and green

Fig. 18 Placement of an endoanal transducer

and implemented 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 (as low as reasonably achievable) principle should be observed when 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.

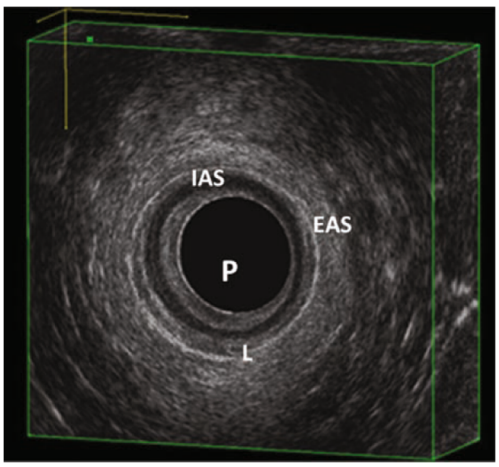

Fig. 19 Endoanal scan using the 3600 rotating probe (P) showing the hypoechoic IAS, the hyperechoic EAS, and the conjoint longitudinal muscle (L)

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

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