Endoluminal Ultrasonography

37

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Abstract The pathophysiology of pelvic organ prolapse (POP) is complex. The most common mechanisms underlying pelvic floor disorders are represented by damages to the connective tissue supporting the pelvic organs and to the levator ani muscle occurring during childbirth. Management of POP still seems to be guided largely by personal preferences and experience rather than evidence-based medicine. Diagnostic tests frequently result in a revised initial management plan; however, no guidelines exist concerning their optimal use in a clinical practice setting, and their use as a routine strategy appears not to be an option. The advent of high-resolution three-dimensional ultrasonography and dynamic ultrasonography has improved our understanding of pelvic floor function. On the basis of ultrasonographic findings, additional tests may be performed in selected conditions to optimize treatment planning and to identify the reason for surgical failure.

Keywords Cystocele • Endoanal ultrasonography • Endovaginal ultrasonography • Enterocele • Intussusception • Levator ani • Pelvic organ prolapse • Pubovisceral muscle • Rectocele • Three-dimensional ultrasonography

37.1 Introduction

Pelvic organ prolapse (POP) is a very common clinical problem that affects more than 30% of women aged 50 years and older [1, 2]. In the United States, it is estimated that one in every ten women will require surgical therapy for pelvic organ dysfunction. Unfortunately, up to 30% of operations performed each year for POP are unsuccessful [2–4]. Once a female has undergone surgery for POP, her risk of developing a further prolapse is 500% greater than in the general population. This indicates the necessity for a precise diagnosis of the nature and severity of the POP and of the interrelationships of the pelvic organs, to obtain an adequate correction of the underlying structural alterations that lead to prolapse. Moreover, little is known about those factors that prevent or promote recurrence of prolapse after repair. Most patients are selected for treatment on the basis of clinical history and physical examination with POP Quantification (POP-Q) scoring. The pelvic examination, however, does not provide adequate information on the fascial and muscular defects underlying a specific disease. For this reason, the use of additional diagnostic tests may be very helpful in the assessment of pelvic floor disorders to improve our approach to surgical repair of POP and to identify the reasons for the high rate of surgical failure. However, due to a lack of evidence for their clinical value,

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no guidelines exist to date concerning the optimal use of these tests in a clinical practice setting.

Techniques for imaging of the pelvic floor, including evacuation proctography, cystocolpodefecography, voiding cystourethrography, dynamic magnetic resonance imaging (MRI), and ultrasonography, are valuable to quantify and define pelvic floor support [5].

Defecography represents a long-established diagnostic procedure for the investigation of posterior compartment disorders [6] (see Chapter 39). However, controversy still exists as to the interpretation and clinical utility of this modality, largely due to absent or imperfect reference standards for comparison. Furthermore, defecography is uncomfortable for the patient, requires exposure to ionizing radiation, and, when used without opacification of the bladder, lacks the ability to visualize the anterior and central compartments. Cystocolpodefecography is even more invasive, poorly tolerated, and requires an additional radiation dose.

Recently, more advanced imaging modalities have become available, such as MR defecography, and dynamic and three-dimensional (3D) ultrasonography. MR defecography is a much more comprehensive examination that allows assessment of coexisting bladder and uterocervical prolapse, which is fundamental when planning surgical treatment [7] (see Chapter 40). Moreover, MRI may determine the architectural distortion associated with pelvic prolapse [8]. However, this technique is very expensive, time consuming and limited to referral centers.

Ultrasonography has become an established procedure in the diagnostic evaluation of pelvic floor disorders [9]. Ultrasound examination has several important advantages over other imaging modalities: absence of ionizing radiation, relatively easy to perform, minimal discomfort, cost-effectiveness, reduced time requirement, and wide availability. Two-dimensional transperineal ultrasonography (2D-TPUS), and more recently 3D-TPUS, can define the presence of cystocele or recto/enterocele, hypermobility of the urethra, and levator ani damage [10] (see Chapter 38). However, TPUS is not able to evaluate precisely the disorders of the central and posterior compartment of the pelvic floor, as reported by Broekhuis et al [11]. These authors compared TPUS and dynamic MRI in patients with POP and found a good correlation in the assessment of the anterior compartment but no correlation regarding assessment of the posterior and central compartments. The recent advent of high-frequency 3D endovaginal (3D-EVUS), 3D endoanal (3D-EAUS), and dynamic endovaginal ultrasonography provide us with a new alternative to visualize the pelvic floor structures and to evaluate all pelvic organ movements [12, 13].

This chapter reviews the indications, results, and limitations of endoluminal ultrasonography and illustrates morphologic and functional ultrasonographic features in patients with POP. The techniques of examination and normal pelvic floor anatomy were previously reported in detail in Chapters 6 and 8.

37.2 Levator Ani Damage

The levator ani muscle is thought to be of central importance for pelvic organ support, and levator trauma seems to be a major cause of POP in parous woman [14]. DeLancey et al [15] have found that women with POP have an odds ratio of 7.3 for having a major levator injury compared with asymptomatic women. Levator tears and avulsion are the most common consequence of hyperstretching of the levator ani during the second stage of labor [16] (see Chapter 12). Disconnection of the levator ani from its insertion on the inferior pubic ramus and the pelvic sidewall occurs in 15–36% of POP patients, according to many studies [2, 3, 17, 18]. Anatomically, the levator ani muscle and the connective supportive structures (uterosacral

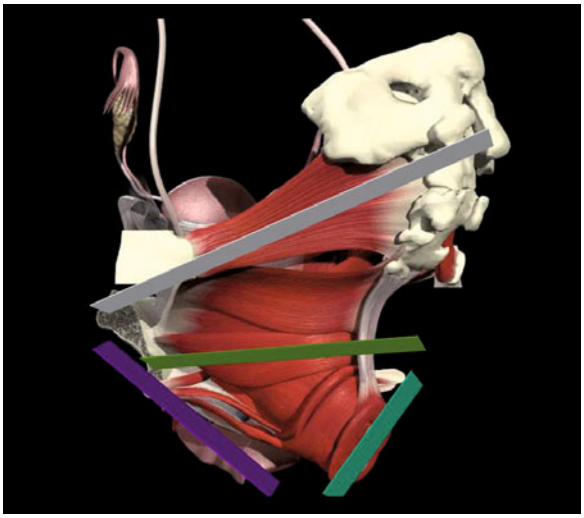


Fig. 37.1 Schematic illustration showing that the various pelvic floor structures are located in different planes (*gray plane*: pubococcygeous muscle; *green plane*: puborectalis muscle; *blue plane*: anal triangle of perineum; *violet plane*: urogenital triangle of perineum) (© Primal Pictures Ltd., with permission)

ligaments, endopelvic, pubocervical, and rectovaginal fascia) are partners in providing pelvic support. A healthy levator ani with normal tone prevents transmission of pressure to connective tissue. Once the muscle is damaged, the area of the levator hiatus through which the urethra, vagina, and anal canal traverse to enter into the perineum, increases. As a consequence, the ligaments are burdened to carry an increasing share of the load, which may, over time, result in connective tissue failure and development of prolapse. Huebner et al [8] reported an odds ratio of 8.3 for POP when both levator defect and architectural distortion to the connective structures were present. Levator ani defects appeared to be a necessary condition for architectural distortion to occur. These authors found that women with anterior predominant prolapse were more likely than those with posterior or apical prolapse to have levator defects and architectural distortion [8].

Levator tear and damage to the connective tissues can be difficult to detect clinically, and bilateral or symmetric defects and thinning of the levator ani may be overestimated or underestimated by palpation of the muscle alone [19]. Modern imaging techniques enable visualization of the morphology of the levator ani, levator hiatus, and pelvic fascia and ligaments [6, 8–19]. As the defect itself is still not unequivocally defined, levator ani trauma can

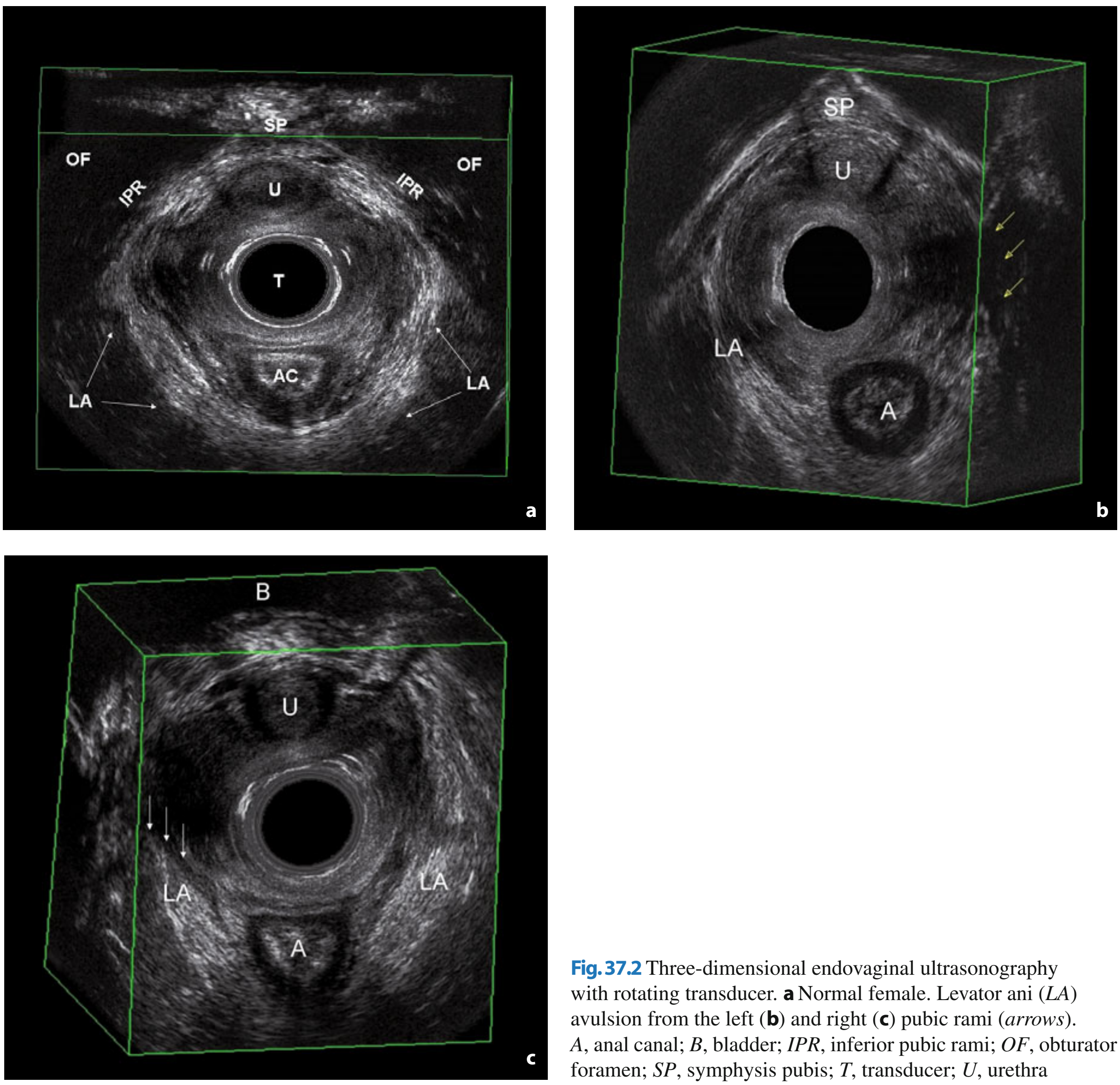
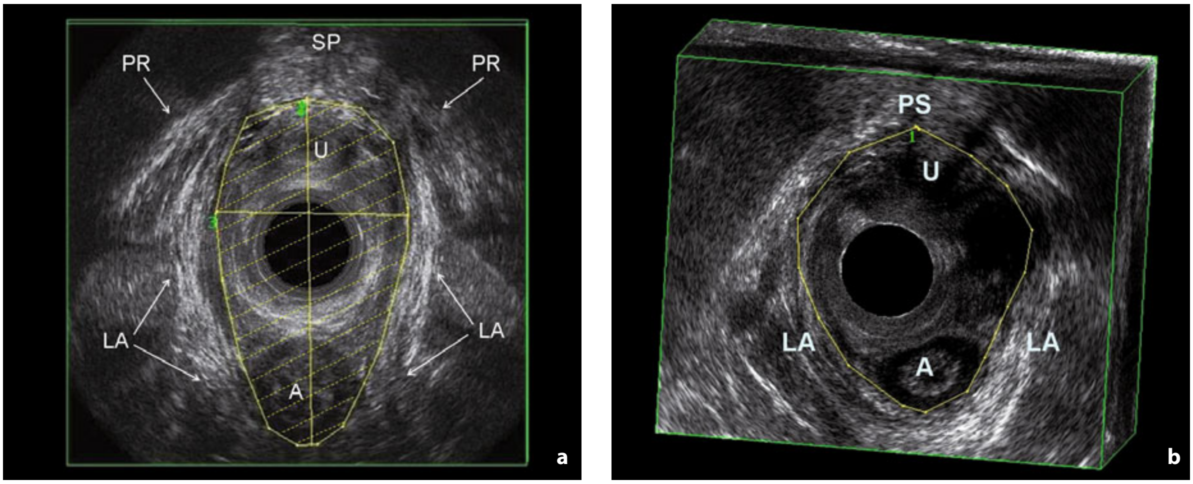


Fig. 37.2 Three-dimensional endovaginal ultrasonography with rotating transducer. **a** Normal female. Levator ani (*LA*) avulsion from the left (**b**) and right (**c**) pubic rami (*arrows*). *A*, anal canal; *B*, bladder; *IPR*, inferior pubic rami; *OF*, obturator foramen; *SP*, symphysis pubis; *T*, transducer; *U*, urethra



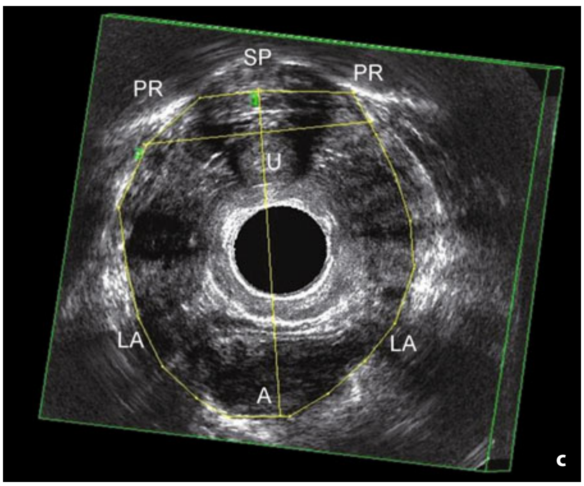


Fig. 37.3 Three-dimensional endovaginal ultrasonography with rotating transducer. The levator hiatal area, measured in the axial plane, increases with the POP-Q stage. **a** Normal female: 12.4 cm^2. **b** POP-Q stage II: 17.5 cm^2. **c** POP-Q stage III: 24 cm^2. *A*, anal canal; *LA*, levator ani muscle; *PR*, pubic rami; *SP*, symphysis pubis; *U*, urethra

be indirectly assessed by measurement of the levator hiatus by ultrasonograhpy. Athanasiou et al [20] reported that high-frequency 2D-EVUS allows assessment of levator function at rest and during contraction and Valsalva maneuver in the axial plane. They found that levator hiatal area was significantly larger in women with prolapse compared with those without (17.8 cm^2 vs. 13.5 cm^2). The authors demonstrated that the greater the prolapse staging the larger the hiatal area ($P < 0.001$), as assessed by the maximum descent of the leading organ.

High-resolution 3D-EVUS allows detailed visualization of the complex anatomy of the pelvic floor structures in their proper planes (axial, coronal, sagittal, and oblique), clarifying their spatial relationship (Figs. 6.13, 37.1). Compared to 3D-TPUS, the resolution of 3D-EVUS is theoretically better because the probe is closer to the pelvic floor structures. In healthy asymptomatic women, a normal levator ani appears as a well-defined horseshoe-shaped muscular structure surrounding the anus from its posterior part, localized laterally to the vagina and urethra, and attaching symmetrically to the pubic rami [15] (Fig. 6.15). Levator ani defects or avulsion can be precisely visualized and localized (Fig. 37.2). Moreover, the biometric indices of the levator hiatus can be determined in various POP-Q stages (Figs. 6.16, 37.3).

This technique also allows identification of defects in the connective tissue, such as detachment of the vaginal sulci from the lateral pelvic sidewall, with unilateral or bilateral widening of the paravaginal spaces, and asymmetry of the urethra and anus (Fig. 37.4).

37.3 Cystocele

Cystocele refers to prolapse of the bladder (Fig. 37.5). It is common in elderly women and may cause symptoms such as pelvic heaviness, dryness of the vagina, discomfort, and difficulties in emptying the bladder [21]. An isolated anterior vaginal wall prolapse is usually not difficult to diagnose at clinical examination. However, cystocele frequently coexists with other disorders involving the middle and the posterior compartments, such as uterine prolapse, rectocele, enterocele, and peritoneocele [22, 23]. In these cases it is sometimes difficult to establish a correct diagnosis at clinical examination only. Radiological examination is therefore used to complement the clinical assessment. Cystodefecoperitoneography is the most commonly used method, where contrast medium in the urinary bladder enables visualization of the bladder base. However, several studies [24, 25] have demonstrated a relatively poor correlation between clinical examination and radiological findings, suggesting that the contrast in the bladder is not useful in the routine preoperative assessment of patients with genital prolapse.

High-frequency 3D-EVUS and dynamic EVUS allow imaging of the anterior compartment (see Chapter 15) and represent useful modalities to detect defects of the connective supporting structures, subclinical cystoceles, or multicompartmental damage. At 3D-reconstruction, paravaginal defects or asymmetry of the urethral axis can be visualized in the axial plane, and rotation of urethra or the presence of small cystocele can be identified in the coronal plane (Fig. 37.6).

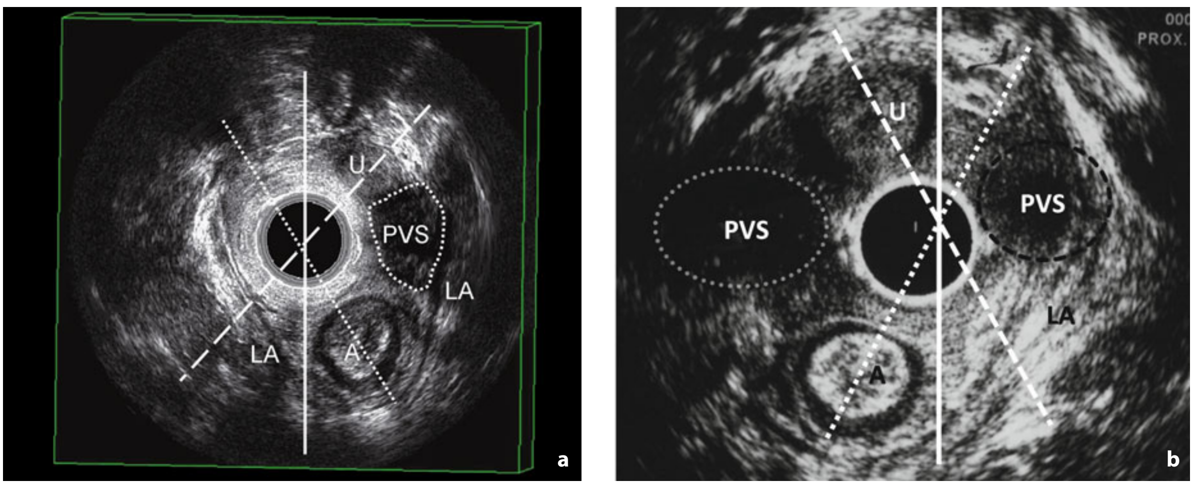


Fig. 37.4 Three-dimensional endovaginal ultrasonography with rotating transducer. Demonstration of paravaginal defects (**a**, left side; **b**, bilateral), asymmetry of the urethral and anal canal axis (**a**, **b**) and levator ani damage (**b**, avulsion of the right arm) in two females with pelvic organ prolapse. *A*, anal canal; *LA*, levator ani; *PVS*, paravaginal space; *U*, urethra

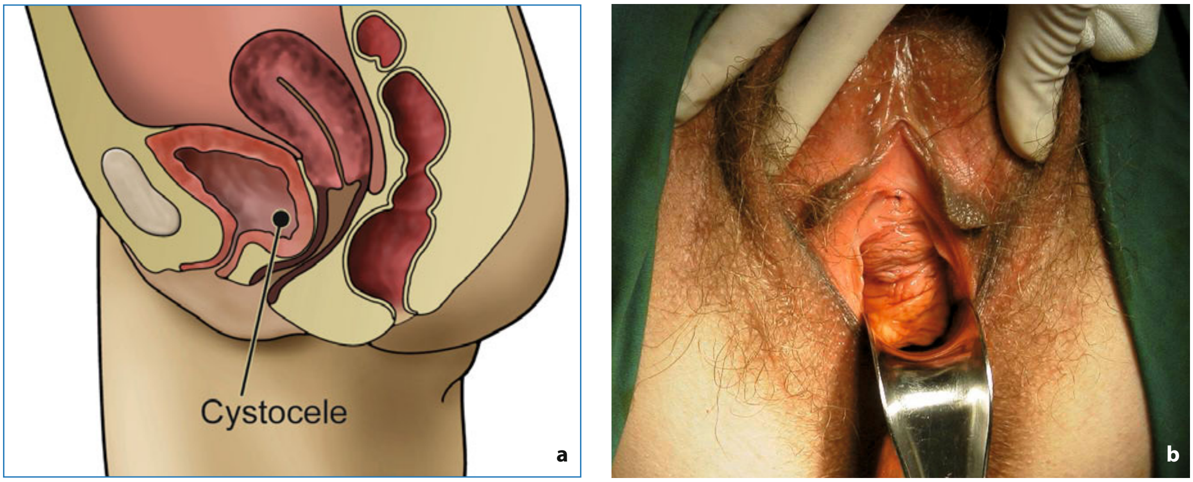


Fig. 37.5 Schematic illustration of a cystocele (**a**) and its clinical appearance (**b**)

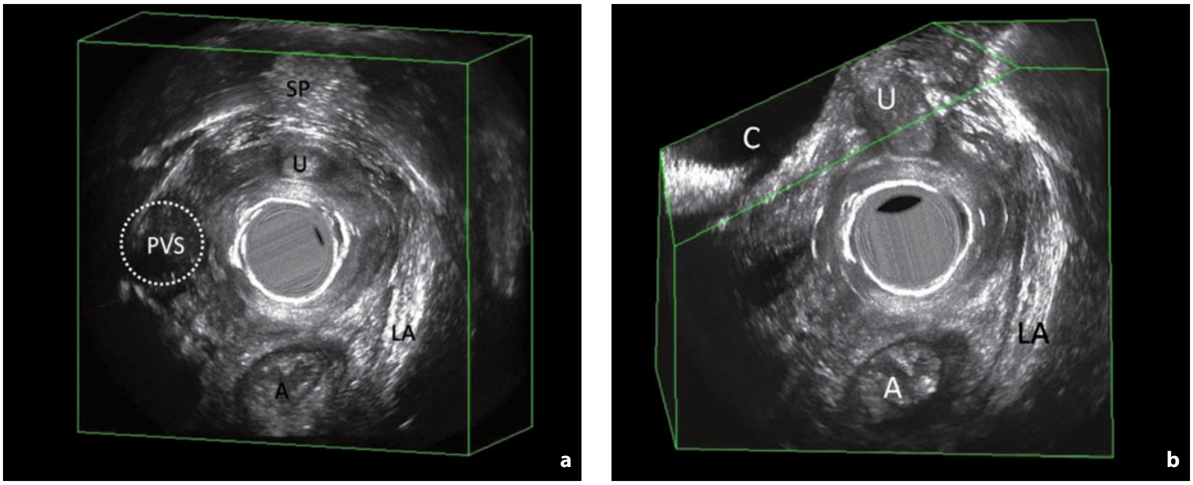


Fig. 37.6 Three-dimensional endovaginal ultrasonography with rotating transducer and volume render mode. **a** In the axial plane, the right arm of the levator ani (*LA*) is detached from the pubic rami and the right paravaginal space (*PVS*) is widened. **b** On the same side, using an oblique coronal plane, an early-stage cystocele (*C*) can be seen. *A*, anal canal; *SP*, symphysis pubis; *U*, urethra

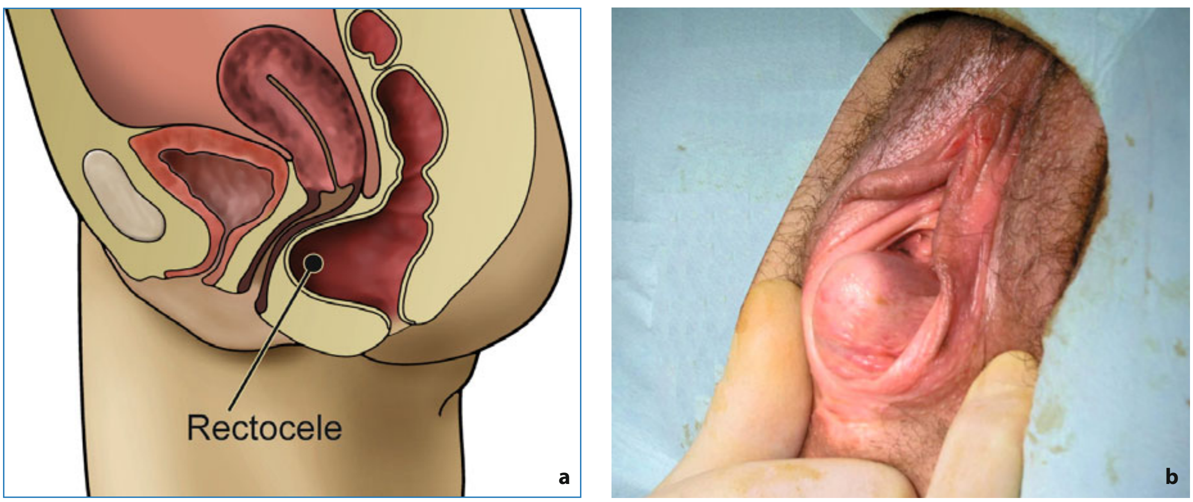


Fig. 37.7 Schematic illustration of a rectocele (**a**) and its clinical appearance (**b**)

37.4 Rectocele

Rectocele refers to an abnormal bulge of the anterior rectal wall, usually observed during defecation (Fig. 37.7). It is also defined as a posterior vaginal wall prolapse. This terminology, however, is not precise, as a posterior vaginal wall prolapse may also be due to the presence of an enterocele.

Rectocele is common in women after vaginal birth trauma (multiple or prolonged deliveries, forceps , perineal tears) and can also develop in women with chronic constipation. The underlying etiology is a weakening of the support structures of the pelvic floor and thinning or tear of the rectovaginal fascia. Symptoms related to the rectocele include: vaginal bulging, defecatory dysfunction, and a sensation of incomplete evacuation.

Several modalities to quantify the extend of rectocele have been reported. To date, defecography has been "the gold standard" for its evaluation. At evacuation proctography, a rectocele is measured as the depth of the wall protrusion beyond the expected margin of the normal anterior rectal wall. A depth of < 2 cm is considered within normal limits; rectocele should be considered moderate if its size is 2–4 cm, and large if it is > 4 cm. MRI is also used to assess rectocele during straining or defecation.

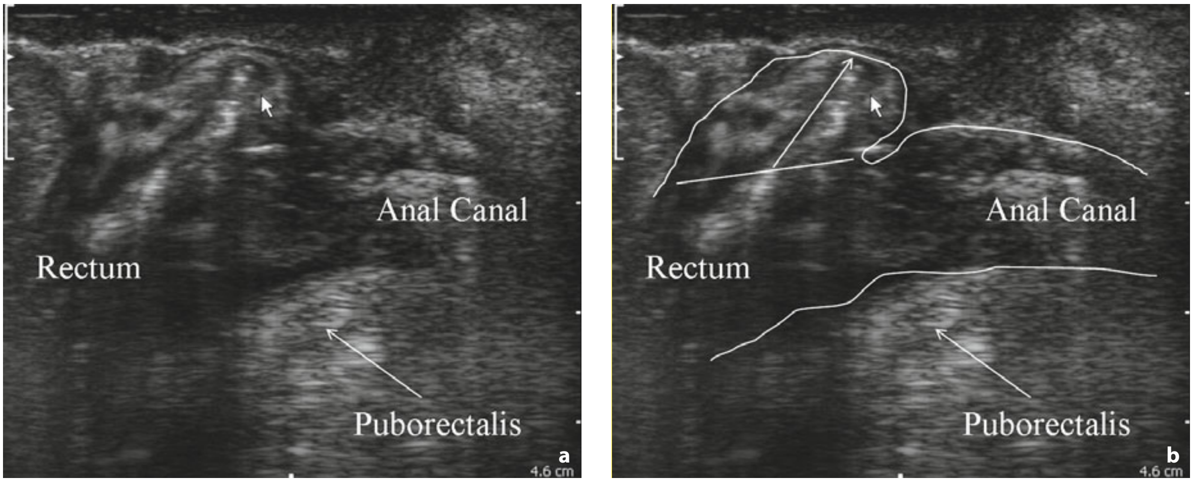


Fig. 37.8 Endovaginal ultrasonography with biplane probe. Longitudinal view of the posterior compartment using the linear array of the probe (positioned on the top of the image). **a** During Valsalva maneuver, a rectocele is demonstrated as bulging of the anterior rectal wall (*arrow*). **b** Rectocele depth is measured perpendicular to the expected contour of the anterior rectal wall (*arrow*)

More recently, TPUS has been shown to demonstrate rectocele, enterocele, and rectal intussusception. Perniola et al [26] performed a comparative clinical study to determine the agreement between defecation proctography and TPUS. They found a poor agreement between the two methods in the measurements of quantitative parameters. However, when ultrasound showed a rectocele or rectal intussusception, there was a high likelihood of this diagnosis being confirmed on proctography.

Dynamic EVUS performed with the use of a biplane probe (type 8848 – linear array, B-K Medical; see Chapter 6) seems to be an accurate modality to demonstrate a rectocele during straining and defecation (Fig. 6.12). This procedure is non-invasive and does not require any contrast medium. On ultrasound, the anorectal angle (ARA) at rest and during Valsalva maneuver is determined, as well as the presence/absence of a rectocele and its maximum depth. Rectocele depth, as on defecography, is measured perpendicular to the expected contour of the anterior rectal wall (Fig. 37.8). Similarly to TPUS [18], EVUS has the following limitations: it is operator dependent; it is performed in a supine position; Valsalva maneuver does not represent physiological defecation; it can prevent development of the prolapse due to the presence of the probe.

For these reasons, ultrasound may underevaluate rectocele. On the other hand, other studies have suggested that defecography overdiagnoses this abnormality [27]. We agree with Perniola et al [26] that ultrasonography cannot replace defecation proctography in clinical practice, but it should be performed as an initial examination or screening method in patients with defecatory disorders. Positive findings on ultrasound may avoid more invasive tests, whereas negative findings require confirmation by defecography.

Murad Regadas [28] described a dynamic 3D anorectal ultrasonography (echodefecography) to assess patients with obstructed defecation. The technique consists of positioning a 360 degree rotational transducer (type 2050, B-K Medical; see Chapter 8; Fig. 8.2) into the rectum at 6–7 cm from the anal margin. Four automatic 3D acquisitions are performed to identify anatomical and functional changes induced by straining. The images are evaluated in the axial and longitudinal planes. This modality has been shown to represent an alternative tool to defecography.

37.5 Intussusception

Rectal intussusception is defined as an invagination of the rectal wall into the rectal lumen. It may be described as anterior, posterior, or circumferential. The intussusception may involve the full thickness of the rectal wall or only the mucosa. It can be classified as intra-rectal (if it remains in the rectum), intra-anal (if it extends into the anal canal), or external (if it forms a complete rectal prolapse).

There is often no identifiable cause in adults, although it is more common in multiparous women, suggesting it

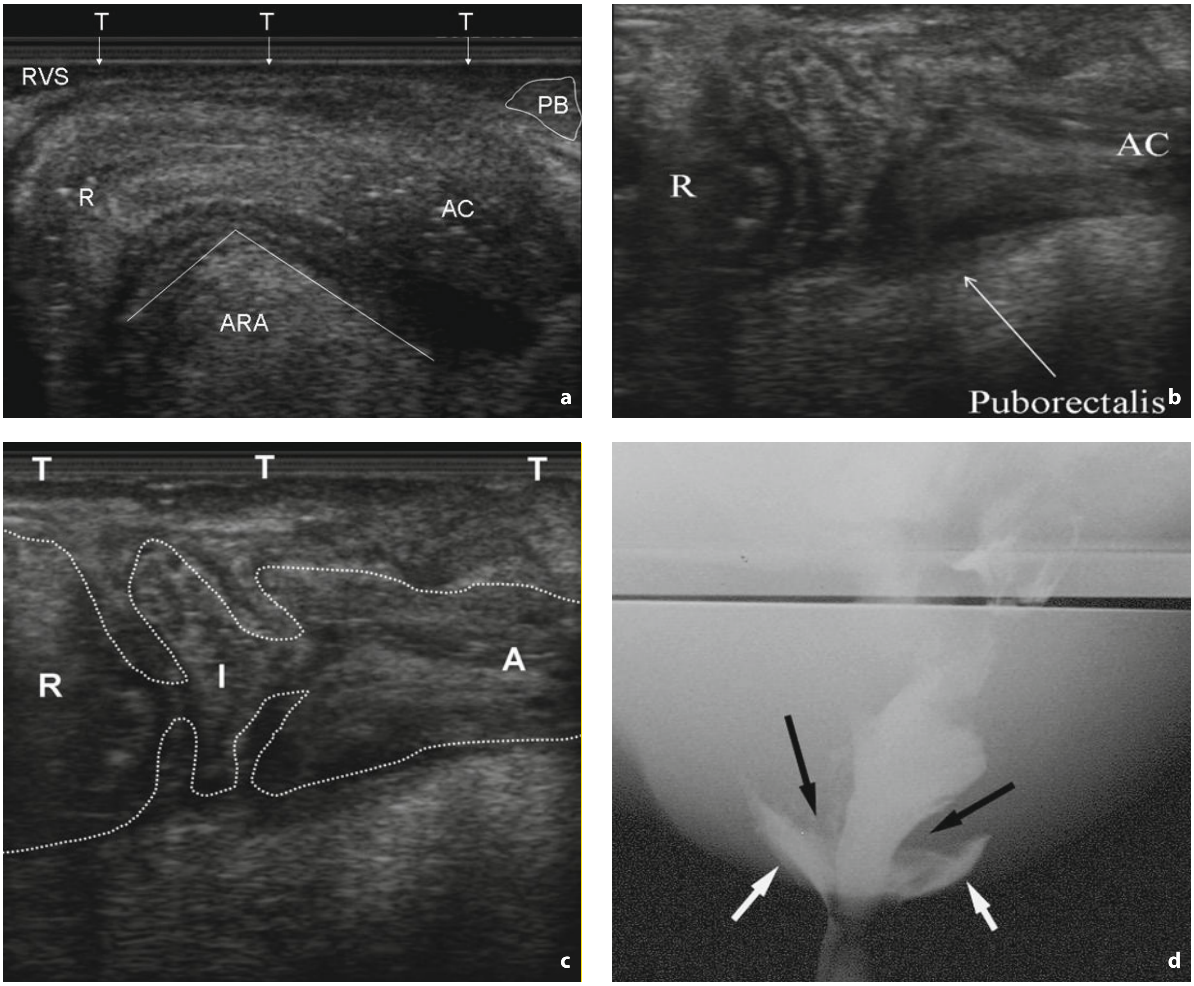


Fig. 37.9 Endovaginal ultrasonography with biplane probe. Longitudinal view of the posterior compartment using the linear array of the probe (positioned on the top of the image). **a** At rest. **b, c** During Valsalva maneuver, an intussusception (*I*) is demonstrated as wide invaginating rectal folds. **d** Intussusception at defecography. *AC*, anal canal; *PB*, perineal body; *R*, rectum; *RVS*, rectovaginal septum; *T*, transducer

may be a sign of more global pelvic floor damage. Small intrarectal intussusception may be detected in asymptomatic patients; however, if the invagination becomes intra-anal, the patient experiences a sensation of incomplete defecation due to outlet obstruction.

A defecographic study showed that most prolapse commences around 6–8 cm upstream of the anorectal junction [29]. However, proctographic diagnosis is often difficult because the intussusception may not be clearly distinguished from normal mucosal descent. A relatively useful indicator of true intussusception is the presence of abnormally wide invaginating rectal folds measuring more than 3 mm [30]. MR defecography has several advantages over evacuation proctography in the diagnosis of rectal intussusception: it allows differentiation between mucosal versus full-thickness descent and it provides additional information on movements of the whole pelvic floor.

Dynamic EVUS with the use of the linear array of the 8848 probe may detect rectal intussusception. Invagination may be seen as an infolding of the rectal wall into the rectal lumen while asking the patient to push, or during maximal Valsalva maneuver (Fig. 37.9). The intussusception may be observed to enter the anal canal or exteriorized beyond the anal canal. This technique is relatively easy to perform and provides adequate information comparable to MRI and proctography for the proper management of this disorder. Additionally, it may be used to evaluate whether a good functional outcome is achieved after treatment.

37.6 Mucosal Rectal Prolapse

Mucosal rectal prolapse creates a circular thickening of the mucosal layer of the anal canal that narrows the lumen (Fig. 37.10).

This condition is almost always associated with an anterior–posterior asymmetry and an increased thickness of the internal anal sphincter (IAS). Three-dimensional EAUS is an accurate modality to detect these abnormalities in mucosal prolapse (Figs. 8.2, 37.11). Any internal sphincter measuring more than 4 mm in thickness, regardless of the patient's age, is considered to be an indicator of an underlying mucosal prolapse or solitary rectal ulcer syndrome. It is interesting to note that the IAS thickness recovers after surgical treatment, as reported by Halligan et al [31].

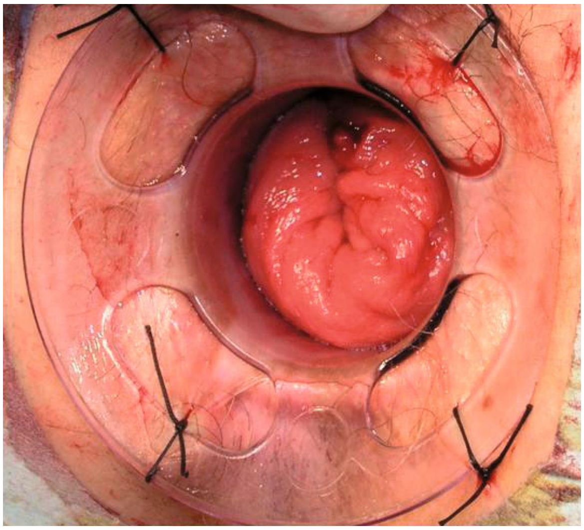


Fig. 37.10 Clinical appearance of a mucosal rectal prolapse as a circular thickening of the mucosal layer of the anal canal narrowing the lumen

37.7 Enterocele

An enterocele is diagnosed when small bowel loops enter the rectovaginal space (Fig. 37.12). Large enterocele may herniated into the vagina, resulting in a posterior vaginal wall prolapse that needs to be differentiated from rectocele. An enterocele may be symptomatic, causing a sense of fullness and incomplete evacuation. It occurs primarily in patients who have had a hysterectomy, due to separation of the pubocervical and rectovaginal fascia. There is an association with multiparity, age, and obesity. A redundant sigmoid may also prolapse into the rectovaginal space as a sigmoidocele. Diagnosis of an enterocele on proctography is only possible if oral contrast has been administered before the examination. Enteroceles are often apparent only when the rectum and bladder are emptied, as otherwise the limited space in the pelvis prevents small bowel descent. Alternatively, enteroceles are usually diagnosed at the end of the procedure when the rectovaginal space widens after evacuation, and pressure from the adjacent full rectum is reduced. The advent of MR defecography holds considerable promise in the diagnosis of enteroceles and other forms of pelvic herniation; however, this requires an open technique which is very expensive and not widely available.

Transperineal ultrasonography has also been used to demonstrate the presence of an enterocele [19]. Steensma

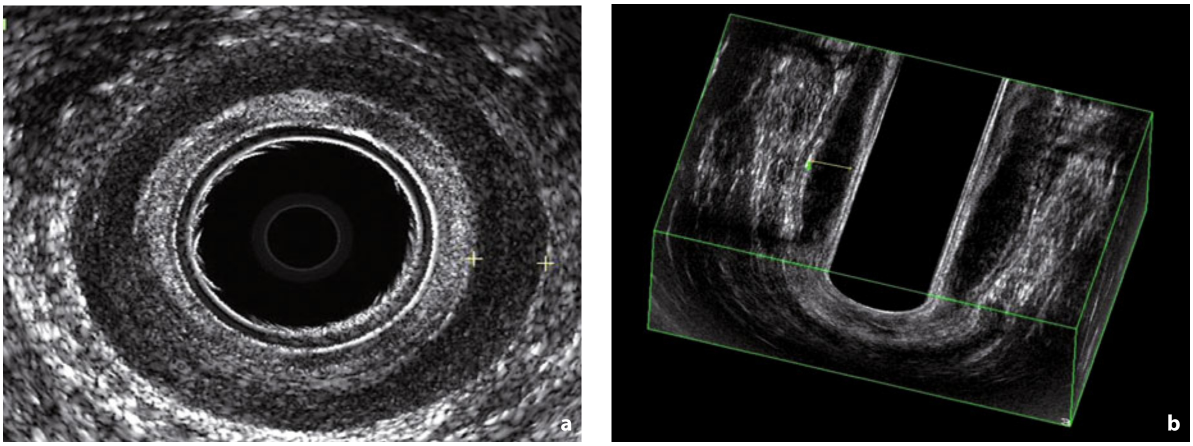


Fig. 37.11 3D-EAUS with rotating transducer. In this female with a mucosal rectal prolapse, the internal anal sphincter is thicker than 4 mm. **a** Axial view. **b** Coronal view

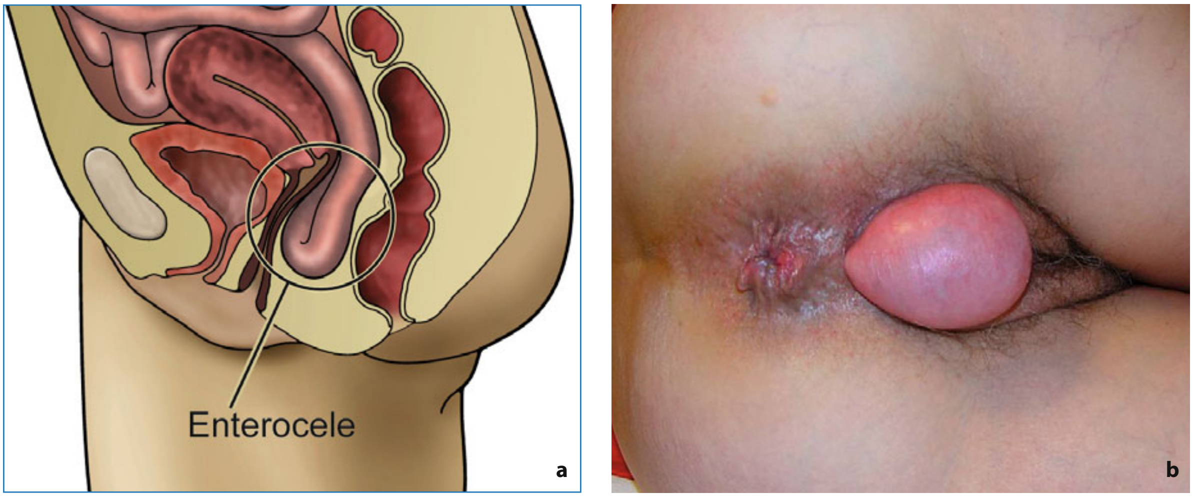


Fig. 37.12 Schematic illustration of an enterocele (**a**) and its clinical appearance (**b**)

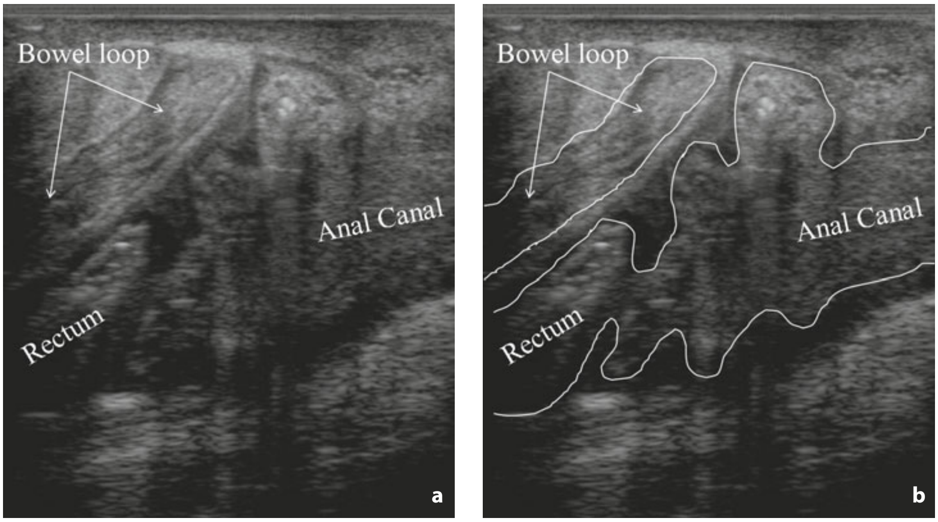


Fig. 37.13 Endovaginal ultrasonography with biplane probe. Longitudinal view of the posterior compartment using the linear array of the probe (positioned on the top of the image). **a**, **b** During Valsalva maneuver, an enterocele is demonstrated as a bowel loop entering into the rectovaginal space

et al [27] reported a good agreement between 3D-TPUS and defecography for detecting enterocele. Similarly to TPUS, dynamic EVUS with 8848 probe (linear array) may be used as an alternative to evacuation proctography. Enterocele is ultrasonographically diagnosed as a herniation of abdominal contents into the rectovaginal space (Fig. 37.13). It can be graded into small, when the most distal part descends into the upper third of the vagina; moderate, when the most distal part descends into the middle third of the vagina; and large, when the most distal part descends into the lower third of the vagina. Enterocele may also be concomitant with the presence of rectocele (Fig. 37.14). A limitation of EVUS is the difficulty of distinguishing an enterocele from a sigmoidocele.

Another limitation is the so-called "crowded pelvis", which refers to competition of the anatomic space in the pelvis. In some cases an enterocele that is visible during straining competes for the same anatomic space as a rectocele, which might prevent the true prolapse size from becoming visible.

37.8 Pelvic Floor Dyssynergy

Anismus, also known as spastic pelvic floor syndrome, or paradoxical puborectalis syndrome, is a phenomenon characterized by a lack of normal relaxation of the puborectalis muscle during defecation. The patient experiences constipation and incomplete evacuation. Although the diagnosis of anismus may be suggested by tests of anorectal physiology (electromyography and anorectal manometry), proctography and dynamic

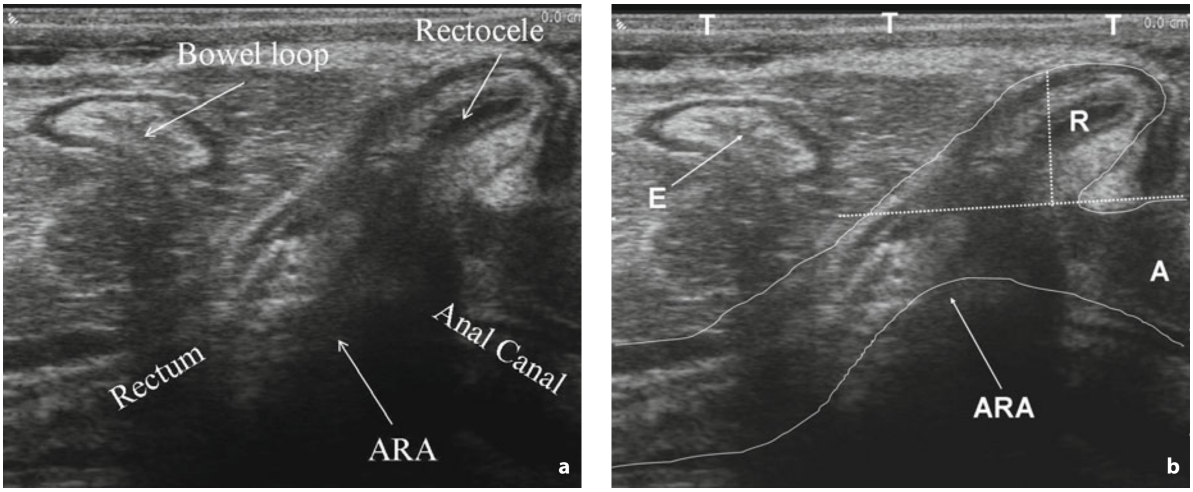


Fig. 37.14 Endovaginal ultrasonography with biplane transducer (*T*). Longitudinal view of the posterior compartment using the linear array of the probe (positioned on the top of the image). **a, b** During Valsalva maneuver, an enterocele (*E*) is demonstrated as a bowel loop entering into the rectovaginal space and a rectocele (*R*) as a bulging of the anterior rectal wall. *A*, anal canal; *ARA*, anorectal angle

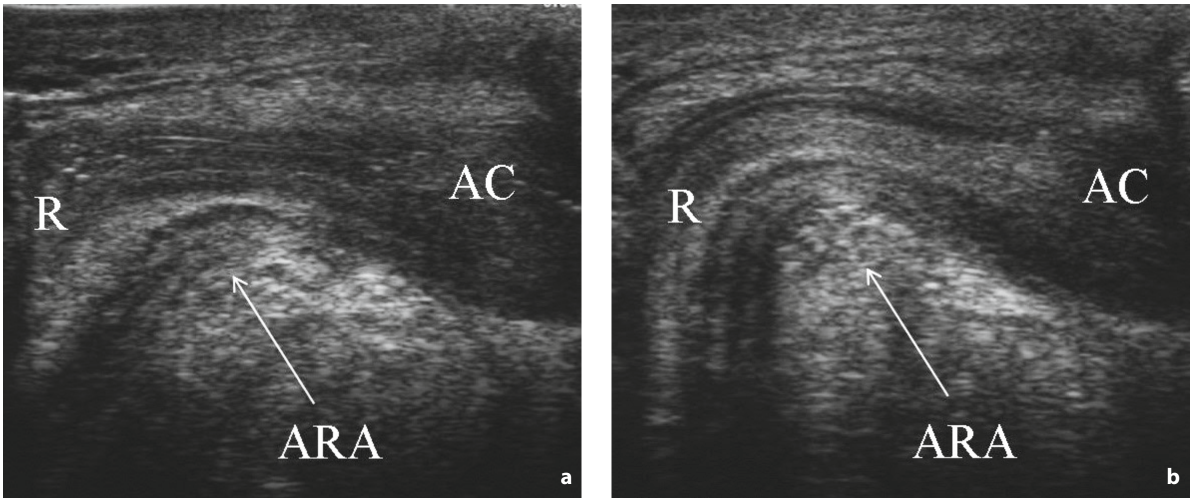


Fig. 37.15 Endovaginal ultrasonography with biplane probe. Longitudinal view of the posterior compartment using the linear array of the probe (positioned on the top of the image). **a** At rest. **b** During Valsalva maneuver, the anorectal angle (*ARA*) becomes narrower due to the contraction of the puborectalis muscle, indicating a pelvic floor dyssynergy. *AC*, anal canal; *R* rectum

MR defecography have an important diagnostic role. Various abnormalities have been described, including prominent puborectal impression and acute anorectal angulation during straining and defecation [32].

Dynamic EVUS with the linear array of the biplane probe may easily document pelvic floor dyssynergy. Images are acquired at rest, and during straining and Valsalva maneuver. The ARA, measured by placing lines through the hypoechoic band representing the posterior IAS and through the posterior wall of the distal rectum, becomes narrower, and the puborectalis muscle becomes thicker during Valsalva maneuver (Fig. 37.15). These findings may guide the treating physician to use biofeedback therapy. Moreover, EVUS can be used to evaluate the results after treatment.

37.9 Uterovaginal Prolapse

Uterovaginal prolapse affects 50% of parous women, with 20% of these being symptomatic. It develops as a consequence of the uterosacral ligaments breaking. The uterus descends into the vagina and can fall outside the vaginal opening (complete uterine prolapse). Vaginal vault prolapse usually refers to an apical vaginal relaxation in a patient who has had a hysterectomy. Continued descent of the apex of the vagina results in complete eversion of the vagina. Dynamic MR defecography as well as TPUS may document these conditions. Endovaginal ultrasound, however, cannot be used in this disorder, as the presence of the probe in the vagina prevents development of the uterovaginal prolapse [13].

37.10 Postoperative Follow-up

Three-dimensional EVUS seems to be a very reliable and useful modality in the postoperative follow-up of prolapse surgery. This modality is particularly needed in cases when the expected correction of anatomy does not result in improve of the function. Post-processing techniques (render mode, multiplanar reconstruction, and tilting) allow precise evaluation of the positioning of meshes or tapes (Fig. 37.16), providing a number of items of information in a patient with complications (see Chapter 60). Dynamic EVUS may also be used to assess the function of these plastic elements to prevent POP during straining or Valsalva maneuver (Fig. 37.17).

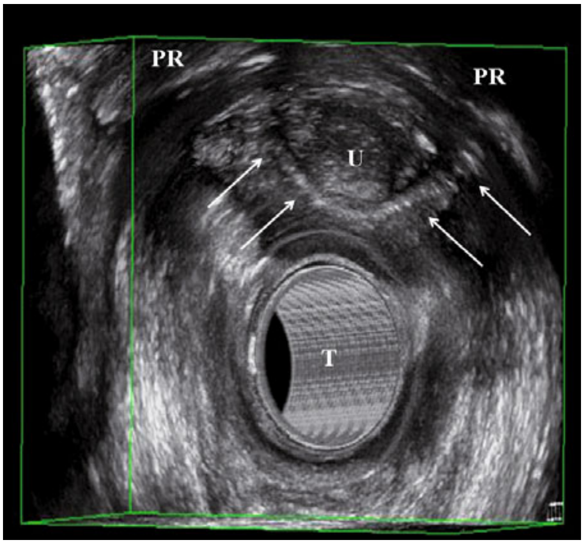


Fig. 37.16 Three-dimensional endovaginal ultrasonography with rotating transducer (*T*). In the axial plane, the transobturator sling (*arrows*) is visualized as a hyperechoic band. *PR*, pubic ramus; *U*, urethra

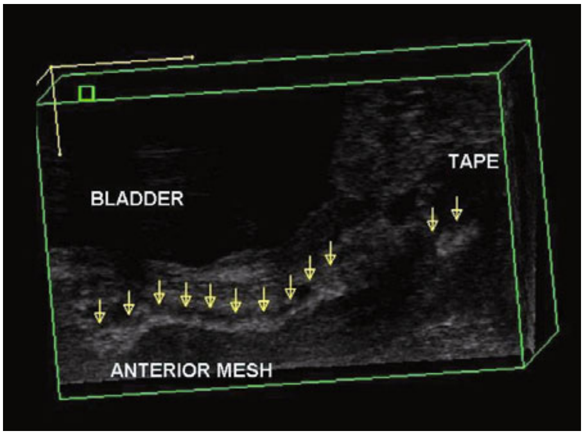


Fig. 37.17 Three-dimensional endovaginal ultrasonography with biplane probe. Longitudinal view of the anterior compartment. Visualization of an anterior mesh and transobturator tape as hyperechoic bands (*arrows*)

37.11 Discussion

Surgical principles of reconstructive surgery are aimed at either restoring anatomy with a presumed restoration of function, or creating compensatory anatomical mechanisms [33]. So far, decision making in relation to operative treatment has been mainly on the basis of clinical assessment, which has a limited role in evaluating the pathomorphologic changes leading to POP.

Assessment of the anatomic alterations and evaluation of the function should both form part of a preoperative workup of the pelvic floor. However, the role of additional diagnostic testing in selecting treatment for primary POP has not been clarified [33]. Pelvic organ prolapse and symptoms of pelvic organ dysfunction are poorly correlated. Constipation, obstructed defecation, urinary and fecal incontinence, and voiding dysfunction are frequently reported in patients with POP, but it remains questionable whether these symptoms are directly related to the degree of anterior or posterior vaginal wall prolapse [34]. In other words, there are no specific symptoms related to the descent in the different compartments. In addition, diagnostic tests bear the risk of overestimating the severity of POP as compared to clinical examination, and also carry the risk of overtreatment. As consequence, no benefit in relation to symptoms can be expected from surgical correction of POP detected with diagnostic testing. Broekhuis et al [35] reported a low agreement between patients' symptoms as assessed with validated questionnaires and findings on dynamic MRI of the pelvic floor. In view of the low correlations, these authors suggested that dynamic

MRI is not likely to have an additional value in the prediction of symptoms. On the other hand, Hetzer et al [36] reported that MR defecography findings led to changes in the surgical approach in 67% of patients, and Kaufman et al [37] showed that dynamic MRI led to altered operative plans in 41% of cases. Groenendijk et al [38] reported that, on average, additional diagnostic tests resulted in a revised initial management plan in 38% of cases. Overall, defecography was regarded as most valuable (assigned diagnostic value 49%) compared with MRI, which was rated the least useful (assigned diagnostic value 20%). However, despite tests, consensus was not reached in one-quarter of cases. An interesting conclusion that can be drawn from this study is that to obtain more relevant information, diagnostic tests should be selected on the basis of specific pelvic floor disorders. The assigned value of defecography increased significantly in cases of posterior vaginal wall prolapse POP-Q stage > 2 (assigned diagnostic value 74% vs. overall value 49%), as well the value of EAUS in cases of fecal incontinence (assigned diagnostic value 68% vs. overall value 38%). The same authors [39] indicated that anorectal function testing (anorectal manometry, surface electromyography, pudendal nerve terminal motor latencies, EAUS) is not useful in the workup of patients with POP and constipation, because it fails to discriminate between symptomatic and asymptomatic patients. Broekhuis et al [11] reported that POP staging with the use of POP-Q, dynamic MRI, and TPUS only correlates in the anterior compartment, whereas correlation in the posterior compartment is poor. This study is in agreement with Dietz et al [40], who found good correlation between TPUS and POP-Q for the anterior and central compartment and poor correlation for the posterior compartment.

In the workup of patients with posterior vaginal wall prolapse, defecography is recommended as a helpful diagnostic tool, as physical examination overestimates the presence of posterior wall defects by mistaking enteroceles for rectoceles (high false-positive rate) but often misses occult defects like enteroceles, rectal prolapse, intussusception, and solitary ulcer syndrome or pelvic floor dyssynergia (high false-negative rate) [34].

Groenendijk et al [41] reported that defecography can be regarded as the best available diagnostic test for evaluation of the anorectum. Harvey et al [42] found that evacuation proctography altered the intended diagnosis and therapy in 18% and 28% of patients, respectively. In contrast, the routine postoperative use of colpocystodefecography is unjustified unless there is clinical evidence of surgical failure [43].

Dynamic ultrasonography (TPUS or EVUS) and 3D high-resolution ultrasonography (3D-TPUS, 3D-EVUS, 3D-EAUS) provide an accurate assessment of POP. The 3D reconstruction allows a spatial assessment of the pelvic floor, which facilitates visualization of the causative lesion of prolapse. However, ultrasonography does not seem to lead to a consequent improvement in prediction of prolapse symptoms as compared to POP-Q system [44].

Despite this, ultrasonography has other significant advantages, such as evaluation of the anatomy (fascia, ligaments, muscles) as well as of the function (at rest, during contraction, weak straining, and forceful straining) of the pelvic floor. Ultrasonographic techniques are able to define the presence and grade of cystocele, rectocele, and enterocele, and to detect levator trauma and connective tissue damage. More research will be needed to define the role of these modalities in the workup of POP and to classify morphologic subtypes of prolapse. The ultrasound findings of specific muscle or connective tissue damage may, in the future, affect surgical decision making.

37.12 Conclusions

The treatment decision in patients undergoing POP surgery is still based on history taking and pelvic examination. The routine use of a "battery" of diagnostic testing appears not to be an option. In view of the high correlations, imaging is not likely to have an additional value for the anterior compartment, and POP-Q can be regarded as the gold standard of POP staging in the anterior compartment. In assessment of the central and posterior compartments, clinical examination alone has not been proven adequate, and additional tests are needed. However, at this stage, the available evidence does not provide proof for the superiority of any one of the various imaging techniques. An optimal compromise could be to perform a multicompartmental ultrasonography of the pelvic floor (dynamic TPUS/EVUS and high-resolution 3D-ultrasonography) as the initial diagnostic test in all patients with POP. On the basis of ultrasonographic findings, additional tests may be further performed in selected cases, to direct therapy.

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