Native Tissue Repair for Incontinence and Prolapse

Philippe E. Zimmern
Elise J.B. De *Editors*

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Editors
Philippe E. Zimmern
Department of Urology
UT Southwestern Medical Center
Dallas, Texas
USA

Elise J.B. De
Division of Urology
Albany Medical Center
Albany, New York
USA

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Preface

This book began as a lobby conversation in the wake of FDA warnings regarding vaginal mesh, at the American Urological Association (AUA) 2012 meeting headquarters hotel. We realized we had an entire generation of surgeons dependent – to one extent or another – on mesh-augmented techniques. Initially we developed a video course aiming to display the catalogue (armamentarium) of native tissue techniques available in vaginal surgery and taught this for 3 years. Through exploring even our own differences (see the difference between the two techniques demonstrated in the videos for Kelly-Kennedy plication in Chap. 6), we realized the subject matter was gaining more and more interest and relevance.

Conveying technique in native tissue repair for incontinence and/or pelvic organ prolapse during vaginal surgery brought forth important historic concepts regarding structural support and repair. It also highlighted the inherent flaws in reporting of data, the anecdotal nature of why surgeons do things the way they do as well as the variability that each particular training program introduces to a technique.

Every new undertaking teaches in ways unanticipated. At a certain point in one's career speaking at meetings becomes, to some extent, regurgitation of knowledge one already possesses. The joys of synthesizing this book with the contributing faculty have helped us appreciate further the depth, heterogeneity, versatility, and nuance of techniques in our field.

An example is the type of suture material used. This is a fundamental element of all of our surgeries, but rarely studied. A recent publication [1] compared outcomes in slowly absorbable suture versus rapidly absorbing suture for anterior and posterior colporrhaphy. Comparing rapidly absorbing (Vicryl®, Dexon®, Polysorb®) to slowly absorbing sutures (PDS®, Maxon®) showed a 1.6 times higher likelihood (odds ratio 1.6, CI 1.1–2.3; $p = 0.01$) of recurrence of anterior wall prolapse in the rapidly absorbing group. This is especially important information when one evaluates the literature comparing the recurrence rates in mesh-augmented repairs versus native tissue repairs. What technique was used for the native tissue repair? What suture material was employed? Was the repair a central plication alone, or was a lateral paravaginal repair (Chap. 7) included, and was an apical support added as well?

Examples of the heterogeneity in technique can be extended to perioperative care, for example postoperative activity restrictions. One of the editors has advised patients to avoid riding in a car postoperatively, based on the experience in individual patients who suffered impact of a motor vehicle accident in the postoperative period from prolapse repair, with subsequent recurrence. This instruction was not echoed among the other authors. In fact, one contributor challenges any restrictions, citing a study [2] that demonstrated there is no difference in intra-abdominal pressure between the exertion of getting out of a chair and performing abdominal crunches.

The indispensability of perioperative vaginal estrogens, timing and duration of antibiotics, importance of urine culture, use of vaginal packing, and the type of intravenous dye all vary depending on the author. If the postvoid residual is high postoperatively, does one offer a Foley catheter or clean intermittent catheterization, or consider a suprapubic tube from the start?

Atul Gawade wrote on the concept of “Surgical Coaching” in which an experienced surgeon surpasses his or her plateau through input from an experienced colleague, just as professional athletes continue to benefit from coaching throughout a career [3]. We concluded our project with a visiting professorship together and did just this.

The perspectives above demonstrate that the more we are aware of one another’s technique and practices, the more we can understand the reasons – or lack thereof – for our own. Whether the reader is a recent graduate or reflecting on a long career, one should always be open to putting tools in the toolbox, challenging assumptions, and evaluating what treatments we have to offer our patients. For this reason, this book and its associated videos will be of great value to vaginal reconstructive surgeons at all levels of practice.

The information relayed in these chapters – from the anatomy to the instrumentation to the various surgical techniques all the way to the re-do surgery after mesh removal and ways to evaluate our outcomes – offers a level of creativity and experience valuable to us all. Brief literature reviews help the reader understand the data behind the recommendations. We especially hope the videos will allow the reader/viewer to appreciate the techniques directly as one reads along.

This volume is only a beginning…the field of vaginal native tissue repair for the FPMRS reconstructive surgeon is growing as more evidence-based data is being accrued. We hope this comprehensive effort provides a big step in the right direction!

Dallas, TX, USA Philippe Zimmern, MD
Albany, NY, USA Elise J.B. De, MD

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Chapter 1
Surgical Anatomy for the Reconstructive Surgeon

Alexandra Rehfuss, Nucelio Lemos, and Elise J.B. De

Abstract Pelvic floor anatomy is based on a complex, dynamic interplay of organs and their support structures. The surgeon's goal is to restore normal vaginal support while preserving its size, depth, axis and elastic properties, aiming to rehabilitate urinary, anorectal and sexual functions. In order to accomplish this, the surgeon needs a working understanding of the anatomy and structural supports for an anatomic repair.

Keywords Pelvic anatomy • Incontinence • Prolapse • Pelvic floor surgery • Pelvic neuroanatomy

Physical Examination

The pelvic exam is performed with a speculum, split speculum, ruler, and/or hand in order to evaluate for prolapse in the anterior (central and lateral), posterior, and apical compartments, urethral hypermobility or palpable periurethral cysts/diverticuli, iatrogenic material, pelvic floor muscle function, tissue quality, and to identify any pain or lesions. It should be repeated in a sitting or standing position to allow maximal eversion if poor effort is suspected (e.g. weak Valsalva) or if the patient reports greater prolapse than demonstrated in the supine exam.

A. Rehfuss, MD
Resident, Division of Urology, Albany Medical Center, Albany, NY, USA

Nucelio Lemos, MD, PhD
Head of the Pelvic Neurodysfunctions Clinic, Department of Gynecology, Federal University of São Paulo, São Paulo, Brazil

E.J.B. De, MD (✉)
Associate Professor Urology, Division of Urology, MC 208, Albany Medical Center, 23 Hackett Boulevard, Albany, NY 12208, USA
e-mail: elisede@gmail.com

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Image 1.1 Prolapse identified on the dependent examination (Photo Elise J.B. De)

The dependent exam can be essential to extrude the prolapse (Image 1.1) and the seated position during urodynamics routinely allows an additional opportunity to clarify the anatomy. An additional exam under anesthesia is performed at the time of prolapse repair in order to be sure of the anatomical defects under applied traction.

Prolapse staging on physical examination has been reported according to a few staging systems. The most common in clinical practice is the Baden-Walker Halfway system (Fig. 1.1) [1]. The Baden Walker system consists of four grades reported with respect to the compartment in question: Grade 0 (no prolapse), Grade 1 (halfway to the hymenal remnant), Grade 2 (at the hymen), Grade 3 (halfway past the hymen) and Grade 4 (maximum descent). More recently, the Pelvic Organ Prolapse Quantification system (POP-Q) was described to provide a more objective and reproducible staging system (Fig. 1.2) [2]. This system allows for more consistent reporting in research. The POP-Q measures six points relative to the hymen *during maximal Valsalva maneuver* (Aa, Ba, C, D, Ap, Bp) as well as total vaginal length (TVL), perineal body (PB), and the genital hiatus (GH) *which are measured supine at rest*. The stage reports

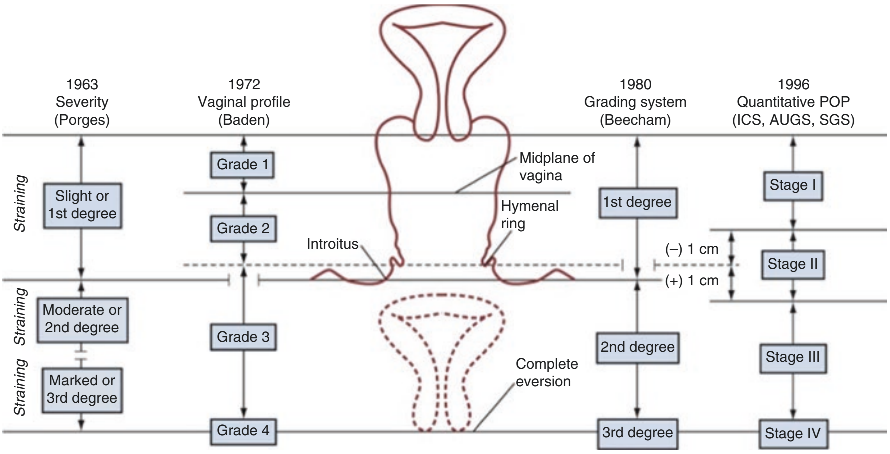


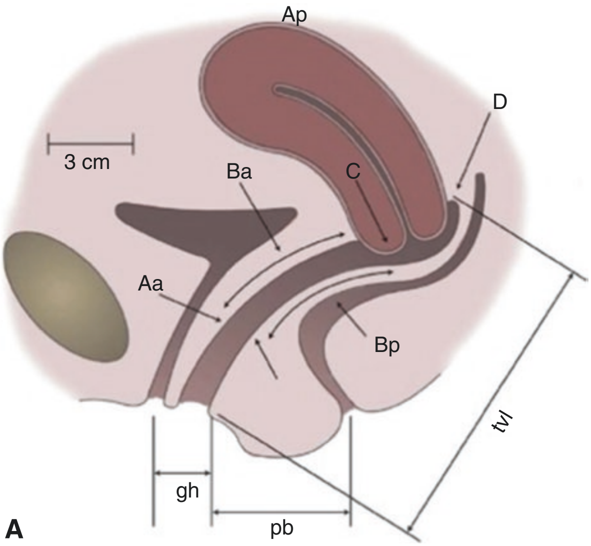
Fig. 1.1 Visual comparison of systems used to quantify pelvic organ prolapse (POP) (Image 1 in: Theofrastous and Swift [1])

the most severe portion of prolapse. All points above the hymen are negative, the hymen is zero, and those beyond the hymen are positive. For Stage 1, the most distal aspect of the prolapse is more than 1 cm above the hymen (<−1). Stage II, the most distal point is within 1 cm of the hymen (−1 to 1). Stage III is more than 1 cm beyond the hymen (>+1) and Stage IV involves complete eversion.

An enterocele can be visible or palpable but often it is not confidently identified until the surgical procedure (Image 1.2). Some clinicians employ magnetic resonance imaging (MRI) to aid in the assessment of prolapse, particularly enterocele. Dynamic MRI with straining effort does not show the apical and posterior compartment defects as well as magnetic resonance defecography. Preoperative MRI is not the practice of the authors. Confounders that will impact surgical planning include ulceration (Image 1.3a). Severe ulceration can put the untreated patient at risk for bowel evisceration if neglected (Image 1.3b). A foreshortened vagina will limit the vaginal reconstructive options (Image 1.4). It is also important to recognize rectal mucosal prolapse, which the patient can mistake as a vaginal bulge when reporting her intake history (Image 1.5).

Supports

Supports within the pelvis include bones, muscles, and viscerofascial layers. The “fascias” are in fact condensations of areolar tissue, and the “ligaments” condensations of fibrous tissue, collagen, muscle and nerves.



A

Point	Description	Range of values
Aa	Anterior vaginal wall 3 cm proximal to the hymen	–3 cm to +3cm
Ba	Most distal position of remaining upper anterior vaginal wall	–3 cm to +tvl
C	Most distal edge of cervix or vaginal cuff scar	–
D	Posterior fornix (N/A if posthysterectomy)	–
Ap	Posterior vaginal wall 3 cm proximal to the hymen	–3 cm to +3 cm
Bp	Most distal position of remaining upper posterior vaginal wall	–3 cm to +tvl
gh (genital hiatus)	Measured from middle of external urethral meatus to posterior midline hymen	–
pg (perineal body)	Measured from posterior margin of gh to middle of anal opening	–
tvl (total vaginal length)	Depth of vagina when point D or C is reduced to normal position	–

B

Fig. 1.2 Pelvic organ prolapse quantification system (Figure 1 in: Bump et al. [2])

Bony Pelvic Anatomy

The anatomy of the pelvis starts with the bony pelvis. Important structures relevant to pelvic reconstruction include the pubic symphysis, obturator foramen, sacral promontory, ischiopubic rami and the ischial spines (Image 1.6). Special attention should be given to the relationship of the obturator vessels and nerves to the obturator foramen, the pudendal nerves and vessels to the ischial spine, the sacral nerve roots to the piriformis muscle and the internal iliac vessels, and the anterior longitudinal ligament to the sacral promontory.

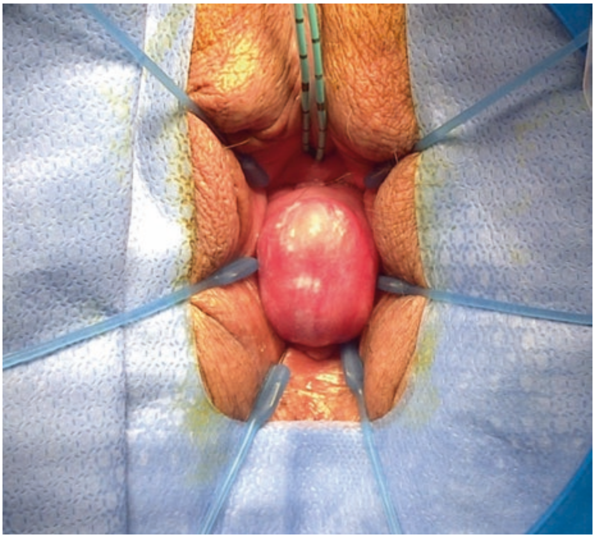


Image 1.2 Enterocele visible on exam (Photo Elise J.B. De)

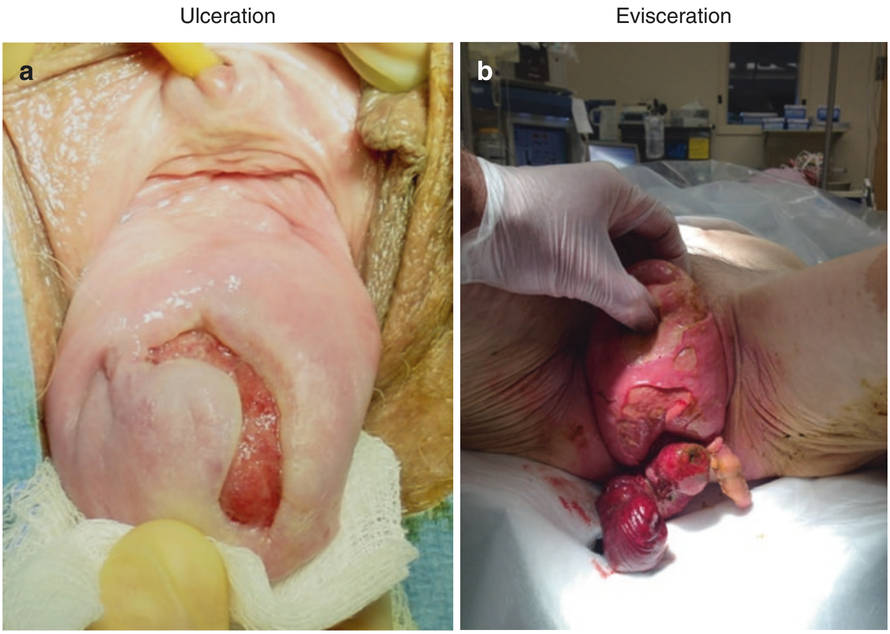


Image 1.3 (**a**, **b**) Ulceration and, in the worst case scenario, evisceration (Courtesy of O. Lenaine Westney, M.D. and Brian Murray, M.D.)

Image 1.4 Foreshortened vagina (Courtesy O. Lenaine Westney MD)

Image 1.5 Rectal mucosal prolapse (Courtesy Elise J.B. De, M.D.)

Rectal Mucosal Prolapse

Muscles of the Pelvic Floor

The superficial muscular layer of the female perineum includes the ischiocavernosus muscle, the superficial transverse perineal muscle, the external anal sphincter and the bulbocavernosus muscle (Image 1.7) [3]. The convergence of the superficial

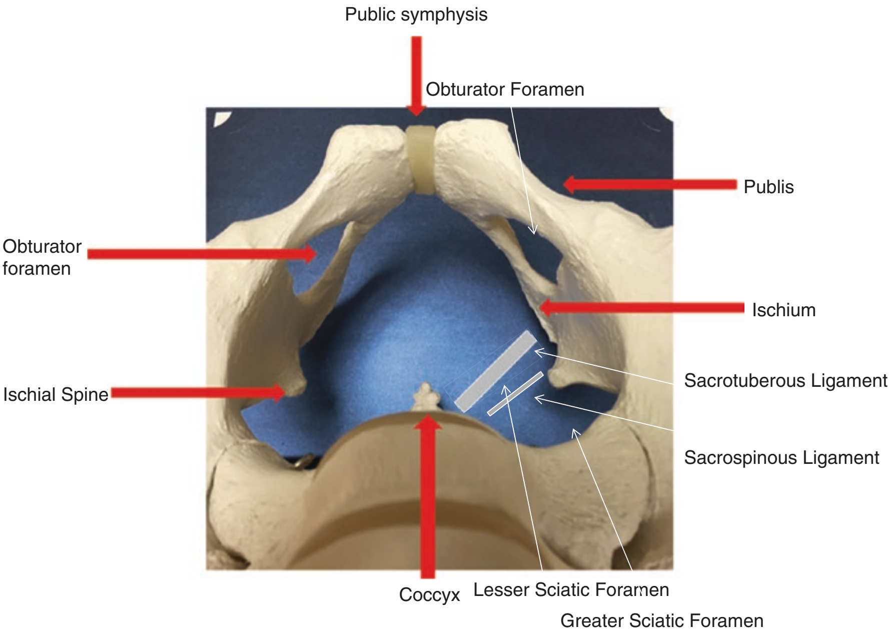


Image 1.6 Anatomy of the bony pelvis (Courtesy Alexandra Rehfuss, M.D.)

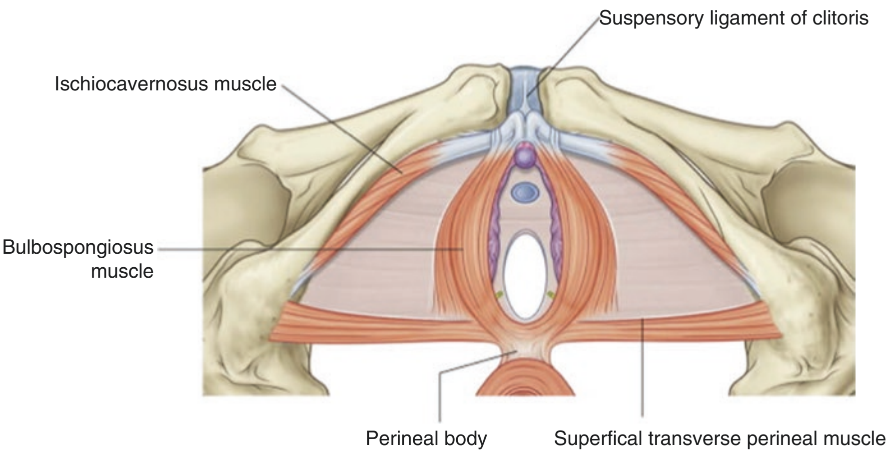


Image 1.7 Muscles in the superficial perineal pouch in women (Fig. 5.71 in Drake et al. [12])

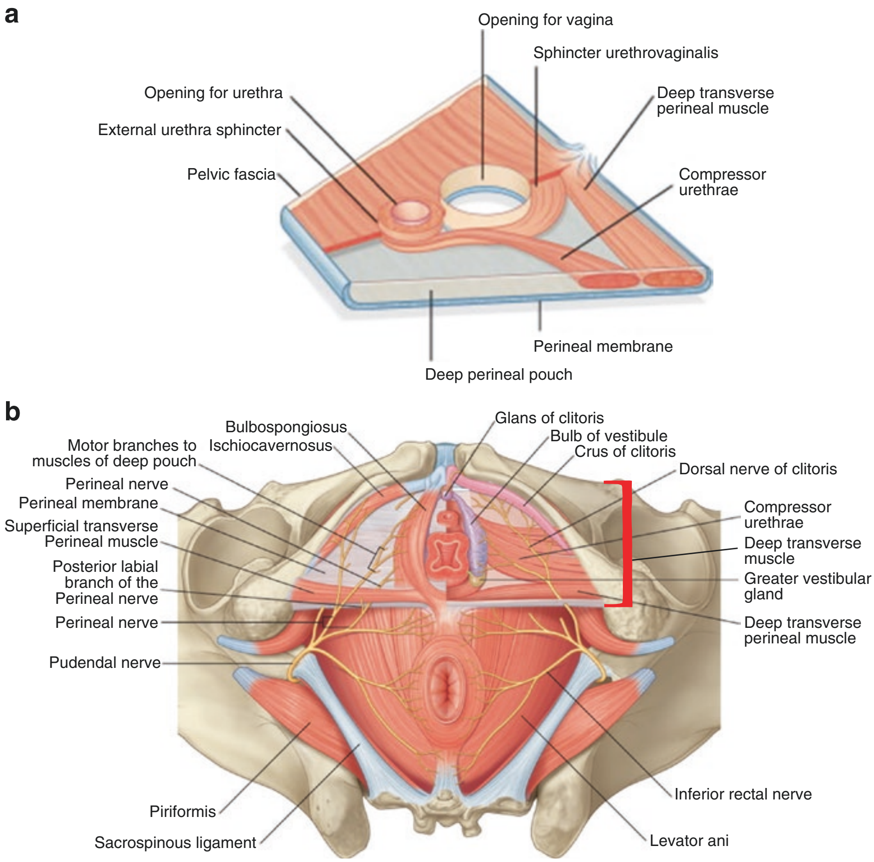


Image 1.8 (**a**) Muscles of deep perineal pouch in women (Image 259 in Drake et al. [4]). (**b**) Nerves of the perineum in women (perineal membrane removed on left side to expose deep perineal pouch; inferior view) (Image 267 in Drake et al. [5])

transverse perineal muscle, external anal sphincter and bulbocavernosus muscle forms the base of the perineal body, which is a cone-shaped structure the apex of which continues with the rectovaginal fascia.

The next deepest muscular layer of the pelvic floor includes the deep transverse muscle of the pelvis, the urethrovaginal sphincter, the compressor urethrae muscles and the external urethral sphincter (Image 1.8) [4–7].

The deepest muscular layer of the female pelvic floor is the pelvic diaphragm. It forms a support layer among the pubis, coccyx, and arcus tendineus levator ani to provide support to the urethra, vagina and rectum. The pelvic diaphragm is made up of (1) the coccygeus muscle and (2) the levator ani: the puborectalis, pubococcygeus or pubovisceral and iliococcygeus muscles (Image 1.9) [8].

The coccygeus (also termed the ischiococcygeus) muscle attaches medially to the lateral margins of the coccyx and the levator plate and laterally to the ischial spine (Image 1.9) [8]. The puborectalis muscles arise from the posterior pubic symphysis/rami and form a sling around the vagina, rectum, and the apex of the perineal

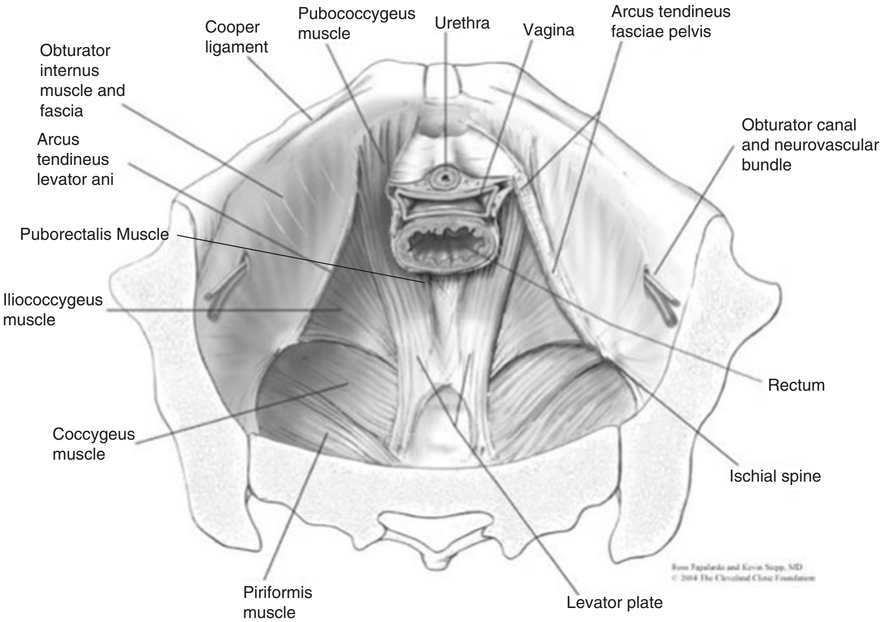


Image 1.9 Pelvic diaphragm. The pelvic diaphragm is made up of (1) the coccygeus muscle and (2) the levator ani: the puborectalis (added to original image), pubococcygeus (or pubovisceral) and iliococcygeus muscles. Additional structures to note: arcus tendineus fascia pelvis, arcus tendineus levator ani, obturator internus muscle, piriformis muscle, ischial spine, obturator canal (not to be confused with Alcock's) (Figure 2.2 in Walters and Karram [8])

body, determining the pelvic hiatus. The pubococcygeus (or pubovisceralis) muscles originate from the posterior aspect of the pubic bones and form four groups of fibers: the pubovaginal muscle, urethral hammock (pubourethral and urethropelvic) ligaments; the puboperineal muscle that inserts on the apex of the perineal body; the puboanalis muscle that inserts in between the internal and external anal sphincters; and the pubococcygeus fibers that form the levator plate. The iliococcygeus muscle arises from the arcus tendineus levator ani and inserts on the coccyx posteriorly as well as the levator plate. The boundaries of the pubrectalis, pubococcygeus and iliococcygeus muscles are difficult to delineate but all work to provide pelvic floor support. These four muscles fuse in the midline to form the levator plate, which attaches posteriorly to the coccyx.

The muscles of the pelvic sidewalls are the piriformis and obturator internus (Images 1.8b and 1.9). The obturator internus, which essentially lies over the obturator foramen, arises from the obturator membrane, ischium, and rim of the pubis. It passes through the lesser sciatic foramen and inserts on the greater trochanter. Its anteromedial fascia forms the arcus tendineus fascia pelvis (the lateral attachment of the pubocervical fascia) and the arcus tendineus levator ani – this being the origin of the iliococcygeus muscle. In the pelvis, the posteromedial surface of the obturator internus forms the lateral wall of the ischioanal fossa and forms the sheath that surrounds the internal pudendal nerve and vessels (Alcock's canal). The piriformis is located dorsal and lateral to the coccygeus muscle. The piriformis arises from the anterior surface of the

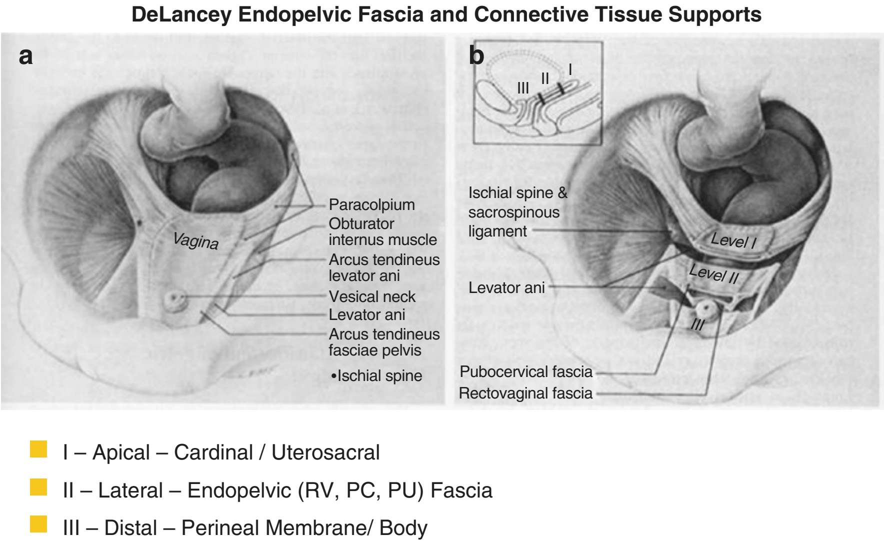


Image 1.10 Endopelvic fascia and connective tissue supports (Figure 2 in DeLancey [9])

sacrum and from the gluteal surface of the ilium near the posterior inferior iliac spine. It passes out of the pelvis through the greater sciatic foramen and inserts on the greater trochanter. In the pelvis, the anterior surface of the piriformis is in contact with the rectum, sacral nerve plexus and branches of the internal iliac vessels.

Viscerofascial Layers and Ligaments

The endopelvic fascia is formed by fibrous and elastic tissue, collagen, and proteoglycans, in association with muscles and nerves and is responsible for the suspension of all pelvic viscerae, receiving different names according to its morphofunctional characteristics: the cardinal-uterosacral complex, the pubocervical fascia, the rectovaginal fascia and the urethropelvic ligament. The arcus tendineus fascia pelvis (ATFP), (Images 1.9 [8], 1.10 [9] and 1.15 [14]) runs from the pubic symphysis to the ischial spine and represents the insertion of the pubocervical fascia on the obturator internus muscle fascia. It supports the bladder and vagina laterally, forming the anterolateral vaginal sulcus. Detachment of the bladder from this support is seen in a lateral cystocele, appreciable by palpation of the descending sulcus during Valsalva on exam. It is important to note the position of the ischial spine in relation to the ATFP. The ATFP is used by some as an anchoring stitch for the Kelly-Kennedy plication, it provides the lateral support in a vaginal paravaginal repair, and is also the site of graft attachment in many non-native tissue repairs. See below regarding the three levels of support characterized by DeLancey. The ATFP is considered "Level II".

The commonly called uterosacral and cardinal ligaments are ligament-like structures formed by a condensation of the hypogastric fascia that suspends the pericervical

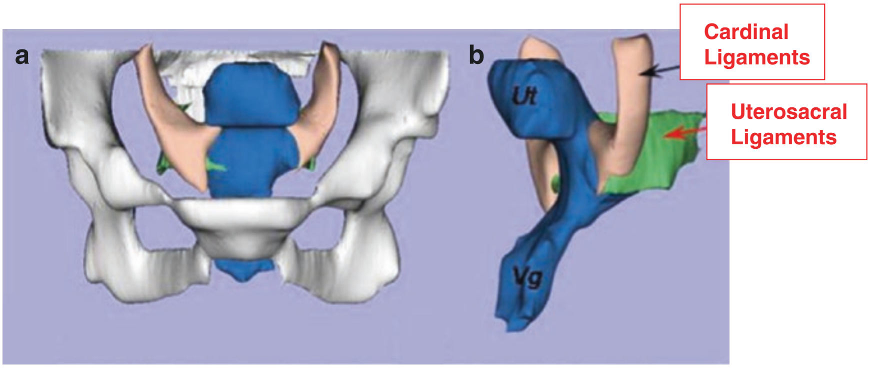


Image 1.11 MR reconstruction: the "Cardinal Ligament" fibers are positioned in a cranial to caudal direction and the "Uterosacral Ligament" fibers are positioned in a ventral to dorsal direction (Figure 2a and b in Ramanah et al. [10])

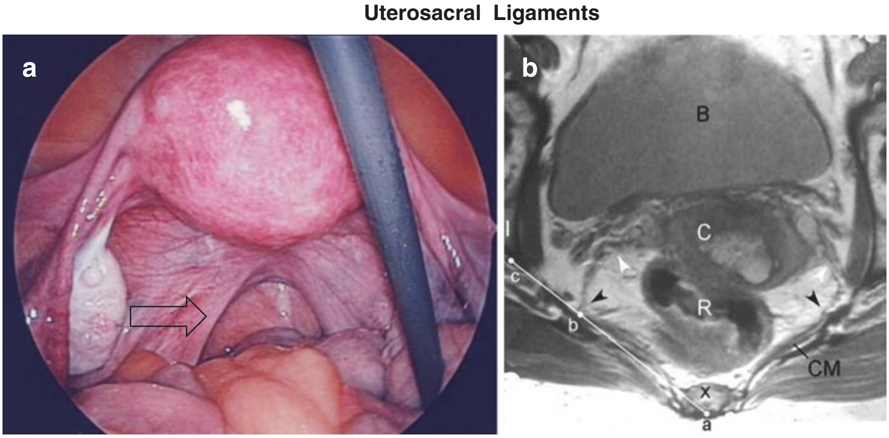


Image 1.12 (**a**) Photo: Transparent arrow indicates the uterosacral ligament complex (Photo Courtesy Peter Cole, M.D.) (**b**) MRI of uterosacral ligament insertion: The origin of the uterosacral ligaments from the cervix (*white arrowheads*) and their insertions (*black arrowheads*) on the pelvic sidewall. The location of the insertion point (*b*) on a line (*ac*) between the body midline and the ischium (*I*). The location of the bladder (*B*), cervix (*C*), rectum (*R*), coccyx (*X*), and coccygeus muscle (*CM*) are shown (Image 1 in Umek et al. [11])

ring and/or upper part of the vagina (paracolpium). Based on an anatomical magnetic resonance imaging study of 20 patients, the fibers of the portion of this fascial condensation that is called the cardinal ligament are positioned in a cranial to caudal direction and originate at the pelvic sidewall at the upper margin of the greater sciatic foramen in the majority of cases (Image 1.11) [10]. The uterosacral ligament (USL) fibers are oriented in a ventral to dorsal direction, arise from the anterior sacral aspect at the level of the greater sciatic foramen medial to the sacral foramina, and contain fibrous tissue and smooth muscle (Image 1.12) [11]. Together, these are called the cardinal-uterosacral ligament complex and, when dissected, they are

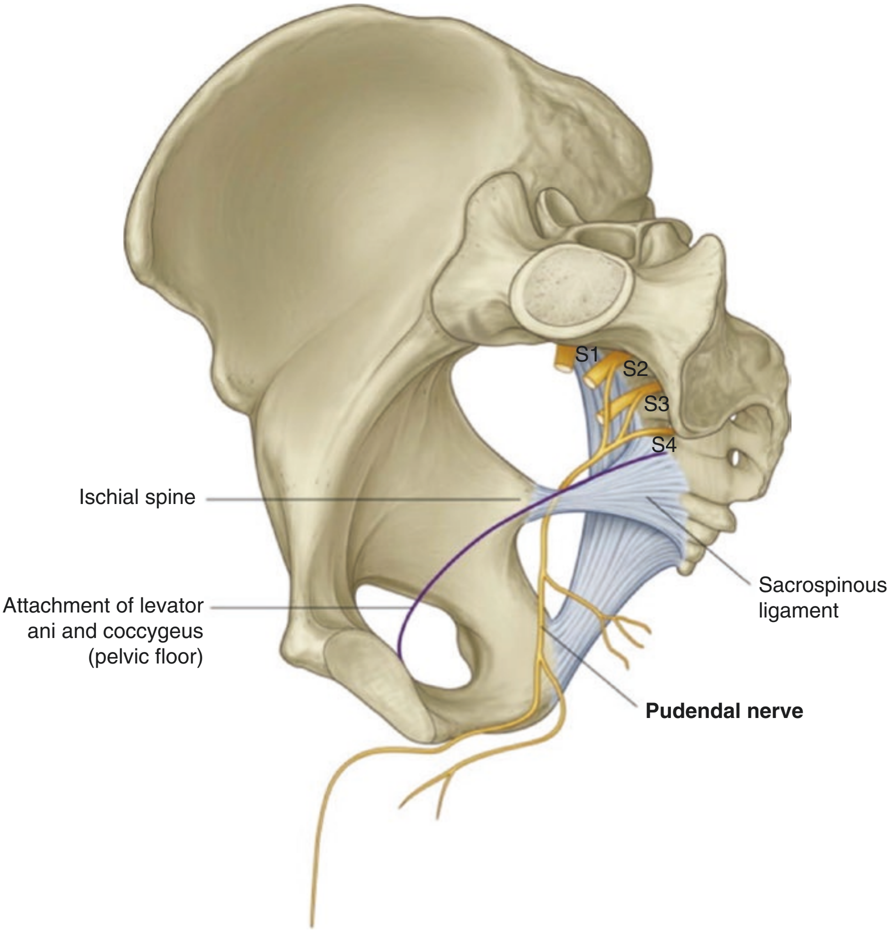


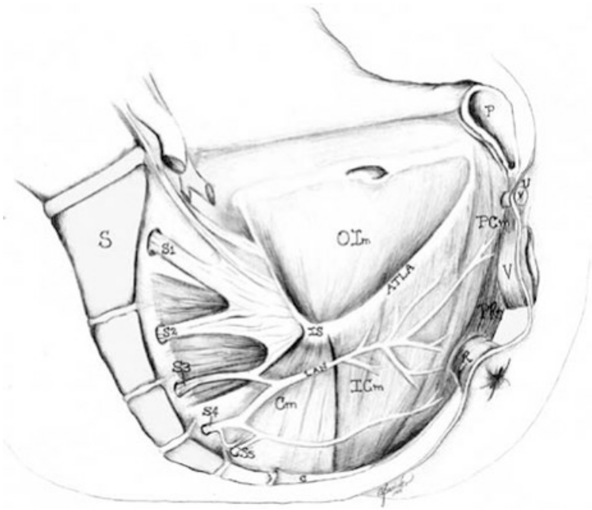
Image 1.13 Sacrospinous ligament and relationship to pudendal nerve (Figure 5.15 in Drake et al. [12])

revealed as more of a condensation or fold than an actual structure. Nevertheless, when placed on traction there is usually a substantial structure to palpate, visualize and suture (see below regarding avoidance of nerve injury).

The sacrospinous ligament connects the ischial spine and the sacrum (Image 1.13) [12]. The internal pudendal artery and nerve run posterior to the sacrospinous ligament, close to the spine, and the nerve to the levator ani muscle runs anterior to its medial third (Image 1.14) [13].

In 1992, DeLancey described three levels of support created by the endopelvic fascia and connective tissue (Image 1.10). Level I support (apical-uterus and post-hysterectomy vaginal apex) includes the cardinal-uterosacral complex. Loss of level I support results in apical prolapse. Level II support consists of the

Image 1.14 Nerve of the levator ani (Figure 4 in Barber et al. [13])



pubocervical fascia and its attachment to the ATFP and the rectovaginal fascia and its attachment to the iliococcygeus muscle. Loss of level II support can result in anterior wall prolapse, which can be due to a transverse detachment (detachment of the pubocervical fascia from the pericervical ring), a lateral defect (detachment from the ATFP), or a central defect. Disruption of the rectovaginal fascia is also a level II loss of support and will result in a proximal (fascial detachment from the pericervical ring) or distal (detachment for the perineal body apex) rectocele. Level III support (distal urethra and distal vagina) includes the perineal membrane and perineal body. Loss of level III support results in urethral hypermobility and perineal body disruption [7].

DeLancey theory on stress urinary incontinence is depicted in a lateral drawing expanding on these relationships (Image 1.15) [14]. In this drawing, one can appreciate the importance of the ATFP providing lateral support to the vagina and urethra. The support of the urethra is contiguous with the anterior vaginal wall and is bridged by the endopelvic fascia fusing into the ATFP. The detrusor fibers tunnel laterally into the bladder neck providing constant tone. The circumferential striated sphincter fibers of the external urethral sphincter provide compression primarily in the middle third of the urethra. Stress urinary incontinence will result from poor urethral coaptation, compression or support. Pliability can be reduced by radiation, pelvic surgery or poor estrogenization. Tone can be impacted by hypermobility, pelvic surgery, radiation and neurologic conditions. The surgical approach will only address the anatomic factors. The anatomic lateral supports are seen in vivo in the MR image and the photo (Image 1.16a), in which one can appreciate the continuity of support of the urethra with the anterior vaginal wall (Image 1.15 and 1.16c).

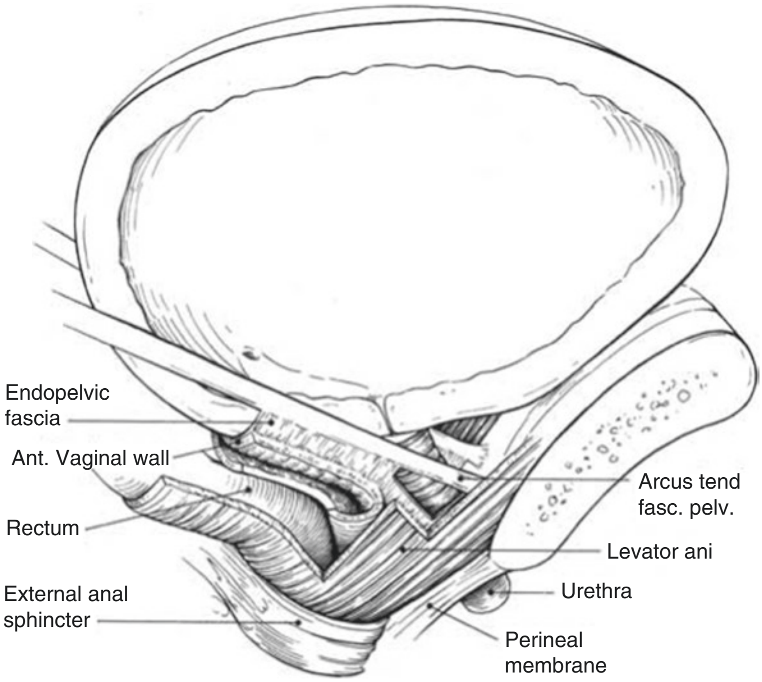


Image 1.15 Relationship of urethra to lateral supports (Figure 1 in Ashton-Miller and DeLancey [14])

Compartments

Anterior compartment prolapse (cystocele) involves four defects (Image 1.16a–e) [15]. Weakness can occur centrally (Image 1.16c), laterally (Image 1.16d), proximally (cuff, transverse, Image 1.16e) and distally (urethral level, Image 1.16a). On physical exam, an isolated central defect is associated with loss of central rugation and preservation of the lateral sulci. A lateral defect is associated with detachment of the vagina from the ATFP and is appreciable as mobility of the lateral sulcus with Valsalva. Apical or transverse defects involve loss of integrity of the pubocervical fascia at the level of the vaginal vault or juxta-cervical. A distal defect (urethrocele) occurs primarily in conjunction with a cystocele and involves loss of lateral support as a continuum with the bladder (Image 1.16a). Surgical approaches include plication of a central bulge (Image 1.17) and reconfiguring lateral support (Image 1.18) [16, 17], (Image 1.19) [18] based on the anatomy at hand.

Prolapse of the posterior compartment (rectocele) can involve four defects. A weak rectovaginal fascia (Image 1.20), a widened levator hiatus (Image 1.21), open perineal membrane (Image 1.22) [19], and descent of the levator plate (Image 1.23). A weak rectovaginal (pre-rectal fascia) is most amenable to a site-specific defect repair (Image 1.24) or plication (Image 1.25). Widening of the levator hiatus reduces the overall support to the posterior wall and can also impact sexual function. Opening of the perineal membrane furthers this loss of support. Both need to be

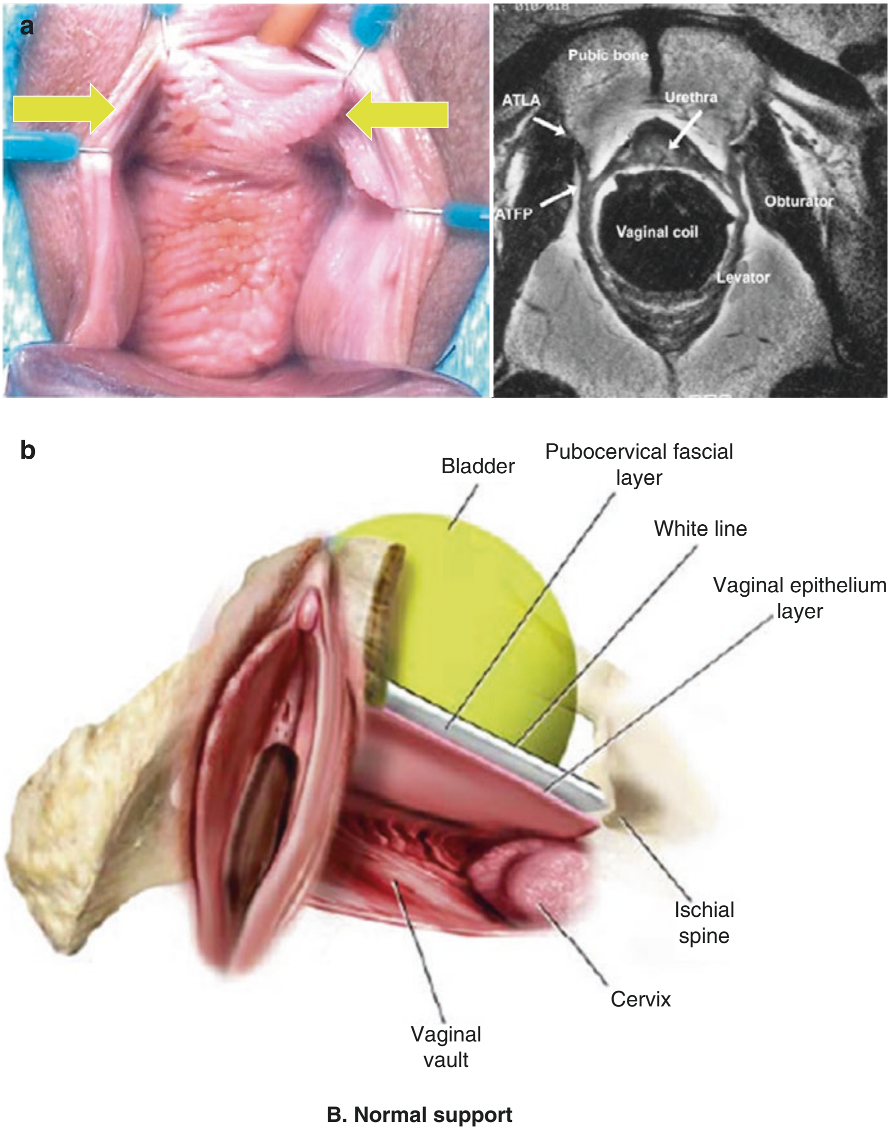


Image 1.16 (**a**) Distal defect of anterior support involving the urethra and proximal lateral vaginal support (Courtesy Philippe Zimmern, M.D.) MR Image showing the lateral attachments of the urethra (normal support). (Courtesy Shlomo Raz M.D.) (**b**) Lateral view of normal anterior vaginal wall support with bladder support extending back to the level of the ischial spines. Note normal midline and lateral support (Figure 54-1A in Karram [15]) (**c**) Lateral view of a midline defect. Note the bulging of the bladder into the midportion of the vagina with maintenance of lateral support. Thus the anterior vaginal fornix is maintained on each side (Figure 54-1C in Karram [15]). (**d**) Lateral view of bilateral paravaginal defects. Note the complete detachment of the white line from its normal attachment, resulting in complete loss of the anterolateral supports of the anterior segment. Figure 54-1E in Karram [15]) (**e**) Lateral view of a transverse defect. Note that the bladder prolapse is between the normal upward attachment and the cervix or vaginal apex, usually resulting in what is termed a high cystocele (Figure 54-1G in Karram [15]). (**f**) Note that the bladder descends around the normal upper attachment of the fascia or the muscular lining of the vagina (Figure 54-1H in Karram [15])

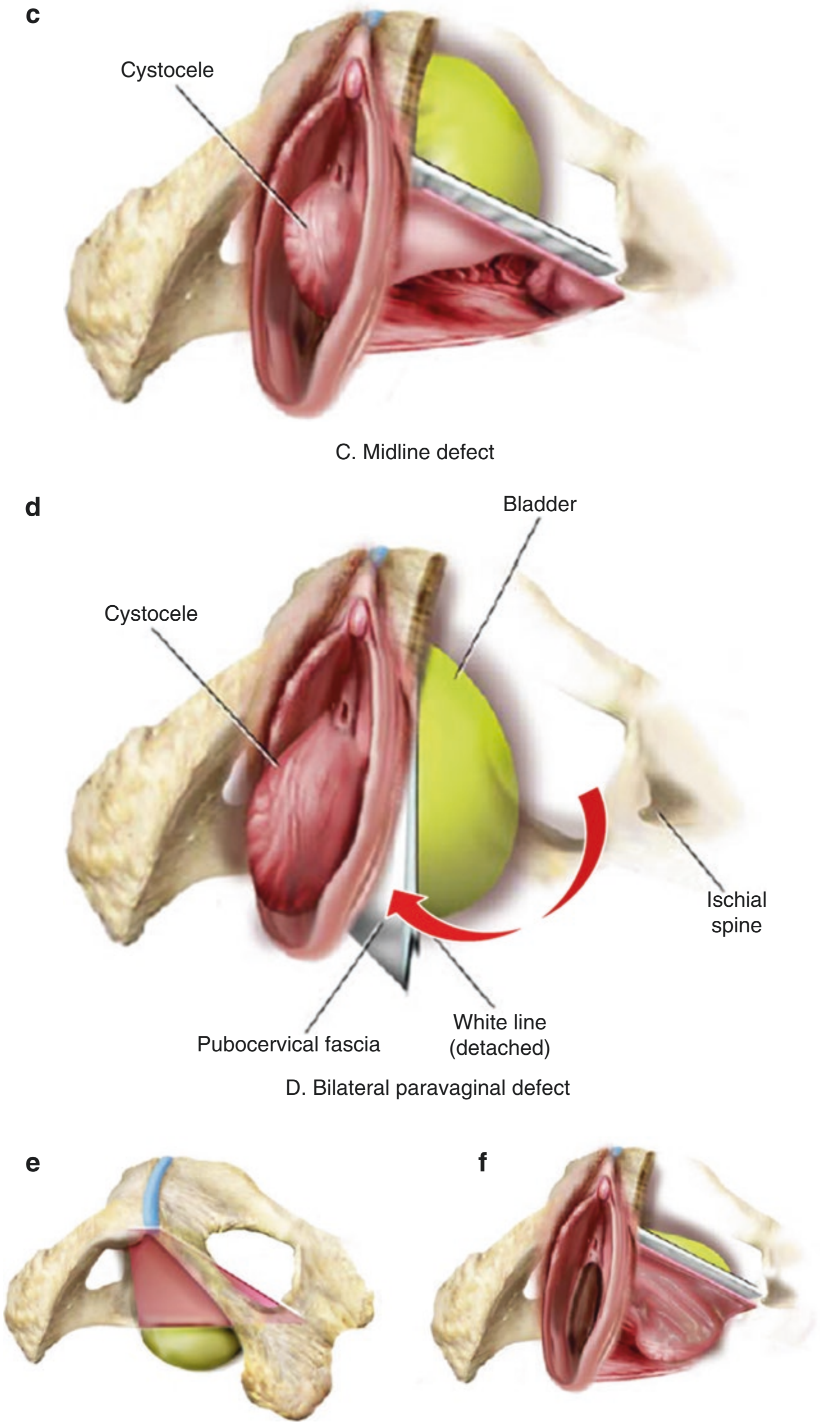
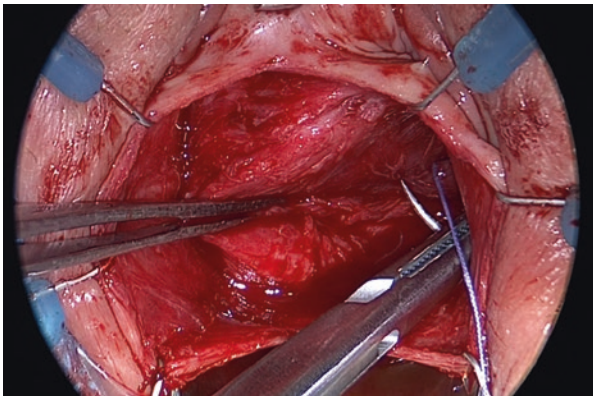


Image 1.16 (continued)

Image 1.17 Kelly Kennedy Plication – Midline plication of the pubocervical fascia in order to address a central anatomical defect (Photo courtesy Elise J.B. De M.D.)



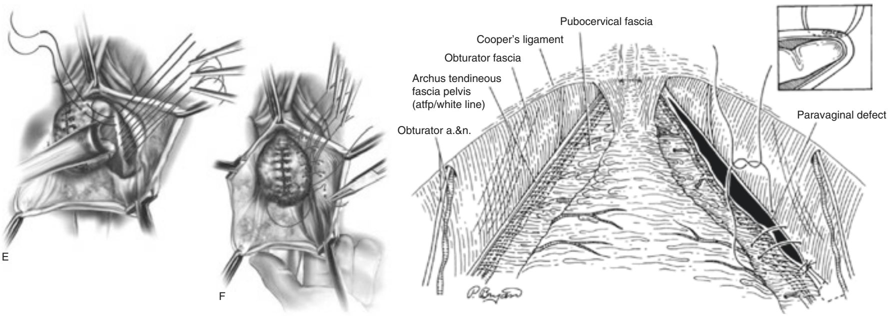


Image 1.18 Paravaginal repair. Vaginal and abdominal approaches. Reattachment of the pubocervical fascia to the arcus tendineus fascia pelvis [16, 17]

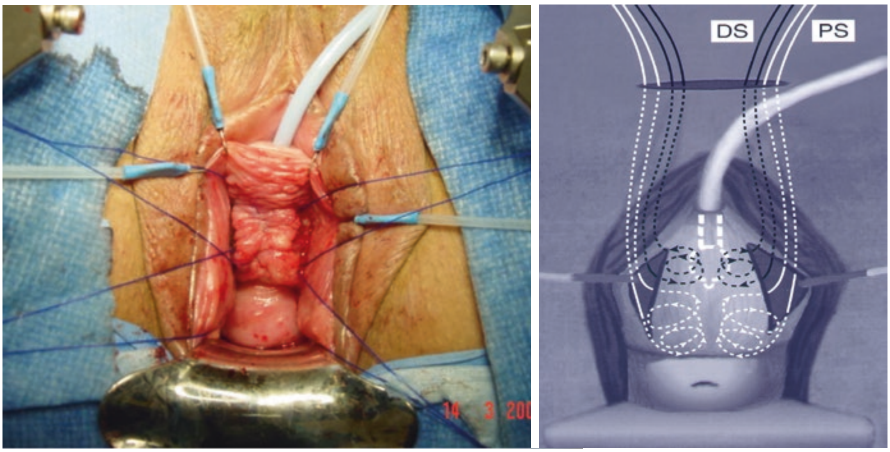


Image 1.19 Anterior vaginal wall suspension allows for support of the entire anterior vaginal wall plate to the anterior abdominal wall using helical sutures and a tension-free approach (Photo and Diagram Courtesy Philippe Zimmern M.D.)

Image 1.20 Weak prerectal fascia can involve a transverse break (perineal body or higher), a midline vertical defect, or separation laterally (Photo Courtesy Elise J.B. De M.D.)

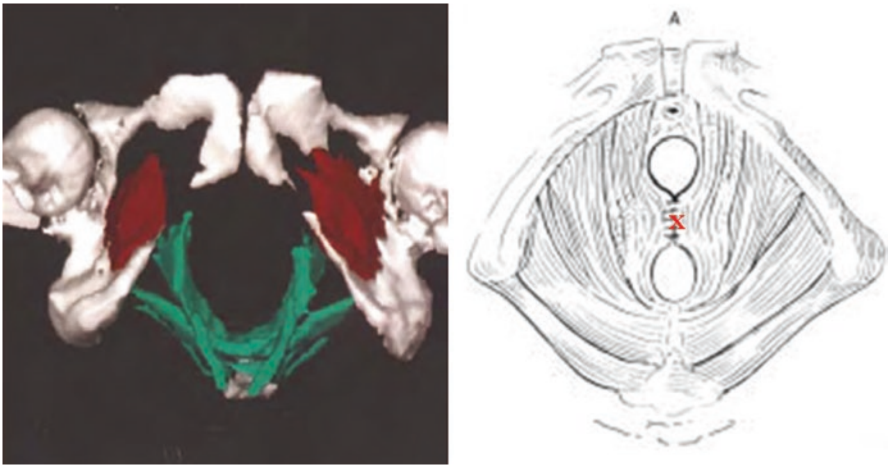


Image 1.21 Widening of the levator hiatus and schematic of correction (Images Courtesy Shlomo Raz M.D.)

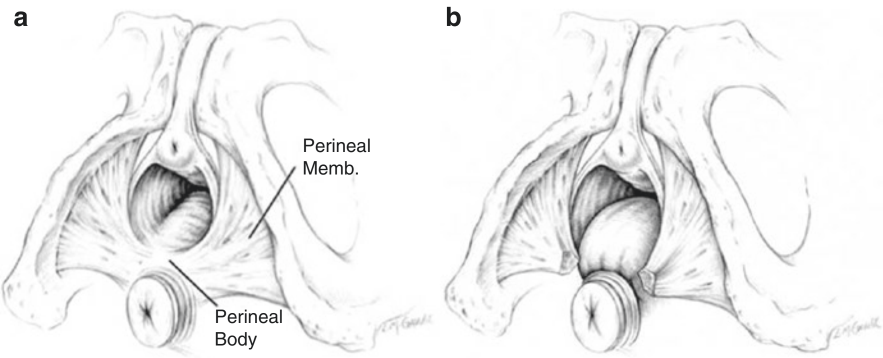


Image 1.22 Opening of the perineal membranse, for example after delivery (Figures 11a and b in Ashton-Miller and DeLancey [19])

Image 1.23 Descent of the levator plate. Only apical suspension will address this defect (Photo Courtesy Shlomo Raz, M.D.)

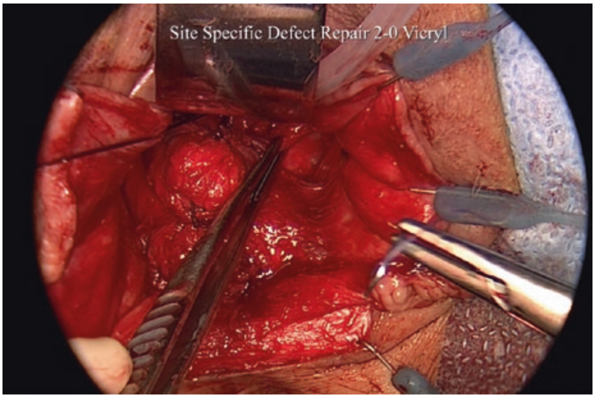


Image 1.24 Site specific defect repair for discrete breaks in the pre-rectal fascia (Photo courtesy Elise J.B. De, M.D.)

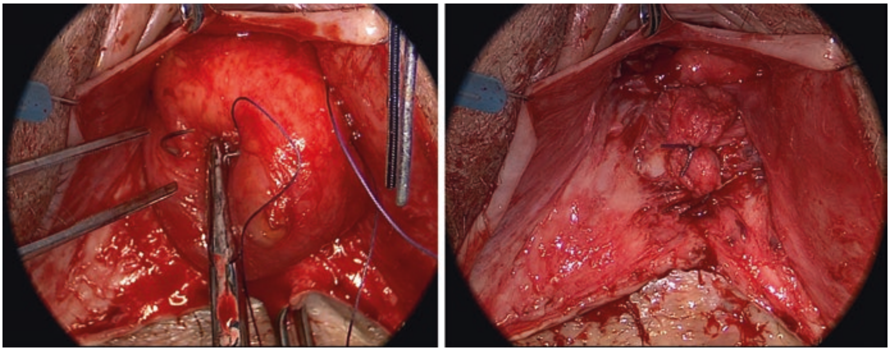


Image 1.25 Plication of rectocele. Very little pre-rectal fascia is appreciated for attachment (Photo Courtesy Elise J.B. De M.D.)

addressed and reconstructed as a component of the repair. Lastly, descent of the levator plate implies loss of apical support extending along the entirety of the recto-vaginal fascia through the perineal body and requires an apical procedure for correction.

Apical support for the vagina includes the cardinal ligaments and uterosacral ligaments as described above. The uterosacral ligaments can still be identified post-hysterectomy and if still substantial can be used for the repair, but in stage IV prolapse one would not expect the ligaments to be adequate (Image 1.26). The cardinal ligaments are not employed due to their vector. The sacrospinous ligament (Image 1.27) [20] and iliococcygeus muscle (Image 1.9) are reliable lateral options for apical support using the vaginal approach. The sacral promontory is a common option during the abdominal approach for apical support, but typically employs a polypropylene mesh graft. Options such as fascia lata have been employed as described in the chapter on Native Tissue Repair after Mesh (Chap. 20).

The rectovaginal septum lies in continuity among the cardinal and uterosacral ligaments proximally and the perineal body, transversus perineal muscle, and the external anal sphincter distally. These structures in turn are in continuity with the coccyx and bulbocavernosus muscle as well as the pubic symphysis. (Image 1.28) [21]. Therefore, apical support forms the foundation of any repair involving an

Image 1.26 In this severe case of prolapse, the uterosacral ligaments are likely to be attenuated or detached, and therefore not the appropriate support for repair (Photo courtesy Elise J.B. De, M.D.)

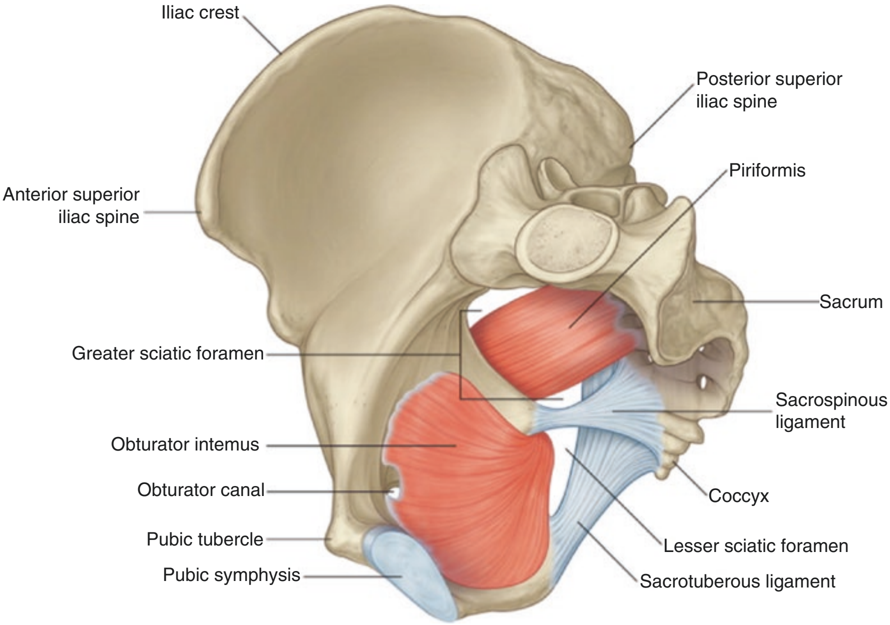


Image 1.27 Obturator internus and piriformis muscles (oblique medial view) (Image 226 in Drake et al. [20])

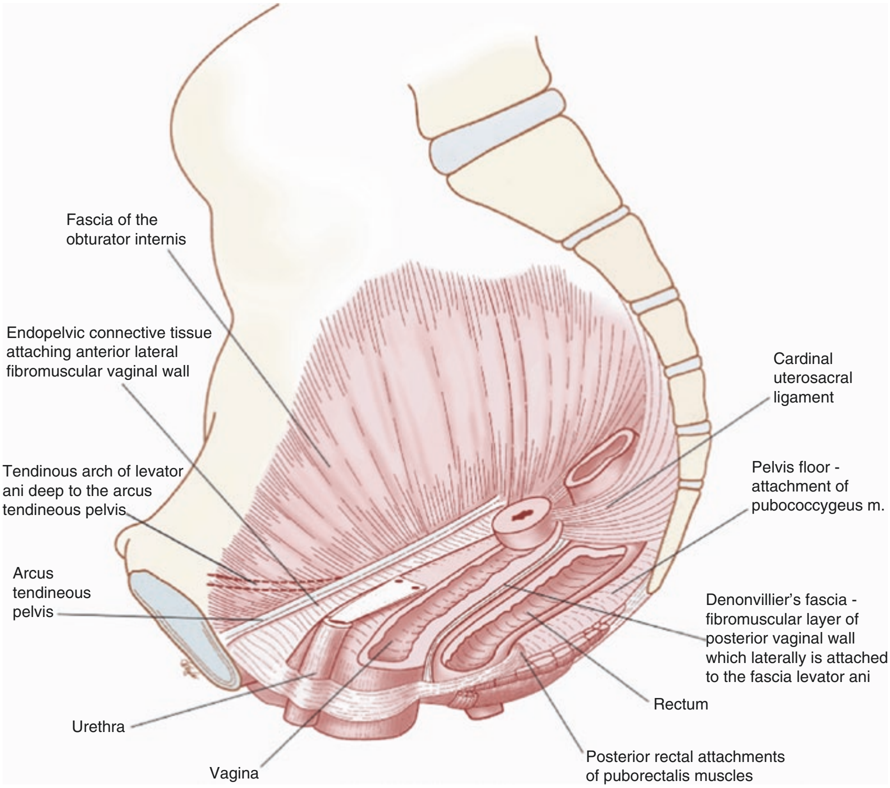


Image 1.28 Anterior and posterior vaginal fibromuscular planes in continuity with the rectovaginal fascia (Figure 24.1 in Berek and Novak [21], p 899 [1671 p])

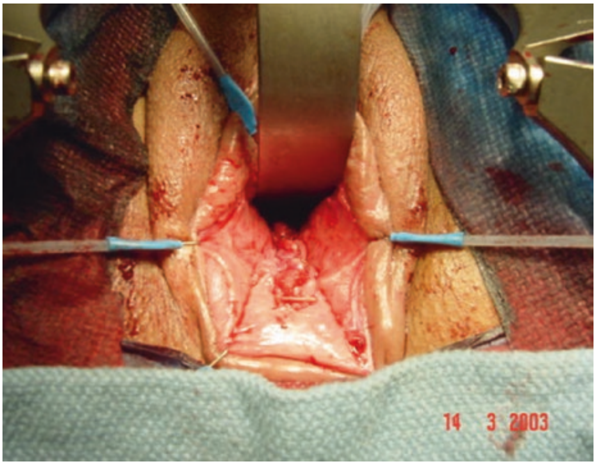


Image 1.29 High midline levator myorrhaphy. The levator plate is reapproximated in the midline followed by perineorrhaphy (Photo Courtesy Philippe Zimmern, M.D.)

apical component prolapse – for example in the high midline levator myorrhaphy (Image 1.29).

Nerves Encountered During Pelvic Reconstruction

There are SOMATIC (sacral nerve roots, femoral, obturator, sciatic, superior gluteal, pudendal and the nerves to the levator ani muscle) and AUTONOMIC (hypogastric, pelvic splanchnic, inferior and superior hypogastric plexus) nerves within the pelvis. It should be noted the iliohypogastric nerve, lumbosacral trunk, ilioinguinal nerve, lateral cutaneous nerve of the thigh, femoral nerve, and genitofemoral nerve all traverse and many innervate the pelvis despite higher origin (Image 1.30) [22] and (Image 1.31) [23].

The obturator nerve emerges on the medial border of the psoas muscle and crosses the obturator space to the obturator canal. (Image 1.32) [24]. It provides adduction (adductor muscles), lateral rotation of the hip (gracilis muscle), and sensory innervation of the inner side of the thigh and knee. Injury can impact adduction and leg crossing, and lead to pain and paresthesias.

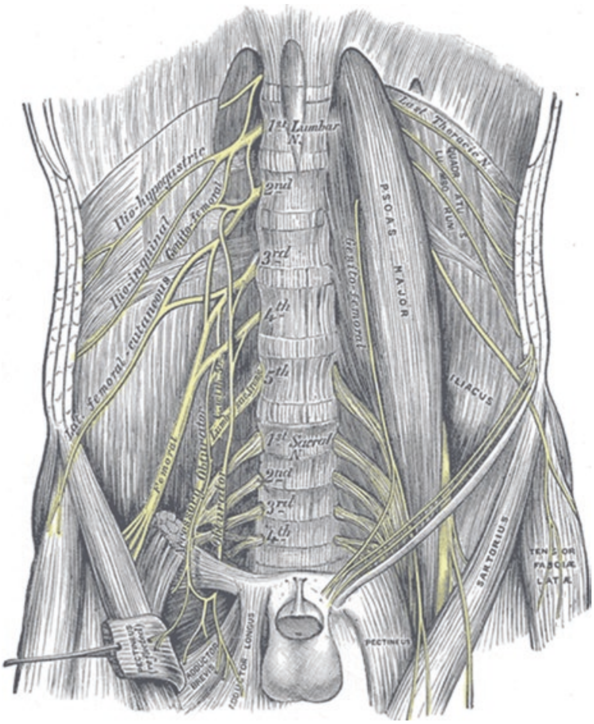


Image 1.30 Lumbar plexus (Plate 823 in Gray [22])

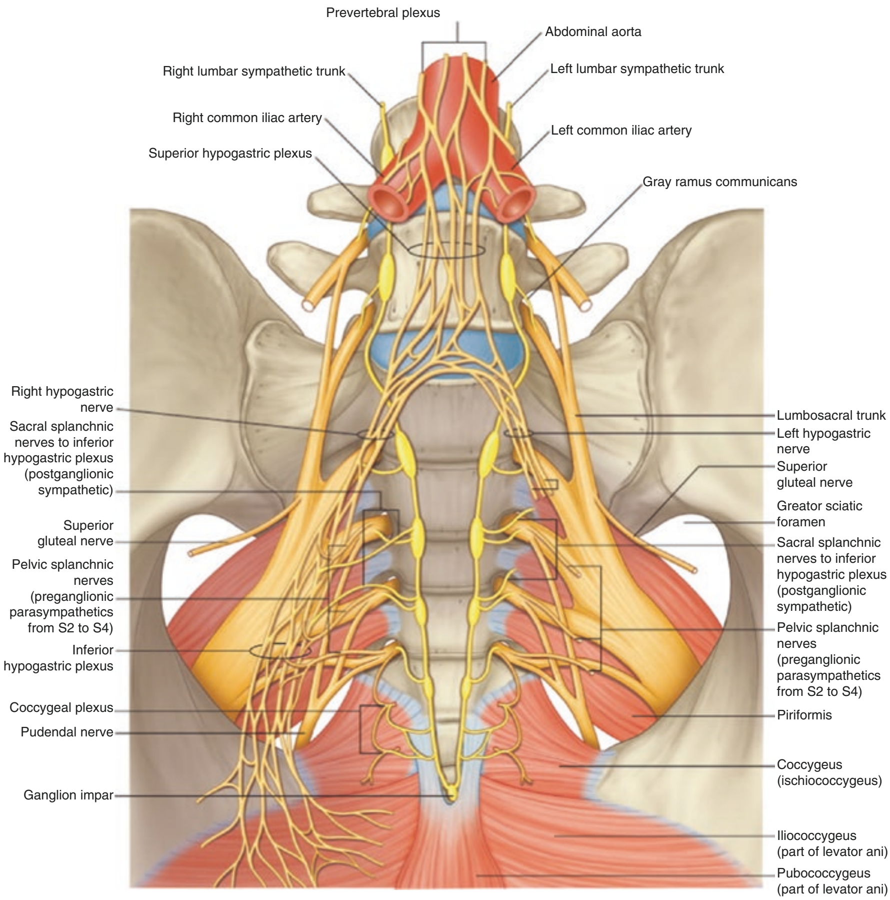
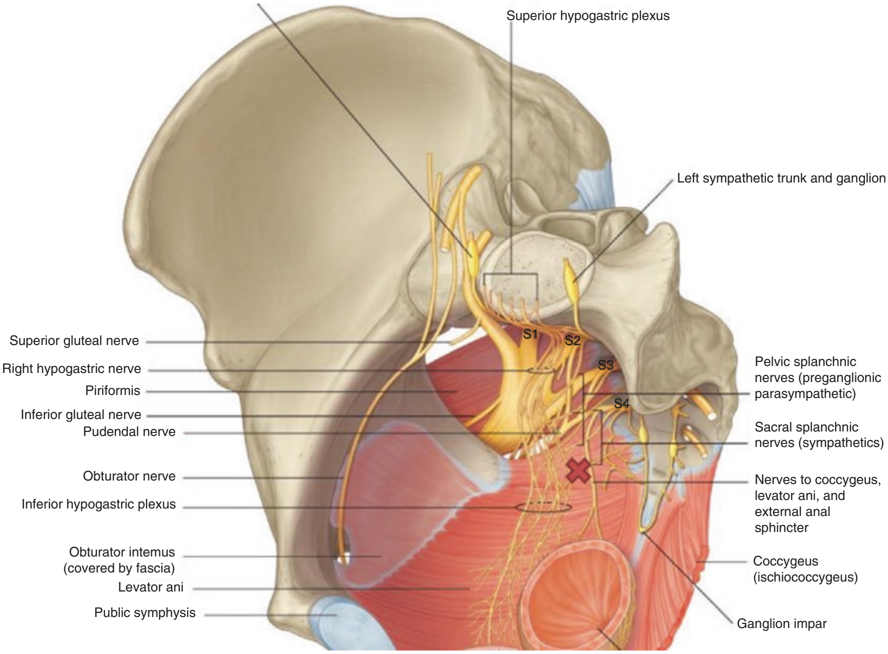


Image 1.31 Pelvic extensions of the prevertebral nerve plexus (anterior view). Pelvic nerve plexus (Image 253 in Drake et al. [23])

The pudendal nerve is formed by the confluence of S2–S4 nerve fibers over the anteromedial aspect of the piriformis muscle and runs distally crossing behind the sacrospinous ligament and the coccygeus muscle close to their attachment to the ischial spine. (Image 1.32) Therefore it is susceptible to injury during sacrospinous ligament suspension. The pudendal nerve has three branches (inferior rectal, perineal, and dorsal nerve of the clitoris) and is responsible for carrying efferent signals to pelvic floor muscles [13] and sensation from the urethra. Barber et al examined the innervation of the levator ani muscles in 12 female cadavers. The authors, histologically confirming their gross findings, found no contribution from the pudendal nerve to any of the levator ani muscles. They identified a nerve that originated from S3–S5 foramina and traveled along the superior surface of the levator ani muscles before penetrating each of the pelvic floor muscles at their approximate midpoint. (Image 1.14) [13]



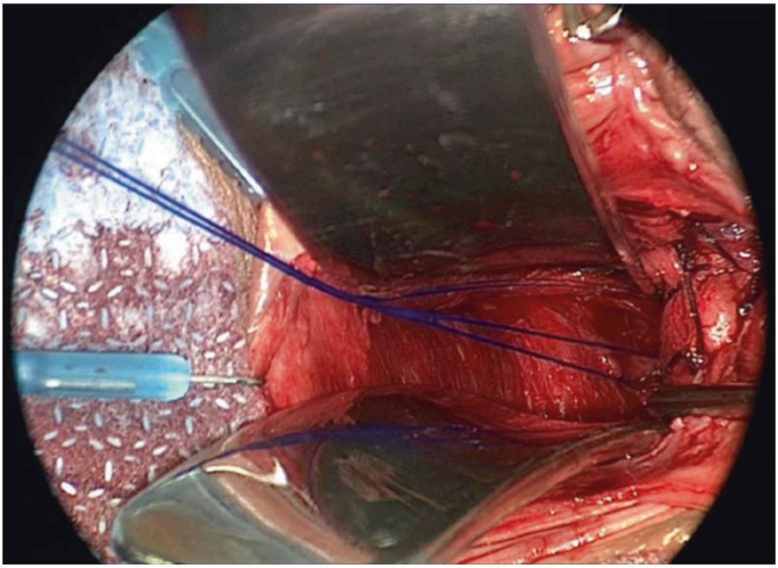


Image 1.32a and b (**a**) Hypogastric nerve plexuses (oblique sagittal view). (*X added to demarcate site of sacrospinous ligament suture, which would be deep to this plexus and to the coccygeus muscle*) (Image 253 in: Drake et al. [23].) (**b**) Suture in the right sacrospinous ligament. (Photo courtesy Elise J.B. De, M.D.)

The sciatic nerve (Images 1.31 and 1.32) lies 2 cm cephalad from the sacrospinous ligament and can be injured if needle passage is too deep or high. The nerve to the levator ani muscle (Image 1.14) runs over the anterior aspect of the sacrospinous

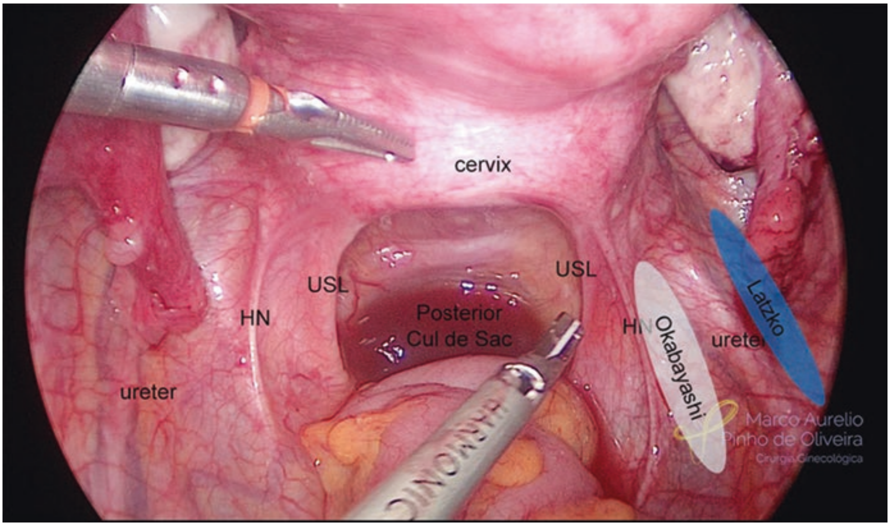


Image 1.33 The anatomy of the uterosacral ligament in relation to the hypogastric nerve and the ureter. The ureter is closest to the USL at the level of the cervix. Deep to the USL, the inferior hypogastric plexus and sacral nerve roots can be injured. *Okabayashi* = Okabayashi pararectal space, *Latzko* = pararectal space (Courtesy Marco Aurelio Pinho de Oliviera, M.D. Chief of the Department of Gynecology of the State University of Rio de Janeiro – Brazil. Member of AAGL Board of Trustees (2011–2013))

ligament and can be injured if sutures are placed in that region. The preferential site for suture placement on a sacrospinous fixation is the middle third of the ligament, slightly inferior (Image 1.32).

The sympathetic hypogastric nerves can be visualized during abdominal sacrocolpopexy bilaterally along the sacral promontory, noting that the superior hypogastric plexus is cephalad (Images 1.33, 1.34a, b, and 1.35) [25]. The hypogastric nerves pass laterally along the pararectal folds, on top of the presacral fascia, medial to the ureter and in the pararectal fossa, then deep to the uterosacral ligaments, joining the inferior hypogastric plexus. The pararectal fossa also houses the parasympathetic system (pelvic splanchnic nerves, injury of which can lead to atonic bladder, decreased sensation, and decreased blood flow/lubrication to the vagina), the inferior hypogastric plexus and the visceral nerve branches (deficit depends on level of injury, e.g. the rectal plexus can be injured by mesh). Deep within the pararectal fossa the sacral nerve roots can be appreciated – and injured.

During uterosacral ligament vaginal vault suspension, one should avoid the hypogastric nerves laterally between the USL and the ureter, and the inferior hypogastric plexus underlying the USL. To reiterate, deeper to that, within the pararectal space, one finds the pelvic splanchnics and the sacral nerve roots (Image 1.35) [25] and (Image 1.36) [26]. The ureter runs lateral to the uterosacral ligament beyond the hypogastric nerve and care must be taken to avoid injury when using the USL. S2 was the most frequently injured nerve in a series of 95 cases of intrapelvic nerve injuries secondary to pelvic reconstructive surgery [27]. Siddiqui et al. [28] investigated the potential for nerve injury during uterosacral ligament vaginal vault suspension using comparative suturing technique

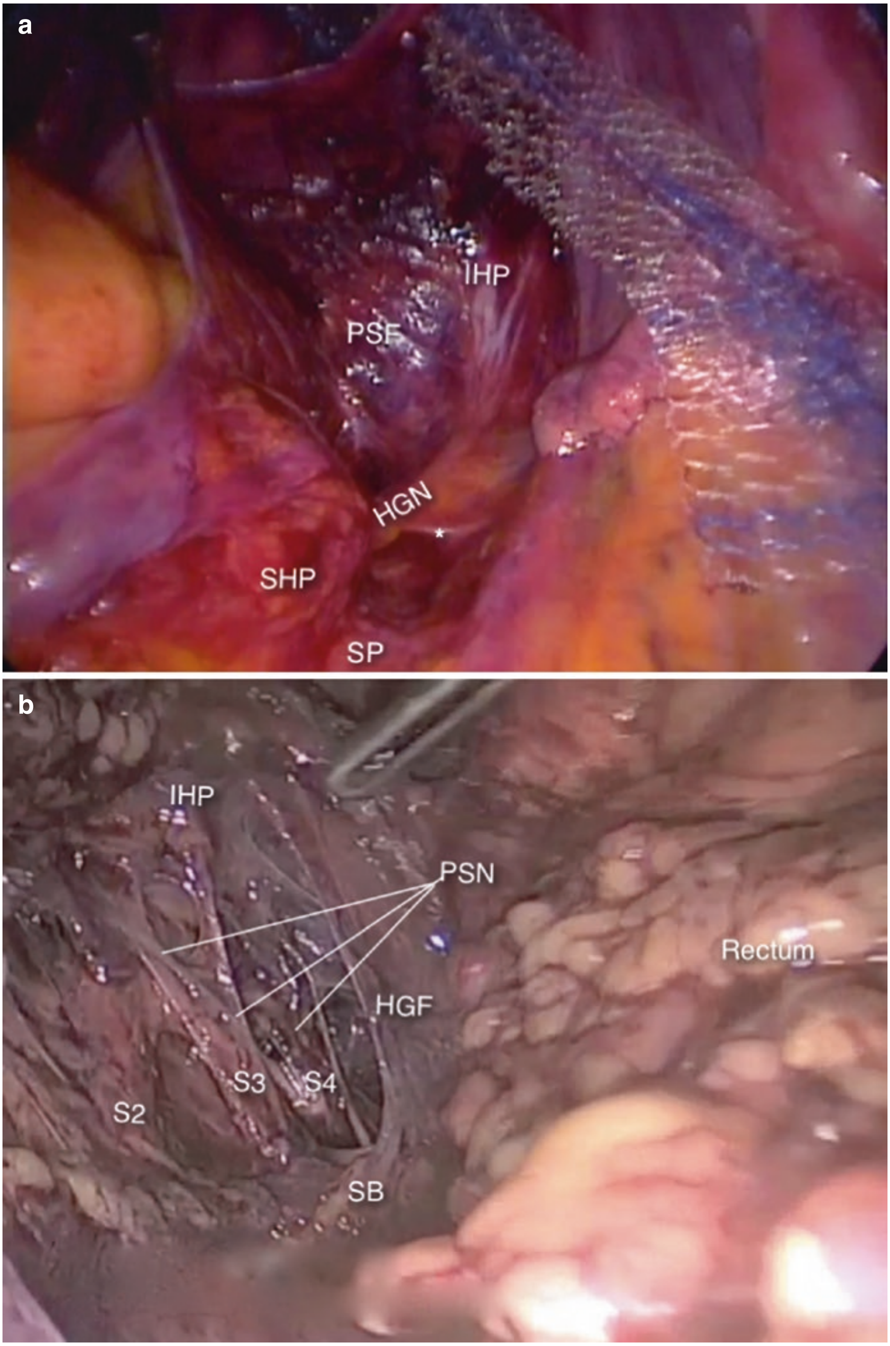


Image 1.34 (**a**) Innervation at risk during sacrocolpopexy and uterosacral ligament vaginal vault suspension (*SHP* superior hypogastric plexus, *SP* sacral promontory, *HGN* hypogastric nerve, *IHP* inferior hypogastric plexus, *PSF* pre sacral fascia) (Courtesy Nucelio Lemos M.D., Ph.D.) (**b**) Pelvic splanchnic nerves. (*PSN* pelvic splanchnic nerves, *IHP* inferior hypogastric plexus, *S2, S3, S4* sacral nerve roots, *HGF* hypogastric fascia, *SB* sacral bone) (Courtesy Nucelio Lemos, MD, PhD)

Image 1.35 Pelvic innervation on the right pelvic side wall. (*A*) Superior hypogastric plexus, (*B*) right hypogastric nerve, (*C*) inferior hypogastric plexus, (*D*) uterovaginal nerve plexus, (*E*) sacral nerves (Figure 1 in Spackman et al. [25])

(deep versus superficial bites tenting the ligament) in ten cadavers. Nerve entrapment was possible, and most likely to involve fibers of the S2 sacral nerve root or S2/S3 sacral nerve trunk. Hypogastric nerve involvement was noted and small diameter nerves, likely autonomic branches, were present in all the tissue biopsy specimens. There were no instances of nerve entrapment when sutures were placed using the technique recommended in this book. The USL should be tented with an Allis clamp and the suture directed medially, incorporating 1/3 of the thickness along the anteromedial border of the uterosacral ligament, preferably palpating and lifting the ureter and hypogastric nerve off the ligament during the stitch placement.

Vessels Encountered During Pelvic Reconstruction

The internal iliac arteries (Image 1.37) [29] supply the majority of the pelvis. The middle sacral artery and ovarian arteries also contribute. The internal iliac artery branches into a posterior and an anterior trunk. The posterior trunk supplies the iliolumbar artery (which includes a spinal branch to the cauda equina), the lateral sacral

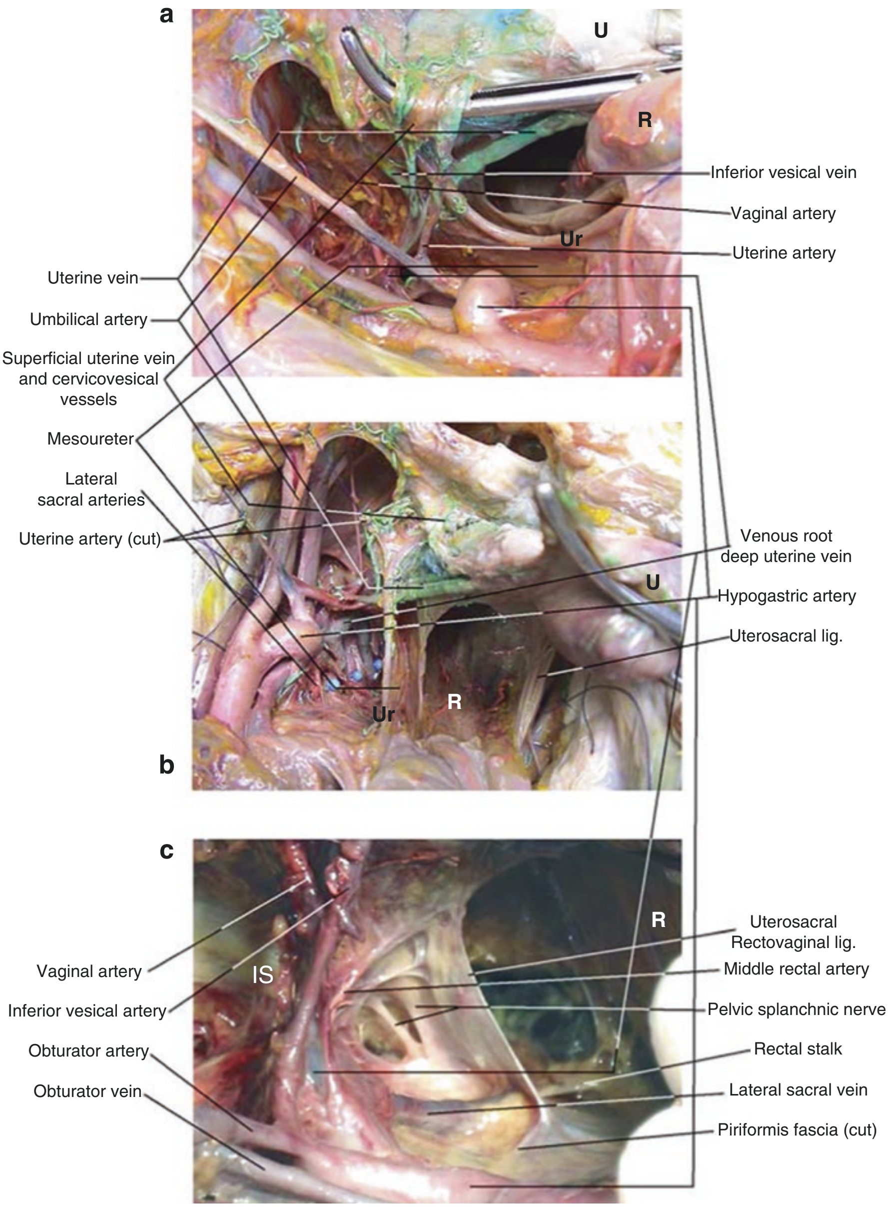


Image 1.36 *Author's Comment: Note the relationship of the uterosacral ligament to the underlying pelvic splanchnic nerves in C.* Fresh cadavers, classic dissection, lateral view of the left hemipelvis at different stages of dissection. Red latex and green or blue latex was injected into arteries and veins, respectively. (**a**) *IS* ischial spine, *Ur* ureter, *R* rectum. (**b**) *IS* ischial spine, *Ur* ureter, *R* rectum. The *blue dots mark* the S1–S3 sacral roots. (**c**) *IS* ischial spine, *R* rectum (Figure 4 in: Ercoli et al. [26])

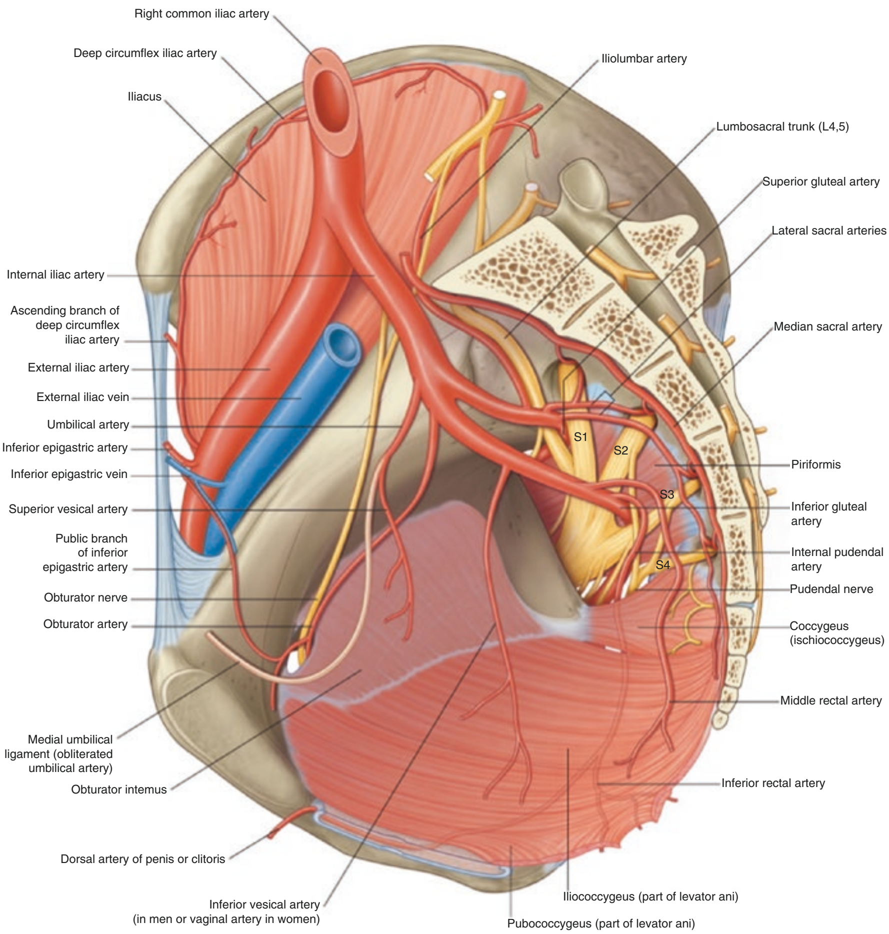


Image 1.37 Arterial supply to the pelvis (right side sagittal view) (Image 246 in Drake et al. [29])

arteries, and the superior gluteal artery. The anterior trunk of the internal iliac artery can demonstrate anatomic variation and therefore the order of the branches and whether they branch directly from the internal iliac or one another is inconsistent:

1. Umbilical artery. Prior to being appreciable as the medial umbilical ligament (the obliterated umbilial artery, not to be confused with the midline median umbilical ligament which is the urachus) along the anterior abdominal wall bilaterally, it gives rise to the superior vesical artery. The medical umbilical ligament (Image 1.38) [30] can be useful as a guide to identify the anterior trunk of the internal iliac artery (aka hypogastric artery) in the setting of profuse uterine bleeding. The superior vesical artery heads inferomedially to supply the superior bladder and distal ureter.

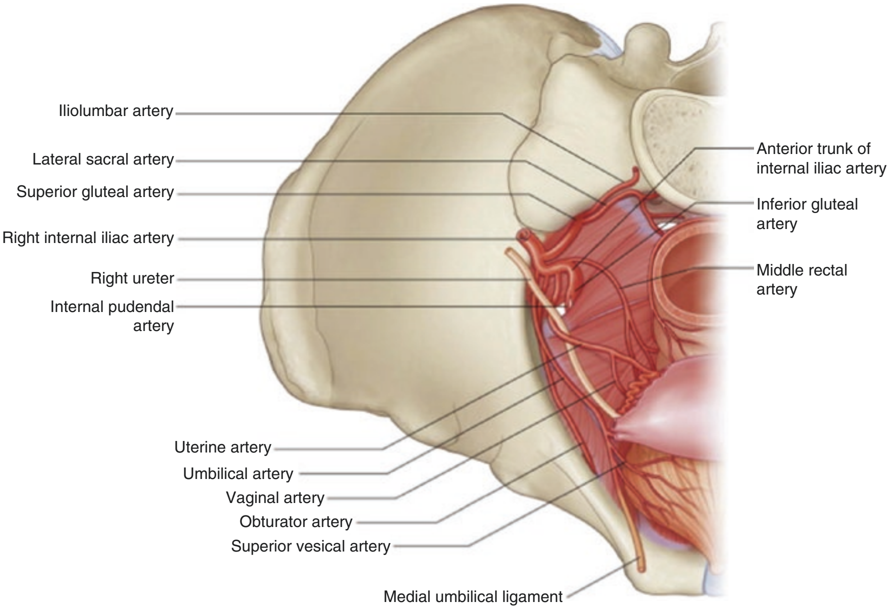


Image 1.38 Branches of the anterior trunk of the internal iliac artery. Female (Figure 5.64B in Drake et al. [30])

2. Vaginal artery (equivalent to the inferior vesical artery in men). This supplies the vagina, bladder, and rectum.
3. Middle rectal artery. This anastomoses with the superior and inferior rectal arteries to supply the rectum.
4. Obturator artery: This passes through the obturator canal and supplies the adductor muscles. It also supplies a medial branch of the labial fat pat used in the Martius flap.
5. Internal pudendal artery. This passes inferior to the piriformis muscle and through the greater sciatic foramen. It passes with the nerve lateral to the ischial spine, through the lesser sciatic foramen, then enters the perineum as its main arterial supply, including the erectile tissue.
6. Inferior gluteal artery. This supplies the gluteal region and the hip joint, exiting via the greater sciatic foramen under the piriformis.
7. Uterine artery. This passes anteromedially through the base of the broad ligament toward the cervix. It passes anterior to the ureter (“bridge over water”). It courses along the lateral margin of the uterus and anastomoses with the ovarian artery. It provides some supply to the ovary and vagina via anastomoses.

The ovarian arteries derive from the aorta, crossing into the pelvis within the suspensory ligament of the ovary (the infundibulopelvic ligament). Their branches traverse the mesovarium as well as the mesometrium of the broad ligament, anastomosing with the uterine artery.

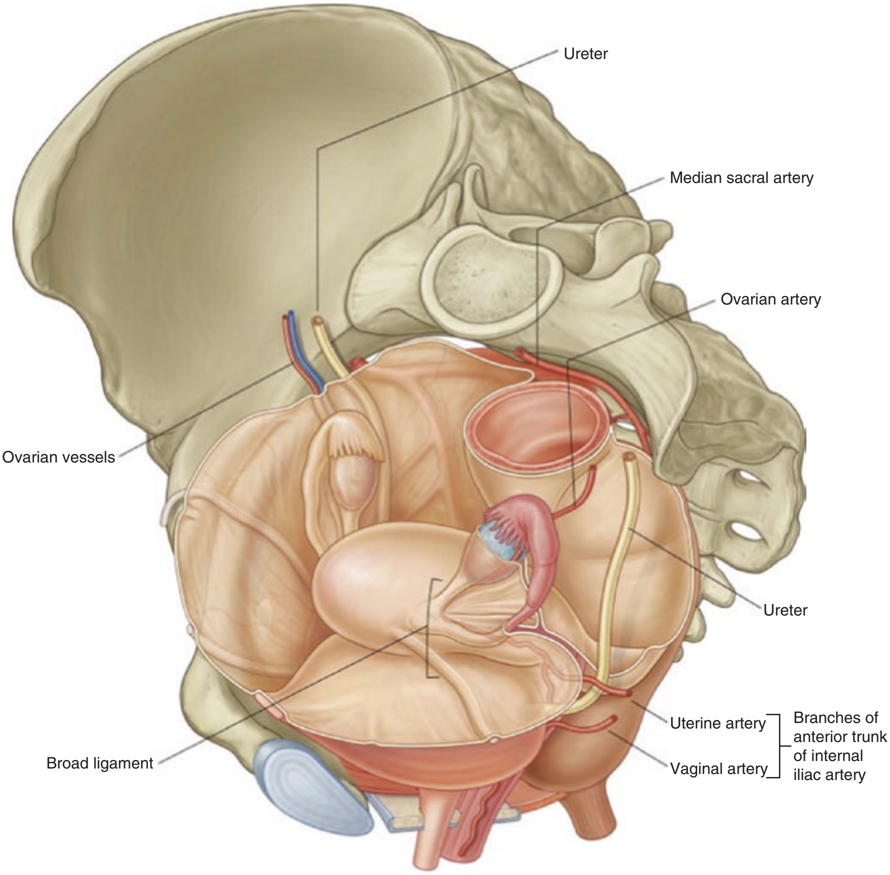


Image 1.39 Uterine and vaginal arteries (Figure 5.65 in Drake et al. [31])

Some additional vessels require special mention (Image 1.37) [29]. Along the sacral promontory, the aortic bifurcation and external iliac arteries are easy to appreciate but the external iliac veins are flattened and harder to see. Often the left external iliac vein is displaced slightly to the right. The middle sacral artery and vein can be injured during sacrocolpopexy and then retract rendering control difficult. If a stitch has been placed through the promontory and bleeding is noted, control is usually achieved by compression with a 4 by 4 and tying the suture to the promontory either before or after completing suture passage through the graft. It is important to confirm it is the middle sacral artery or vein rather than the bifurcating iliac veins that are bleeding prior to committing. The middle sacral artery crosses vertically along the sacral promontory to supply the last lumbar arteries and anastomosing with the iliolumbar and sacral arteries.

When performing a Burch urethropexy, veins can be encountered laterally at the level of the obturator nerve or more medially in the retropubic space (Santorini's plexus).

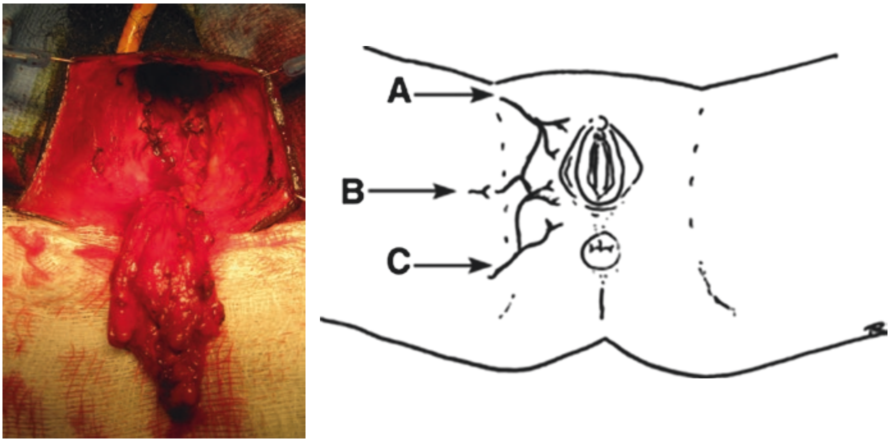


Image 1.40 Martius flap. *A* External pudendal artery. *B* Branch of the obturator artery. *C* Internal pudendal artery. Photo Courtesy Elise J.B. De (Figure 3 in Roth and Meeks [32])

The uterine artery crosses anterior to the ureter (Image 1.39) [31]. Uterine bleeding is the most common cause of ureteric injury during hysterectomy, as efforts to ligate the uterine artery can include the ureter. Cystoscopy after injection of intravenous dye is indicated if there is concern for ureteric injury. Tracing the obliterated umbilical artery from the anterior abdominal wall retrograde will lead one to the hypogastric artery, which can lead one to the uterine artery or be ligated proximal to the uterine artery. This maneuver can compromise gluteal blood supply and is therefore not ideal.

The Martius flap (Image 1.40) [32] is helpful in reconstruction of fistula or urethral diverticulum when the tissues are compromised. Its vascular supply derives from the external pudendal artery anteriorly, a branch of the obturator artery laterally (which must be sacrificed), and the internal pudendal artery posteriorly. The flap can be harvested based on either pudendal artery.

Conclusion

An in-depth understanding of the structural supports of the pelvic floor is essential for the reconstructive pelvic floor surgeon. The reader should consider performing cadaveric dissections to identify the structures named above, in an effort to solidify familiarity. This anatomic knowledge allows the pelvic surgeon the flexibility of the full armamentarium of procedures as described in this book. The history, physical exam, functional studies will guide when and where to apply them.

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Chapter 2
Instrumentation for Native Tissue Repair Reconstructive Procedures

Elise J.B. De and Philippe Zimmern

Abstract The reconstructive vaginal set includes specific items in addition to standard surgical instrumentation. This will differ from surgeon to surgeon and is heavily influenced by training. In fact, entering the operative room with surgeons trained in related fields (urology, gynecology, colorectal surgery) or in different training programs will expand one's repertoire for instrumentation. We would like to call your attention to some particular instruments below.

Keywords Instrumentation • Surgical instruments • Vaginal surgery • Prolapse • Technique

Cystoscope

Female Urethroscope (Figures 2.1, 2.2, 2.3, 2.4, 2.5)

Male cystoscopes are curved at the end and the fluid throughput exits at the bottom of the inferior groove (see photo comparison of male and female scopes – Figs. 2.1, 2.2 and 2.4). As such the male scope is not intended to distend or evaluate the short female urethra. By the time there is enough irrigant traversing the sheath to distend the female urethra, the scope is already located in the proximal urethra or bladder neck area. So urethral pathology that is distally located will be overlooked (Fig. 2.3: pathology detected with the female scope had been missed on prior office evaluation). Both scopes are equivalent for bladder evaluation.

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E.J.B. De, MD (✉)
Associate Professor Urology, Division of Urology,
MC 208, Albany Medical Center, 23 Hackett Boulevard, Albany, NY 12208, USA
e-mail: elisede@gmail.com

P. Zimmern, MD
University of Texas Southwestern, 5323 Harry Hines Bld, Dallas, TX 75390-9110, USA
e-mail: philippe.zimmern@utsouthwestern.edu

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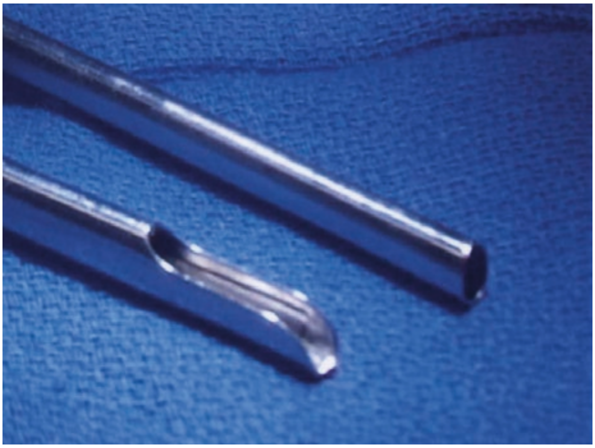

Fig. 2.1 Male versus female cystourethroscope tip comparison. The female tip prevents escape of irrigant and allows better urethral lumen distension

Fig. 2.2 Female urethrocystoscope

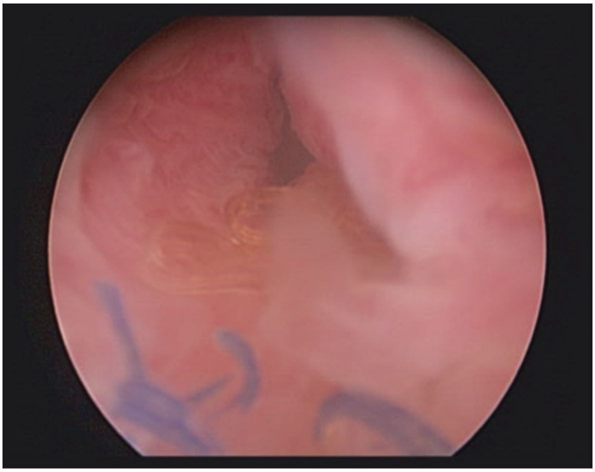

Fig. 2.3 Better view: Pathology such as sling mesh erosion in the female urethra can be missed without the superior distention allowed by the female urethrocystoscope

Several female urethro-cystoscopes exist. The smallest one made by Wolff is a 17.5 Fr scope (Fig. 2.2). There are larger ones, such as a 21 Fr intended for injection of bulking agents. They all have an obturator sheath in case the meatus is too tight for introduction and the tip gets caught at the meatal lip. These cystoscope sheaths can accommodate a 30° lens as well as a 70° lens to carefully inspect the anterior bladder wall and dome.

A flexible scope can also be used to inspect the urethra. This is generally employed more for diagnostic purposes in the clinic setting. However, both flexible and rigid scopes can be used to detect small areas of exposed mesh in the vagina and provide documentation of such. This procedure, called vaginoscopy, can also be useful in

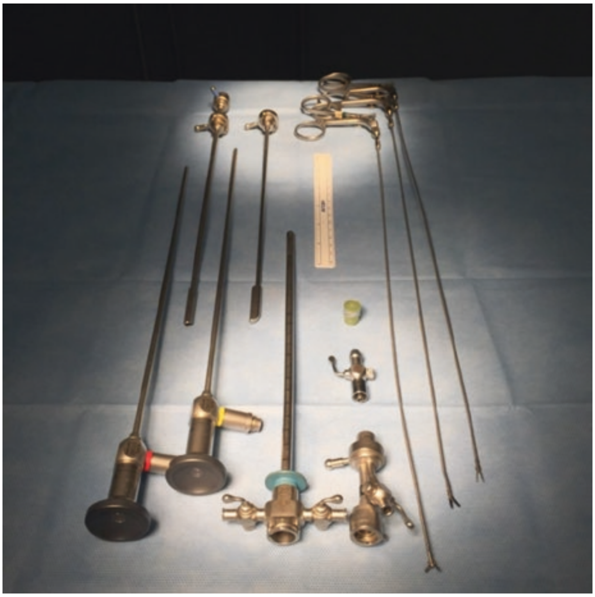

Fig. 2.4 General cystoscopic equipment: Male 22 French cystoscopy set including obturators, graspers and endoscopic scissors. The flexible graspers can be used, for example, next to the cystoscope to place traction on eroded mesh during endoscopic laser removal

Fig. 2.5 Pediatric tonsil suction tip: small and angled so as to be unobtrusive in a small field. It does obstruct periodically so it is recommended to have an extra available separate from the set

some very elongated vaginas after open or laparoscopic/robotic mesh sacrocolpopexy when it is difficult to reach the upper vagina to locate the site of extrusion. The vagina may be manually pinched or plugged to allow for distension. The flexible scope can also help in visualizing sutures or mesh exposed along the anterior bladder wall or bladder neck by using its retroflexion feature, or to identify the site of a small fistula and its relationship to the trigone and ureteric orifices.

Equipment for Vaginal Reconstruction

(Figs. 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, 2.17, 2.18, 2.19, and 2.20). The following equipment should be familiar and available to the vaginal surgeon. The list is not an absolute, but some version of each function will be necessary at one point or another during vaginal dissection and reconstruction.

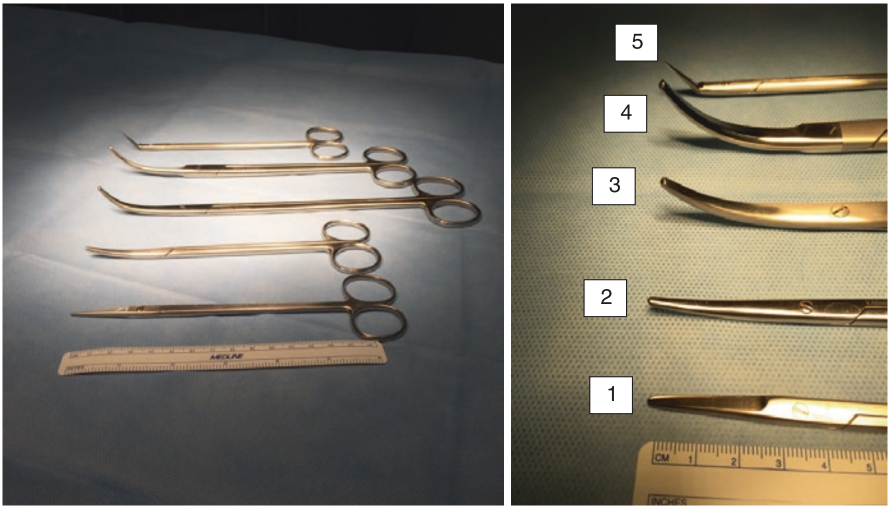

Fig. 2.6 Scissors in order near to far: (*1*) The "Church" vaginal scissors are sharp and flat with a blunt leading edge, useful for the majority of sharp dissection. They are the dissection tool of choice for one of the authors. (*2*) Metzenbaum, more blunt-tipped than Church. (*3*) Curved Metzenbaum, useful in fistula. (*4*) Curved Mayo, which can be used for deep dense scar, rarely used. (*5*) Demartel acutely angled, useful for the initial edge in fistula, rarely used, can create a hole in dissection

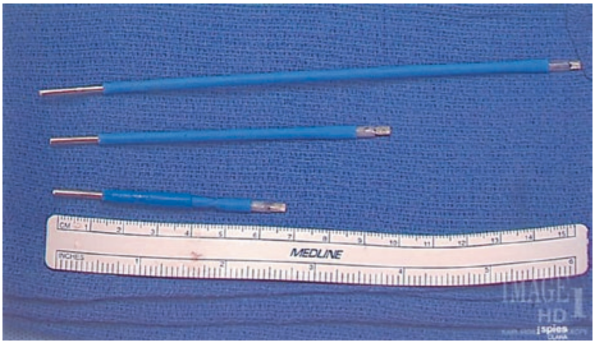

Fig. 2.7 Bovie tips. Useful in keeping bleeding under control throughout the dissection, a protected bovie tip can be extremely handy. Bovie is the dissection tool of choice for one of the authors. One can switch from cutting to coagulating with no time loss. The cutting/coagulation levels can be adjusted from 20 to 30 depending on the situation and the proximity of vital structures. The bovie tip comes in short, medium or long sizes. The medium size is suitable for mesh sling removal for example (Refer to Video 19.2, Vaginal removal of suburethral sling, Chap. 19) as the hand of the operator is away from the field, allowing the assistant to follow the dissection well. When working close to the undersurface of the urethra, the coagulation is lowered to the 20s. A longer bovie tip can be useful in freeing prolapse kit mesh arms extending deep laterally into the pelvic sidewalls. The "gritty" texture of the mesh is easily recognizable from the surrounding scar tissue with both bovie and scissors, comparable to running one's fingers along a screen door

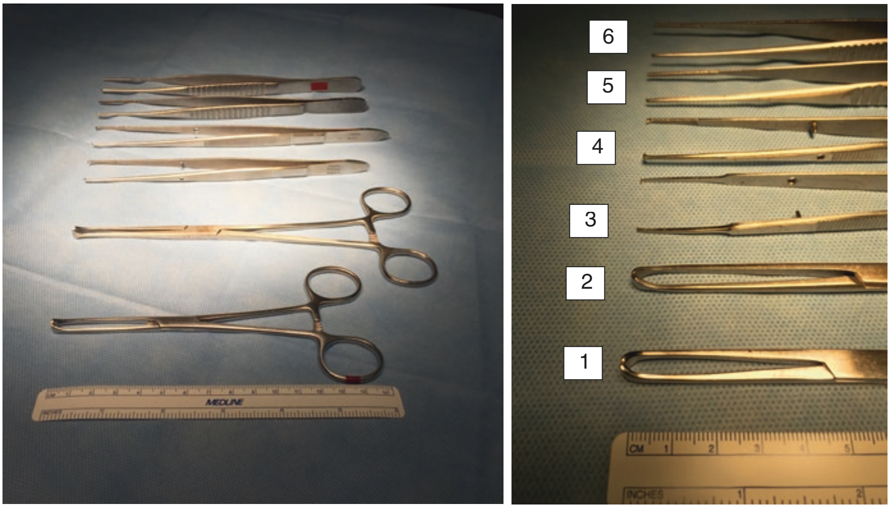

Fig. 2.8 Grasping Forceps in order near to far: (*1*) and (*2*) Allis Tissue Forceps 5 × 6 teeth – 6″ and 7.5″, used throughout dissection to grasp mucosal edge. They can also be hooked to Scott retractor (see also Fig. 2.16). (*3*) and (*4*) Gerald Forceps with 1 × 2 teeth. These hold tissue and needles well, due to the flat raised distal edge abutting the tips. Avoid grasping the bladder, urethra, bowel, and ureter with toothed Geralds due to teeth. (Smooth Geralds are useful for fine work such as a Monti or ureteric anastomosis). (*5*) and (*6*) Debakey Forceps Heavy tips – 7 ¾ inch. Used to grasp more delicate structures and to provide tension during dissection of tissue planes. Good at manipulating the needle during suturing

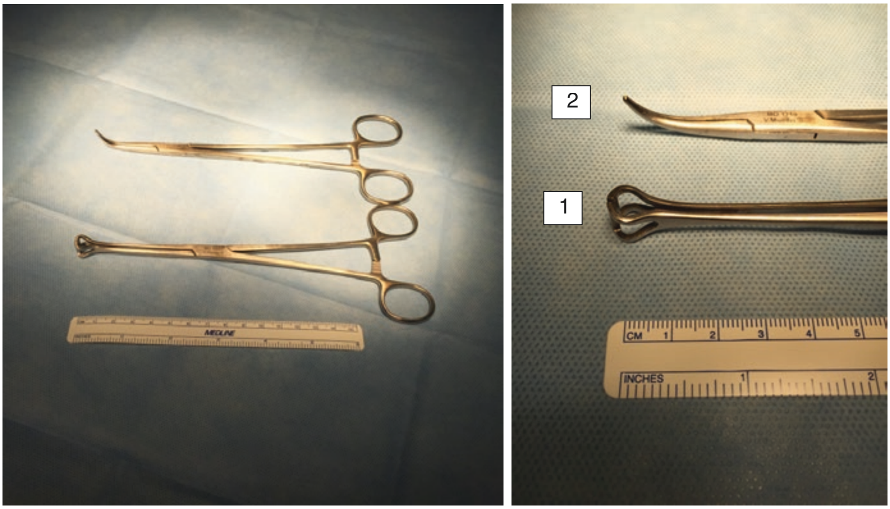

Fig. 2.9 Clamping Forceps near to far: (*1*) Babcock intestinal forceps: useful for grasping bowel, bladder, rectum for retraction. (*2*) Tonsil artery forceps, curved: excellent for passing through the endopelvic fascia (abdominal to vaginal during a pubovaginal sling), also for grasping mesh for removal in salvage cases. The narrow tip allows easy piercing and visualization around the tip

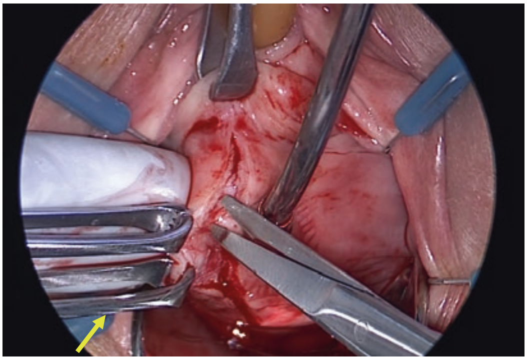

Fig. 2.10 Allis or Allis-Adair clamps (*yellow arrow*): Available in short or long, these can be useful during sharp mucosal dissection. Also useful to hold on to exposed mesh and to lift mesh away from adjacent organs

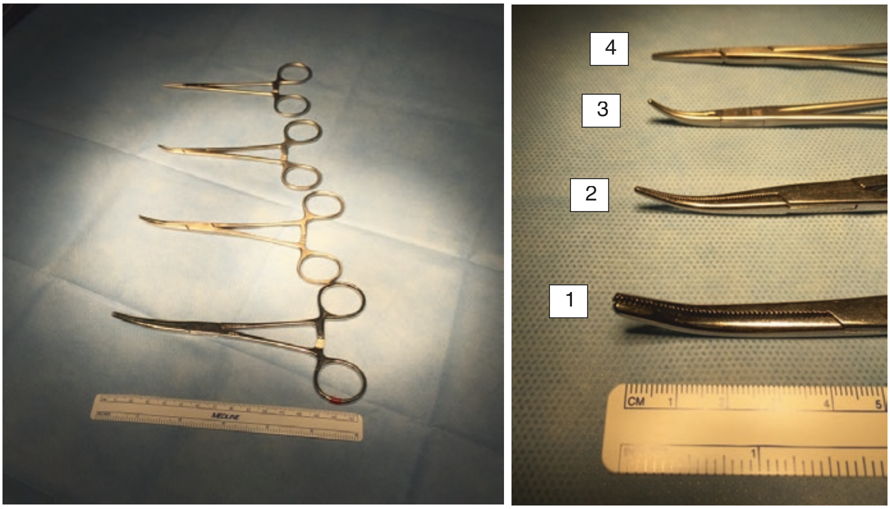

Fig. 2.11 Additional Clamping Forceps near to far: (*1*) Rochester-Pean (Kelly) – good for clamping the foley catheter as well as large gathers of drape (beware of damaging the catheter's balloon port – clamp distal to the bifurcation). (*2*) Criles: still heavy duty, can be used on the drape or to mark heavy sutures on strong tissue. (*3*) and (*4*) Curved and straight Mosquito: good for identifying sutures on more fine tissue (curved versus straight to distinguish the sutures as anterior versus posterior). Also consider rubber shodded mosquito clamps on fine sutures to avoid damaging them

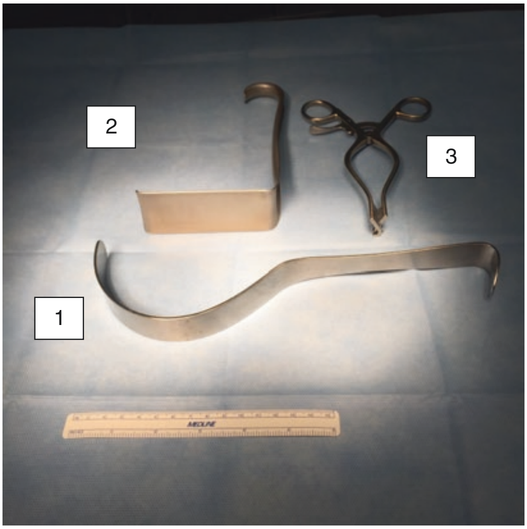

Fig. 2.12 Retractors: (*1*) *Front center*: the small Deaver $1 \times 10''$ is useful for retracting the higher portions of the vaginal wall, for example exposing the uterosacral ligament vaginally. (*2*) *Back left*: the Eastman vaginal retractor is an option – not used much by the authors. (*3*) *Back right*: Weitlander retractors come in sharp and blunt tip, shallow and deep blades. A deeper angled version is called the Adson Beckman. These work well for retracting the layers of the Pfannenstiel or other small abdominal incisions

Fig. 2.13 Retractors: Small blades are useful to protect the urethral wall or bladder wall during lateral dissections, for example while tracking the course of a trans obturator tape towards the back of the pubic bone or dissecting a mesh prolapse kit off the bladder wall and ureteric implantation area headed laterally toward the perivesical space. Pictured is the versatile 1.5×19 cm malleable blade

Fig. 2.14 Brietsky Navratil (Vienna) Retractors: Narrow, solid metal allows for heavy handed retraction without bending. Concavity allows good visualization

Fig. 2.15 Scherbak retractor: Weighted speculum with detachable pieces. Highly recommended due to versatility. The smaller blades are essential for work on small pelvis, e.g. rural obstetric fistula, stenotic atrophic vagina, or foreshortened vagina. The surgical bed must have a cut-out and diving board as the weight will hit a foot board that has been lowered

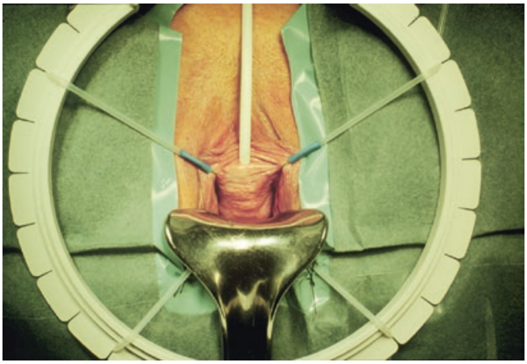

Fig. 2.16 Additional retractors: (1) In vagina: Steiner Auvard weighted speculum: weighted speculum with channel allows for drainage during the case. (2) Brantley Scott Retractor (from Lonestar – see figure): figure-of 8 shaped retractor from which sterile hooks can be suspended. The Scott retractor comes in metal of different weights or plastic disposable material. Lighter weight is recommended lest the field be weighed down. The hooks can retract the labia and avoid the need for labial sutures. The hooks can also be moved easily or added here or there as needed to facilitate exposure. This can apply to distal retraction to open the field of view, but also higher up in the vagina to retract sideways when needed (e.g. vaginal repair of apical fistula). Blunt and rake hooks are also available. Many shapes are available for pediatric or colo-rectal applications. The grooves in the frame are useful to secure clamped sutures and provide counter-traction. The superior part of the retractor can be moved down or up, and locked in place with side screws

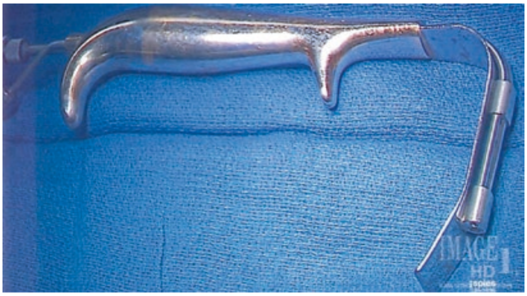

Fig. 2.17 Vaginal specula: Specula are very important for vaginal wall exposure (anterior vaginal wall and apex) and come in different lengths and angles. They can be replaced by narrow Deavers at times, especially in the more narrow and deep vagina. A special retractor used for breast surgery, named the smooth light breast retractor, can bring light at the tip of the retractor and thus can become useful in deeper dissections either at the top of the vagina or during lateral dissections. Combination light/suction devices are also available

Fig. 2.18 Suture anchoring devices: In order to place a deep suture designed to return to the needle driver, for example in the sacrospinous or iliococcygeus ligament, there exist the **Miya hook** as well as a number of commercially available disposable products

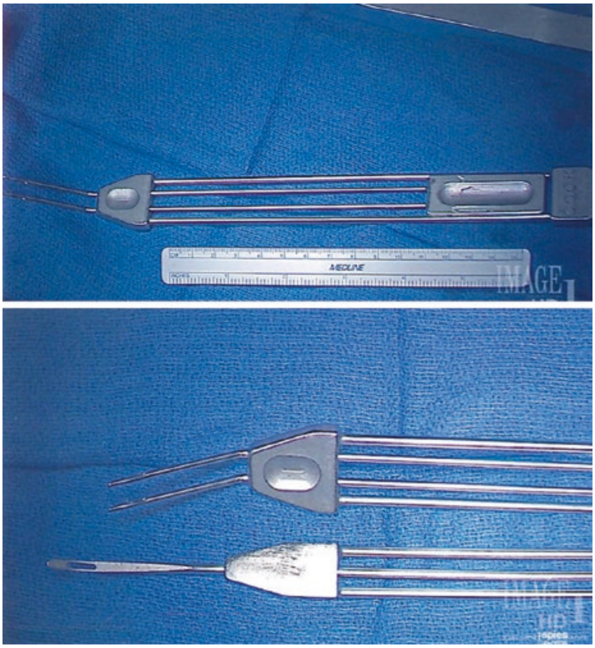

Fig. 2.19 Needle Passers: For needle suspension procedures, there are several instruments available at present. The Stamey needle, the Pereyra-Raz single needle, and the double-prong Raz needle are the most commonly used. These needles are passed via a small suprapubic incision through the ligamentous attachments of the rectus abdominus muscle under finger guidance to avoid bladder injury, from the suprapubic region down into the vaginal incision. The guiding finger passes from the vaginal dissection lateral to the bladder, along the pubic bone, under the fascia, and awaits the needle tip. Mobility of the central arm allows for maintenance of a constant angle proximally while advancing the needle. Once delivered out through the vaginal incision, the suspension sutures can then be threaded in the eyes of the ligature carrier and easily withdrawn suprapubically. This move allows the transfer of vaginally placed suspension sutures to secure the anterior vaginal wall – for example, as in the anterior vaginal wall suspension procedure (Chap. 3) – from the vaginal area to the suprapubic region. There these sutures can be tied individually or to each other. The **Raz Double Prong Needle Passer** allows for retrieval of 2 sutures with just one pass through the space of Retzius. The sutures will be separated by a bridge of fascia once retrieved and therefore can be tied to one another for anchoring. There is also a **single prong needle passer** (two sutures can be passed through the eyelet and then secured contralaterally or via suture in the suprapubic region)

Fig. 2.20 Curved Lowsley prostatic retractor: This instrument can be used to assist with placement of a suprapubic tube (Refer to Video 18.2 Transvaginal bladder neck closure (P. Zimmern, J. Hou, G. Lemack)). It is passed gently through the urethra with the blades closed, up to the anterior bladder wall (open incision) or abdominal wall (percutaneous technique). The tip of the Lowsley is palpable, and in fact visible directly through the wall of the bladder. Bovie (or knife) is used to cut to the tip, the retractor is passed into the incision, and the suprapubic catheter is tied to then grasped by the open tip. Tip is tightened over the extremity of the catheter and the catheter drawn into the incision, out the urethra. The blades are opened and the suture cut, then the catheter followed into the bladder with the cystoscope. Catheter balloon is inflated under vision. Using this technique, any size suprapubic tube can be placed with complete control

Additional Considerations (Figs. 2.21, 2.22, 2.23, and 2.24)

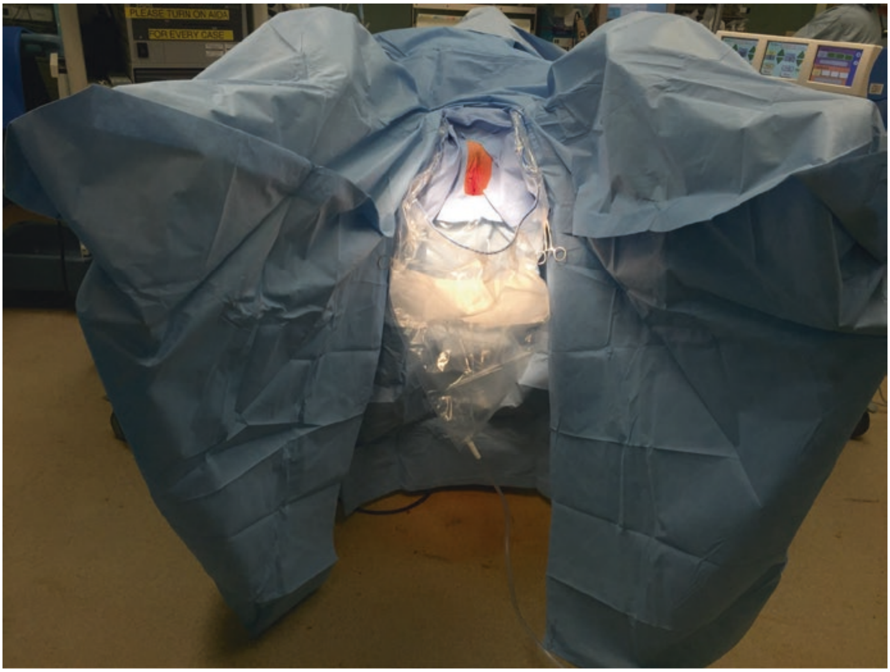

Fig. 2.21 Drapes: The authors recommend a drape extending as a barrier between the anesthesiologist and the surgical field with connected sterile leggings and a suction pouch. The one-piece set-up prevents disconnection and contamination during the case. The pouch can also be used as a sterile place to rest instruments rather than handing them back

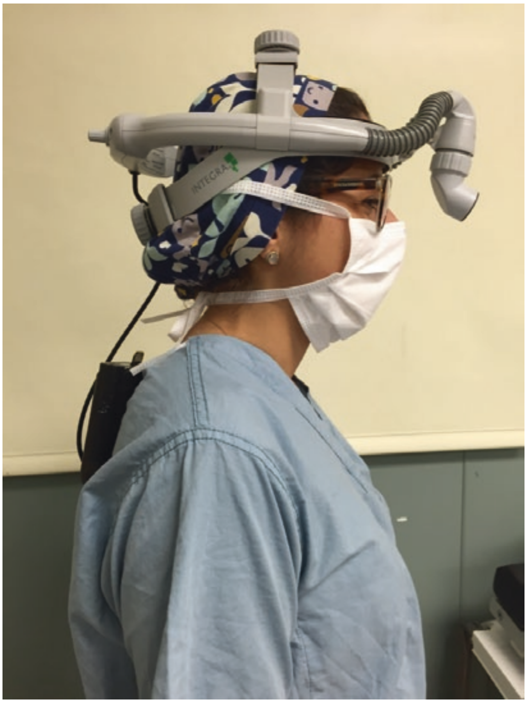

Fig. 2.22 Headlight. A cordless headlight is ideal for visualization, comfort, and mobility

Fig. 2.23 Table. The table should have a cut-out under the perineum, with a gel pad under the patient. In order to avoid sacral pain for a long case, additional gel can be placed under the sacral area laterally leaving a 3–4 inch recessed strip in the midline. The table should allow for positioning of a C arm in the rare case that fluoroscopic evaluation of the ureters is required

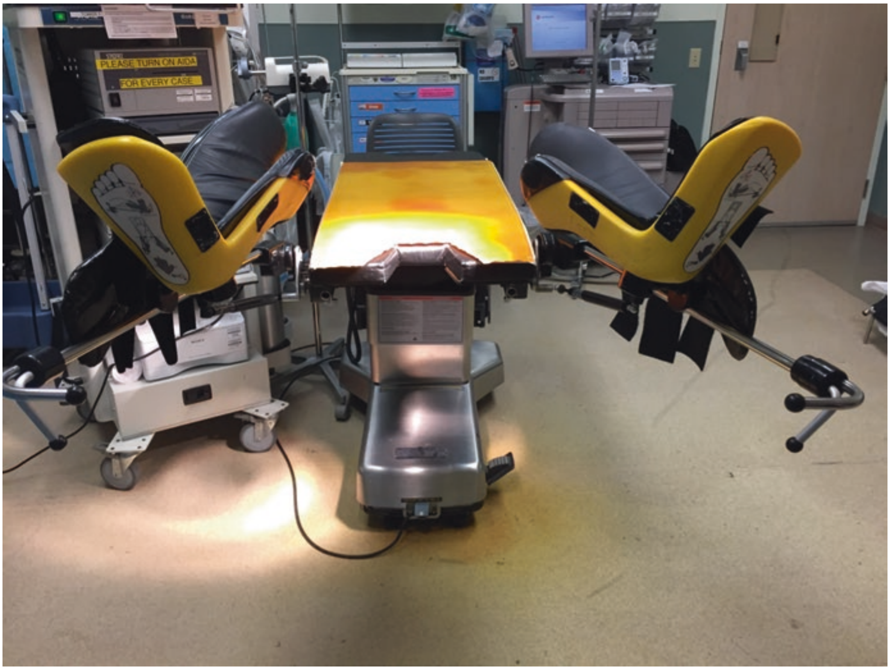

Fig. 2.24 Stirrups. Chapter 19 (Intra-operative complications of vaginal surgery for incontinence and prolapse repair) discusses positioning. Pictured above are padded pneumatic stirrups

Pharmacologic Agents

For identification of ureteric injury, cystoscopy is performed after prolapse repair and any time ureteric compromise is a potential risk. The following agents can be used:

– Indigo carmine 1 ampule (not currently available, can rarely cause methemoglobinemia).
– Methylene Blue 1 ampule (contraindicated with certain antidepressants due to serotonin syndrome, more frequently causes methemoglobinemia, and excretion can take long enough that use is not practical).
– Phenazopyridine 100–200 mg (must be given orally pre-operatively).
– Fluorescein: 10 % preparation of sodium fluorescein: 25–50 mg of 500 mg/5 mL solution (0.25–1 mL intravenously).

Conclusion

Understanding instrumentation is especially important for the new graduates starting in practice, but even the established reconstructive surgeon should be open to new concepts in equipment, technology, and their application. It is our hope that the details discussed above will aid the vaginal surgeon in choosing the best surgical set to attain a controlled, efficient operating experience.

Chapter 3
Anterior Vaginal Wall Suspension Procedure for Stress Urinary Incontinence Associated with Variable Degrees of Anterior Compartment Prolapse

Chasta Bacsu and Philippe Zimmern

Abstract Stress urinary incontinence is for the most part due to a sudden descent of the urethra pulled open by a dropping vagina which has lost its lateral attachment support during straining efforts. The goal of this procedure is to restore back this vaginal support, thus stabilizing the vaginal plate underneath the urethra and bladder base to prevent this rapid downward process with efforts. Inspired by the Raz bladder neck suspension, this anterior vaginal wall suspension procedure has been part of our practice for several decades. Long-term data is now available, attesting to its durability, safety and efficacy. It is also a very versatile procedure which can be performed along with other vaginal repair procedures, uterine preservation, or autologous fascial sling.

Keywords Stress urinary incontinence • Cystocele • Vaginal repair • Native tissue repair

Case Presentation

A 55 year old female presents with complaints of stress urinary incontinence (SUI) for the past 6 years with gradual worsening over the past year. She now has to wear 2–3 pads per day for protection. She voids frequently to decrease her rate of leakage accidents. She leaks primarily with coughing, sneezing and exercising. She has stopped

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C. Bacsu, MD
Island Health, 1952 Bay Street, Victoria V8R 1J8, British Columbia
e-mail: cd_bascu@yahoo.com

P. Zimmern, MD (✉)
Department of Urology, UT Southwestern Medical Center, Dallas, TX, USA
e-mail: Philippe.zimmern@utsouthwestern.edu

P.E. Zimmern, E.J.B. De (eds.), *Native Tissue Repair for Incontinence and Prolapse*, DOI 10.1007/978-3-319-45268-5_3

running because of leakage. She does not leak during sexual activity. She has some urgency but no urge incontinence. She denies any other urological symptoms, specifically no history of urinary tract infections and no hematuria. She does not complain of any vaginal bulge but feels pressure at times vaginally. She gets up once at night on average and does not wear pads at night. She had four pregnancies, with vaginal deliveries. No leakage was reported during pregnancy and she had a relatively easy delivery with no need for forceps. She has regular periods, and negative pap smears.

On examination, she had anterior vaginal wall mobility with Aa: −1, TVL: − 9 and C: − 6, and Ap: − 2. A well repaired right sided episiotomy was noted. She had strong pelvic floor muscles and performed a good Kegel contraction. Stress test was performed at 300 ml and confirmed stress leakage. Her flow after the stress test was normal with a bell shaped curve, Qmax at 28 ml/s and she had no post-void residual by bladder scan.

Urogenital Distress inventory short form confirmed a score of 2 for questions 1 and 2 on frequency and urgency and a score of 3 for question 3 on stress incontinence. Incontinence Impact Questionnaire short form (IIQ-7) ranged from 1 to 2 for most questions, with a score of 3 for the last item (question 7) on frustration. A global quality of life questionnaire on her bladder condition [VAS QoL with a scale from 0 (pleased) to 10 (terrible)] was at 8, confirming the impact of incontinence on her everyday life style.

Her standing voiding cystourethrogram (VCUG) confirmed a moderate degree cystocele with urethral hypermobility when comparing rest and strain views. Normal urethra configuration was observed during voiding and no post-void residual was seen. Given her stress predominant incontinence, and normal voiding pattern by flow and VCUG, an urodynamic study was discussed but not recommended.

Then because of her high level of bother by self-report and by questionnaires, strong pelvic floor musculature, and desire to avoid any mesh replacement at her age in life, a simple vaginal procedure to support her mobile anterior vaginal plate to restore bladder neck and bladder base supports was offered to her. Pelvic floor therapy and vaginal dishes were discussed with her but she was looking for a definite therapy at this stage. As a teacher, she made plans for surgery during the summer break and was counting on her family to be around at that time to assist with the care of her children during her post-operative recovery period.

Indications

Anterior vaginal wall suspension (AVWS) is indicated in women with:

– Stress urinary incontinence secondary to urethral hypermobility alone or in association with a cystocele as illustrated in our Case presentation.
– Recurrent stress incontinence following anti-incontinence surgery where urethral hypermobility is confirmed.
– Cystocele (mild/moderate anterior compartment prolapse, associated with lateral defects; a central defect cystocele is not an indication for this procedure) after prior bladder neck or mid-urethral sling placement for incontinence.

The AVWS is not indicated in the treatment of SUI due to intrinsic sphincter deficiency with a well-supported urethra. In women who have ISD but also have a symptomatic cystocele, the AVWS procedure may be combined with an autologous pubovaginal sling.

The AVWS can be performed in women regardless of whether there is uterine descent.

– If uterine descent is beyond the distal 3rd of the vagina, a vaginal hysterectomy is recommended.
– If the uterine descent does not extend to the level of the distal 3rd of the vagina, Pap smears are negative and pelvic ultrasound is normal with no evidence of ovarian pathology, uterine preservation with AVWS can be considered if the patient accepts follow-up routine gynecological examinations and a low risk of secondary hysterectomy (13 %) [1].

AVWS is very suitable for obese women since the morbidity of vaginal surgery is much less than for an abdominal or retropubic approach. In addition, AVWS can be considered in women on steroids, with neurogenic bladder like Multiple sclerosis, or on immunosuppression after renal, lung, or liver transplant.

Risks/Outcomes

Pre-operative Counseling

Surgical consent is attained after a comprehensive discussion of the mechanism of stress incontinence and anterior compartment prolapse, review of the surgical procedure, alternative treatment options, and potential complications.

Intraoperative Complications

Generally, the AVWS is a safe and well-tolerated procedure lasting around 45–60 min. Bleeding and bladder injury can occur during the retropubic dissection. Cystoscopy with a 70° lens is essential to ensure there is no bladder injury that has occurred during the transfer of the suspension sutures using the ligature carrier passed under direct fingertip control. The risk of bladder perforation due to ligature passer is estimated at 1.6 % [2]. If a blue polypropylene suture is visible in the anterior bladder wall, the suture needs to be pulled out vaginally. Then the ligature passer should be redirected more laterally and the suture retransferred from the vaginal area to the suprapubic region. The defect left by the suture perforation in the bladder wall seldom bleeds and its anterior location is of no concern for a potential secondary vesico-vaginal fistula. The urinary catheter can be left in for a couple of extra days depending on the extent of injury. The risk of ureteric injury is extremely low. This is due to the fact that the sutures are placed beneath the vaginal wall, thus not affecting the trajectory of the ureters. Ureteric patency is confirmed by the presence of ureteric jets bilaterally on cystoscopy. Visualization of the jet can be aided by the intravenous injection of dye.

Early Post-operative Complications (Within 30 Days)

In a recent long-term series, early post-operative complications included urinary tract infection 3.3 %, early urinary retention requiring indwelling catheterization for 5–7 days 2.4 %, vaginal candidiasis, wound infection/seroma, retropubic discomfort and constipation [3].

Delayed Complications

The long-term complications of AVWS are minimal. Vaginal width and length are well preserved, and pelvic pain/dyspareunia are exceptional if absent pre-operatively [4].

Possible complications include:

- Suture extrusion along the anterior vaginal wall, which can be remedied by simply cutting the vaginally exposed suture. Once the retropubic scar is present, the support achieved early on by these suspension sutures is no longer necessary. Cutting the exposed suture placed with no or little tension will not affect the restored support of the anterior vaginal wall plate. This can be done as early as 3 months post-operatively with no untoward consequences. We have seen late extrusion up to 10 years after the surgery, often asymptomatic, sometimes causing vaginal discharge, rare bleeding, or recurrent vaginal candidiasis. A lighted vaginal speculum exploring the whole anterior vaginal wall all the way up to the well-supported apex is needed to recognize and correct this simple issue.
- Recurrent stress urinary incontinence is very rarely related to recurrent urethral hypermobility and is most often due to secondary ISD. As seen in our long-term series over 15 years, injectable agents can be considered as well as autologous fascial sling in more severe incontinence cases. Because the procedure does not affect the urethra directly or change the voiding dynamics, secondary detrusor overactivity is infrequently observed. When it does, it is important to look first for another etiology than the AVWS procedure itself. In our series, there was a rate of repeat surgery for SUI at 4.7 % [2] in cases where the uterus was preserved [1]. There was an 8 % rate of de novo urgency incontinence with diuretic use being a poor prognostic factor.
- Recurrent pelvic organ prolapse which can involve the anterior compartment, another compartment or multiple compartments: three recent series explored

this risk [1, 3, 5]. There is no doubt that early stage anterior compartment prolapse fares better than more advanced stages. However, even in cases of vaginal eversion or advanced stage anterior compartment prolapse associated with vault prolapse, this procedure can be considered as long as it is combined with additional repairs to suspend the vaginal vault and correct the posterior compartment prolapse at the same time.

Surgical Technique [6]: (Refer to Video 3.1 Anterior Vaginal Wall Suspension (Zimmern P))

- *POSITIONING*
  - Patient is placed in dorsal lithotomy position after general anesthesia with compression/pneumatic stockings placed for DVT prevention and pressure points padded to avoid neuropraxia. Lower abdomen, perineum and vagina are prepared and draped.
  - A Lone Star/self-retaining ring retractor is positioned to facilitate exposure.
  - Head lamp is imperative and reverse Trendelenburg positioning will aid in visualization.
- *VAGINAL INSPECTION AND MEASUREMENTS*
  - Vaginal length is measured as well as vaginal width. The typical vaginal length is 8–9 cm. It is easy to divide the anterior vaginal plate in thirds. The first or distal third generally extends from the urethral meatus to the location of the bladder neck. The middle third goes from bladder neck to the mid-portion of the upper anterior vaginal wall plate. The upper third goes to the cervix if present or to the scar at the vaginal apex.
    This case started after completion of an LAVH. The sutures on the cardinal ligaments were tagged and left long. The vaginal cuff was closed (Images 3.1 and 3.2)

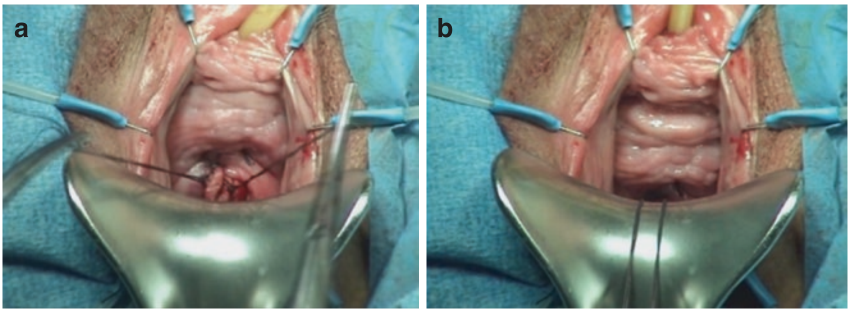

Image 3.1

– Bladder neck level on the anterior vaginal wall is marked with a marking pen after placing a Foley catheter with 10 cc into the balloon to identify the location of the bladder neck (Image 3.2.) This anterior vaginal wall marking indicates the distal limits of the anterior vaginal wall plate. No suture should be placed distal to that point in order to avoid any urethral distortion or obstruction during this procedure

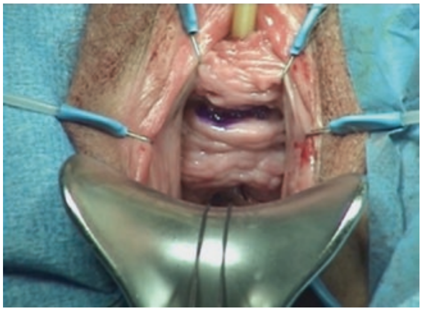

Image 3.2

– Marking absorbable sutures are placed laterally at the right and left sides of the apex of the vagina/cervix to delineate the proximal or upper limit of the anterior vaginal plate. These sutures are placed at the level of the dimples left by a prior hysterectomy or in case of a uterus, just cephalad to the cervix and at the junction between the anterior vaginal wall transverse ridges and the shiny lateral vaginal wall area of detachment (vaginal sulcus). Pulling on these marking sutures may help in determining the degree of support of the vaginal apex or cervix (Images 3.2 and 3.3 sutures coming over the speculum).

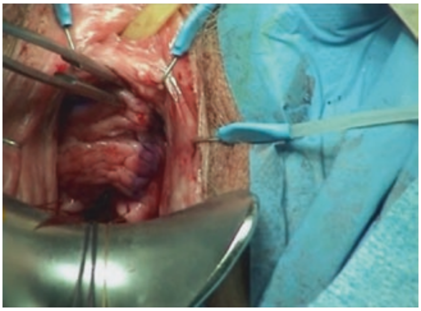

Image 3.3

• STEP 1: Vaginal incisions

– A longitudinal (vertical) vaginal incision is marked (Image 3.3) starting 1.5–2 cm lateral to the bladder neck on the anterior vaginal wall and that incision is extended proximally to just lateral to the anchoring marking suture at the vaginal apex on the same side (Image 3.4). This incision is located about 1 cm medial to the vaginal sulcus to allow upward elevation of the anterior vaginal plate later on (Image 3.4).

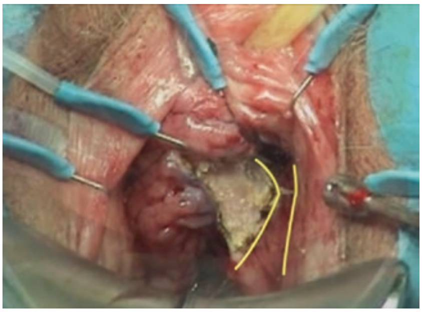

Image 3.4

- Another vaginal incision is made on the contralateral side in a similar fashion (Image 3.5). Sometimes, when there is vaginal wall redundancy, the incision is helped by placing a retracting hook on the medial edge of the incision to help expose the lateral sulcus (Images 3.5 and 3.6). The incision can be made with a blade or with a long tip bovie cautery (See Chap. 2) using the cutting element (Images 3.5 and 3.6).

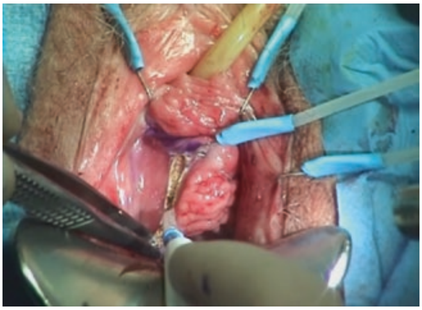

Image 3.5

Image 3.6

- STEP 2: Suture placement (for a right handed surgeon)

– After the vaginal incisions have been made bilaterally, a marking pen is used to mark the mid-portion of the anterior vaginal plate (Image 3.7). The plate is typically trapezoidal in shape, ie larger at the apex and narrower distally at the bladder neck level. When the anterior vaginal plate is longer than in this case, a transverse line can be drawn marking the separation between the mid and upper third sections of the anterior vaginal plate, thus delineating 4 quadrants for the placement of four individual anterior vaginal wall suspension sutures.

– In this case, only one set of suspension suture will be used on each side because the anterior vaginal plate is rather short. So, next, one set of non-absorbable sutures (No. 1 polypropylene sutures, CT-2 needle) are placed on each side to serve as support of the anterior vaginal wall, analogous to a needle suspension procedure. The important point here is that the suture should not be passed over and over in one location as it will likely pull-through as it was done in the original four corner suspension procedure described by Raz. Instead, as shown as the most reliable technique for permanent suture anchor in an animal model [7], the suture should be passed

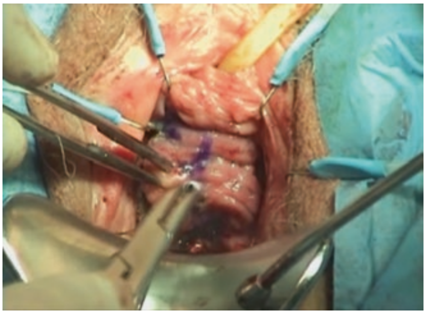

Image 3.7

underneath a broad area of vaginal wall to provide for a strong durable anchor. Therefore, each suture is passed in an overlapping/helical fashion on each side. The start of the needle passage is to secure the cardinal ligament complex (Images 3.8 and 3.9); each pass is placed full thickness into the anterior vaginal wall sparing the vaginal epithelium, and is positioned so that each needle passage overlaps with the preceding pass. Now the suture is advanced for a second pass halfway between the entry and exit site of the prior pass, to allow a helical advancing progression (Images 3.10, 3.11, and 3.16 beginning and end of second pass). Third pass is ending up at the bladder neck level (Image 3.12). Typically 2–3 passes are needed on each side to secure a broad segment of anterior vaginal wall (Image 3.13 for securement on the left side and Images 3.14 and 3.15 for securement on the contralateral side).

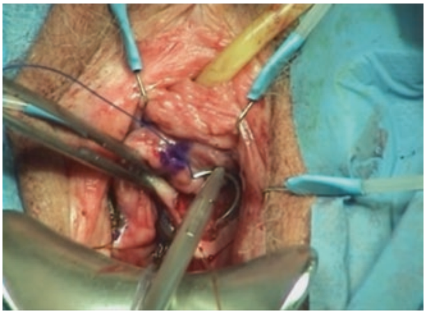

Image 3.8

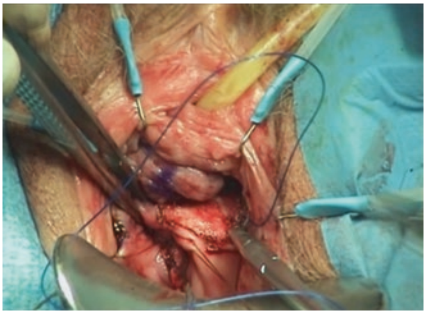

Image 3.9

– In case of two sets of suspension sutures on each side (Image 3.16), the first bite starts at the cardinal/uterosacral ligament complex or apical scar to provide apical support, and then extends to the middle marking by adding a few additional passes of the needle which is seen passing beneath the vaginal wall from the edge of the incision to the midline marking to secure enough supporting tissue. The 2nd suture on the same side is started at the mid vagina, overlapping the end of the first suture, and ends just lateral to the bladder neck after 2–3 passes of the needle in a helical fashion. Then the same procedure is repeated on the opposite side starting from the bladder neck going down to the cardinal ligament at the vaginal apex.

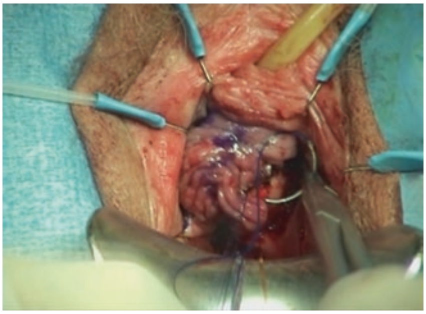

Image 3.10

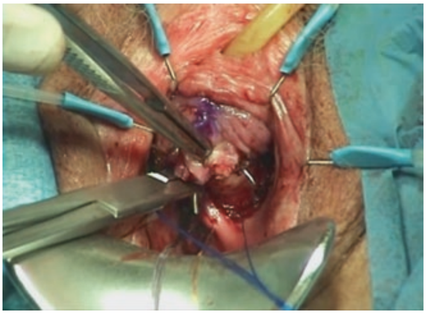

Image 3.11

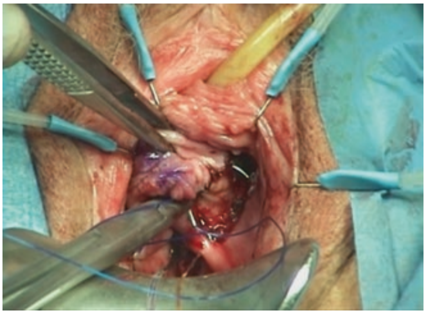

Image 3.12

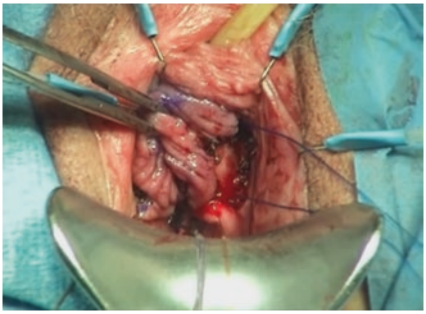

Image 3.13

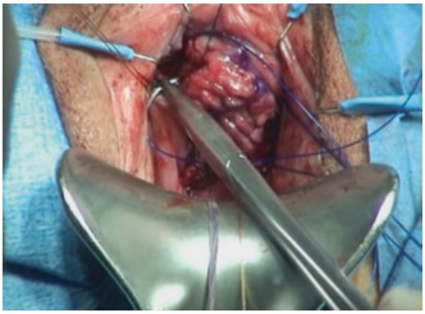

Image 3.14

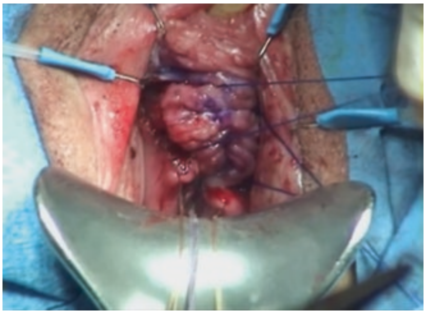

Image 3.15

Image 3.16

- STEP 3: Suprapubic incision
  - A short (2 cm) midline horizontal incision is made approximately one finger-breadth above the symphysis pubis (Images 3.17 and 3.18), away from the trajectory of the ilio-inguinal and genito-femoral nerve branches going to the mons pubis. This incision is deepened to expose the tendinous portion of the rectus fascia at the back of the pubic bone. This incision will allow direct passage of the ligature carrier under fingertip guidance later on.

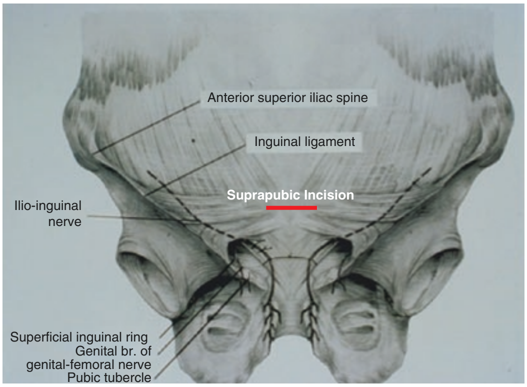

Image 3.17

Image 3.18

- STEP 4: Retropubic dissection
  - So far, none of the steps of this procedure should have caused much bleeding. This is why they are done first. Now comes the dissection of the retropubic space to accomplish several goals, including the transfer of the suspension sutures without bladder injury and the elevation of the anterior vaginal plate without any tension. After ensuring the bladder is completely empty by suctioning of the Foley catheter, blunt and sharp dissection are used to perforate the endopelvic fascia and develop the retropubic space with finger dissection on each side using a sweeping motion of the index finger alongside the surface of the obturator internus (Image 3.19). This step follows the plane of lateral detachment and should not encounter much resistance unless a prior retropubic dissection for a Burch or an

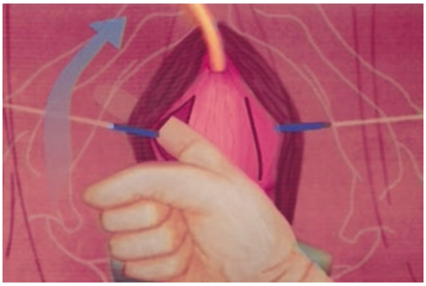

Image 3.19

MMK procedure has been done before. The risk of bleeding comes from travelling too lateral into the obturator muscle itself or tearing large retropubic venous plexuses displaced by the finger motion. One should always be ready to transfer the sutures expeditiously if this happens, with each set of suspension sutures passed in each eye of the ligature carrier to speed up the process and avoid a second retropubic pass of the ligature carrier. The sutures can then be recovered suprapubically and secured to the tendinous portion of the rectus fascia with a free needle later on or tied to each other.

Image 3.20

- STEP 5: Transfer of suspension sutures from vagina to suprapubic region
  - In the absence of much retropubic bleeding, which is generally the case, there is time for two passes of the ligature carrier on each side, thus allowing a small space of tendinous fascia between each suture arms. Under fingertip guidance, the double prong (see Chap. 2) ligature carrier is guided from the suprapubic incision down into the vaginal incision (Image 3.20). The ends of the suspension sutures are passed through the eyes of the ligature carrier (Image 3.21), which is then withdrawn suprapubically. Once the sutures have been transferred (Image 3.16 showing two suspension suture sets on each side), a cystoscopy can be performed if there is any concern for a bladder injury during this transfer; If not, the cystoscopy can be done later and the vaginal incision can now be closed with a running absorbable suture (Image 3.22) starting from apex towards bladder neck area. After the incision is closed on one side, the same retropubic dissection can be done on the contralateral side, the sutures transferred, and the second vaginal incision closed in a likewise manner.

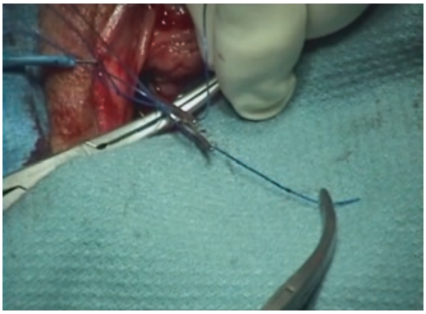

Image 3.21

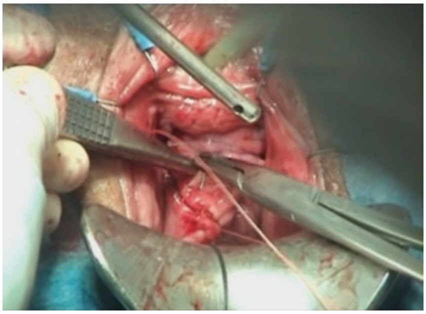

Image 3.22

- STEP 6: Cystoscopy
  - At this point, if a cystoscopy has not been done yet, it should be performed after administration of IV dye if necessary (Image 3.23), with both a 30 and 70° lens to inspect the anterior bladder wall, or a flexible cystoscope.
  - The purpose of cystoscopy is to ensure no suture entry anteriorly with a 70° lens and to confirm ureteral patency. Then the Foley catheter can be replaced.

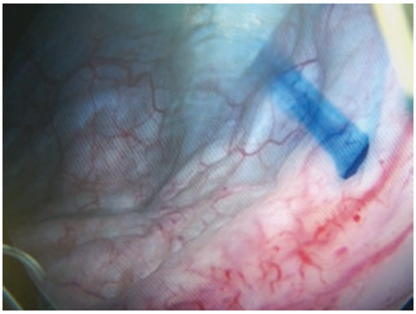

Image 3.23

- STEP 7: Tying of suspension sutures

– If the patient was in Trendelenburg position, it is time to return her to a flat levelled position.

– To provide support of the anterior vaginal wall plate but avoid overtightening and overcorrection, a rubber shod right angle clamp is placed along the course of the suspension sutures at 1.5–2 cm above the tendinous portion of the rectus fascia (Images 3.24 and 3.25).

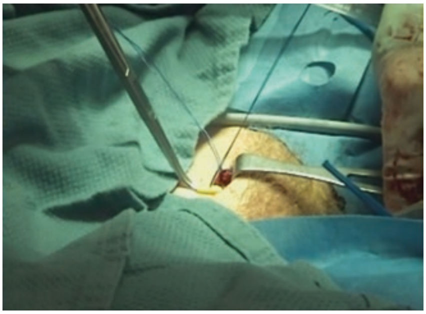

Image 3.24

Image 3.25

– The vaginal finger can confirm the lack of overcorrection of the anterior vaginal wall which should always keep a natural posterior direction with the superior portion resting over the levator plate (Image 3.26). This is important to avoid changing the direction of forces in the vagina and unmasking a posterior compartment defect. Vaginal size/length is confirmed unchanged

Image 3.26

compared to the start of the procedure. This is important to avoid affecting sexual function (Image 3.27).

– Once the four sutures are tied, the ends can be divided above the knots. The suprapubic fat is then gently pulled over the suture ends to avoid any palpable feel of these sutures over the suprapubic region later on.

– It is best to err on a loose support as patients under anesthesia do not have resting tone and it is easy to overcorrect this anterior vaginal wall support by tying the suspension sutures too tight (Image 3.25). Our long-term experience with VCUG obtained at 6 months postoperatively when the healing process is over clearly demonstrates very adequate restoration of urethral support and bladder base once the retropubic scarring has taken place. In fact, these suspension sutures are only necessary during the initial steps of healing (2–3 months) and can always be removed afterwards without risking any recurrent prolapse of the anterior vaginal wall compartment.

Image 3.27

Image 3.28

– An antibiotic soaked vaginal pack is inserted to prevent secondary bleeding. It can be removed the next day with the Foley catheter.

• STEP 8: Closure of suprapubic incision

– After irrigation and rechecking of hemostasis, the suprapubic incision is closed in layers using absorbable sutures and the skin edges are approximated with steristrips (Images 3.28). A small telfa tegaderm can be placed on top.

Post-operative Care Recommendations

Patients are generally hospitalized overnight and discharged home the following morning after vaginal pack and Foley catheter are removed. A voiding trial to document sufficient bladder emptying (at least > 50 % of bladder volume) is verified with a bladder scanner prior to discharge. Occasionally, those who need to strain to void, empty poorly, or cannot void at all are discharged home with a urethral catheter left indwelling for 3–5 days.

Patients are invited to take stool softeners to avoid constipation post-operatively and minimize exposure to people with flu symptoms to avoid excessive coughing. Those with allergies are usually carefully monitored and treated if needed to avoid strong cough spells as well. Patients are told to avoid swimming pools, bath-tubs, use of tampons, sexual activity, lifting > 10–15 lb, long car rides, or high impact aerobic exercise in the first 4–6 weeks after surgery to facilitate undisturbed vaginal healing. Patients are counselled that vaginal discharge is normal in the peri-operative period. Antibiotics are prescribed only in case of urinary tract infections or rarely for skin changes suggesting early cellulitis forming around the suprapubic incision.

Mid–Long Term Results

Over the past 20 years, several studies have been devoted to studying the outcome of this procedure. The initial report dates back to Dmochowski et al. [8], followed by an anatomically based outcome study in 2001 using a standing VCUG at 6 months post-operatively to assess return to adequate urethral and bladder base support on these follow-up imaging studies. Each patient in that study was age-matched to a control patient who underwent a VCUG for a non-SUI or prolapse related condition [9]. Then Lemack et al. also studied the impact of the AVWS on sexual function and found preservation of sexual activity with no negative effect among those who were sexually active pre-operatively [4]. Since then, a prospectively maintained database was started at our institution for all women undergoing AVWS procedure. The data was entered retrospectively from 1996 to 2004 and prospectively afterwards.

Patients have been assessed pre- and post-operatively with a detailed history, physical examination, validated questionnaires (Urogenital Distress Inventory-6 {UDI-6}, Visual analogue quality of life score {VAS QoL}), standing lateral voiding cystourethrogram (VCUG) pre and post operatively at 6–12 months comparing urethral angle at rest, urethral angle at strain (to quantify urethral hypermobility) and degree of the cystocele with lateral height (in centimeters).

In a cohort of our patients with SUI and early stage anterior compartment prolapse, 213 women met the inclusion criteria for review from 1996 to 2011 [10]. POP Q scores of Aa and Ba points, questionnaire results and Quality of life scores improved postoperatively and remained stable over time (Table 3.1). Only 12 (6 % of women) received additional therapy for recurrent stress urinary incontinence at a median follow-up of 3.5 years (range: 1.2–10.3 years) which translates into 94 % of patient not requiring repeat treatment for stress incontinence recurrence (Fig. 3.1).

Table 3.1 Mixed model least square means for follow-up period mean score comparison [10]

		Baseline		Follow-up period mean			
	Patients	Mean	p-value	1–3 Years	3–5 Years	>5 Years	p-value
Physical exam				(n=197/213)	(n=80/177)	(n=73/147)	
Aa (−3, +3)	213	−1.0	0.0003	−2.8	−2.8	−2.7	0.1913
Ba (−3, +8)	213	−2.8	0.0003	−2.8	−2.7	−2.7	0.3462
Questionnaires				(n=113/122)	(n=45/99)	(n=41/88)	
UDI 6 Total (0–18)	122	8.2	0.0045	4.0	4.6	5.1	0.0936
UDI Q2 (UUI) (0–3)	122	1.6	0.0251	0.8	0.9	1.3	0.1112
No OAB treatment	107	1.6	0.1248	0.8	0.9	1.2	0.2223
OAB treatment	15	1.5	0.0092	1.0	1.5	1.7	0.2174
UDI Q3 (SUI) (0–3)	122	1.7	0.0023	0.6	0.7	0.9	0.0396[a]
UDI Q5 (Empty) (0–3)	122	1.0	0.0008	0.5	0.6	0.5	0.6151
				(n=113/120)	(n=45/97)	(n=41/87)	
QoL (0–10)	120	6.2	0.0005	2.2	2.7	2.8	0.2182

UUI urge urinary incontinence, *SUI* stress urinary incontinence, OAB overactive bladder
[a]1–3 years follow-up and >5 years follow-up is significantly different, $p<0.05$

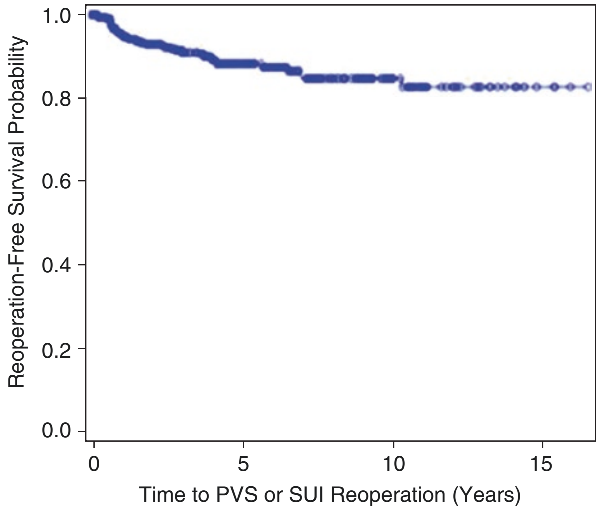

Fig. 3.1 Kaplan-Meier Curve for Overall Pubovaginal sling (PVS) or Periurethral injection (PUI) Reoperation-Free Survival [10]

We have also prospectively assessed another cohort of women with symptomatic stage 2 anterior compartment prolapse who underwent AVWS alone and had at least 1 year follow-up. Failure was defined as stage 2 or greater prolapse recurrence on examination or reoperation for symptomatic pelvic organ prolapse. From 1996 to 2014, 121 women met study criteria with a mean follow-up of 5.8 years (±3.7 years). Recurrence rates were isolated anterior at 7.4 %, isolated apical at 10.7 %, isolated posterior at 8.3 % and multiple compartments at 19 %. Of the patients with isolated anterior compartment recurrent, 3.3 % required surgery for their anterior prolapse symptoms at 0.2–2.7 years. The majority (73 %) of the secondary prolapse recurrences occurred beyond 1 year of follow-up, highlighting the importance of long-term follow-up [2].

Finally, in our series of women who underwent AVWS and met criteria for uterine preservation between 1996 and 2012, 52 women had a mean follow up of 55 months (range 12–175, median 44 months). Seven (13 %) underwent a subsequent hysterectomy for uterine prolapse at 7 months to 6 years post-operatively [1].

Advantages

The AVWS restores the anatomical support of the anterior vaginal wall and eliminates urethral hypermobility. Unlike some other anti-incontinence procedures, voiding function is not altered at the expense of establishing continence. Subsequent procedures like autologous pubovaginal sling and abdominal procedures such as mesh abdominal sacrocolpopexy can be performed without increased difficulty if indicated after an AVWS. The AVWS has great versatility as it allows for the option of uterine preservation or additional procedures (hysterectomy, apical suspension, autologous sling procedure). The procedure preserves sexual function by maintaining the vaginal axis, length and width. In a recent analysis at our institution of data collected in 2013 and 2014, the procedure was cost-effective based on operative materials, surgical time and short recovery period [11] over other existing anti-incontinence procedures. Also the steps of the procedure as outlined in this chapter are very standardized and easy to teach to trainees. The AVWS is safe, conceptually simple, has limited peri-operative morbidity, and allows the use of native tissue to obtain durable anterior compartment repair outcomes.

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Chapter 4
Burch Colposuspension

Ajay K. Singla and Nirmish Singla

Abstract The surgical management of stress urinary incontinence (SUI) in women has evolved over the last several decades, with bladder neck suspension procedures representing the oldest approach. The Burch colposuspension in particular was originally introduced in 1961 and has since undergone modification in technique, most recently with the introduction of robotic approaches. With the recent rise in litigation and concerns over vaginal mesh, there has been renewed interest in bladder suspension procedures. Outcomes remain promising for this technique, based on its long-term efficacy and durability. In this chapter, we present an index patient with SUI who experienced favorable outcomes following Burch colposuspension. We discuss surgical indications, patient counseling, intraoperative techniques, postoperative considerations, and contemporary outcomes using this approach. In the accompanying video supplements, we provide an open Burch colposuspension as well as an illustrative example demonstrating a robotic Burch colposuspension.

Keywords Stress urinary incontinence • Bladder suspension • Burch colposuspension • Retropubic suspension • Surgical technique • Outcomes

Background

Urinary incontinence is estimated to affect between 15 and 50 % of adult women [1]. Of incontinent women, stress urinary incontinence (SUI) predominates in approximately 50–80 % [2]. Two mechanisms of SUI have been recognized: (1) hypermobility of the proximal urethra and bladder neck due to weakened urethral support with an otherwise normal sphincter muscle, and (2) intrinsic sphincter deficiency (ISD)

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A.K. Singla (✉)
Department of Urology, University of Toledo, Toledo, OH, USA
e-mail: ajay.singla@utoledo.edu

N. Singla
Urology, UT Southwestern, Dallas, TX, USA
e-mail: nirmish@gmail.com

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resulting in poor urethral coaptation. The goal of surgery is to reposition the proximal urethra and urethrovesical junction in cases of hypermobility or to correct urethral coaptation in cases of ISD. It is not uncommon to exhibit some combination of both types of SUI. Hypermobility may be present on physical examination without SUI, as seen in many women following multiple vaginal deliveries, while some element of ISD may be evident if leakage is demonstrated with stress.

The mainstay of SUI treatment is surgery, though we continue to lack an ideal procedure for this problem. There has been an evolution in the surgical management of SUI over the last several years with the emergence of various slings. Open retropubic bladder suspension remains the oldest SUI procedure with robust longitudinal data available. Three variations of bladder neck suspension procedures have been described:

1. Marshall Marchetti-Krantz (MMK) procedure
2. Burch colposuspension
3. Paravaginal repair or Obturator Shelf procedure

In the late 1990s mid-urethral slings were introduced as a less invasive alternative and became very popular because of short operative time, quick recovery and decreased morbidity relative to open abdominal procedures. Recent anti-mesh publicity and FDA warnings concerning potential mesh complications, however, have led to resurgence of the Burch procedure, as patients increasingly desire mesh-free surgery.

The Burch procedure was originally described in 1961 by attaching the paravaginal tissue to the arcus tendineus [3]. The point of fixation was later shifted to Cooper's ligament, with additional modification described by Tanagho in 1976 [4]. More recently, minimally-invasive approaches including laparoscopic and robotic Burch colposuspension have been described, reducing the morbidity of the traditional open procedure.

Case Presentation

History and Physical Examination

Our patient is a 42-year-old G3P3A0 female (all vaginal deliveries) who presents with progressively worsening SUI over the last few years. She denies any urinary frequency, urgency, dysuria, or hematuria, and her history is not suggestive of voiding dysfunction. She denies any prior abdominal surgeries. Her urinary leakage is primarily prompted by abdominal straining including coughing, laughing, and sneezing. She uses 2–3 pads per day and maintains an active lifestyle. Her incontinence is very bothersome to her and negatively impacts her quality of life. She has tried pelvic floor (Kegel) exercises with no improvement.

Her pelvic examination reveals normal genitalia without pelvic organ prolapse. She is noted to have hypermobility of her proximal urethra and bladder neck on bimanual examination. A Q-tip test is positive with deflection of more than 30° during Valsalva.

A bladder diary shows frequency every 3 h during the day and nocturia twice over a 48-h period. Her urinalysis demonstrates no evidence of urinary tract infection.

Urodynamic study reveals a bladder capacity of 350 ml with normal bladder sensations and no evidence of detrusor overactivity. Abdominal Valsalva leak point pressure is measured at 96 cm H_2O, and SUI is demonstrated during the study. She is able to void to completion with both detrusor contraction and pelvic floor relaxation.

Surgical Indication

The ideal patient for the Burch colposuspension procedure is a young woman usually in her 20s, 30s and 40s preferably in pre-menopausal age group with pure hypermobility, high abdominal leak point pressures, and no prior anti-incontinence procedures. She should not have a history of postural incontinence, defined as urinary leakage with change in posture from the sitting position to standing position (this suggests poor sphincter function).

Surgical options were discussed with our patient, including mid-urethral sling using synthetic prolene mesh tape, periurethral bulking agents, pubovaginal fascial sling, needle suspension and retropubic bladder suspension (Burch).

Our patient declined procedures using synthetic mesh due to mesh concerns. Given her young age and pure hypermobility, Burch colposuspension was offered as an ideal alternative that would correct her hypermobility and restore the vesicourethral angle while avoiding the potential complications associated with synthetic mesh.

Patient Counseling

We counseled our patient regarding the various surgical options, including their risks and benefits. Benefits of the Burch colposuspension include the avoidance of synthetic mesh and excellent, durable long-term surgical outcomes. The procedure does entail slightly longer recovery time, however, and may risk complications including bladder or urethral injury, intra-operative bleeding, or urinary retention due to overcorrection. Patients should also be counseled regarding the temporary need for intermittent catheterization, the possibility of recurrent or persistent SUI, the risk of developing posterior segment vaginal prolapse i.e. enterocele and rectocele, and the possibility of de novo frequency and urgency.

Surgical Technique (Open) (Refer to Video 4.1 Retropubic Urethropexy (Zimmern P))

Anesthesia: A general anesthetic is preferred, but epidural anesthesia may be used if necessary.

Patient positioning: The patient is placed in a low dorsal lithotomy position with her legs abducted to allow vaginal access during the procedure. The lower abdomen and vagina are prepped with betadine and draped exposing both the vagina and lower abdomen.

A 22 Fr Foley catheter is inserted with 20 ml of sterile water instilled in the catheter balloon for easy identification of the bladder neck and urethra.

A low Pfannenstiel skin incision is made. The rectus fascia is incised and the rectus muscles are separated to gain access into the retropubic space. A self-retaining retractor (Balfour or Bookwalter) is used to gain optimal exposure. The peritoneum is reflected off the bladder and care is taken to avoid inadvertent entry into the peritoneal cavity. The dissection is carried into the retropubic space to expose the urethra and bladder neck. The fat is dissected off bluntly using a Kittner. Care is taken to avoid injuring the retropubic veins. The urethrovesical junction and urethra are identified by palpating the catheter; partially filling the bladder can also help outline the bladder base. The bladder is retracted with a bladder blade. An assistant stands between the patient's legs and tents the vagina either by using a gloved finger or a small malleable retractor. The fat overlying the periurethral space and vaginal wall are cleaned off completely, and the future site of suture placement is marked on either side of the bladder neck and proximal urethra using a skin marking pen or Bovie electrocautery. Care is taken to avoid injury to the large veins overlying the vaginal wall. If bleeding is encountered, they can be oversewn with 3-0 figure-of-eight vicryl sutures. Two sutures—preferably non-absorbable–are placed on each side. I find that 2-0 Gore-Tex double arm suture works well for this step. Next, the bladder neck and proximal urethra are retracted with a sponge stick to avoid injury to the urethra or bladder wall with suture. The first row of sutures is placed at the level of the bladder neck, incorporating the anterior vaginal wall and overlying fascia, but avoiding vaginal mucosa. A figure-of-eight stitch is placed to securely anchor the vaginal tissue and to bolster the suture from pulling through the tissue, while assisting with hemostasis. A second row of sutures is then placed approximately 1 cm distal to the first row of sutures.

Cystourethroscopy is carried out to rule out bladder or urethral injury, and intravenous dye can be administered to confirm patency of the ureters.

Next, attention is diverted to Cooper's ligament along the anterior surface of the pubic bone. The overlying periosteum is cleaned with the assistance of a Kittner to expose the white glistening thick ligament. One end of the anchored sutures is passed through the corresponding sites in Cooper's ligament. The other ends of these sutures are then passed through Cooper's ligament also using either the double arm needle or a free French-eye needle close to the previous suture pass. The authors prefer to place a sheet of Gelfoam® absorbable gelatin sponge between the sutures and lateral pelvic wall to help with hemostasis and future adhesion formation. The sutures are then tightened with adequate tension. A gloved finger in the vagina helps during suture tying. The goal is to approximate the anterior vaginal wall to the pelvic wall; it is not necessary to approximate it to Cooper's ligament. Overcorrection and excessive tension should be avoided, as doing so may theoretically risk the sutures pulling through the vaginal tissue.

The 22 Fr Foley catheter is then replaced by a 16 Fr catheter on conclusion of the procedure. Hemostasis is achieved, and the incision is closed in layers. No additional drain is necessary.

Surgical Technique (Laparoscopic/Robotic Burch Colposuspension) (Refer to Video 4.2 Robotic Burch (Singla A and Singla N))

With increasing applications of the robot, Burch colposuspension can also be performed in a minimally-invasive manner, either alone or in combination with laparoscopic or robotic hysterectomy. The anesthetic is general anesthesia. The robot is docked on the right side of the patient in low lithotomy position with two robotic arms placed on the right side and an assistant port and one robotic port on the left. The principal steps of the procedure remain the same. We have recently performed robotic Burch colposuspension in conjunction with robotic hysterectomy (See Video 4.2); this was a 24-year-old patient with SUI and grade 3 uterine prolapse who had three children and elected for hysterectomy.

Post-operative Monitoring

The patient is admitted overnight for observation. The catheter is removed on post-operative day 1. If the patient is unable to void or has a high residual urine volume (>200 ml), clean intermittent catheterization (CIC) is commenced, or a temporary foley catheter can be placed if the patient is unable or refuses to perform CIC. The patient is usually discharged from the hospital on the day after surgery and instructed to refrain from heavy lifting, exertion, or sexual activity for 6 weeks.

Results

There is extensive literature available on the long-term outcomes of the Burch procedure. Lapitan et al. [5] reviewed 53 trials involving 5,244 women who underwent open Burch colposuspension and reported overall cure rates between 68.9 and 88 %. Continence rates at 1 year were between 85 and 90 %, dropping to 70 % after 5 years. Additional evidence from 20 trials comparing Burch procedure with mid-urethral slings using polypropylene tape found no significant difference in incontinence rates. Laparoscopic Burch procedures have been shown to have comparable rates of 72 % in the long term (mean follow up of 52 months) as reported by Hong et al. [6]. Moehrer et al. [7] published a systematic review of four randomized controlled trials from the Cochrane Incontinence Review Group comparing laparoscopic and open Burch procedures. Their meta-analysis demonstrated no significant difference in the subjective cure rates ranging from 85 to 95 % in the laparoscopic group and 85–100 % in the open group with 18 months of follow up. The objective cure rates using urodynamics were found to be significantly lower in the laparoscopic group (RR 0.89, 95 % CI 0.82–0.98).

A multicenter randomized trial comparing pubovaginal sling using autologous rectus fascia and Burch colposuspension (SISTEr Trial) was reported in 655 women by Albo et al. [8]. A higher success rate with respect to stress incontinence in the sling group was reported at 24 months (66 % vs. 49 %), but slings were also associated with greater morbidity, such as harvest site pain and post-operative voiding dysfunction, urge incontinence and reoperation for sling takedown. At 2 years the urodynamic data showed both Burch colposuspension and pubovaginal sling were associated with similar decrease in flow rates but the sling group was associated with higher mean voiding pressures and higher bladder outlet obstruction index (BOOI); this was suggestive of an obstructive component in the pubovaginal sling group but not in the Burch group [9]. The 2 year multivariate analysis comparing quality of life (QOL) improvement in Burch colposuspension and fascial sling in 655 women showed that Burch had a higher improvement rate than the PVSling [10]. This finding was based on no reoperation for obstruction in the Burch group along with a lesser rate of urgency incontinence and urinary tract infections compared to the sling group. However, patient satisfaction rates for incontinence cure at 5 years using strict incontinence criteria were found higher in the sling group versus Burch urethropexy (83 % vs. 73 %, $p = 0.04$) [11].

A retrospective study comparing the effectiveness of transobturator tape (TOT) mid urethral sling and Burch colposuspension in 770 women with SUI concluded that the two procedures appear to be equally effective at 5 years [12]. In a trial that randomized 344 women to transvaginal tape (TVT) or Burch colposuspension, no statistically significant difference was noted between the two groups at 5 years follow up [13]. In another randomized trial comparing laparoscopic Burch colposuspension and TVT in 72 women, similar long term efficacy was reported between the two procedures at a median follow up of 65 months [14].

Patel et al. recently reported a small case series of their robotic Burch colposuspension technique [15]. They compared clinical outcomes between open and robotic Burch colposuspension in a retrospective case control study involving five patients in each group. All cases were performed by the same surgeon. All but one patient in each group experienced resolution of SUI. The authors concluded that the robotic approach may be equivalent to, if not better than, the open approach with regard to clinical outcomes. The robotic approach additionally facilitates quicker recovery, decreased hospital stay, and better visualization of the space of Retzius.

These results attest to the long term efficacy and durability of Burch colposuspension.

Conclusion

Burch Colposuspension is a traditional, time-tested, highly successful and durable retropubic bladder suspension procedure. Because of the FDA warnings regarding vaginal mesh and risk of potential complications from the use of vaginal mesh, more interest is growing in the Burch as an alternative surgical option (especially in patients who refuse mesh). With the advent of robotic technology, the morbidity from an open procedure has decreased and the Burch may now be offered as a minimally invasive outpatient procedure.

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Chapter 5
Autologous Fascial Sling for Female Stress Urinary Incontinence

Himanshu Aggarwal, Catherine Harris, and Gary E. Lemack

Abstract The autologous fascia pubovaginal sling remains an excellent choice for the treatment of female stress urinary incontinence (SUI), nearly four decades after it was first popularized. We contend that the autologous sling should be offered to all women considering surgical treatment for SUI as one of several available options. As one might expect, proper technique and training is required for an optimal outcome. This chapter focuses on indications, proper surgical technique, postoperative care, outcomes and adverse events of this procedure.

Keywords Autologous fascial sling • Stress urinary incontinence • Fascia lata • Rectus fascia

Case Presentation

This is a 68-year-old woman with history of abdominoplasty and single incision sling placement for SUI. She underwent transvaginal sling excision 3 years after its placement due to bladder outlet obstruction. Post-operatively she developed significant stress incontinence. She wears 5 heavy pads per day with minimal urgency and no recurrent urinary tract infections. Her stress incontinence has not improved with a regimented weight loss program, Kegel exercises, and fluid management at 1 year after sling removal.

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H. Aggarwal, MD, MS • C. Harris, MD
Female Pelvic Medicine and Reconstructive Surgery, Department of Urology,
University of Texas Southwestern Medical Center, Dallas, TX, USA
e-mail: himanshuaggarwal@uabmc.edu; catherine.harris@utsouthwestern.edu

G.E. Lemack, MD (✉)
Department of Urology, University of Texas Southwestern Medical Center, Dallas, TX, USA
e-mail: gary.lemack@utsouthwestern.edu

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Physical Examination

On physical exam, she was noted to be obese, with a BMI of 39. Her abdominal exam was only notable for a well-healed low transverse abdominoplasty scar. On pelvic exam, her vagina was well estrogenized, and her prior incisions were fully healed. She had stage I anterior prolapse. She had a positive cough stress test with no urethral hypermobility.

Cystoscopy

Cystoscopy was performed in this case given the history of mesh excision to exclude urethral or bladder erosion. She was noted to have a normal urethra and bladder, with no evidence of fistula, mesh or foreign bodies. Ureteral efflux was noted bilaterally.

Imaging

Voiding Cystourethrogram (VCUG) demonstrated leakage with straining, a normal bladder and urethra with complete bladder emptying (Fig. 5.1).

Urodynamics (UDS)

The urodynamic study demonstrated adequate bladder capacity of 300 ml with normal compliance, stress incontinence, and a differential valsalva leak point pressure of 60–65 cm H_2O. She voided with low pressure and normal flow with minimal post void residual.

Assessment and Plan

This is a 68-year-old obese female with a history of abdominoplasty and synthetic sling excision, now with recurrent stress urinary incontinence. Bulking agents were discussed with the patient but it was noted that this intervention had a lower likelihood of success overall than an autologous sling and she did not desire repeated treatments. Due to her prior abdominoplasty and obesity, there was concern regarding the accessibility and integrity of the patient's rectus fascia. Therefore, it was decided to proceed with a fascia lata sling.

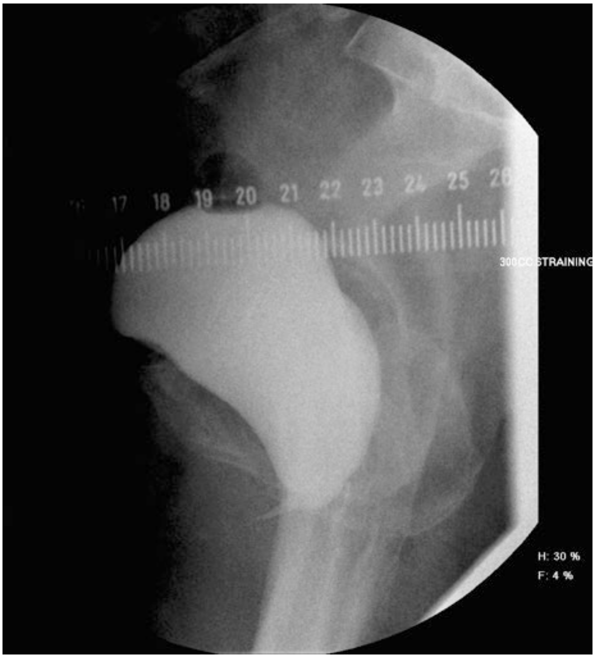

Fig. 5.1 VCUG: Demonstrating leakage with straining

Indications and Preoperative Evaluation for PVS

The autologous fascial pubovaginal sling (PVS) was initially introduced in the 1940s but was popularized by McGuire and Lytton in 1978 for patients with SUI resulting from intrinsic sphincter deficiency (ISD). While synthetic mid urethral slings (MUS) have become more widely used recently, and currently remain an appropriate treatment option for women with SUI, the recent FDA warnings have created increased scrutiny of all synthetics for use in prolapse or incontinence surgery, including MUS [1]. As such, the PVS has reemerged as a viable and well-studied treatment which, while having its own risks and complications, does avoid some of the risks inherent in the use of MUS. In our practice we offer autologous fascial sling as a treatment option for women who have demonstrable SUI on exam and who desire surgical treatment.

In uncomplicated patients, a urinalysis, physical exam, demonstration of SUI during pelvic exam, and assessment of post void residual (PVR) may be all that is necessary before offering therapy to patients [2]. It is imperative that SUI be demonstrated before any invasive procedure, such as PVS, is recommended as a treatment option. UDS may be particularly helpful in those patients who have failed prior surgeries in order to confirm the type of incontinence present, and to better assess voiding function, as well as those with mixed incontinence. Patients with significant detrusor dysfunction (underactive) at baseline may be at an elevated risk of voiding dysfunction/urinary retention postoperatively, and should be counseled on the possible need for clean intermittent catheterization (CIC) and/or further surgical procedures to address this concern, such as sling incision/urethrolysis.

Other indications for this procedure include use as an adjunct for urethral reconstruction, and even as a way to functionally “close” the urethra in situations where it is appropriate to consider abandoning voiding altogether. This might be reasonable, for example, in a patient with spinal cord injury who is reliant on intermittent catheterization, but who experiences leakage due to severe intrinsic sphincteric deficiency with transfers. Also, patients with stress incontinence who are undergoing either simultaneous or prior urethro-vaginal fistula or diverticulum repair may be candidates for this PVS [3].

Consent

A written informed consent is obtained with explanation of possible outcomes, adverse events and alternatives of this surgery. The main adverse event which may be quite bothersome and may occasionally require further surgery is the risk of developing prolonged voiding dysfunction. A small subset of patients may need to perform CIC if voiding dysfunction develops postoperatively though this typically resolves within 1–2 weeks. Persistent voiding dysfunction may require suture release or sling incision, and typically would be offered within 3–6 months of the procedure. Patients should also be counseled about the risk of de-novo urgency and frequency.

Surgical Technique (Refer to Video 5.1 Rectus Fascia (Zimmern P, Lee D, Dillon B) and Video 5.2 Fascia Lata (Zimmern P))

Preoperative Preparation

In compliance with AUA antibiotic prophylaxis guidelines, perioperative antimicrobial treatment should include a first or second generation cephalosporin or an aminoglycoside with clindamycin or metronidazole [4]. Patients should also receive deep vein thrombosis prophylaxis in line with the AUA guidelines and patient risk factors; pneumatic compression devices are generally sufficient [5]. Patient should be placed in the dorsal lithotomy position with close attention to all pressure points and prepped and draped in a standard sterile fashion. A 16 F urethral catheter is placed and the balloon is inflated. Attention is first turned to the facial harvest. The two most commonly utilized autologous slings are the rectus abdominis fascia or fascia lata graft slings. The rectus abdominis fascia sling is preferred by most surgeons due to a greater familiarity with the abdominal wall anatomy and the relative ease of harvesting. Both of these autologous slings have otherwise been shown to be equally effective [6].

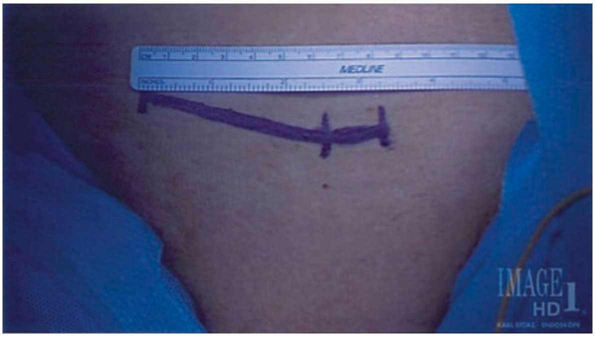

Fig. 5.2 Incision site for rectus fascia sling on the skin

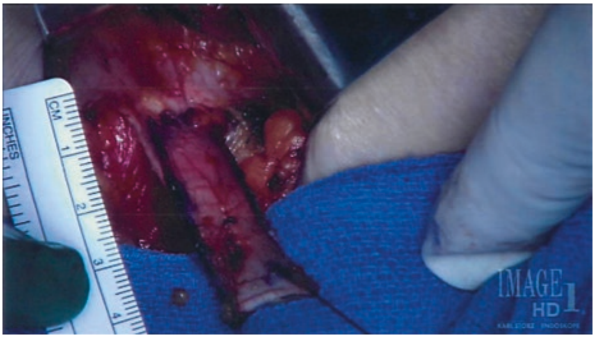

Fig. 5.3 Harvesting of rectus fascia

Rectus Fascia Harvest (Refer to Video 5.1 Rectus Fascia (Zimmern P, Lee D, Dillon B))

A 6–8 cm Pfannenstiel incision is made on the skin approximately 2–4 cm cephalad to the pubic symphysis, extending 3–4 cm on either side of the midline or 1 cm from midline to 6–8 cm on right or left side, depending on surgeon's preference (Fig. 5.2). The incision is carried down through subcutaneous tissue taking care not to cause any trauma to the rectus fascia. An area sufficient to expose the 2×6 cm rectus fascia sling is cleared of overlying adipose and connective tissue. The sling site should follow the direction of the rectus fibers and avoid extending laterally toward the internal inguinal ring or the ileo-inguinal nerve. After marking the sling harvest site, 3-0 absorbable suture is placed on each of the lateral long edges of the sling to minimize manipulation of the fascia (Fig. 5.3). The fascia for the sling is then incised and sharply freed from the underlying muscle. The fascial defect is then closed with running 1-0 poly-dioxanone suture. An injection of local anesthesia (Bupivacaine) may be given for pain control. One cm area cephalad to the pubis bone (and inferior to the fascial incision) is cleared of overlying adipose and connective tissue in the midline for later passage of the suture carrier. The wound is packed with saline soaked gauze and attention turned to the vaginal portion of the case.

The sling is prepared on the back table by sharply removing any remaining adipose tissue and a 1-polypropylene is passed through the lateral edges of the sling in

Fig. 5.4 Harvested rectus fascia with the sutures at each end

a horizontal mattress fashion. A single suture is used for each edge with the ends kept long for passage through the retropubic space and held with hemostat on each end (Fig. 5.4). The midline of the sling is marked. The sling is then wrapped in sterile saline soaked gauze and set aside. It is important to complete the sling preparation prior to commencing the vaginal portion of the procedure, particularly prior to breaking through the endopelvic fascia and entering the retropubic space, during which bleeding can be occasionally encountered.

Fascia Lata Harvest (Refer to Video 5.2 Fascia Lata (Zimmern P))

In morbidly obese patients, in patients with prior ventral hernia repair and in patients who have had prior abdominoplasty we prefer to harvest fascia lata from the thigh. We ask the patient what side does she usually sleep on and harvest the fascia lata from the opposite side. The thigh is generally prepped in with the general prep of the vagina and lower abdomen with the patient in the dorsal lithotomy position, and the fascia is harvested prior to proceeding with the vaginal incision.

A 2–3 cm longitudinal incision is marked 2 cm above the patella over the iliotibial band on the lateral side of the thigh. Dissection is carried down to the level of the fascia lata using electrocautery. We typically do not use a stripper device; however the Crawford fascia lata stripper can be used if one wishes to harvest longer strips of the fascia lata. The distal end of proposed fascia harvest site is transected using electrocautery or knife allowing one free end following which 3-0 absorbable sutures are placed on each end to minimize fascial manipulation. Using electrocautery/scissors, a 6 cm × 1.5–2 cm fascia can be harvested easily by lifting it off the underlying muscle. The harvest area is carefully evaluated for any bleeding before closure. A small Penrose drain is placed and brought out through the corner of the incision. The wound is irrigated and closed in two layers without closing the fascia lata. The skin is closed using 4-0 Nylon in an interrupted manner. The wound is dressed with a Telfa and Tegaderm and inspected at the end of the case for any bleeding.

Sling Procedure

The patient is placed in mild to moderate Trendelenburg position. A weighted speculum is placed in the vagina and a ring retractor (we prefer a Lone Star retractor) is used to expose the vagina. By placing traction on the Foley balloon the bladder neck is marked horizontally with a marking pen in the vagina. Saline or lidocaine with 1 % epinephrine is used by some for hydro-dissection. An inverted U shaped incision is made in the suburethral portion of the vagina extending to the bladder neck following the rugae. The vaginal flap is raised to the level of the bladder neck. It is important to stay in the correct plane as to not devascularize the vaginal flap.

At this point, the periurethral fascia is incised lateral to the urethra and dissection is carried out toward the ipsilateral shoulder to perforate the endopelvic fascia. Should bleeding be encountered with perforation of the endopelvic fascia, pressure with a sponge stick or digitally from vagina in combination with retropubic pressure can tamponade the venous bleeding. However, prompt placement of the sling and closure of the wound will generally control bleeding and prolonged attempts to stop retropubic bleeding from dissection and needle passage are discouraged. Therefore, prior to perforation of the endopelvic fascia, ensure that the sling is prepared. The bladder is emptied and the endopelvic fascia is perforated bluntly with the index finger sweeping medially to laterally and hugging the pubic bone until the bladder neck and proximal urethra are freed from their retropubic attachments and two finger tips can nearly meet each other (one from the suprapubic incision and one in the vaginal incision) with only fascia intervening. In the setting of significant retropubic scarring the endopelvic fascia may require sharp dissection with Metzenbaum scissors.

For passage of the sling a double prong needle passer (Pereyra-Raz Ligature Carrier™) is passed from the suprapubic incision, below the prior fascial harvest site, about one finger breadth lateral to the midline, to the vaginal incision. The needle should be palpated by the opposite index finger and directed out of the vaginal incision over this finger. The ends of the Prolene suture on the harvested fascial sling are passed through the eyes of the ligature carrier and pulled above the fascia. The same procedure is carried out on the contralateral side. If there is an extensive scarring in the retropubic space a single prong (Pereyra Ligature Carrier™) is passed using the same technique as above and both the ends of the Prolene suture are passed through only one eye of the ligature carrier. The urethral catheter is removed. A female cystoscope with a 30° lens is passed into the urethra and ureteral orifices checked for efflux bilaterally. The lens is changed to a 70° lens and the bladder filled to where there are no folds in the mucosa. The mucosa is inspected for perforation, with close attention to the anterior bladder wall from 10 to 2 o'clock position. Should a perforation be encountered, the sutures should be pulled out and the needle should be re-passed more laterally and the procedure be continued as planned, with rechecking of the bladder after each pass. After confirming no bladder entry, the urethral catheter is replaced. The suprapubic ends of the sutures are clamped with a hemostat and the sling is centered at the proximal urethra and secured to the peri-urethral fascia proximally,

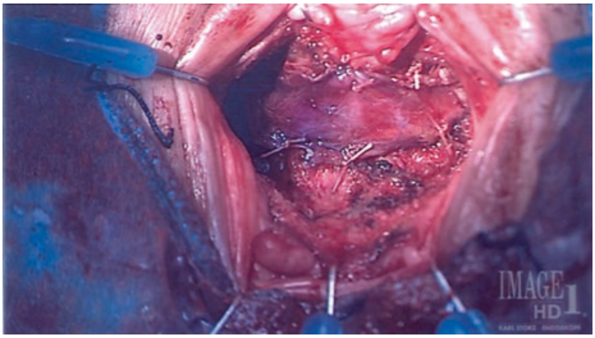

Fig. 5.5 Fascial sling centered at the proximal urethra and secured to the peri-urethral fascia

distally as well as laterally with of 4–5 interrupted 4-0 absorbable sutures to keep the sling flat against the urethra (Fig. 5.5). The vaginal incision is then closed with running 2-0 absorbable suture.

It is well accepted that autologous fascial sling can be more obstructive in nature as compared to Burch colposuspension procedure and tensioning of the sutures is more an art than a true science. A booted right angle clamp is applied to the sutures approximately 2 cm above the rectus fascia on each side and the sutures are tied. The sling should be placed loosely being careful not to tie the sling sutures down to the rectus fascia. However in patients who are already on CIC or who are willing to perform CIC and who have severe SUI with low VLPP, the sutures can be tied at the level of rectus fascia. When a single needle passer is used, the sutures are tied to one another with approximately two finger-breaths between the rectus fascia and the knot. The suprapubic incision is then closed using two layers of absorbable sutures and antimicrobial moistened vaginal packing is placed into the vagina.

Post-operative Care

The patient is typically admitted overnight for observation and pain control. The vaginal packing and Foley catheter are removed the next day and patient is allowed a trial of void. Patients who fail to void may need to go home with a catheter, typically for 5–7 days, and are instructed to return to clinic for catheter removal. Many transient causes of postoperative urinary retention are possible, such as local pain, edema, retropubic hematoma, and the effects of general anesthesia and narcotics on bladder function. Most patients regain spontaneous voiding within 1 week [7].

The leg drain is removed in patients with fascia lata harvest in 24 h and patients are instructed to return to clinic for suture removal in 10–14 days. Patients are sent home with stool softeners and a prescription for pain control however advised to use it minimally. We ask patients to refrain from exercise, lifting more than 10 pounds, sexual intercourse, and bathing (baths, hot tubs, swimming pools) for at least 4–6 weeks.

Mid to Long-Term Outcomes

The autologous fascial sling (PVS) has a long track record of providing excellent outcomes for the treatment of SUI. While outcomes vary considerably depending on the definition of success, multiple studies have shown that this is efficacious in 50–95 % of patients, depending on the length of follow up [8–19]. Even after a failed synthetic mid urethral sling, PVS is effective in curing SUI in up to 70 % of patients [20].

The best data in the form of level 1 evidence is available from the Stress incontinence surgical treatment efficacy trial (SISTEr) which was a NIH-sponsored multicenter randomized clinical trial comparing autologous fascial sling and the modified Tanagho Burch colposuspension in women with documented pure SUI or stress-predominant mixed incontinence for at least 3 months [21, 22]. Using a very strict, multi-component definition of success, at 24-months significantly more women in the autologous fascial sling group than those in the Burch group were considered to have a successful outcome (47 % vs. 38 %) ($p=0.01$), and success specific to SUI was noted in 66 % vs. 49 % ($P<0.001$) respectively. These findings were true irrespective of concomitant surgery for pelvic organ prolapse (POP). On extended follow up at 5 years, the overall continence rates were 24 % in the Burch and 31 % in the autologous fascial sling group ($p=0.002$) [23]. The very strict definition of successful outcome is largely to blame for the seemingly inferior outcomes in this cohort, along with the fact that women who were incontinent 24 months after surgery were much more likely to enroll for 5 year extension (E-SISTEr) (85.5 %) compared with those who were continent (52.2 %) ($p<0.0001$).

Patient reported satisfaction rates, perhaps more reflective of success in the minds of the patients, were significantly higher in the autologous fascial sling group than in the Burch group at 2 years (86 % vs. 78 %, $p=0.02$) [22]. At follow up of 5 years satisfaction rates did decline but remained higher in the autologous fascial sling group ($p=0.03$). Satisfaction was related to continence status and was higher in women in the autologous fascial sling group sling group, and was considerably superior to the rather low continence rates reported (83 % vs. 73 %, $p<0.04$) [23]. In a subsequent multivariable analysis of the same group, the quality of life improvement was found to be related to decrease in urinary incontinence (UI) symptom bother, greater reduction in UI severity, younger age, and Hispanic ethnicity [24].

Among women in the SISTEr trial, the risk factors for SUI-specific failure included greater preoperative urge incontinence symptoms (10 point increase in the urge score increased the odds of stress failure by 1.84 times), more advanced prolapse (stage 3/4 compared to stage 0/1), and being menopausal but not on hormone replacement therapy (HRT). A risk factor for non-SUI failure was the presence of higher preoperative urge scores (10 point increase in the urge score increased the odds of non-stress failure by four times). Women with higher preoperative stress scores were significantly less likely to have non SUI failures postoperatively, indicating those women with more pure forms of SUI were less likely to fail with urge symptoms postoperatively (10-point increase in preoperative stress score decreased the odds of non-stress failure by two times) [25].

Prolonged follow-up after PVS for both primary and secondary indications has also been reported. Among women evaluated for long-term follow-up (7 years) after PVS, patients who had primary fascial sling surgery for SUI and/or secondary fascial sling surgery after failed prior SUI surgery had comparable favorable functional outcomes with low morbidity. However, those undergoing secondary fascial sling surgery were more likely to need additional procedures [26].

Sexual function also appears to improve following PVS. Brubaker et al. noted that sexual function, as assessed by mean total score of PISQ-12, improved significantly from baseline at 24 months (32 ± 7 to 37 ± 6, $p < 0.0001$). Sexual function was significantly better (5.77 vs. 3.79, $p < 0.006$) following successful surgery. After surgery, fewer subjects reported incontinence during sex (9 % vs. 53 %, $p < 0.0001$), restriction of sexual activity due to fear of incontinence (10 % vs. 52 %, $p < 0.0001$), avoidance of intercourse because of vaginal bulging (3 % vs. 24 %, $p < 0.0001$) and negative emotional reactions during intercourse (9 % vs. 35 %, $p < 0.0001$) [27].

Adverse Events (AE)

At 2 years following autologous fascial sling surgery, the more common AE's included urinary tract infections (UTI) (48 %), voiding dysfunction (14 %) and urgency urinary incontinence (UUI) (27 %) [22]. Approximately 6 % patients required release of sling for persistent voiding dysfunction postoperatively. On postoperative urodynamics at 2 years after autologous fascial sling surgery, a decrease in non-instrumented flow (NIF) rate and increased detrusor pressure at maximum flow (Pdet@Qmax) with increases in bladder outlet obstruction index (BOOI) (change, sling +20.12) were reported, indicating a more obstructed voiding type picture, though PVR was not noted to be increased at that time point [28]. Interestingly, it was noted that women with successful outcomes after sling had greater increases in mean Pdet@Qmax from baseline compared with women who were failures ($p = 0.008$) suggesting some degree of increase outlet resistance was associated with improved incontinence outcomes [29]. Since sling sutures were tied well above the fascia for the SISTEr trial, with no intent to create tension and despite this there were significant increase in voiding pressure, we believe it is imperative to avoid over-tensioning at the time of PVS in the vast majority of patients.

Urinary tract infections are not uncommon after stress incontinence surgery. Overall, a third of women reported at least one episode of UTI in the first 6 weeks after surgery in SISTEr, regardless of concomitant surgery and the postoperative bladder emptying mechanism. Intermittent self-catheterization independently increased the risk of UTI [30].

With regard to post-operative urgency incontinence, about 18 % of patients who had no preoperative UUI developed de novo postoperative UUI after PVS. Overall 21 % of women required treatment for this postoperatively within 6 weeks of surgery. Preoperative urge symptoms, detrusor overactivity, and/or prior use of anticholinergic medications independently increased the risk of bothersome postoperative UUI [31].

Long term AE's can occur following PVS. At 5 years follow up 9% patients in the SISTEr study reported AE's and nearly all of these were recurrent UTI (36 events in 21 patients) [23]. Persistent voiding dysfunction has been reported in 4–10% after the pubovaginal sling procedure [32]. Various studies have reported sling incision [33], sling release [34], and ultimately the need of formal urethrolysis [32] for management of post sling voiding dysfunction.

Wound complications are rare following PVS procedures. In a review of 500 patients who underwent autologous fascial sling 1% patients had abdominal wound related complications ranging from seroma to wound infection to incisional hernia, most of which occurred in the early postoperative period [35].

Conclusions

The autologous PVS is an effective and safe option in the surgical management of female SUI. It can be performed with low morbidity and has clearly stood the test of time. The PVS should be in the armamentarium of all female pelvic medicine reconstructive surgeons as a treatment option for their patients with SUI.

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Chapter 6
Anterior Colporrhaphy

Jubilee C. Tan and Tracey Wilson

Abstract Anterior vaginal wall prolapse is defined as clinically evident descent of the anterior vaginal compartment. This may be the result of a midline, lateral or transverse fascial defect. Oftentimes, the patient does not experience symptoms until the anterior prolapse descends to the level of the introitus. Associated symptoms may include: pelvic pressure, palpation of a vaginal bulge, voiding difficulties (the need for positional voiding), urinary incontinence, and interference with sexual activity. Younger patients may complain of the inability to retain a tampon. Surgical correction of the anterior vaginal wall defect is indicated when the prolapse has a negative impact on the patient's quality of life.

The objective of the anterior colporrhaphy is to fold and tighten the layers of the vaginal muscularis and adventitia overlying the bladder (also called the pubocervical, pubovesical, or endopelvic fascia). This surgical procedure should be tailored to the specific site(s) of anterior compartment defect, and is most suited for the central (midline) defect. Patients should be assessed for stress urinary incontinence and other compartment defects, which can be corrected concomitantly.

When compared to non-native tissue repairs, the anterior colporrhaphy is associated with fewer complications. It does have a higher long-term failure rate but is the recommended procedure for patients with no history of prior repairs.

Keywords Cystocele • Anterior vaginal wall prolapse • Pelvic organ prolapse • Colporrhaphy

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J.C. Tan, MD
Instructor, Female Pelvic Medicine and Reconstructive Surgery, University of Alabama at Birmingham, Birmingham, AL, USA
e-mail: jctan@uabmc.edu

T. Wilson, MD (✉)
University of Alabama at Birmingham, Birmingham, AL, USA
e-mail: traceywilson@uabmc.edu

P.E. Zimmern, E.J.B. De (eds.), *Native Tissue Repair for Incontinence and Prolapse*, DOI 10.1007/978-3-319-45268-5_6

Case Presentation

A 60 year old woman presents with bothersome vaginal bulge and pressure. Her symptoms worsen as she remains on her feet throughout the day. She denies any stress urinary incontinence, obstructive voiding symptoms, bowel dysfunction, or dyspareunia.

Vaginal exam with straining demonstrates descent of the distal anterior vaginal wall to the level of the hymen (POP-Qa point Ba = 0, stage II anterior prolapse). She has loss of anterior wall rugae, consistent with a central defect. The uterus and posterior component are well supported (C = −7, Bp = −3). The anterior prolapse is reduced and no occult stress urinary incontinence is demonstrated.

She has not had any prior pelvic surgeries and informed consent is obtained for a native-tissue anterior colporrhaphy.

Indications for Procedure

Anterior vaginal wall prolapse is defined as clinically evident descent of the anterior vaginal compartment. In 1996, the International Continence Society, to standardize terminology on pelvic organ prolapse, suggested that the term "anterior vaginal wall/compartment prolapse" replace the commonly-used term "cystocele"[1]. The rationale was that on initial physical exam, the practitioner cannot determine with certainty the structure that underlies the anterior bulge, though in most cases it involves descent of the bladder base. Other pelvic organs that can herniate anteriorly include the urethra (urethrocele) or small bowel (anterior enterocele).

Three types of anterior vaginal wall prolapse were described by Richardson et al in 1976: midline defect, paravaginal defect, and transverse defect [2]. A **midline** defect results from weakening of the pubocervical fascia supporting the bladder base. Protrusion through a midline defect results in loss of the rugae, or vaginal folds, of the anterior vaginal wall (Fig. 6.1). A **paravaginal** defect involves separation of the lateral connective tissue from the arcus tendinous fascia pelvis (white line). Preservation of rugal folds is usually seen with this defect. A **transverse** defect involves separation of the pubocervical fascia from its insertion at the vaginal apex or cervix.

The objective of the anterior colporrhaphy is to fold and tighten the layers of the vaginal muscularis and adventitia overlying the bladder (also called the pubocervical, pubovesical, or endopelvic fascia). This surgical procedure should be tailored to the specific site(s) of anterior compartment defect, and is most suited for the central (midline) defect. For example, if a patient has both a midline and paravaginal defect, correcting only the central compartment has high likelihood of recurrence because the lateral defect remains unaddressed.

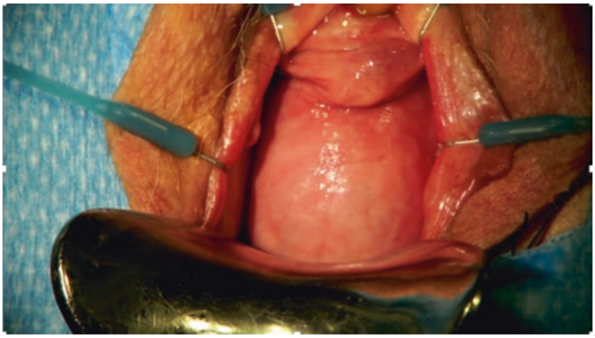

Fig. 6.1 Anterior vaginal wall prolapse with loss of rugal folds, more consistent with a midline defect

Informed Consent

Before surgical intervention, consideration should be given to the patient's age, functional status, medical comorbidities, sexual activity, and prior surgeries. A critical factor to consider is the severity of the patient's symptoms and impairment on quality of life.

Regarding vaginal native-tissue anterior repairs, patients should be informed of potential complications including but not limited to: recurrence of prolapse, *de novo* or occult stress urinary incontinence, *de novo* overactive bladder, urinary retention, significant bleeding, infection, bladder or ureteral injury, vesicovaginal fistula, dyspareunia, vaginal shortening, and *de novo* apical or posterior prolapse.

Anatomic recurrence of anterior prolapse is reported at a rate between 3 and 70 % [3, 4]. Subjective recurrence rates are lower with some reporting a recurrence rate of 11–21 % [5, 6]. Risk factors for prolapse recurrence include increasing age and vaginal parity, smoking, conditions that impair wound healing (diabetes mellitus and steroid use), and conditions that could strain the repair (constipation, chronic pulmonary disease, heavy lifting, and obesity). Additionally, patients with more severe initial prolapse have higher likelihood of recurrence. Some surgeons suggest mesh-augmented repairs in appropriately counseled patients with recurrent or Stage 3 or higher prolapse [7]. Patients undergoing concomitant sacrospinous ligament suspensions for apical prolapse have an increased risk of recurrent anterior vaginal prolapse. It is unknown whether this is due to the retroflexion of the vaginal axis or simply due to a predisposition to failure after pelvic surgery [8].

Randomized controlled trials reported a 0–10 % rate of *de novo* stress urinary incontinence following anterior vaginal prolapse repair [6]. This risk can be reduced by preoperative detection of occult SUI with reduction of prolapse and performing a simultaneous anti-incontinence procedure.

De novo detrusor overactivity has been reported in 5–17 % of patients postoperatively [6]. Conversely, Weber et al. demonstrated a 56 % rate or resolution of urge incontinence after surgical correction of anterior prolapse, suggesting a potential benefit of surgical repair on urgency symptoms [3].

Rates of urinary retention after anterior colporrhaphy may be seen in approximately 20 % of patients [9]. Patients undergoing concomitant anti-incontinence procedures are more likely to develop postoperative urinary retention. Retention is often transient, and patients should be taught clean intermittent self-catheterization. The majority of patients have return of spontaneous voiding within 6 weeks of self-catheterization.

Bladder or ureteral injuries are rare with native-tissue anterior colporrhaphy. Altman et al 2011 reported a rate of 0.5 % [10]. The risk is higher in women with atrophic tissues and may occur during dissection of vaginal flaps. Ureteral injury is reported at 2 % in some series, likely to occur during placement of lateral plication sutures [11]. Cystoscopy should be performed intraoperatively to rule out bladder or ureteral injury. Indigo carmine or methylene blue can be administered to assist with identification of ureteral jets. If efflux is not visualized, evaluate for kinking or ligation with ureteral catheterization or retrograde pyelography. If obstruction is suspected, the plication sutures should be taken down. Sutures should also be immediately removed if inadvertently placed within the bladder or urethra. If a bladder injury occurs, repair this intraoperatively with an absorbable suture in two layers and leave an indwelling catheter for 7–14 days.

Sexual function can improve, remain unchanged, or worsen after anterior repair. Most studies demonstrate modest improvement in sexual function scores postoperatively. Others report rates of *de novo* dyspareunia ranging from 0 to 43 %, with an average of 6.25 % [6]. Care should be taken to avoid excessive trimming of vaginal edges at the conclusion of the procedure. This decreases risk for vaginal narrowing and stenosis that can cause dyspareunia.

Missed or *de novo* apical or posterior prolapse may occur after anterior compartment repair. However, this risk is increased in repairs augmented with mesh [12].

Surgical Technique

Preoperative Evaluation

Patients should be evaluated for loss of apical support, which should be repaired simultaneously to reduce the risk of prolapse recurrence. Studies show that 53–77 % of anterior prolapse can be attributed to apical descent [13, 14]. Occult stress urinary incontinence should also be ruled out by reducing the prolapse on exam. If present, concurrent anti-incontinence procedures should be performed.

Patients with atrophic vaginitis should be placed on vaginal estrogen cream for 4–6 weeks prior to surgery. Use of vaginal estrogen in the preoperative period results in improved connective tissue synthesis and increased vaginal wall thickness, potentially improving the connective tissue integrity of the pelvic floor for surgical repair.

Surgeons should ensure that the patient has a negative preoperative urine culture.

Surgical Technique (Refer to Video 6.1 Cystocele Repair Zimmern P, as Well as Video 6.2 Anterior Colporrhaphy Alternate Technique (De E))

1. Administer one dose of perioperative antibiotics to cover organisms of the genitourinary tract, skin, and Group B Streptococcus. Antibiotics should continue for less than 24 h [15].
2. Start mechanical and/or pharmacological DVT prophylaxis. Anterior colporrhaphy is considered a high-risk procedure for the development of deep vein thrombosis and subsequent pulmonary thromboembolism. Moderate risk patients should receive intermittent pneumatic compression, low-dose unfractionated heparin, or low molecular weight heparin. High- and highest-risk patients should receive combination therapy with IPC plus LDUH or LMWH, unless the bleeding risk is considered unacceptably high [16].
3. Induce anesthesia. The procedure can be done under general or spinal anesthesia. Local anesthesia with IV sedation is also a feasible alternative for vaginal surgery to correct pelvic organ prolapse.
4. Place the patient in a mid- to high-dorsal lithotomy position.
5. Perform exam under anesthesia. It is important to determine if there is an apical component to the prolapse because failure to suspend the vaginal apex will increase the risk of recurrence.
6. Some surgeons elect to use an electric razor to shave labial or perineal hair that may obscure their view. Prep and drape the lower abdomen, vagina, and perineum.
7. Insert a Foley catheter for bladder drainage and easy identification of the bladder neck
8. Gain exposure to the vagina. A Lone Star retractor, Scott ring, or translabial sutures may be useful to retract the vaginal epithelium. A posterior weighted speculum can allow for visualization of the anterior vaginal wall. If assistants are available, handheld retraction can also be helpful.
9. Place Allis clamps in the midline at the proximal and distal aspect of the incision. If prior vaginal hysterectomy was performed, the incision will begin at the apex of the vagina. If the patient still has her uterus, this may be as proximal to the cervicovaginal junction as possible. If apical prolapse is present, the incision could possibly extend through the apex into the posterior vaginal wall.
10. In most instances, the distal portion of the incision will be in the midline 1–2 cm below the meatus. If a concomitant midurethral sling is planned, Allis clamps should be placed lower, at the level of the bladder neck, approximately 4 cm from the external urethral meatus. The sling should be placed after the anterior repair through a separate and more distal incision. For a pubovaginal sling, a single incision up to the mid-urethra may allow for more accurate placement of the sling at the bladder neck. This can be palpated at the level of the Foley balloon. If surgical correction of distal anterior wall prolapse (urethrocele) or Kelly-Kennedy plication is anticipated, the incision should continue distally to the inferior aspect of the pubic bone.

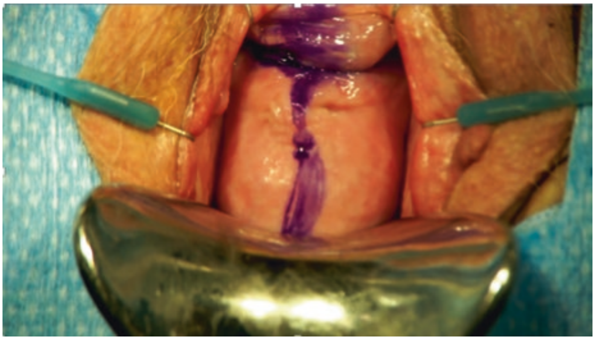

Fig. 6.2 A midline incision is made over the anterior vaginal wall

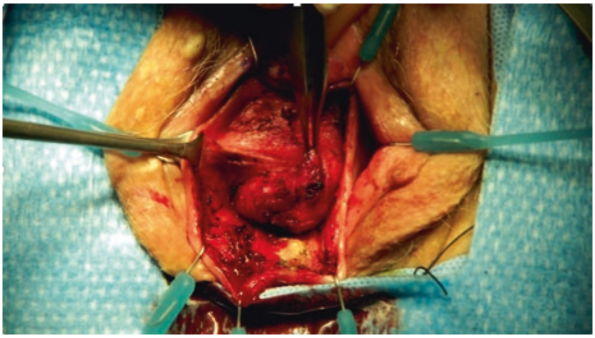

Fig. 6.3 On each side, vaginal flaps are raised off the underlying bladder wall

11. Depending on preference, inject a hemostatic solution (lidocaine with epinephrine or dilute vasopressin) or sterile saline below the epithelium along the midline of the anterior vaginal wall. Infiltration of the proper plane is confirmed if the tissues bulge, but do not blanch, upon injection.
12. Using a #15 blade scalpel, a midline incision is made in the anterior vaginal wall between the Allis clamps (Fig. 6.2). The incision should only be as deep as the vaginal epithelium sparing the underlying fibromuscularis, which has a shiny white surface. Alternatively, a transverse apical incision can be made between the two proximal Allis clamps. Then using curved Mayo scissors, the vaginal epithelium is incised in the midline.
13. Using sharp dissection, undermine the epithelium in the midline, starting at the apex and proceeding toward the distal Allis. The tips should be pointing upwards facing the vaginal epithelium to decrease the risk of bladder perforation. Grasp the edges of the vaginal epithelium with Allis clamps and draw them away from the underlying pubocervical fascia. This counter-traction is crucial for demonstrating the proper plane of dissection. The proper plane is typically avascular, so bleeding may indicate incorrect depth under the vaginal wall.
14. Sharply dissect out the vaginal flaps laterally using Metzenbaum scissors (Fig. 6.3). Place the forefinger of the contralateral hand underneath the vaginal mucosa to maximize traction. This also prevents "button-holing" of the vagina during dissection. The contralateral hand can provide additional traction by

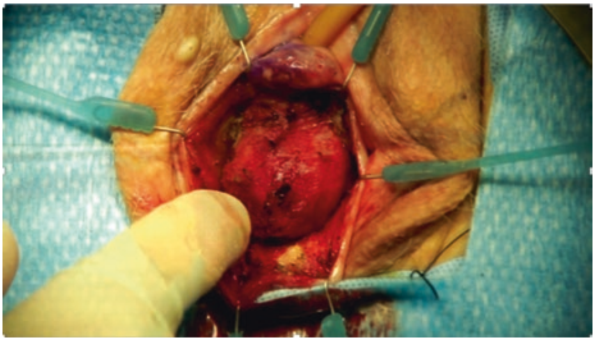

Fig. 6.4 Complete mobilization of the cystocele off the vaginal wall bilaterally

grasping an Allis over the excised vaginal epithelium. An assistant can provide countertraction by pushing down on the bladder medially. Dissection can be continued bluntly with a moistened sponge if the plane between the vaginal epithelium and the underlying endopelvic fascia and bladder opens up easily.

15. Continue dissection until the cystocele has been completely mobilized off the vaginal wall bilaterally (Fig. 6.4). The dissection should be carried laterally to the inferior pubic rami. This allows for visualization of lateral paravaginal defects and subsequent correction if present. The more advanced the prolapse, the more lateral the dissection should extend. It is also crucial to mobilize the bladder off the vaginal cuff or cervix to the level of the preperitoneal space. This allows fixation of the fascial repair to the proximal anterior vaginal wall. Dissection in this area should be performed sharply.
16. At this point, some surgeons will perform a Kelly-Kennedy plication at the proximal urethra and bladder neck. In the past, a Kelly plication was used to treat mild stress incontinence. However, in modern practice, it is felt to be inferior to midurethral slings, autologous fascial bladder neck slings, or Burch colposuspension for the surgical treatment of urinary incontinence [17]. Some surgeons will perform the plication only in patients who demonstrate urethral hypermobility and no occult stress incontinence [18]. Others will routinely plicate all patients if an anti-incontinence procedure is not planned [19]. These sutures theoretically will reinforce posterior urethral support and could potentially prevent the development of *de novo* stress incontinence, but there are currently no studies that confirm this advantage.
17. If a Kelly plication is planned, extend the midline dissection to the undersurface of the inferior pubic ramus. This will provide adequate periurethral tissue for the plication. Starting at the bladder neck, incorporate the fibromuscularis lateral to the urethra bilaterally with 2-0 or 0 delayed absorbable sutures, such as polygalactin-10 (Vicryl). The bladder neck can be identified by pulling the Foley catheter downward and palpating the balloon. One or two additional interrupted stitches are placed distally, reapproximating the pubocervical fascia along the urethra, to create a posterior shelf of support.
18. Retract the bladder with a finger or instrument to expose the lateral pubocervical tissues.

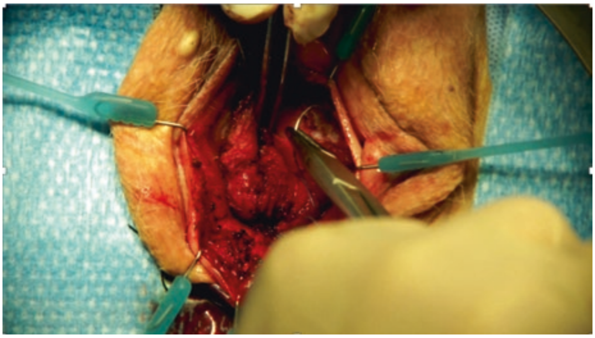

Fig. 6.5 An absorbable suture is placed in the lateral-most aspect of the exposed fibromuscular tissue overlying the bladder

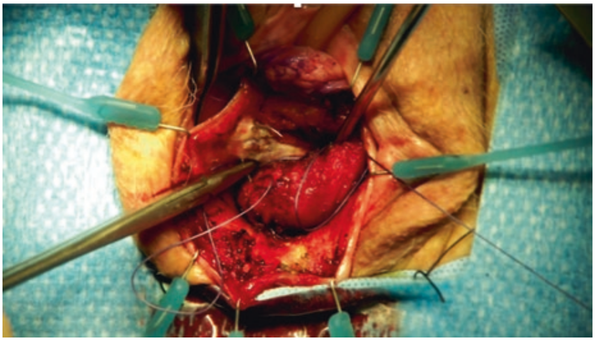

Fig. 6.6 The suture is brought across midline and placed through the pubocervical fascia directly across on the contralateral side

19. Starting at the bladder neck, using a 2-0 or 3-0 delayed absorbable suture (such as polydioxanone or polyglactin), take a bite of the lateral-most aspect of the exposed fibromuscular tissue overlying the bladder (Fig. 6.5). This will be just medial to the previously created vaginal flaps. Take a substantial bite, but avoid going excessively deep, as this could inadvertently enter the bladder lumen or obstruct the ureters. Do not incorporate the inside lining of the vaginal wall, as this can result in a scarred, foreshortened anterior segment. The direction of the plication sutures should be tailored to the anatomy of the prolapse, specifically, the length of the vaginal wall [20]. If the vaginal wall is elongated (stretched-out), consider orienting the plication sutures vertically to reduce vaginal length and width [21]. If the patient has a shortened anterior segment, horizontally-thrown sutures can better preserve vaginal length.
20. Bring the suture across the midline and take a bite directly across on the contralateral side (Fig. 6.6). Some surgeons take a shallow bite of the fibromuscular tissue at the midline before proceeding to the other side. Place a hemostat on the suture so it can be tied at the midline once all sutures have been placed.
21. Proceed with interrupted sutures toward the apex. Some surgeons may prefer running stitch to cover the entire defect (Fig. 6.7). Ensure that the sutures are closely-spaced, leaving no gaps in the repair.

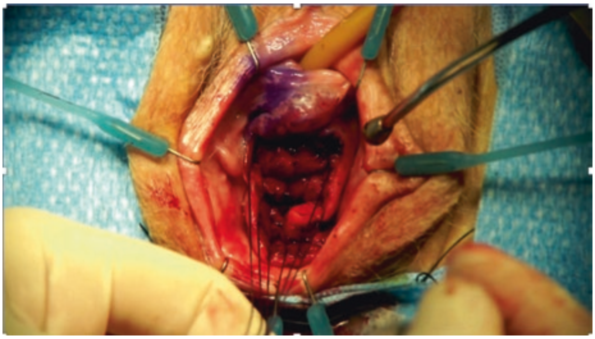

Fig. 6.7 Cystocele defect closed by four sets of absorbable sutures

22. A crucial step is to incorporate the most proximal, apical, fibromuscular plicating stitch to the apex of the vaginal wall. If these fibromuscular sutures are not well-suspended to the apex, the anterior vaginal wall will continue to prolapse toward the introitus. The apical plicating stitch should therefore incorporate the anterior cervical tissue or vaginal cuff of prior hysterectomy. If a transverse defect is present, this proximal stitch can be placed in the cardinal-uterosacral ligament complex. If a concurrent apical suspension is performed, the apical stitch should be attached to the suspension sutures.
23. While reducing the prolapse with a finger or instrument, tie the plication sutures.
24. In cases of more severe prolapse, a second layer of 2-0 or 3-0 delayed absorbable plicating sutures may be placed to imbricate the first layer and completely reduce the prolapse. This may require further mobilization of the pubocervical fascia off the vaginal epithelium.
25. Place Allis clamps along the edges of the incision for traction. Use curved Mayo scissors to trim the edges of the vaginal epithelium, starting from the apex and moving toward the urethra. Avoid excessive trimming, as this can result in shortening and narrowing of the vaginal canal. The trimmed portion should narrow moving distally. Close the anterior vaginal wall with 2-0 or 3-0 absorbable sutures (Fig. 6.8). Hold countertraction on the proximal and distal ends of the incision. The stitch can be running, locking, or interrupted. There is less risk of vaginal shortening with closure using interrupted stitches.
26. Perform cystoscopy to ensure patency of the ureters and to evaluate for intravesically placed sutures. To help identify the ureteral jets, intravenous dye can be administered approximately 10 min prior to cystoscopy (Fig. 6.9) or a single, oral dose of phenazopyridine may be given in the immediate preoperative period.
27. Replace the Foley catheter.
28. If a synthetic mid-urethral sling is planned, it should be done at this time through a separate distal incision. Fixing the cystocele will affect the tension needed to tighten the sling.
29. Place an estrogen-cream coated gauze as a vaginal packing to cover the incision and aid with hemostasis.

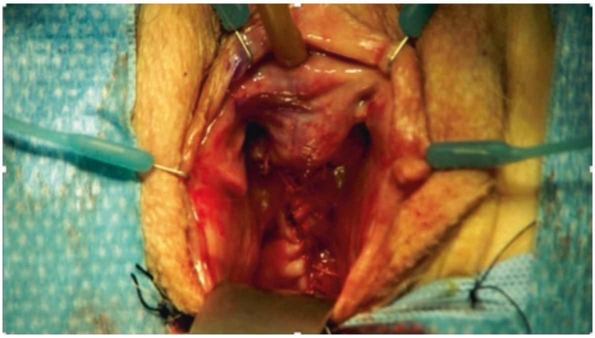

Fig. 6.8 Vaginal flaps are trimmed and the vaginal incision is closed with running absorbable sutures

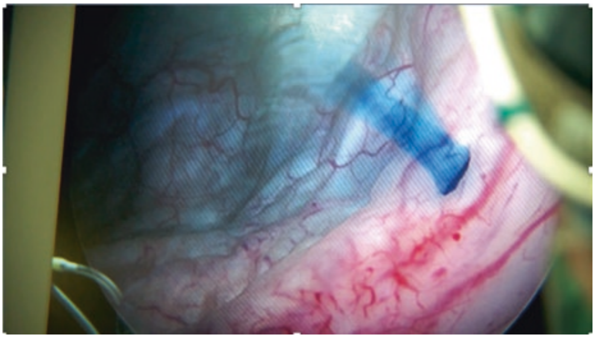

Fig. 6.9 After administration of 1 ampule of IV indigo carmine, cystoscopy is performed to confirm ureteric integrity

Post-operative Care

Patients are admitted overnight for observation. The vaginal packing and Foley are removed the following morning. The bladder is filled prior to removal of the Foley to ensure the patient can void completely prior to discharge home. If the patient is unable to void, she is taught clean intermittent catheterization or sent home with a foley catheter for a few days. Patients follow up in clinic in 2–4 weeks for a post-operative check. They are provided a stool softener and laxative to prevent bearing down and placing pressure on the repair. Other than vaginal estrogen cream, they should have nothing per vagina until seen in follow up.

Results

Short-Term Success Rates

Early retrospective series from 1978 to 1994 reported 80–100 % anatomic success rates with native-tissue anterior colporrhaphy [22, 23]. Modern series demonstrate a success rate between 30 and 97 % [3, 4]. The variable results within these studies can also be attributed to variability in definition of success (anatomic vs subjective), extent of prolapse, presence of multi-compartment prolapse, and length of follow up.

In 2001, Weber et al. conducted a randomized controlled trial demonstrating a 30 % success rate with native tissue anterior colporrhaphy (compared to 42 % for polyglactin 910 mesh overlay and 46 % for unilateral plication) [3]. The trial had a strict anatomic definition of success, defined as Stage 0 or I at Aa and Ba. The data was reanalyzed in 2011. Success was redefined using more clinically-relevant criteria (no prolapse beyond the hymen, no symptoms, and no retreatment demonstrated). Outcomes significantly improved with an 89 % success rate with native-tissue repair (91 % for mesh, 77 % for unilateral, 88 % overall) [5]. This study suggests that success after prolapse surgery depends greatly on the criteria used to define treatment success. Even though anatomic cure rates may be low, subjective improvement in prolapse symptoms and low rates of reoperation are more clinically meaningful outcomes. Using awareness of prolapse as an outcome, 78 % of patients who underwent anterior colporrhaphy experienced a favorable outcome in the 2016 Cochrane review of 587 patients [6].

Long-Term Success Rates

The long-term durability of anterior colporrhaphy is largely unknown. Although retrospective studies have been reported, only a few randomized controlled trials evaluate the long-term outcomes after surgery. Nieminen et al (2010) reported a 41 % rate of anatomic recurrence and 27 % rate of symptomatic recurrence 3 years after anterior colporrhaphy. Rate of reoperation was 8 % for recurrent anterior prolapse, 1 % for apicoposterior prolapse, and 9 % for incontinence. The majority of recurrences took place within the first year. Mean estimated time to recurrence was 26 months [24].

Rudnicki et al. (2016) also presented 3 year follow up data, with a 59 % anatomic and 32 % subjective recurrence rate. 4.4 % of patients required reoperation for recurrent anterior prolapse and 5.9 % required another operation for middle or posterior compartment prolapse [25].

Native Repair Versus Mesh

Compared to polypropylene-mesh reinforced repairs, native-tissue anterior colporrhaphy may have a lower anatomical and subjective success rate. However, this should be weighed with the increased morbidity associated with mesh-augmented repairs.

The largest randomized controlled trial (N = 389) by Altman et al. assigned patients to anterior repair with a mesh kit or to traditional colporrhaphy. Follow up was 1 year. Anatomic success was 60.8 % in those who had mesh versus 34.5 % in those who underwent traditional colporrhaphy. Complications were higher in the mesh-repair group including increased operative times, intraoperative hemorrhage, rate of bladder perforation, new SUI, dyspareunia, and rate of surgical reintervention for mesh exposure [10].

A Cochrane review in 2016 compared native tissue repairs against those augmented with mesh and biological grafts. Patients with anterior compartment mesh repairs had decreased rates of anatomic failure (12 % vs 35 %; RR 0.36; 95 % CI 0.28–0.47; 9 RCTs; n = 1004; $I^2 = 0\,\%$) and perception of prolapse at 1–3 years (14 % vs 22 %; RR 0.65 [0.51, 0.84]). For prolapse in all compartments, mesh had decreased rates of reoperation for prolapse alone (2.3 % vs 4.6 %; RR 0.53 [0.31, 0.88]), but increased rates of reoperation for a combination of prolapse, stress urinary incontinence, and mesh exposure (13 % vs 5.4 %; RR 2.40 [1.51, 3.81]. Mesh exposure was seen in 12 % and surgery for mesh exposure was required in 8 %. Permanent mesh in all compartments also had increased morbidity with regards to *de novo* stress urinary incontinence (10 % vs 6.9 % RR 1.45 [1.00, 2.11]), bladder injury (2.8 % vs 0.54 %; RR 3.92 [1.62, 9.5]), and bowel injury (1.2 % vs 0 %; RR 3.26 [0.13, 78.81]. There was no difference between the groups on rates of *de novo* dyspareunia. Insufficient evidence was available to draw conclusions regarding absorbable mesh or biological grafts compared to native tissue repair. The authors concluded that transvaginal mesh has limited utility in primary surgery due to the risk-benefit profile. Women with higher risk of recurrence may benefit from mesh, but there is currently no evidence to support this [6].

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Chapter 7
Paravaginal Repair

Kathryn G. Cunningham and O. Lenaine Westney

Abstract Pelvic organ prolapse is defined as the descent of one or more of the pelvic organs including the uterus, vagina, bladder or bowel due to laxity of pelvic fascial structures and/or disruption of attachments to the pelvic sidewall. Usually defects arise together as the fascia has several interconnected layers. As the endopelvic fascia weakens and releases from the arcus tendinous fascia pelvis (ATFP), cystocele due to lateral paravaginal prolapse occurs. The pubocervical fascia is contiguous with the circular muscular layers of the vagina and attaches to the endopelvic fascia laterally. This can also weaken centrally producing a midline or central cystocele defect. Optimal surgical management requires addressing both lateral and central cystocele if present, with the goal of preventing persistent and/or recurrent prolapse. Central cystocele repair is addressed in Chap. 6. Reconstitution of the fascial attachments between the vagina and AFTP can be accomplished from the vaginal or abdominal approach depending on surgeon preference. Due to the FDA warning, most surgeons are veering away from synthetic mesh due to risk of erosion and extrusion, although synthetic mesh has been associated with less anatomical recurrence. This anatomic success has not been shown to correlate with subjective outcomes; therefore biologic graft or native repairs are used to avoid the risk of operative re-intervention for mesh complications. There are several surgical techniques utilized by surgeons today for paravaginal repair. We will describe our technique in this chapter, as well as surgical indications, preoperative preparation, alternate surgical techniques and surgical risks. In the end, it is important to educate your patient on all risks and benefits of each option and what would suit her needs best.

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K.G. Cunningham, MD (✉)
Department of Urology, MD Anderson Cancer Center, Houston, TX, USA
e-mail: KCunningham1@mdanderson.org

O.L. Westney, MD
Department of Urology, MD Anderson Cancer Center, Houston, TX, USA
e-mail: owestney@mdanderson.org

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Keywords Paravaginal repair • Pelvic organ prolapse • Lateral defect • Arcus Tendinous Fascia Pelvis (ATFP) • Cystocele

Introduction

Pelvic organ prolapse is defined as the descent of one or more of the pelvic organs including the uterus, vagina, bladder or bowel due to laxity of pelvic fascial structures and/or disruption of attachments to the pelvic sidewall. As the female pelvic fascia has several interconnected layers, isolated single organ prolapse is uncommon. Usually, defects arise together; thus a comprehensive assessment is mandatory prior to considering repair. At this time, we will discuss defects in the lateral anterior vaginal compartment, specifically, the paravaginal tissues. However, as this constitutes a support structure for the bladder, the resultant lateral defect may be associated with a central cystocele for simultaneous management. As the endopelvic fascia weakens and releases from the arcus tendinous fascia pelvis (ATFP), paravaginal prolapse occurs. The pubocervical fascia, which attaches to the endopelvic fascia laterally, can also weaken centrally producing a midline defect. This causes the bladder to descend as a central cystocele. It is notoriously difficult to decipher between these two defects – lateral and central. Optimal surgical management requires addressing both, if present, with the goal of preventing persistent and/or recurrent prolapse [1, 2].

The risk factors for paravaginal wall defects are consistent with general pelvic organ prolapse. These include childbirth, low estrogenic states (menopause), high intraabdominal pressure causing diseases and chronic states such as COPD, obesity, congenital or acquired connective tissue abnormalities, pregnancy, childbirth, aging, and hysterectomy [3].

Case Presentation

A 68-year-old G3P3 post-menopausal female presented with a history of Lynch Syndrome and multiple sclerosis with a pre-existing diagnosis of cystocele. She had been using a pessary for 1 year as recommended by her local gynecologist due to complaints of pelvic pressure with her prolapse. She had never received oral hormone replacement therapy and underwent menopause at age 52. She was started on Estrace® cream 3 years prior to presentation. In regards to her urinary symptoms, she complained of occasional urgency, frequency and stress incontinence for which she used one panty-liner per day, barely soaked. She had a sensation of incomplete bladder emptying, but denied any history of recurrent UTIs, hematuria, or dysuria.

On initial examination (Fig. 7.1), the patient had Grade II uterine prolapse (Baden-Walker), Grade III cystocele, and Grade I rectocele with mild vaginal atrophy [4].

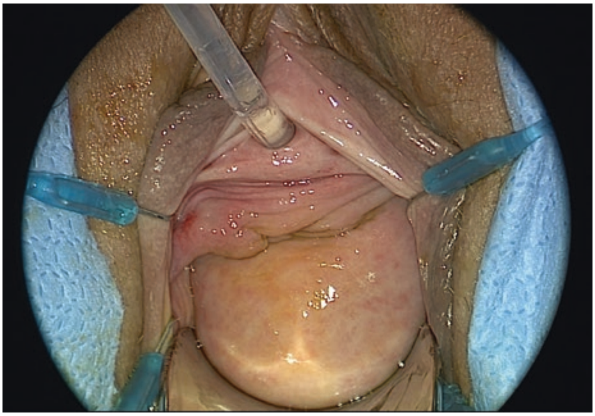

Fig. 7.1 Grade II uterine prolapse (Baden-Walker), Grade III cystocele

A post-void residual and urinalysis was checked on the first visit with post void residual showing 74 mL after double voiding and urinalysis was negative. She was asked to fill out a voiding journal for 3 days and return for urodynamic studies.

As planned, she returned for fluoroscopic urodynamic studies (FUDS) with and without vaginal packing. Post void residuals were high with the cystocele extruded, and Valsalva straining with an element of obstruction was identified during voiding. The fluoroscopic images corresponded to a Grade 3 cystocele. She had a high post void residual (275 cc) with the pessary removed. During the stress test, she showed a Valsalva Leak Point Pressure (VLPP) of 100 cmH_2O with and without pessary. The interpretation was complicated by the diagnosis of multiple sclerosis but no overt dyssynergia or neurogenic detrusor overactivity was noted. Thus, considering the symptoms and the findings related to her prolapse, we elected to offer her repair.

After discussion with the patient regarding her options, she was taken to the operating room for a hysterectomy, bilateral salpingo-oophorectomy, vaginal vault suspension using uterosacral ligament suspension, and possible porcine dermis-augmented paravaginal repair for her anterior vaginal prolapse. The final decision to utilize biological graft was planned as an intraoperative decision after assessing the integrity of her pubocervical fascia. After discussing the risks and benefits of treatment of her stress incontinence, she chose not to undergo a sling procedure.

Per our standard, a Foley catheter was left indwelling for 24 h with a voiding trial the following day. Due to failure to empty, the Foley catheter was replaced; follow-up in several days was arranged. Voiding trial was unsuccessful at day 4 despite a well-suspended vault on exam. Repeat voiding trial on post-operative day 10 was successful. She continues to void with 15–20 mL residual on follow up, and her stress urinary incontinence is minimal without bother by patient assessment. The pre-operative sensation of pelvic pressure has resolved and she is very satisfied with her results.

Surgical Indications

In the majority of cases, the indications for surgical intervention are related to a negative impact on quality of life measures secondary to pelvic organ prolapse. An asymptomatic prolapse does not require repair. Commonly reported symptoms include pelvic "heaviness" or a vaginal bulge. Superimposed voiding symptoms are also not unusual due to simultaneous bladder prolapse including hesitancy, intermittency, slow stream, feeling of incomplete bladder emptying, urgency, and frequency. The symptoms may be linked to intermittent or complete bladder outlet obstruction [5, 6]. Manual reduction of the prolapsed vagina may be necessary to facilitate urination or defecation ("splinting"). Constant irritation and exposure of vaginal mucosa may result in edema, bleeding, and ulcerations which can be quite painful. Patients who develop functional and/or structural outlet obstruction are at risk for hydronephrosis and renal insufficiency. Correction of the anatomical defect will only be curative in patients able to void with a normal detrusor contraction paired with pelvic floor relaxation. Alternatively, intermittent catheterization may be required to effect emptying of the bladder.

Conservative measures which should be employed prior to operative intervention are lifestyle changes such as weight loss and tobacco cessation, pessary, topical estrogen, vaginal lubricants, and pelvic floor exercises, especially when the prolapse is mild. Regardless, surgery may be indicated depending on the severity of the prolapse, patient symptoms, upper urinary tract dysfunction related to the prolapse, patient willingness, and existing medical comorbidities.

Pre-operative Preparation

The goals of surgical repair are restoration of normal vaginal anatomy in combination with relief of associated bladder/bowel symptoms and sexual dysfunction related to the prolapse [3]. It is important to note that the correlation between objective and subjective outcomes of pelvic organ prolapse is not always direct. Postoperatively, the patient may demonstrate full correction of the anatomical defect with persistent symptomatology [7–10].

In order to optimize surgical outcomes, the patient must be fully evaluated to allow for correction of any reversible conditions which could impair recovery. Chronic conditions should be stabilized, estrogenic status of the vaginal tissues improved, and the patient counseled regarding appropriate expectations. In our clinic, a preoperative serum laboratory workup includes electrolytes, BUN, creatinine, glucose, PT/PTT. Additional values are ordered as indicated based on existing co-morbidities. In diabetic patients, hemoglobin A1c is evaluated to assess for control of blood glucose. Any concerning results are investigated further with specialty consultation and/or imaging.

Fluoroscopic urodynamic studies with and without reduction of the prolapse is performed prior to surgical intervention to quantify detrusor contractility, vesicoureteral reflux (laterality and severity), bladder outlet obstruction and occult stress incontinence. It is important to perform these studies on all patients with Grade 2 or higher anterior prolapse in order to better counsel the patient preoperatively. Further, urodynamic evaluation is recommended by the International Continence Society (ICS) in cases characterized by any pre-operative voiding dysfunction [11]. If occult stress incontinence is found, (i.e. asymptomatic patient with stress incontinence demonstrated with prolapse reduction), then concomitant continence repair needs to be discussed during preoperative counseling. If urodynamic detrusor overactivity is identified, the patient should be made aware of the potential for long-term pharmacologic therapy or alternate measures should urgency or urge incontinence persist past the early post-operative phase.

Critical assessment of the quality of the vaginal tissues is important prior to embarking on a surgical repair. Vaginal estrogen is prescribed for all patients preoperatively unless contraindicated. If the vaginal epithelium is severely atrophied, edematous, or even ulcerated, we recommend 6–8 weeks of supplemental topical estrogen with serial reexamination every two weeks. Depending on severity, estrogen cream is prescribed daily and once the tissues appear to be improving, we transition to bi-weekly applications. When patients are transitioned to biweekly applications, we also fit them for a pessary in clinic, if they do not already have one, to protect the tissues from exposure. Once the vaginal tissues appear healthy, we then plan for repair. We do not take patients to the operating room until they have received a minimum of 4 weeks of topical estrogen treatment, regardless of the state of their tissues.

The final step prior to proceeding with surgery is urinalysis and urine culture. A positive urine culture warrants appropriate antimicrobial therapy with confirmation of a negative culture prior to the operative date.

Surgical Risks

Prior to a trip to the operating room, the surgical risks, benefits and alternatives must be reviewed with the patient. Preoperative counseling will be tailored to the individual according to previous surgeries and comorbidities; however, we will discuss the most common risks along with pertinent published data as detailed below. These include recurrent prolapse, complications related to the use of mesh (synthetic and biologic), damage to surrounding structures and de novo lower urinary tract symptoms.

It is also important to discuss with your patient the risks of adjacent organ injury, especially due to the dissection required for paravaginal repair. Adjacent organs include the bladder, ureters, pudendal, perineal and obturator nerve bundles. In general, bladder perforation is quoted at 3.5 %, and inguinal pain as 2.5 %, however this was seen to be associated primarily with the use of trocar-based mesh kits [12, 13]. Neuropathic pain has been quoted as 3 % most likely due to remaining in the dorsal lithotomy position for an extended period of time, or concomitant procedures performed with the vaginal paravaginal repair such as sacrospinous fixation, etc.

Benson et al described pudendal and perineal neuralgia during vaginal paravaginal repair in the form of increased terminal motor latency, which resulted in a preference for the abdominal approach [14]. However, it is important to note that preoperative terminal motor latency was already prolonged in this cohort as a function of the prolapse.

Other reported complications include changes in lower urinary tract and sexual function. New onset stress urinary incontinence, urge incontinence, urinary retention and dyspareunia have been documented. Approximately 35–40 % of patients with occult stress incontinence report resolution of their stress incontinence with POP surgery alone [15, 16]. Reported rates of de novo stress incontinence are between 4 and 12.3 %, with the higher end of the range being related to trocar based mesh-repair [11, 13]. Some have theorized that this is due to mesh overcorrection of the bladder neck and urethra leading to lower maximal urethral closure pressures. Studies have found that preoperative urgency and urge incontinence usually persists after POP repair in patients with detrusor overactivity on preoperative urodynamics [15]. This suggests that urgency symptoms in the absence of urodynamically demonstrated detrusor overactivity are related to the prolapse itself. Thus, patients should be counseled regarding the possibility of continued urgency in those with urodynamically documented DO; conversely the absence of urodynamic correlation with symptoms pre-operatively is more likely to indicate post POP repair resolution. De novo urgency and urge incontinence has been quoted at 28 % in one study, however this is usually rare and not widely reflected in the literature [7]. Urinary retention requiring catheterization after anterior prolapse repair approximates 1 % and is rarely mentioned in paravaginal repair studies. This was found at 2 months in the Altman trial in both the anterior colporrhaphy and paravaginal cohort, however this resolved spontaneously [13]. Prolonged retention was seen in another study of patients who underwent all types of anterior repair in which large post void residuals resolved after 1 month and those who did not, were related to advanced age or a neurogenic cause of detrusor underactivity [15]. New onset dyspareunia ranges around 10 %, however it is important to note that the majority of patients with dyspareunia also have resolution of these symptoms postoperatively [12]. Further, there does not appear to be any difference in de novo dyspareunia rates between native repairs or mesh usage [12, 15, 17].

Risk of bleeding and infection are always present in any operative procedure. The risk of infection ranges between 2 and 4 % and is mostly associated with a urinary tract infection; significant bleeding ranges between 0.5 and 3 % [13]. All patients are given antibiotic prophylaxis according to the SCIP guidelines; however, risk factors include patient comorbidities, current urinary tract infection at time of surgery, or prolonged catheter requirement. During more extensive dissections, as is the case in paravaginal repairs, bleeding risk is increased. As such, there is increased risk of hemorrhage with the use of paravaginal repair (including mesh kits) versus an anterior colporrhaphy, as the lateral pelvic side-walls need to be accessed for adequate placement.

Surgical Technique (Refer to Video 7.1 Lateral Paravaginal Repair, Colporrhaphy, and Sacrospinous Ligament Vaginal Vault Suspension (De E))

Our surgical technique begins with preoperative antibiotics consisting of a first generation cephalosporin according to Surgical Care Improvement Project (SCIP) guidelines [18]. First, a Foley catheter is inserted to fully decompress the bladder and placed to drainage. An Allis clamp is positioned approximately 2 cm inferior to the meatus in the midline to mark the distal aspect of the vaginal incision and to assist with retraction. A weighted vaginal speculum is placed within the vagina (Fig. 7.1) and clipped to the drapes. The incision is marked in the midline from 2 cm below the urethral meatus towards the vaginal apex/cuff. We use Vasopressin 20 units diluted in 100 mL of 0.9 % normal saline for hydrodissection. Using a 23-gauge needle, the mixture is injected just deep to the vaginal epithelium. The vasopressin facilitates separation of the tissues in the correct planes, but also assists with hemostasis. Allis clamps are placed on the lateral edges of the incision and dissection is directed laterally using sharp and blunt methods to the level of the ischiopubic ramus until the arcus tendinous fascia pelvis (ATFP) is palpated bilaterally. We evaluate the pubocervical fascia strength at this juncture to evaluate the need for biological graft augmentation. Central defect plication (Chap. 6) is performed at this juncture if required (Fig. 7.2). We then attempt to palpate the ischial spine. From the vaginal approach, the ischial spine is difficult to reach in some patients, unlike the laparoscopic or abdominal/retropubic approach. If the ischial spine is not palpated initially, then the incision is extended to the vaginal cuff until the ischial spine is identified. Sacrospinous ligament vault fixation can be performed concurrent with this repair if vault suspension is indicated, as demonstrated in the video. Detachment of any remaining lateral attachments will be necessary to reach the ATFP (Fig. 7.3). Zero PDS sutures are then placed at 1 cm intervals into the ATFP

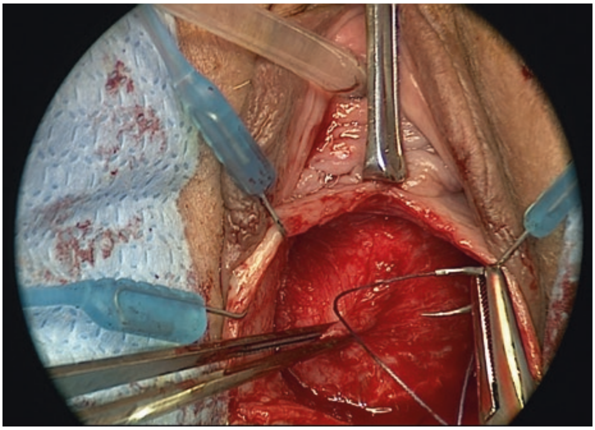

Fig. 7.2 Anterior plication

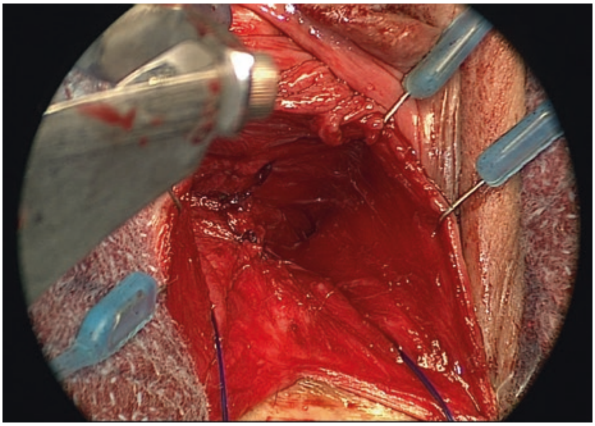

Fig. 7.3 Lateral vaginal attachments

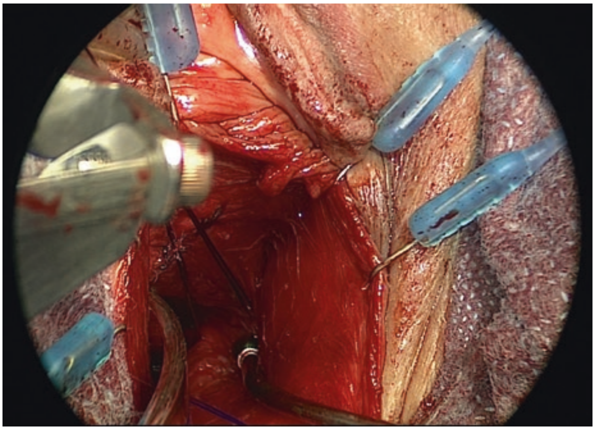

Fig. 7.4 Sutures placed in the arcus tendineus fascia pelvis

bilaterally starting at ischial spine (Fig. 7.4). If no graft is planned, the sutures are passed into the adjacent pubocervical fascia. If the graft, for example porcine dermis (Pelvicol™), is planned, it is initially cut into a trapezoidal configuration with the broad base measuring the length between bilateral ischial spines and the narrow apex measuring the distance between the ATFP at the distal (introital) aspect of the incision. It is important to not "over-trim" the graft prior to placement, as it can always be modified once the initial suturing takes place. The sutures are secured to the graft leaving the knot laterally and tied beginning with those most proximal (Figs. 7.5, 7.6, 7.7, 7.8, and 7.9). Once the tying process is completed, cystoscopy is performed to confirm efflux of bilateral ureters. Intravenous dye can be used to assist with identifying ureteral efflux, if necessary. The vaginal epithelium is minimally trimmed and closed with a 2-0 vicryl suture in a running fashion, not locked, as we believe this can shorten the vaginal length. Irrigation is performed and

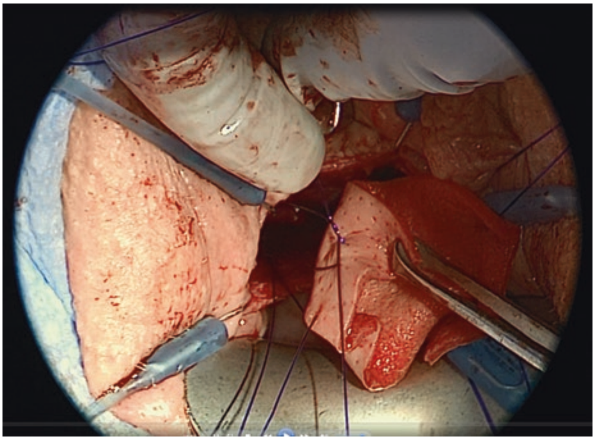

Fig. 7.5 Suture placement in the biological graft leaves the knot lateral toward the arcus, to prevent rolling the graft

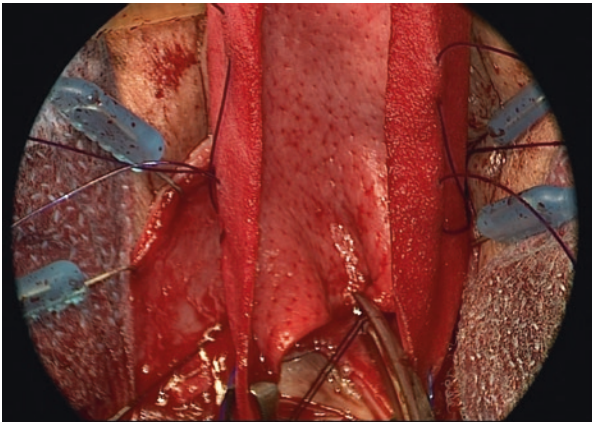

Fig. 7.6 The most cephalad portion of the graft is sutured to the dissected cervix

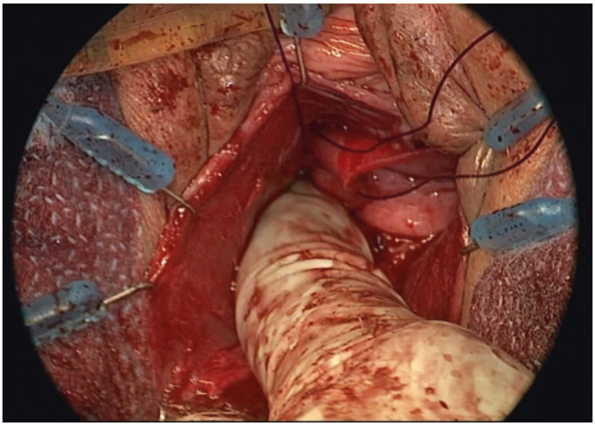

Fig. 7.7 Sutures should be tied such that the graft abuts the lateral pelvic sidewall

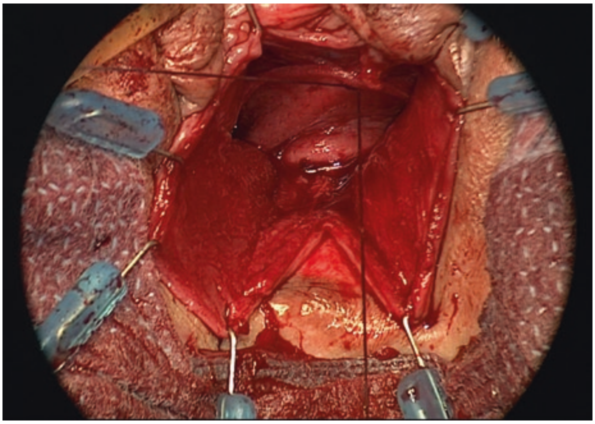

Fig. 7.8 The graft is secured distally at the level of the bladder neck

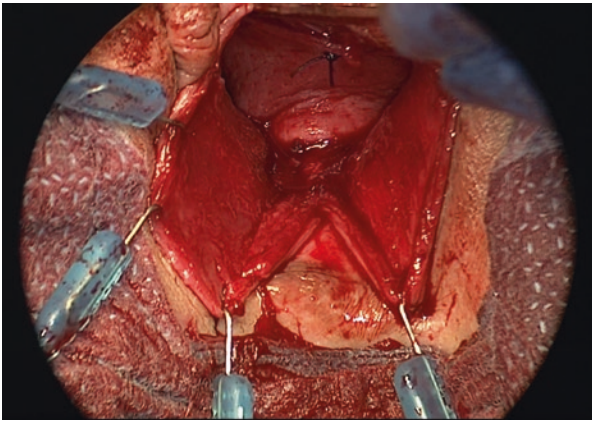

Fig. 7.9 The graft is tied with a little laxity to allow for vaginal mobility. Toothed forceps are used to flatten any folds or rolling of the edges

hemostasis assured. The repair is visualized and palpated to exclude tethering and confirm good support (Figs. 7.10 and 7.11). A vaginal pack impregnated with Premarin cream is then placed and left for 24 h. K-Y® Jelly or RepHresh™ lubricant can also be used if the patient has a history of hormone-sensitive breast or gynecologic cancer.

Post Operative Care

Our standard postoperative care protocol is varied based on patient characteristics. Depending on patient age and comorbidity status, we would recommend keeping the patient for 24-h observation. The vaginal pack and Foley catheter are removed on postoperative day 1 and a voiding trial is performed. If she fails this trial, the

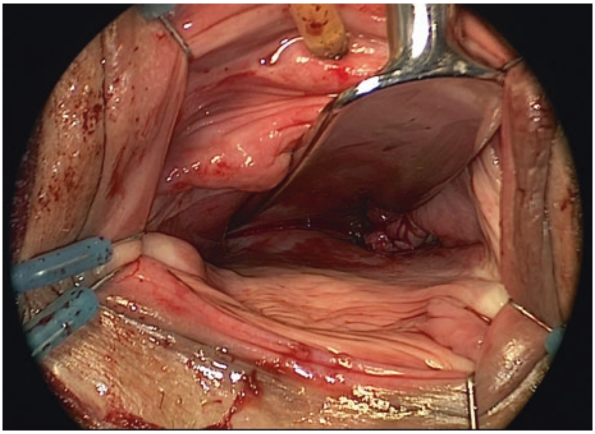

Fig. 7.10 Appearance after plication, lateral paravaginal repair with graft, and sacrospinous ligament vaginal vault fixation

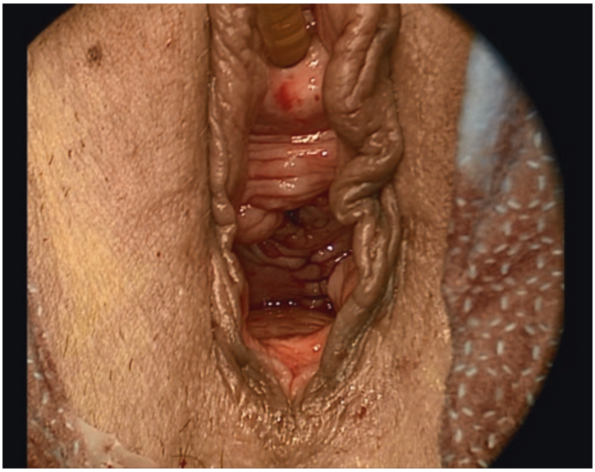

Fig. 7.11 End result at close of surgery

Foley catheter is replaced with plans for a repeat in 1 week as we find it difficult for patients to be taught intermittent catheterization in the immediate postoperative period due to associated swelling and pain. Perioperative antibiotics are normally discontinued after a successful voiding trial on postoperative day 1. However, if the catheter needs to remain, we keep our patients on prophylactic dose nitrofurantoin to prevent catheter-associated urinary tract infection. Our patients are also asked to continue their topical estrogen treatment daily for 6 weeks postoperatively and then bi-weekly thereafter.

The follow-up regimen begins with a pelvic exam at 2 weeks and assessment of any acute postoperative complications. Laboratory studies are performed on follow-up if there is a concern of excess bleeding intraoperatively or to confirm correction of an abnormality. If a patient failed her voiding trial, then she will be seen at 1 week postoperatively only for pelvic exam and voiding trial. The focus of the pelvic exam would be visual and gentle manual confirmation of prolapse reduction. Persistent urinary retention would require assessment of the patient's ability to perform intermittent catheterization, followed by instruction. In the event that intermittent catheterization is not feasible, patients are managed by an individualized program with the goal of achieving a catheter free status. Standard follow-up schedule consists of assessments at 6 weeks, 3 months, 6 months, 1 year and yearly symptom assessment, bladder volume index, pelvic exam and labs (if indicated). Short-term lifting limitations include no greater than 5 pounds at 6 weeks, 10 pounds at 3 months then progressive increases to a limit of 50 pounds. Sexual activity is discouraged until after 6 weeks.

Success of Vaginal Paravaginal Repair

The risk of recurrence after paravaginal repair must be separated by the type of measure reflecting the change - objective and/or subjective. As noted previously, these data points do not consistently correlate. Based on prolapse grading scales, recurrence is defined as descent below point Ba −1 or greater on POP-Q exam or stage II Baden Walker. Symptomatically, it is the reemergence of symptoms attributed to the prolapse such as pelvic pressure, obstructive voiding, etc., as measured by validated questionnaires or unstructured patient report. Objective recurrence rates after paravaginal repair range from 7 to 48 % within 1 year depending on use of grafting material. Repairs with biologic or synthetic grafts are the most commonly compared to native tissue repair when discussing paravaginal repair.

Several studies quote decreased recurrence rates with the use of grafting materials for paravaginal repair. However, these studies compare paravaginal repair using mesh (biologic or synthetic) to anterior colporrhaphy, and are thus not an equivalent procedural comparison. Although both are used to treat anterior compartment prolapse, the techniques are not directed at the same anatomical defect.

Simsiman et al showed a 23 % recurrence rate at 1 year in 111 women with paravaginal defects using porcine dermal graft reinforcement [7]. Another study by Gomelsky et al in 70 women demonstrated a 13 % recurrence rate at 2 years using porcine dermis [8]. Failure in both studies was defined as descent beyond point Ba −1 on POP-Q evaluation. Simsiman et al found that preoperative Ba measurement was a significant predictor of failure (P = 0.004). Patients with a preoperative Ba measurement of 4 or greater could expect a 50 % recurrence rate and this rate correlated directly with increasing preoperative Ba measurement. Cadaveric fascia has also been used with recurrence rates ranging from 19 to 41 %, however these studies had smaller accrual [9].

Native paravaginal repair is less commonly used, especially since the popularization of the vaginal approach to paravaginal repair. One study on 100 patients who underwent native vaginal paravaginal defect repair showed a recurrence rate of 2 % at 1 year when using 1–6 Gore-Tex CV-0 sutures [10]. This recurrence rate is specific to paravaginal defect recurrence. It is important to mention that all patients underwent a concomitant anterior colporrhaphy and 22 % of the cohort had midline cystocele recurrence making the overall recurrence rate of anterior compartment prolapse of 24 % at 1 year. Most of the literature does not distinguish between site-specific recurrences in the anterior compartment rendering a comparison difficult with other studies.

Mesh, whether synthetic or biologic, is most commonly used in paravaginal repair. Studies using synthetic mesh have reported excellent results in regards to recurrence rates. Menefee et al performed a randomized control trial on 99 women with stage II or greater anterior prolapse delegated equally to anterior colporrhaphy, or paravaginal repair with porcine dermis mesh or free-hand polypropylene mesh placement [12]. Failure was defined as stage II or greater prolapse. Polypropylene mesh showed significantly lower recurrence rates (18 %) compared to the porcine dermis (46 %) and anterior colporrhaphy (58 %) at 2 years. This study also included a subjective measure of failure which was the sensation of a "bulge". When the subjective and objective measures were combined, there was no significant difference between surgical techniques, showing the weight of subjective measures on surgical outcomes. Most studies have shown synthetic mesh to provide the lowest recurrence rates, including the largest randomized trial to date on anterior vaginal prolapse repair by the Nordic Transvaginal Mesh Group [13]. Three hundred eighty-nine women were randomized with grade II prolapse or higher to Gynecare Prolift™ mesh kit or anterior colporrhaphy. Recurrence was defined by a composite of subjective and objective measures. Patients had to report a "bulge" sensation as well as have stage 2 prolapse or worsening of the anterior vaginal wall on POPQ exam. The mesh cohort had a resultant recurrence rate of 39.2 % in comparison to 65.5 % in the anterior colporrhaphy group at 1 year. These recurrence rates were higher than in previous literature, however they account for this by their strict criteria for success using combined objective and subjective measures.

The use of synthetic mesh has been associated with reduced recurrence rates but with a higher complication rate due to mesh erosion and extrusion. The literature does not consistently differentiate between "mesh extrusion" and "mesh erosion", however the implications and management are different. Mesh extrusion is defined as mesh exposed through the vaginal epithelium which can usually be handled in an outpatient setting. Mesh erosion implies violation into an adjacent organ such as the bladder, requiring surgical resection with possible reconstruction. Reported mesh erosion rates are often inclusive of extrusions which are significantly less problematic from a management perspective.

Mesh erosion requiring surgical revision was quoted by the Nordic Transvaginal Mesh Group as 3.2 %. Other trials have quoted similar rates; however, the majority do not require surgical intervention. Nguyen et al reported a 5 % mesh extrusion rate with synthetic mesh kits, however numbers as high as 19 % have been reported [17, 19]. Meta-analysis of synthetic mesh usage showed an overall mesh erosion/extrusion rate of 11.4 %, however surgical intervention was needed in only 6.8 % of patients [3]. The remainder were treated conservatively with topical estrogen treatment with limited excision in the outpatient clinic. Biologic mesh extrusion has been documented through the vaginal wall. Extrusion for porcine mesh ranges from 4 to 16.7 % after 1 year, however no requirement for surgery has been recorded, as all were treated with topical estrogen and/or local debridement in clinic [7, 12]. The findings of these studies led the FDA to issue a Public Health Notification on October 20, 2008 on the use of transvaginal mesh of all types. This was later updated on July 13th 2011 in an Updated Safety Communication specifically targeting mesh for pelvic organ prolapse (POP). They reported "serious complications are not rare with the use of surgical mesh in transvaginal repair of pelvic organ prolapse" after reviewing the literature from 1996 to 2011. The review found that the most common complication was erosion of the mesh through the vagina, which can take multiple surgeries to repair and can be debilitating in some women. Mesh contraction was also reported, which causes vaginal shortening, tightening, and pain" [20].

Alternate Surgical Techniques

Abdominal

The paravaginal repair was first described as a vaginal approach by Dr. George R. White in 1911 [21]. This was later changed and popularized into an abdominal approach by Dr. A Cullen Richardson in the 1970s [22]. Complications included cystotomy, obturator nerve injury, ileus, hemorrhage, and infection. Since that time numerous surgeons have reverted back to the vaginal approach, although the concern of damage to surrounding structures, including neurovascular complexes such as the pudendal nerve is still present due to the extent of dissection needed [14, 23]. This has shown to be low risk however in recent studies [10, 23].

Laparascopic

Laparoscopic repair via a transperitoneal approach has been described for paravaginal repair. The descriptions of this technique commonly are combined with an urethropexy for stress urinary incontinence. The laparoscopic approach facilitates access to the space of Retzius and the anterior vaginal wall with clear identification of the ATFP. Unfortunately, cystotomies are the most common complication. It is also possible to injure the pudendal nerve and vasculature. Due to the skill set required, the laparoscopic approach is not commonly reported [24].

Vaginal

The gold standard paravaginal repair is to fixate the endopelvic fascia or even the pubocervical fascia to the arcus tendinous fascia pelvis, however these techniques have been modified over the years. Some describe tacking the pubocervical fascia to the endopelvic fascia, or even to the infra-levator obturator fascia with similar results [25]. In order to access the ATFP some use the Capio suture device (Boston Scientific, Natick, MA) instead of the usual needle-drivers available. Some surgeons prefer this device to allow for better needle placement.

Mid/Long-Term Outcomes/Results

Reports of greater than 5 years follow-up are required to objectively evaluate medium to long-term surgical outcomes. However, most studies have 1 year follow up with a few studies extending the recorded outcomes to 2 and 3 years. Studies with 1-year follow up demonstrate recurrence rates ranging from 7 to 39.2 % for porcine dermis mesh, 4 % for synthetic mesh, and 24 % for native repair [10, 13, 14]. Mesh erosion or extrusion from biologic mesh occurred in 1–21 % of patients, and in 3.2–4 % of patients who received synthetic mesh. No difference in patient satisfaction was seen in any of these studies, again showing the lack of correlation between objective and subjective measures. De novo stress incontinence was documented in 12.3 % of patients who received synthetic mesh, which was significantly higher than the anterior colporrhaphy cohort.

At 2 years, reported recurrence rates for synthetic mesh were 18 % and porcine dermis 22–46 %. No data for native repair outcomes at this time point have been reported. Again, no significant difference was seen in patient satisfaction. Mesh erosion was 14 % for the synthetic mesh and 4 % with porcine mesh [8, 26]. De novo stress urinary incontinence was found in 8 % of patients and 28 % de novo urge urinary incontinence was seen as well [7].

Nieminen et al reported the only available 3 year outcomes in which 201 women were randomly assigned to anterior colporrhaphy or anterior vaginal prolapse repair with synthetic mesh placed through the retropubic space with penetration of the infra-levator obturator fascia [20]. Recurrence was found in the mesh group of 13 % compared to 41 % in the anterior colporrhaphy group ($p < 0.0001$). The mesh erosion rate was 19 %. Symptoms were similar in both cohorts at the end of 3 years with no significant difference in dyspareunia or pelvic pressure. This study also showed that the majority of recurrences occurred within the first year postoperatively.

Conclusion

In conclusion, paravaginal repair is commonly performed in combination with other procedures for prolapse and incontinence. Reconstitution of the fascial attachments between the vagina and AFTP can be accomplished from the vaginal or abdominal approach depending on surgeon preference. Due to the FDA warning, most surgeons are veering away from synthetic mesh due to risk of erosion and extrusion, although synthetic mesh has been associated with less anatomical recurrence. This has not been shown to correlate with subjective outcomes and so biologic graft or native repair is used more often as the risk of operative re-intervention is less. While several options are available for biologic graft, the most studied has been porcine dermis. In the end, it is important to educate the patient on all risks and benefits of each option and what would suit her needs best. Follow up is vital as most recurrences and other complications occur within 1 year, although most are asymptomatic.

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Chapter 8
Sacrospinous Ligament Vault Suspension

Maude E. Carmel

Abstract Various surgical techniques are available to correct pelvic organ prolapse. Owing to recent warnings about the use of mesh in pelvic surgeries and its related complications, sacrospinous ligament vault suspension may play an important role again. Sacrospinous ligament vault suspension is an extraperitoneal vaginal approach that is advantageous in patients with multiple previous abdominal surgeries. It offers a safe and effective native tissue alternative repair technique for the correction of post-hysterectomy vaginal vault prolapse. Adequate knowledge of the pararectal anatomy is essential in order to perform this procedure.

Keywords Pelvic organ prolapse • Sacrospinous ligament • Vault suspension • Outcomes

Case Presentation

This is the case of a 75 year old woman who presented for bulge symptoms, refractory frequency, urgency and urgency incontinence and feeling of incomplete emptying. She had failed anticholinergic medications. She had failed a pessary trial. Patient was G2P2, had a total abdominal hysterectomy 40 years ago and was minimally sexually active.

Her physical exam revealed an atrophic vaginal mucosa. No stress urinary incontinence was demonstrated with her prolapse reduced. She had a stage III pelvic organ prolapse. Her POP-Q was the following: Aa 0, Ba +3, C −3, Ap −1, Bp 0, gh 4, pb 3, tvl 9.

Urodynamic study with and without packing was performed and did not reveal occult stress urinary incontinence. She also underwent a voiding cystogram that confirmed the presence of a moderate cystocele with incomplete bladder emptying (Fig. 8.1).

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M.E. Carmel, MD, FRCSC (✉)
University of Texas Southwestern, 5323 Harry Hines Bld, Dallas, TX 75390-9110, USA
e-mail: maude.carmel@utsouthwestern.edu

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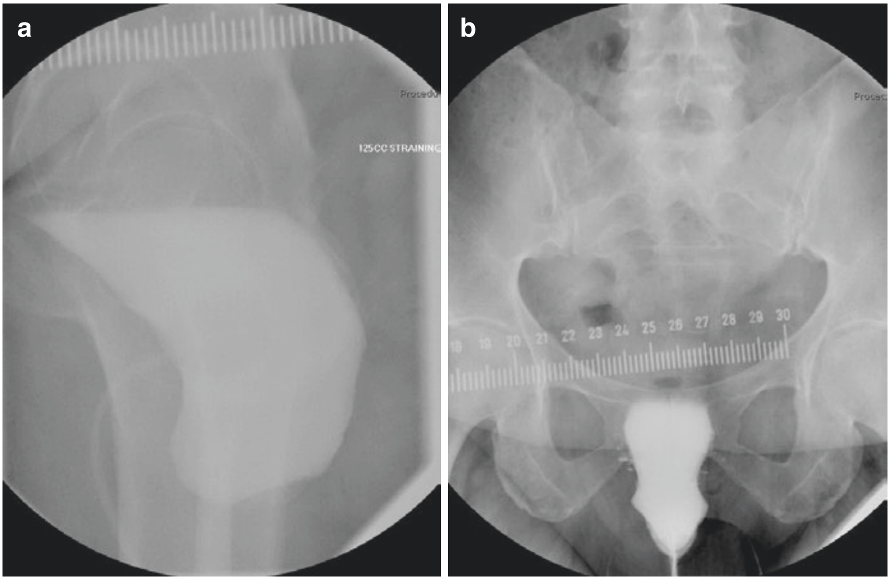

Fig. 8.1 Voiding cystogram confirming presence of moderate cystocele (**a**) and incomplete emptying (**b**)

The patient and the family desired a native tissue repair option for her prolapse from which she would recover quickly. She elected to undergo a sacrospinous ligament vault suspension (SSLS) with an anterior and posterior colporrhaphy.

Surgical Indications

Sacrospinous ligament vault suspension is a technique to correct post-hysterectomy vaginal vault prolapse. This technique can be slightly modified in order to perform a sacrospinous hysteropexy as a uterine-sparing technique. This technique should be considered in patients who wish to avoid synthetic material for their vault suspension. SSLS consists of an extraperitoneal approach, which is an advantage in patients with multiple previous abdominal surgeries. The pararectal space is usually not violated during abdominal surgeries making this extraperitoneal technique a safe approach in this situation to avoid bowel adhesions and injury. Secondary to the risk of dyspareunia and deviation of the axis of the vagina that follows this procedure, the best patients to consider for this technique are older patients who are minimally or non-sexually active who desire to keep a functional vagina.

One needs to verify the patient's vaginal length before consenting the patient for such repair. Vaginal length of approximately 8 cm or more is usually required to ensure that the new apex will reach the sacrospinous ligament without tension to offer adequate support and minimize the risk of failure.

Preoperative Discussion

During the discussion with the patient before surgery, the expected recovery is explained. Minimal to moderate pain is usually experienced requiring some pain relief medication. Patients can expect vaginal bleeding that can last up to 4 weeks after surgery. Patients should limit or avoid exercise, physical activity, heavy lifting and intercourse for 4–6 weeks after surgery. The risks and complications are discussed with patients, including risk of bleeding, infection, pain and buttock pain, organ injury, de novo incontinence and dyspareunia. The reported long term success rate and risk of needing additional procedures are also discussed.

The risk of hemorrhage requiring transfusion has been estimated to be around 0–3 %. Severe bleeding, if it occurs, is usually secondary to hemorrhage from the inferior gluteal vessels, hypogastric venous plexus, or internal pudendal vessels. Controlling this type of bleeding can be difficult. If severe bleeding occurs, it can usually be controlled by packing the vagina and holding pressure for sufficient time (at least 5 min if there is significant bleeding). If this does not control the bleeding, ligation with sutures should be performed. This is a difficult area to approach abdominally and bleeding should be controlled vaginally [1–3].

Perforation of the bladder, rectum and small bowel occur in 0.5–1.7 % [2, 4]. Cystoscopy should be performed to assess the integrity of the bladder. Rectal examination should be done during the operation to identify possible rectal injury that can occur while entering the right pararectal space. Unilateral right-sided SSLS is preferred in order to avoid the recto-sigmoid junction on the left side. Hydrodissection of the right pararectal space prior to its dissection also makes the dissection of the vaginal wall off the rectum easier. Rectal injuries can usually be repaired primarily transvaginally in two or three layers.

One of the most feared complications of this surgery is the occurrence of buttock pain. Approximately 6–14 % of patients will experience moderate-to-severe buttock pain on the side of the SSL fixation. In most patients, this will resolve within 6 weeks after surgery. Reassurance and anti-inflammatory medication are usually sufficient to resolve this type of pain. Because of the proximity of the sciatic and pudendal nerve to the SSL, these nerves can be injured during suture placement. This has been rarely reported. If the patient is experiencing severe and prolonged pain, it should raise the suspicion of potential pudendal nerve entrapment. Removal of the offending sutures should not be delayed and this should offer complete relief almost immediately [2, 3, 5].

Sexual dysfunction and dyspareunia has been reported in up to 3–13 % of patients, but it is unclear if this is secondary to the change in vaginal orientation or other factors. Vaginal stenosis can occur if too much anterior or posterior vaginal wall is trimmed at the time of the anterior or posterior colporrhaphy [5].

As with any prolapse repair surgery, de novo stress urinary incontinence can occur after this surgery, especially if no anti-incontinence procedure was performed concomitantly. The presence of occult stress incontinence should be tested preoperatively with either a stress test with reduction of the prolapse in the office or with a formal urodynamic study with and without vaginal packing.

The reported long term success rate of this surgery is approximately of 75–80 %. The highest incidence of recurrence is usually located along the anterior vaginal wall. Approximately 20 % of patients will have some anterior vaginal wall descent within a year of surgery, but most patients are asymptomatic. Only 5 % of patients will be symptomatic enough to require a repeat surgery to treat the recurrent prolapse. This compromise of the anterior vaginal wall results from the posterior deviation of the vaginal axis compared to its natural position after SSLS.

Surgical Technique (Refer to Video 7.1 Lateral Paravaginal Repair, Colporrhaphy, and Sacrospinous Ligament Vaginal Vault Suspension (De E))

After administration of general anesthesia, patient is positioned in dorsal lithotomy position. A surgical headlamp and a lone-star retractor can be highly beneficial for this procedure. The vaginal vault prolapse is examined to identify the sacrospinous ligament (SSL) and the location of the new apex. The SSL is a firm, somewhat fixed structure that can be identified on pelvic examination between the ischial spine and the lateral border of the sacrum and coccyx. It has a length of 7–8 cm. The SSL lies within the coccygeus muscle. Therefore, the fibromuscular coccygeus muscle and SSL are basically the same structure.

The new apex is positioned on the posterior vaginal wall slightly to the right side of the midline and as close to the vaginal apex as possible. Using an Allis clamp, the new apex is grasped. Verification is made to ensure that the vaginal wall will reach the SSL without tension and that it will touch the SSL without space in between. The intended apex is tagged with an interrupted suture for later identification. The unilateral SSL is usually preferred compared to bilateral suspension. The patient's right side is the most common side for unilateral SSLS because it is easier for right-handed surgeons and the rectosigmoid junction is avoided on the left side. After the suspension, the vaginal length should be approximately 10 cm.

Decision can be made intraoperatively with the apex reduced manually in the new position as to whether an anterior repair and/or a posterior repair will be necessary. Patients should be consented for possible anterior and posterior repair because it is often difficult to identify the extent of the anterior and posterior defect preoperatively. If an anterior colporrhaphy is warranted, it should be performed prior to suspending the vault. Considering that the axis of the vagina will be more posterior than the "anatomic" position, one should err on the side of performing an anterior colporrhaphy with the SSLS to provide stronger anterior support. Once the anterior colporrhaphy is completed, the anterior vaginal wall incision is closed with a continuous running suture.

The attention is then drawn to the posterior vaginal wall for the SSLS. The posterior vaginal wall is infiltrated with a solution of lidocaine with epinephrine for hydrodissection and hemostasis. A midline incision is made from the introitus toward the apex as for a usual posterior colporrhaphy, ending the posterior incision 3–4 cm distal to the vaginal apex (Fig. 8.2). In cases where a posterior colporrhaphy is

Fig. 8.2 Posterior vaginal wall incision and infiltration for sacrospinous ligament vault suspension

required, the vaginal wall is dissected off the rectovaginal fascia on both sides down to the lateral sulcus. For patients with no posterior compartment prolapse or very small rectocele that is reduced when the new vaginal apex reaches the SSL, a posterior colporrhaphy is not required to complete this procedure. In this situation, only the right posterior vaginal wall is dissected sharply and bluntly toward the lateral sulcus.

At this point, lidocaine with epinephrine or injectable saline can be injected into the right pararectal space toward the ischial spine for hydrodissection of the right pararectal space to facilitate the dissection. While protecting and retracting the rectum towards the patient's left side, the right pararectal space is entered by perforating the fibroareolar tissue between the rectum and the arcus tendineus fascia pelvis toward the ischial spine using the tip of Metzenbaum scissors. The right pararectal space is then dissected using mostly blunt dissection with the index finger with or without the use of gauze, following the edge of the pelvic wall anteriorly toward the sacrum. With this movement, the identification of the ischial spine should be made. During the dissection of the sacrospinous ligament, one must caution against too radical exposure of this area since the vascular supply is abundant in this region. Once the ischial spine is identified, more dissection is required toward the sacrum to isolate the sacrospinous ligament. To facilitate the identification and exposure, the Breisky-Navratil retractors are used.

It is easier to have three different sizes of Breisky-Navratil retractors to complete this surgery: a long and narrow, a long and wide, and a short. To position the retractors and expose the SSL appropriately, one hand is placed in the dissected pararectal space, retracting the rectum to the left side. The long and narrow retractor is placed over the hand to retract the rectum medially. The long and wide retractor is put on top of the narrow retractor in order to provide better support to the rectum and the narrow retractor is removed. It is replaced at the 12 o'clock position to retract the vaginal wall and bladder superiorly. The two retractors should be positioned at approximately 90° to maximize the visualization of the SSL. The assistant should be holding these two retractors when well positioned. The short retractor is placed at the bottom to compress the distal portion of the pelvic diaphragm to form a triangle with the other retractors in order to expose the SSL for direct visualization of the ligament (Fig. 8.3).

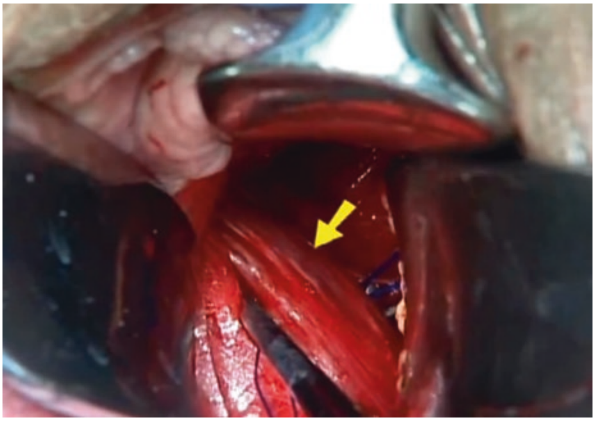

Fig. 8.3 Optimal exposure of the sacrospinous ligament (*arrow*) using the Breisky-Navratil retractors

Care must be taken in this area not to disrupt the nearby hypogastric plexus of veins superiorly and the hemorrhoidal vessels medially with the retractors.

Once exposure is adequate, sutures are passed into the SSL. Two or three No. 0 or 1 delayed absorbable sutures are placed through the SSL. Several instruments are available to perform this step of the procedure. A long needle driver or long Heaney needle driver can be easily used with CT-1 needle. With the left handed finger, the ischial spine should be palpated and the needle should penetrate the SSL at least 1.5–2 cm or two fingerbreadths medial to the ischial spine under direct vision to avoid damages to the pudendal nerve and vessels. The sutures should be placed about 1 cm apart. The needle should be passed superficially through the caudal edge of the ligament with a wide bite, yet without going too distal to avoid incorporating too much coccygeus muscle. Suture placement should also avoid the cephalad border of the SSL in order to minimize the risk of injury to the gluteal vessels and sciatic nerve (Fig. 8.4). These sutures are tagged and kept aside for future use. The sutures are placed at an appropriate depth and length such that a gentle tug on the sutures can essentially move the patient a small amount on the operating table.

A Deschamps ligature carrier can also be used to pass the suture through the ligament. A free suture is threaded inside the eye of the Deschamps ligature carrier and is passed through the ligament in a similar way. Resistance can be encountered when pushing the ligature carrier through the SSL. Once the tip of the suture carrier is passed and can be visualized, the suture is retrieved using a nerve hook. Other instruments have also been developed to help with the passage of sutures in the SSL. One retrospective study reported a lower risk of complication when using a standard needle driver with direct visualization for the placement of the sutures compared to Deschamps ligature carrier or the Miya hook. However, the last two instruments were used without direct visualization of the ligament and sutures were passed with palpation only of the SSL. Whichever the instrument used for the passage of the sutures, direct visualization should be obtained for safe placement of the SSL sutures [6].

One common complaint after this surgery is the new onset of buttock pain on the side of the sutures. Mild to moderate pain can be expected and be normal. This is

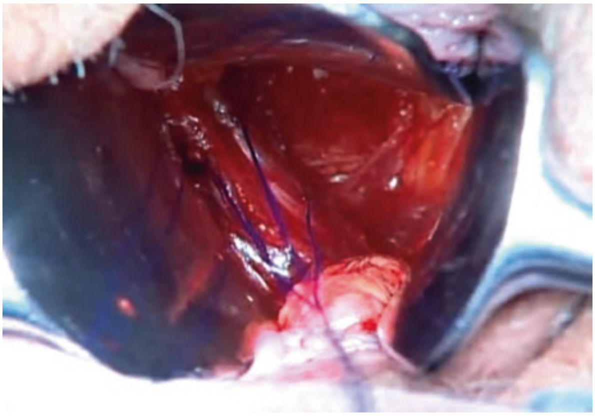

Fig. 8.4 Suture placement in the sacrospinous ligament

secondary to the dissection in the pararectal space and this should resolve within 6 weeks. Prolonged or severe buttock pain may be due to injury to the coccygeus muscle, to the pudendal nerve or the sciatic nerve. Placing the sutures through the ligament alone and not deep through the underlying coccygeus muscle can minimize the risk of injury to the coccygeus muscle. This type of pain should resolve with time. Injury to the pudendal nerve and vessels and sciatic nerve can be avoided by placing the suspension sutures in the middle or medial third of the ligament and avoiding the cephalad border of the ligament. Motor or sensory deficit in the territory of the pudendal or sciatic nerve after surgery should alarm the physician that one of these nerves was injured during suture placement and the suture should be removed immediately.

If a posterior colporrhaphy is necessary, the posterior plication is done at this juncture, without closing the pararectal space created to pass the SSL sutures. Once the posterior plication is completed, the SSL stitches are ready to be brought out of the new apex. Using a free needle, the end of each suture is passed through the vaginal wall, 1–2 cm apart, at the location of the new apex determined at the beginning of the procedure. The posterior vaginal wall incision is then closed. The SSL sutures are tied down while the vaginal apex is advanced up toward the SSL to suspend the vaginal vault. It is important to bring the vaginal mucosa against the SSL, avoiding a “suture bridge”. The vaginal wall suspension is complete (Fig. 8.5). The vaginal apex will have a slight deviation to the right which usually has no consequence.

Post-operative Care Recommendations

Patients are usually observed over-night. A moist vaginal packing is placed in the vagina for 24 h to provide compression and avoid postoperative bleeding. A Foley catheter is also left for 24 h. Patients are discharged home the next day and are instructed to limit physical activity for 4–6 weeks. If the patient develops buttock pain, anti-inflammatory medication can be prescribed and will help to decrease the pain rapidly.

Fig. 8.5 Completed sacrospinous ligament vault suspension after closure of the posterior vaginal wall incision

Mid and Long Term Results

The subjective cure rate of the SSLS has been reported to be between 70–94 % and the objective cure rate based on physical examination 67–94 %. Multiple definitions of objective and subjective success have been used, making comparison between studies difficult. Data after more than 24 months of follow up (2–10 years) report an anatomic success rate of 63–97 % [3, 5, 7, 10]. The anterior compartment has the highest rate of failure. This is thought to be secondary to the posterior deviation of the vaginal axis, which makes the anterior vaginal wall vulnerable to abdominal pressure changes. The incidence of recurrent cystocele has been reported to be around 14–29 %. Apical descent recurrence occurs in 1–13 % and 2–5 % of patients experience a posterior compartment prolapse recurrence [1, 8, 10]. Despite the potential for objective vaginal descent, most patients are still extremely satisfied after this surgery and the subjective success rate after more than 2 years is 78–94 % [1, 7–9]. The intervention or reoperation rate for the treatment of recurrent symptomatic prolapse is only 2.5–9 % [2, 8, 10].

The OPTIMAL trial was a randomized controlled trial comparing SSLS to uterosacral ligament suspension. Using a very strict composite success definition, 63 % of patients in the SSLS group were a surgical success 24 months after the surgery. However, only 20 % had symptomatic vaginal bulge symptoms. The most common compartment of recurrence of prolapse was the anterior compartment (13 %) but there was no difference between the uterosacral ligament suspension group and the SSLS group. The rate of recurrent posterior compartment prolapse was 3.3 % for the SSLS group and apical descent was reported in 2 % of patients. The overall retreatment rate with either pessary or surgery was also the same between the two groups with only 5 % of patients requiring reintervention [2].

Conclusion

Sacrospinous ligament vault suspension is a safe and effective native tissue repair technique for the correction of post-hysterectomy vaginal vault prolapse. This extra-peritoneal approach is advantageous in patients with multiple previous abdominal surgeries. Long term patient satisfaction is excellent and the reoperation rate is very low. The complication rate is low, the most frequent reported complication being new onset of buttock pain. In most patients, this will resolve within 6 weeks after surgery.

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Chapter 9
Uterosacral Ligament Vaginal Vault Suspension

Amy D. Dobberfuhl and Elise J.B. De

Abstract Uterosacral ligament vaginal vault suspension is an elegant reconstructive procedure for apical prolapse which restores the natural vaginal axis using solely native tissue supports. It is suited to women with moderate apical prolapse in which the uterosacral ligaments are likely to be preserved. It can be employed in combination with hysterectomy or in the case of moderate post-hysterectomy vault prolapse. Important points are highlighted, including avoidance of nerve and ureteric injury (see also Chapter 1). Uterosacral ligament suspension can be performed concurrent with other repairs and is one of several options for addressing apical prolapse. In the event that the uterosacral ligaments are unsatisfactory, the surgeon should be prepared to offer alternative repairs to address apical prolapse (see also Chapters 8, 10, 11 and 14).

Keywords Cystocele • Hysterectomy • Uterosacral ligaments • Pelvic organ prolapse • Rectocele • Sutures • Uterine prolapse • Vagina

Abbreviations

FIGO	International Federation of Gynecology and Obstetrics
Pdet	Detrusor pressure
POP-Q	Pelvic Organ Prolapse Quantification
Qmax	Maximum urinary flow rate
SSL	Sacrospinous Ligament
USL	Uterosacral Ligament

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A.D. Dobberfuhl, MD (✉)
Stanford University School of Medicine, Department of Urology,
300 Pasteur Drive, S-287, Stanford, CA 94305, USA
e-mail: adobber@stanford.edu

E.J.B. De, MD
Associate Professor Urology, Division of Urology,
MC 208, Albany Medical Center, 23 Hackett Boulevard, Albany, NY 12208, USA
e-mail: ede@communitycare.com

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Case Presentation

Our index patient is a healthy 55 year old G4P4 female with a history of four vaginal deliveries and total abdominal hysterectomy at 40 years of age for uterine bleeding. She is evaluated for the complaint of a symptomatic and bothersome vaginal bulge causing voiding symptoms and recurrent urinary tract infections. Her voiding symptoms include urinary frequency, splinting to void and a sensation of incomplete emptying, which have improved following a ring pessary with support. She denies stress urinary incontinence, either with or without the prolapse reduced. However three times a week she experiences small volume bothersome urgency urinary incontinence – which improved following anticholinergic therapy. On physical exam she was found to have a total vaginal length of 8 cm and POP-Q stage 2 anterior (Aa +1, Ba +1), stage 3 apical (C +3), and stage 2 posterior (Ap 0, Bp 0) prolapse. Empty supine stress test was negative for leak. Post void residual was 200 mL without and 100 mL with the prolapse reduced. Cystoscopy performed for her complaint of overactive bladder symptoms and recurrent urinary tract infections revealed prolapse of the trigone. There were no urothelial lesions suspicious for malignancy and there was no stress incontinence with cough at the end of the procedure.

After a 6 month pessary trial delaying surgery for work obligations, our patient became intolerant of the pessary and its impact on sexual activity, and she now desired definitive surgical repair of her prolapse. Due to her complaint of urgency urinary incontinence and elevated post void residual, she underwent video urodynamic evaluation in order to further characterize detrusor contractility and the presence or absence of detrusor overactivity. With the pessary in place, her voiding diary revealed small volume voids of 100–150 mL every 1–2 h. She was unable to void without the pessary. With the prolapse reduced her free uroflow demonstrated a Qmax of 10 mL/s, 125 mL voided volume and 100 mL catheterized post void residual. Urodynamics revealed normal filling pressure, mild detrusor overactivity (up to 15 cm H_2O) beginning at 100 mL – which was suppressible and not associated with leak. Maximum cystometric capacity was 325 mL. She voided 175 mL with a Pdet of 20 cm H2O and a Qmax of 8 mL/s. Fluoroscopy revealed a mildly trabeculated bladder, prolapse 6 cm below the pubic symphysis and appropriate funneling of the bladder neck during voiding.

Surgical Indication

In our practice, uterosacral ligament vaginal vault suspension is offered to women with a stage 2 to stage 3 uterine or vault prolapse. Additional repairs may include hysterectomy, concomitant repair of any residual cystocele or rectocele, as well as an anti-incontinence procedure for bothersome stress urinary incontinence. When stage 4 prolapse is present, there is a concern that the uterosacral ligaments will be detached or too attenuated for use. For apical compartment prolapse of the vaginal vault, a systematic review of management options was recently published by the International Federation of Gynecology and Obstetrics (FIGO) working group. This includes a concise summary of the level of evidence, cost-effectiveness, degree of difficulty and guideline recommendations for the non-surgical and surgical management of pre- or post-hysterectomy vaginal vault prolapse [1]. Non-surgical first line conservative treatments include a vaginal pessary to reduce the prolapse and pelvic floor physical therapy to strengthen the pelvic floor [2]. For our index patient who had been refractory to and no longer satisfied with conservative treatments, surgical options will need to include apical vault suspension along with respective compartment repair. She had previously undergone total hysterectomy. The surgeon's transvaginal apical repair options include suspension of the vaginal apex using the uterosacral, sacrospinous or iliococcygeal ligaments, with or without biologic graft placement for compartmental reinforcement [1]. Abdominal approaches include open, pure laparoscopic or robot assisted laparoscopic sacrocolpopexy using a mesh graft. Our patient desired a native tissue repair without graft placement and wished to preserve sexual function (thereby prohibiting colpocleisis and raising concern regarding graft-based repairs).

In the case of our healthy middle aged, physically and sexually active female, uterosacral ligament suspension was chosen, as this would restore her vaginal axis to her pre-hysterectomy state, thus re-creating the support that was previously provided by the cardinal and uterosacral ligaments.

Patient Discussion

The consensus statement by the FIGO working group concludes that "uterosacral ligament suspension can correct the vaginal apical part to an anatomically normal position rather than sacrospinous ligament fixation" with level 1a literature evidence and the highest, grade A, level of recommendation [1]. Surgical risks associated with this procedure were recently published by the OPTIMAL trial following the enrollment of women with apical vaginal prolapse and stress incontinence randomized to either sacrospinous or uterosacral ligament vaginal vault suspension [3]. Neurologic pain was less common in the uterosacral ligament group (USL 6.9 % vs. SSL 12.4 %, OR 0.5, 95 % CI 0.2–1.0, $p = 0.49$), and subsequently improved to only 0.5 % by 4–6 weeks (versus 4.3 % after SSL). Ureteral obstruction was more common following uterosacral ligament suspension, with 3.2 % identified and managed intra-operatively with the removal of the offending suture and ureteral stent placement. Ureteral obstruction was not identified until the postoperative period in one patient (0.5 %) in this study.

In a recent retrospective review of 983 women undergoing uterosacral colpopexy by Unger et al, the overall adverse event rate was 31.2 % (95 % CI 29.2–38.6 %), consisting predominantly of urinary tract infections in 20.3 % of patients (95 % CI 17.9–23.6 %) [4]. In this series, bladder injury occurred at a rate of 1 % (95 % CI 0.6–1.9 %) and ureteral kinking was noted at time of suture placement in 4.5 % (95 % CI 3.4–6.0 %), in whom simple suture removal was performed intraoperatively without any long term consequence to the ureter. In patients who required suture removal, 63.6 % did not have the offending suture replaced, and there was no increase in recurrence of prolapse noted at follow up.

Some surgeons perform prophylactic temporary ureteral stent placement at time of uterosacral ligament suspension to assist with intraoperative identification of the ureter during the placement of uterosacral ligament sutures. The data on this is conflicting and based on theoretical risk; one of the authors does this for every patient, allowing for positive identification of the ureter and tenting it away from the uterosacral ligament. Others use stents only in the setting of re-operation, scar tissue, or altered vaginal anatomy.

Through shared decision making and a careful discussion of risks, benefits and alternatives, taking into account that vaginal prolapse is not a life threatening condition, and the patient's primary goal is to maintain sexual activity with a repair that restores vaginal anatomy to the most anatomically correct state, our index patient chose to proceed with uterosacral ligament vaginal vault suspension.

Surgical Technique (Refer to Video 9.1, Uterosacral Ligament Vaginal Vault Suspension (De E))

The anatomic premise behind the uterosacral ligament suspension is the re-creation of a natural vaginal axis by re-suspending the vaginal apex, rectovaginal and pubocervical fascia to the remaining uterosacral ligament following hysterectomy.

The bladder is decompressed throughout the procedure using a Foley catheter and a Scott retractor is placed at the level of the hymen. The repair is begun by first identifying the leading anatomic edge of the apical prolapse. The vaginal apex is grasped using a Babcock clamp and maximally everted (Fig. 9.1). The prolapse is then maximally reduced using the Babcock clamp and the position of the clamp is repositioned until both the anterior and posterior compartment are reduced equally.

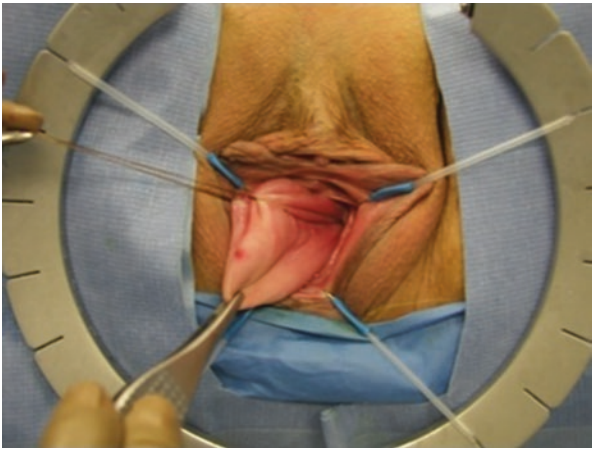

Fig. 9.1 Prolapse everted to identify the leading edge of the apex. Dimples marked

The position of the clamps is then marked using a silk suture on the left and right, in what will eventually become the approximate position of the most lateral and apical portion of the reduced apical prolapse at the completion of the procedure. If the marking sutures do not correspond to the dimples at the insertion of the cardinal/uterosacral ligament complex, an additional set of sutures is placed. The latter will allow for traction on the uterosacral ligaments/dimples for identification. (At this point in the case it may be clear that an anterior or posterior repair will be needed regardless of vault support. These repairs can be completed at any point in the case and may be easier prior to suspending the vault.)

The vaginal epithelium is hydrodissected away from the underlying enterocele, pubocervical and rectovaginal fascia at the vaginal apex. Following an apical incision, using sharp and blunt circumferential dissection a plane is created immediately deep to the vaginal epithelium (Fig. 9.2). It is the author's preference to make a midline apical incision for post-hysterectomy vault prolapse, given the ease of a more natural angle of dissection left and right. In the case of concurrent hysterectomy, an oval defect in the apical vault will be available for the repair, typically with a nice thick cervical ring and underlying pubocervical and rectovaginal fascia for attaching apical suspension sutures. Once the entire apical enterocele sac is dissected free, the peritoneum of the enterocele is then lifted away from the underlying bowel and incised sharply (Fig. 9.3). If the peritoneum cannot be safely entered, alternatively a retroperitoneal approach (sacrospinous ligament or iliococcygeus suspension) may be performed. These alternative apical suspension techniques should be discussed preoperatively with the patient when consenting for native tissue transvaginal apical prolapse repair.

Upon opening the peritoneum, it may then be mobilized and retracted circumferentially, thus allowing the bowel to be packed into the abdomen cephalad using counted laparotomy pads. Meanwhile a long weighted speculum or a Deaver

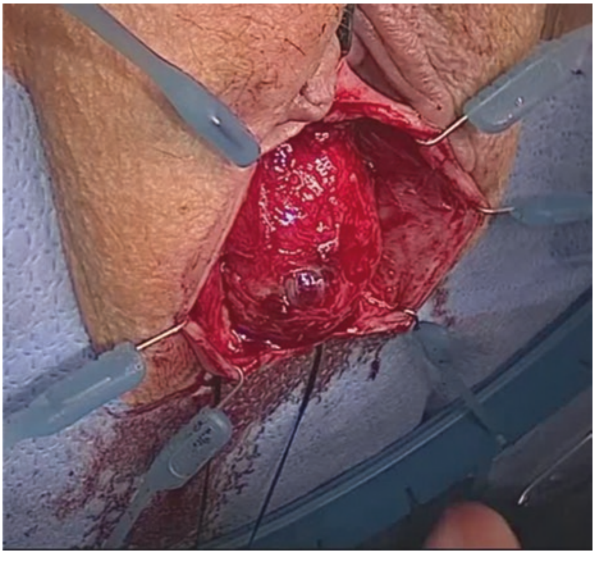

Fig. 9.2 Vaginal epithelium dissected off underlying enterocele

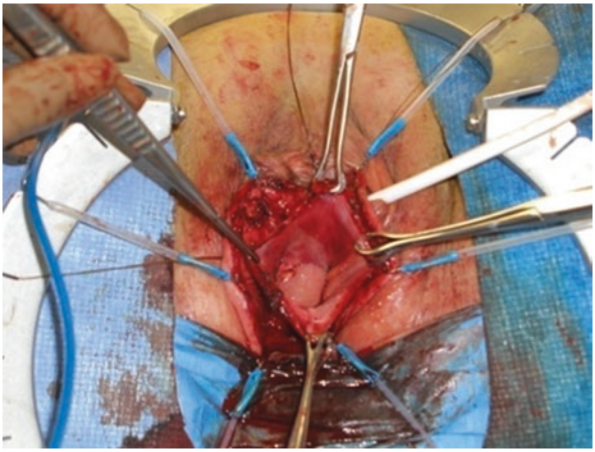

Fig. 9.3 Enterocele opened, exposing underlying bowel

retractor is placed through the peritoneal opening (Fig. 9.4a). The position of the left and right uterosacral ligaments is then identified. The previously placed silk sutures are tensioned, allowing the uterosacral ligament to be palpated (the uterosacral ligament is about the width of the pinky digit on a small hand and should be running in alignment with the silk towards the sacrum at the 5 and 7 o'clock position adjacent to the introitus). The mid to distal uterosacral ligament is grasped using a long Allis clamp. The uterosacral ligaments should be strong and their tented surface when grasped should direct tension towards the level of the sacrum. If concomitant total vaginal hysterectomy is being performed, the uterosacral ligaments should be tagged where they insert into the cervix to aid in identification. It is then the author's preference to place a total of three sutures into each uterosacral ligament, with the highest and most proximal one made of permanent monofilament or braided suture, and the distal of absorbable braided or delayed absorbable monofilament (Fig. 9.5a, b).

The needles for these sutures should be strong to prevent bending and fracture (consider UR-6, CT-2 or equivalent). The ureter may be palpated running lateral to the uterosacral ligament, and along with underlying neurovascular structures are protected by gently tenting the uterosacral ligament away from the retroperitoneal fat using the Allis clamp. The anatomy of the uterosacral ligament can be appreciated in Fig. 9.4b. Neurologic structures within the uterosacral and cardinal ligaments include autonomic branches from the inferior hypogastric plexus innervating the bladder as well as the plexus itself [5]. Deep to the uterosacral ligament, the sacral nerve roots may be inadvertently encircled during suture placement, as noted in 7 out of 10 unembalmed female cadavers subjected to bilateral uterosacral ligament suspension by Siddiqui et al [6]. These authors found that a more dorsal and medial needle arc was associated with sacral nerve root injury, and that by ventrally tenting the uterosacral ligament nerve injury was minimized. It is also advocated that in order to avoid ureter injury, needle passage should be directed toward the floor (clockwise needle passage on the patient's left side, and counter-clockwise on the patient's right side), rolling away from the ureter, about one-third to one-half the lateral depth of the tented ureterosacral ligament to prevent compromise of the underlying hypogastric

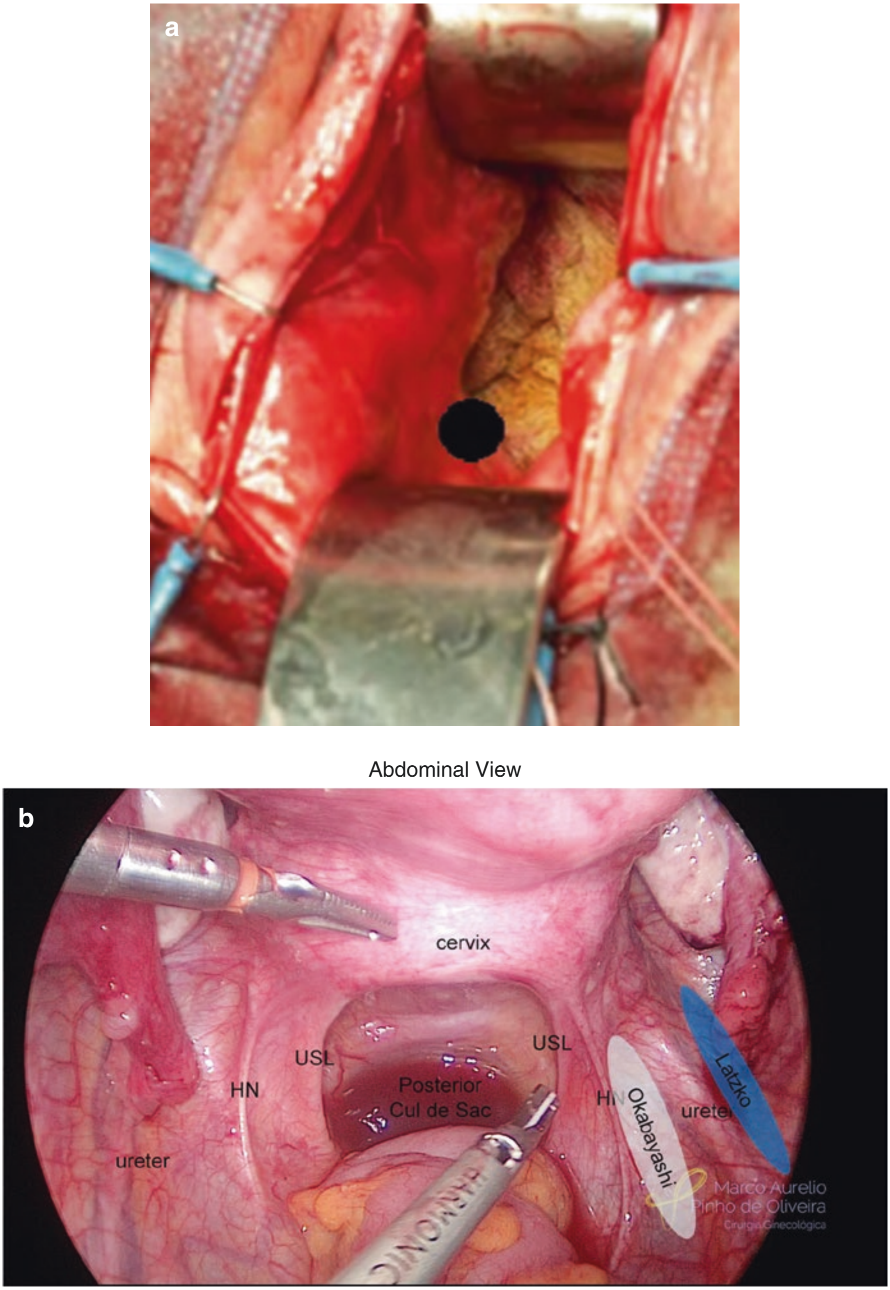

Fig. 9.4 (**a**) Uterosacral ligaments identified with long weighted speculum in place. *Black dot*=Uterosacral ligament. (**b**) The anatomy of the uterosacral ligament (USL) in relation to the hypogastric nerve (HN) and the ureter. The ureter is closest to the USL at the level of the cervix. Deep to the USL, the inferior hypogastric plexus and sacral nerve roots can be injured. *Okabayashi*=Okabayashi pararectal space, *Latzko*=pararectal space (Courtesy of Marco Aurelio Pinho de Oliviera, M.D., Chief of the Department of Gynecology of the State University of Rio de Janeiro – Brazil, Member of AAGL Board of Trustees (2011–2013))

plexus and sacral nerve roots Fig. 9.5a [6]. The needle itself should be used to lift lateral soft tissues off the ligament as the suture is placed in order to further prevent ureteric compromise. The needles are then kept on the sutures and secured to the Scott retractor or drape preserving their orientation for later identification.

At this point, it is mandatory that cystoscopy be performed to visualize efflux of urine from the bilateral ureteric orifices. Traction is placed on the six preplaced uterosacral suspension sutures to simulate the tension that will be in place at the completion of the procedure. If the integrity of the ureter is in question or if there is suspicion of ureter injury, a retrograde pyelogram may be performed or alternatively a guidewire with open ended ureteral catheter may be passed up to the collecting system. If the vaginal apex dissection or the identification of the uterosacral ligaments is anticipated to be difficult, then ureteral stents may be placed preoperatively to assist with ureter identification (one of the authors does this for every patient and uses the stent to palpate the ureter while the uterosacral ligament is tented away from underlying structures with an Allis clamp). If a stent was preplaced it can be manipulated to feel for resistance. Of note, ureteral stents are not without risk, as they prolong the procedure duration and can lead to hematuria or edema of the ureter.

Upon confirmation of ureteral integrity, the preplaced uterosacral ligament suspension sutures will now be used to re-suspend the vaginal vault. The most proximal uterosacral suspension sutures (closest to the sacrum) will be used to close the most medial or proximal aspect of the vaginal cuff incision. Meanwhile the most distal suspension sutures will close the lateral portions of the vaginal cuff. The long weighted speculum is then replaced with the short beak speculum. At the cuff incision, the posterior and anterior vaginal epithelial walls are identified along with the underlying rectovaginal and pubocervical fascial layers. The preplaced suspension sutures are then passed (free Mayo needle for the anterior wall and suture with attached needle for the posterior wall) through their corresponding peritoneal edges and opposing rectovaginal and pubocervical fascial layers, with permanent sutures only passing through the rectovaginal and pubocervical fibromuscular layers, taking care not to penetrate the vaginal epithelium, allowing enough distance between the cut edge of the vaginal walls to allow suture knots to be buried (Fig. 9.5b). It is one of the author's preferences to place absorbable sutures full thickness through the vaginal epithelium, in a manner such that knots will be located within the lumen of the vagina, which makes suture removal much easier in the event of persistent postoperative pain. The other author buries all six sutures. Following suture placement, needles are cut and sutures are then tagged for later identification and replaced on the retractor maintaining orientation. The position of the most lateral and distal portions of the suspension should be adjacent to the pre-placed silk apical marking sutures, which may now be removed. The suspension sutures are not yet tied (Fig. 9.5c).

At this point the laparotomy packing within the abdomen is removed and the anterior and posterior peritoneum is re-approximated via superficial bites using two purse string absorbable braided sutures, thus closing the enterocele completely. The vaginal cuff may then be partially closed by re-approximating the vaginal epithelium with pre-placed figure-of-eight absorbable braided sutures, placed between the uterosacral suspension sutures, prior to tying down and re-suspending the apex. Finally after removing retraction hooks and while manually reducing the apex of the cuff, the api-

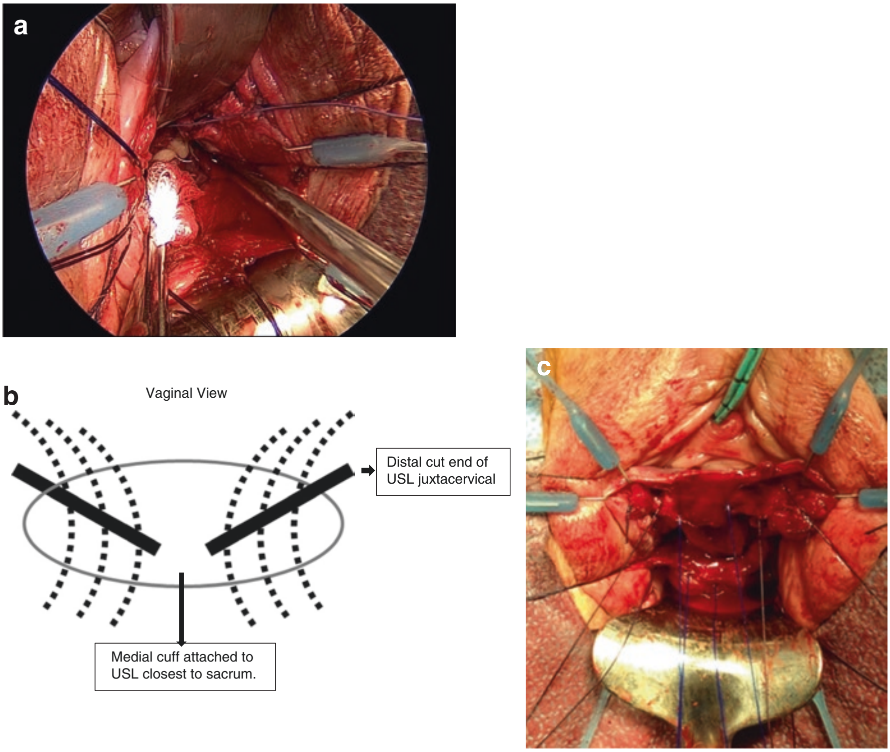

Fig. 9.5 (**a**) Uterosacral sutures are placed sequentially, lateral to medial, in the anteromedial third of the ligament. The suture pictured here is the most distal (toward the introitus). (**b**) Uterosacral ligament suture schematic. *Thick black line* = uterosacral ligament, *Thin grey elipse* = Vaginal cuff, *Dotted lines* = Uterosacral ligament sutures. (**c**) Uterosacral ligament sutures have been secured to the anterior pubocervical and posterior rectovaginal fascia

cal uterosacral ligament sutures are tied down in a serial fashion. This should reduce the prolapse quite nicely (Fig. 9.6). Once these knots are secure, cystoscopy is again performed to evaluate for efflux from the bilateral ureter orifices. Once integrity of the ureters is confirmed, the uterosacral ligament suspension sutures may then be trimmed, with the permanent sutures cut short on the knot to make sure they do not come in contact with the vaginal epithelium. The vaginal cuff is then closed with absorbable braided suture, and should bury the knots of any permanent apical suspension suture. If a cystocele or rectocele persists after the completion of the apical suspension, a concomitant anterior or posterior colporrhaphy may be performed as needed.

Postoperative Care

It is the author's preference to place a compressive vaginal packing at the time of surgery that may be removed on post-operative day 1. This will keep the prolapse reduced and decrease unnecessary strain on the repair. Open-ended ureteral

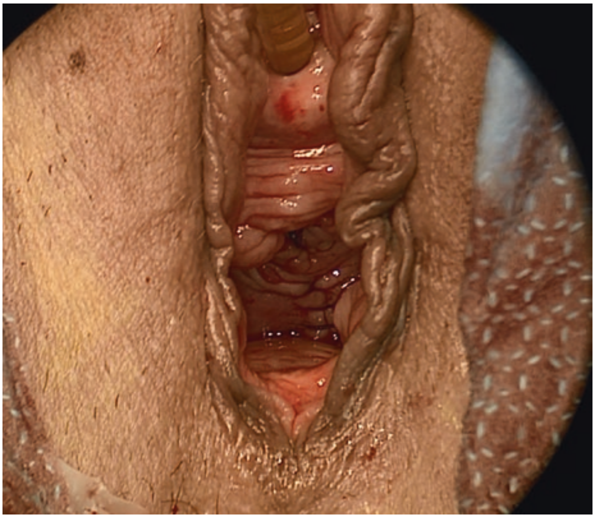

Fig. 9.6 Completed uterosacral ligament suspension

catheters, if placed, are removed at the completion of the procedure and the Foley catheter is left indwelling until postoperative day 1. Diet may be advanced to regular as tolerated and the majority of patients are discharged to home less than 24 hours following surgery. Duty restrictions following surgery include pelvic rest with no heavy lifting greater than 5 pounds and no sex for 6–8 weeks postoperatively. Dietary fiber and scheduled twice-daily prophylactic stool softeners are advised to help keep stool soft and to prevent abdominal straining during defecation. Narcotic pain medication is provided and patients are counseled on how to minimize use, and bolster pain control with non-narcotic options.

Mid and Long-Term Results

Mid and long-term results for uterosacral ligament vaginal vault suspension are the subjects of interest for the recently published OPTIMAL trial by Barber et al. This trial randomized 374 women with POP-Q stage 2 or greater apical prolapse to either uterosacral versus sacrospinous ligament fixation [3]. Surgical success was pre-defined as anatomic success (less than one-third apical descent and no anterior or posterior prolapse beyond the hymen), symptomatic success (no sensation of a vaginal bulge) and no re-treatment for prolapse. After 2 years of follow up, the authors found no difference in surgical success between uterosacral and sacrospinous ligament suspension (USL 64.5 % vs. SSL 63.1 %, OR 1.1, 95 % CI 0.7–1.7) [3]. These findings are slightly lower than those reported by Margulies et al in their meta-analysis of uterosacral ligament suspension. The authors on this study used an anatomic definition of success (POP-Q stage 1 or less prolapse) found a 81.2 % anterior (95 % CI 67.5–94.5 %), 98.3 % apical (95 % CI 95.7–100 %) and 87.4 % posterior (95 % CI

67.5–94.5 %) pooled success rate [7]. Success was also stratified by preoperative POP-Q stage, with a 92.4 % and 66.8 % anatomic success noted in the anterior compartment for stage 2 and stage 3 prolapse respectively (p = 0.06). These findings may be used to further preoperatively counsel our index patient with stage 3 prolapse.

Transvaginal prolapse repair with graft augmentation as well as the use of the sacral promontory as a point of higher fixation in a laparoscopic or open abdominal sacrocolpopexy, has been a subject of debate. With regards to a trans-abdominal surgical approach, the long term durability of abdominal versus transvaginal pelvic organ prolapse repair was published in a recent Cochrane review by Maher et al, which found that after reviewing 56 randomized trials, in addition to requiring intra-abdominal mesh placement, sacrocolpopexy was associated with a lower rate of recurrent vault prolapse, however a longer operating time, slower return to daily activities and increased cost [8]. Furthermore, with regards to graft augmentation for transvaginal approach anterior, apical and posterior prolapse repairs, a recent systematic review by Osborn et al found no difference in symptomatic outcomes when comparing native tissue to graft repairs [9]. Furthermore, in addition to no difference noted in symptomatic outcomes, there was also no difference noted in anatomic results for apical and posterior repairs. These reported rates are useful for counseling our index patient who desires a native tissue repair of the apical compartment without the need for graft augmentation. Small retrospective studies have been performed comparing laparoscopic (n = 54) to vaginal (n = 119) uterosacral ligament vaginal vault suspension. Clinical outcomes and complication rates were found to be similar [10].

Type of suture used in uterosacral ligament suspension, whether permanent or delayed-absorbable has also been the subject of debate. In the largest single center retrospective series of patients treated with uterosacral ligament suspension by Unger et al, out of 983 subjects, there was no difference noted in the likelihood of recurrence with the addition of permanent sutures in combination with delayed absorbable monofilament suture [4]. In a smaller nonrandomized retrospective series by Chung et al, of 248 patients who underwent uterosacral ligament suspension with either permanent or delayed-absorbable suture, anatomic failure (prolapse beyond the hymen) was noted in only 1 out of 105 patients (1 %) with permanent suture, versus 8 out of 141 patients (6 %) using delayed-absorbable suture [11]. Data on suture selection continues to be conflicting. In an even smaller retrospective series of 115 patients by Kasturi et al, the permanent suture did not significantly improve apical support at 1 year of follow up and was associated with a 22 % suture erosion rate [12]. These data should be generalized with caution, as randomized studies are needed before routinely adopting permanent suture placement to all patients undergoing uterosacral ligament suspension.

Conclusion

In conclusion, for our index patient with POP-Q stage 3 prolapse who wishes to maintain sexual activity and restore her vagina to the most anatomically natural position, meanwhile avoiding graft implantation, her best choice of transvaginal apical prolapse repair is uterosacral ligament vault suspension. This procedure can provide durable long term success, and if performed using a methodical technique, achieve a low complication rate.

Conflict of Interest The authors declare that they have no conflicts of interest in relation to the content of the manuscript.

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Chapter 10
Iliococcygeus Fixation for Vaginal Vault Prolapse

Laura Chang Kit and William D. Ulmer

Abstract Attachment of the prolapsed vaginal vault to the iliococcygeus fascia was first described by Inmon in 1963 (Betschart et al. Neurourol Urodyn 2015). The iliococcygeus muscle is part of the levator ani complex which also includes the pubococcygeus and puborectalis muscles. It arises from the arcus tendineus of the levator ani and attaches posteriorly to the last two segments of the coccyx. The iliococcygeus can be approached from an anterior or posterior vaginal incision; therefore concomitant anterior or posterior repair is easily facilitated. Iliococcygeus fixation is an excellent method to suspend the vaginal vault, which maintains the vaginal vault axis and preserves vaginal length.

Keywords Iliococcygeus fixation • Vault prolapse • Post-hysterectomy

Case Presentation

A 65 year old female with previous total abdominal hysterectomy for fibroids presented with a 6 month history of incomplete emptying and symptomatic vaginal bulge. On examination, she was found to have POP-Q stage 2 cystocele and stage 2 vaginal vault prolapse, and a post void residual of 150 cc. She underwent videourodynamics with and without cystocele reduction, which demonstrated a normal capacity bladder without latent stress incontinence, good detrusor function, but bladder outlet obstruction secondary to her cystocele. She was counseled on anterior repair, possible enterocele repair, and vaginal vault suspension via bilateral iliococcygeal fixation.

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L. Chang Kit, MD, FRCSC (✉)
Division of Urology, Albany Medical College, Albany, NY, USA
e-mail: lchangkit@communitycare.com

W.D. Ulmer, MD, PGY5
Division of Urology, Albany Medical College, Albany, NY, USA

P.E. Zimmern, E.J.B. De (eds.), *Native Tissue Repair for Incontinence and Prolapse*, DOI 10.1007/978-3-319-45268-5_10

Surgical Indication

Non-mesh vaginal approaches to suspend the post-hysterectomy vaginal cuff include sacrospinous ligament fixation, iliococcygeus fixation, McCall culdoplasty, and uterosacral ligament fixation. The more common sacrospinous ligament fixation has good subjective cure rates; however, it is associated with posterior deviation of the vaginal axis and up to 30 % prolapse recurrence in the anterior compartment [2]. In addition, 2 % may require blood transfusion [3] and 15 % of patients may experience persistent buttock pain postoperatively due to injury of the inferior gluteal and/or pudendal neurovascular bundles [4]. Fixation of the apical cuff to the fascia of the iliococcygeus muscle, just distal to the ischial spine was designed as an alternative to sacrospinous ligament fixation to help reduce these complications. Bilateral fixation preserves the normal vaginal axis and maintains vaginal length [5]. There are no critical vessels or nerves running through the muscle, and risk of ureteral injury is lower than in uterosacral ligament suspension.

Consent, Including Expected Outcomes and Possible Risks

The consent for iliococcygeus fixation must include intraoperative and postoperative risks, as well as the potential benefits of surgery. In a matched case–control study, bilateral iliococcygeus fixation restored apical support with similar subjective and objective cure rates when compared to sacrospinous colpopexy at a mean follow-up of 19–21 months (91 % vs 94 %, and 53 % vs 67 % respectively) [6]. A prospective study reported an overall subjective and objective cure rate of 84 % at a median follow-up of 5 years [7].

Intra-operative risks include injury to bladder, bowel, ureter, and surrounding vessels and nerves. The pudendal nerve and vessels run posterior to the iliococcygeus and can be injured. Risk of hemorrhage requiring transfusion is low and estimated to be 0–2 % [7, 8]. Postoperatively, patients can complain of transient buttock pain (up to 19 %, which typically resolves within a few weeks), dyspareunia (14 %), and recurrent prolapse (16–33 % in the anterior compartment) [6, 7]. There is also risk of urinary retention and urinary tract infection.

Surgical Technique for Post-hysterectomy (Refer to Video 10.1 Ileococcygeus Fixation for Vaginal Vault Prolapse (Ulmer W and Chang Kit L))

Positioning and Set-up

1. The procedure is conducted under general or spinal anesthetic. The patient is placed in the high lithotomy position, which allows excellent exposure. Yellow fin stirrups provide good leg support and padding to prevent peroneal nerve injury. Avoid excessive leg abduction, external rotation or hip flexion to prevent

femoral nerve injury. The perineum is shaved and the patient is prepped and draped in sterile fashion with betadine.

2. A full inspection of the vagina is conducted under anesthesia to confirm the degree of pelvic organ prolapse in each compartment. It is helpful to grasp the apex of the vagina with Allis clamps and bring it towards the introitus to fully elucidate the severity of prolapse.
3. A weighted vaginal speculum and Lonestar ® (Cooper Surgical, Trumbull CT) retractor with sharp stays are employed. The labia majora and minora are retracted using 2-0 silk sutures. A 16 Fr foley catheter with 10 cc balloon is placed into the bladder and left to drain throughout the case.

Dissection *(Figs. 10.1, 10.2, and 10.3)*

4. Hydrodissection of the vaginal epithelium is undertaken at the apex using either injectable saline or 1 % lidocaine with epinephrine, such that blanching of the epithelium is noted.
5. A midline incision is then made at the apex and extended either anteriorly or posteriorly depending on whether a concomitant anterior or posterior repair is to be conducted. If neither is warranted, a posterior vaginal wall incision is conducted.

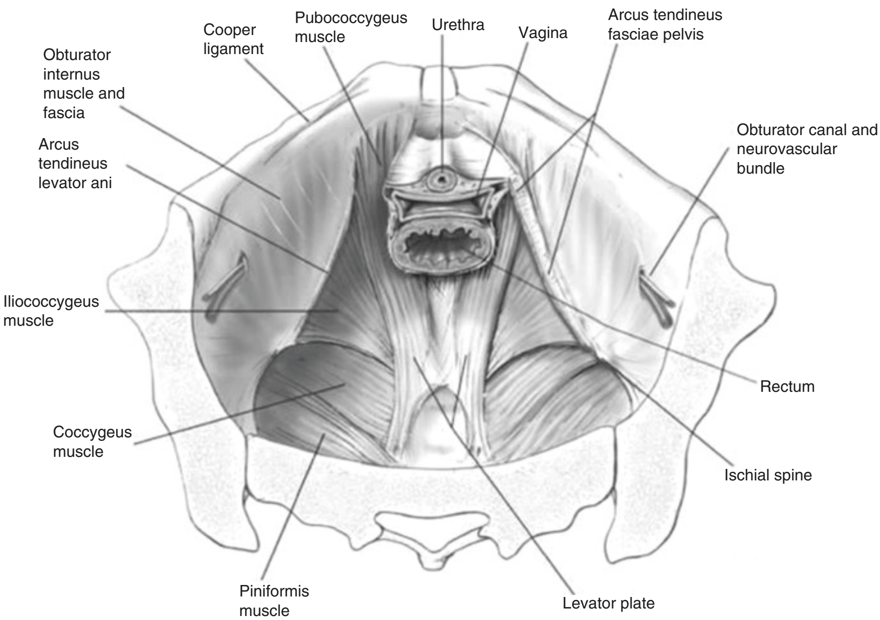

Fig. 10.1 Pelvic diaphragm. The pelvic diaphragm is made up of (1) the coccygeus muscle and (2) the levator ani: the puborectalis pubococcygeus (or pubovisceral) and iliococcygeus muscles. Additional structures to note: arcus tendineus fascia pelvis, arcus tendineus levator ani, obturator internus muscle, piriformis muscle, ischial spine, obturator canal (Adapted from Figure 2.2 in Walters and Karram [8])

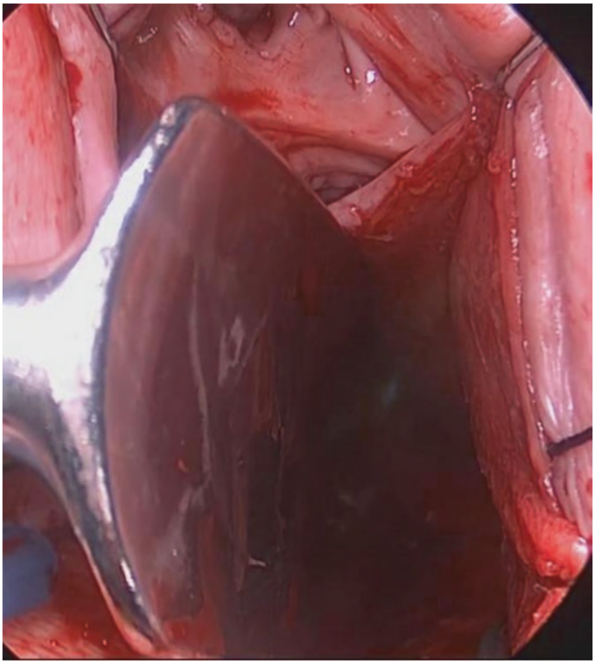

Fig. 10.2 Left iliococcygeus fixation. The Breitsky-Navratil retractor is used to sweep the rectum and pararectal fat medially. The retractor is held by the assistant

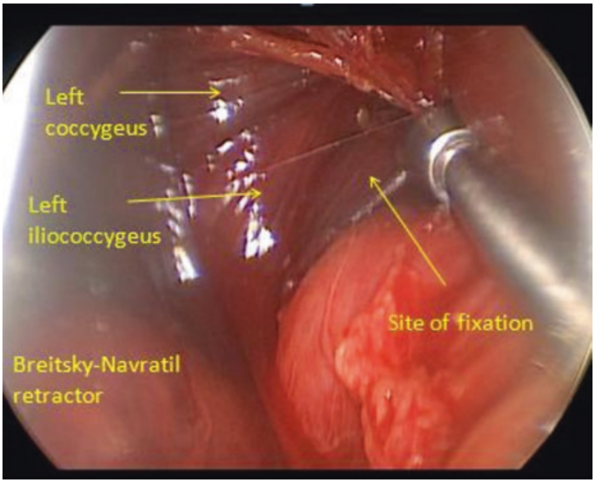

Fig. 10.3 Left iliococcygeus fixation. The metal suction tip exposes the iliococcygeus muscle. The Breitsky-Navratil retractor is medial

6. Sharp and blunt dissection are then used to dissect the vaginal epithelium off of the underlying fascia until either the paravesical space (anterior approach) or pararectal space (posterior approach) is entered laterally, arriving at the levator muscles.

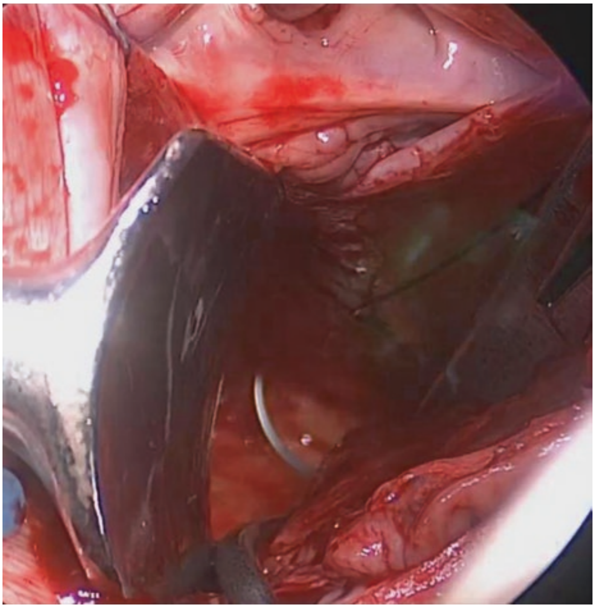

Fig. 10.4 Left iliococcygeus fixation. A single 0-PDS suture on a CT-2 needle is placed 1 cm medial and 1 cm caudad to the ischial spine into the iliococcygeus muscle using a long, straight needle driver

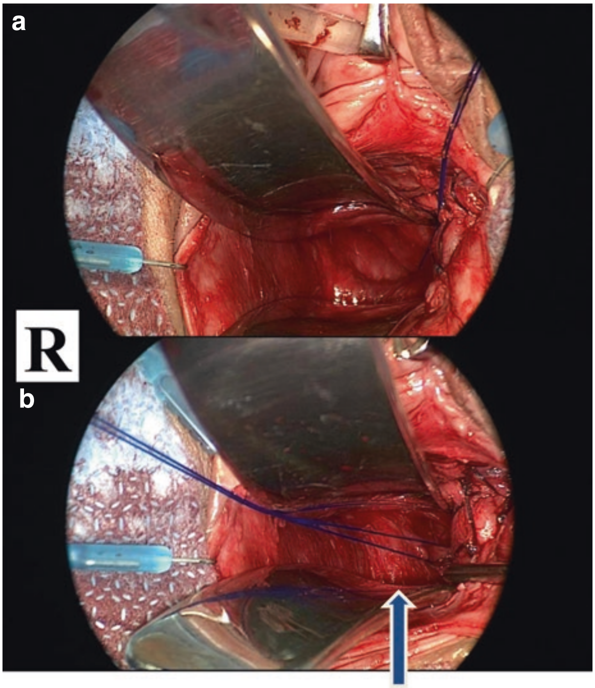

Fig. 10.5 Images for demonstration of anatomy, patient's right side. (**a**) Stitch is on the coccygeus muscle. (**b**) Stich is on the SSL. *Arrow* indicates the iliococcygeus muscle

Placing the Sutures (*Figs. 10.4 and 10.5*)

7. The bilateral ischial spines are palpated. Using a Breitsky-Navratil retractor, the rectum and pararectal fat are swept medially, exposing the iliococcygeus muscle. It is helpful to have an assistant hold the Breitsky-Navratil retractor in place, while the surgeon places the iliococcygeus fixation sutures. A single 0-PDS (polydioxanone) suture on a CT-2 needle is placed 1 cm medial and caudad to the ischial spine in the iliococcgeus muscle using a straight, long needle driver. A tonsil clamp helps to deliver the needle through the tissue. Accurate position of the suture is confirmed by palpating the location relative to the ischial spine and by firmly tugging on the suture to ensure good strength. The procedure is carried out on the contralateral side. Cystoscopy is conducted with the sutures on tension, to verify ureteral patency by brisk, non-bloody ureteric efflux. Both ends of each suture are then passed through the mucosa of the ipsilateral vaginal apex at the widest part.
8. Repair of any enterocele, cystocele or rectocele is now conducted. Repeat cystoscopy should be conducted after repair in any compartment to assess for bladder or ureteral injury. The vaginal epithelium is then closed using running 2-0 vicryl.
9. Both iliococcygeal fixation sutures are then tied down towards the ipsilateral fixation point, elevating the vaginal apex.
10. A vaginal pack is placed and the Foley catheter connected to a drainage bag.

Typical Postoperative Care Recommendations

Patients are admitted for observation overnight. Regular diet is reinstituted soon after recovery from general anesthetic. Pain is usually controlled with staggered doses of acetaminophen and NSAIDs, with oral narcotics reserved for breakthrough pain. The vaginal pack and Foley catheter are removed early on post operative day (POD) #1 and post-void residuals checked with bladder ultrasound prior to discharge. Stool softeners are started on POD#1 in the morning and continued for 6 weeks postmenopausal patients are started on vaginal estrogen preoperatively; postoperatively this is restarted on POD#3, and continues until 6 weeks postoperatively.

The patient is allowed to shower on POD#2, but asked to refrain from any baths or pools for at least 6 weeks. Driving can be resumed when the patient is not taking any further pain medications, usually within 2 weeks of surgery. Heavy lifting >10 lbs and sexual intercourse is prohibited for 6 weeks. The patient is seen in clinic with a pelvic exam and post void residual assessment 2 weeks postoperatively.

Conclusion

Iliococcygeus fixation is an excellent alternative technique to suspend the prolapsed post-hysterectomy vault and is an additional tool in the armamentarium of the pelvic reconstructive surgeon.

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Chapter 11
High Midline Levator Myorrhaphy for Vault Prolapse Repair

Yuefeng (Rose) Wu and Philippe E. Zimmern

Abstract High midline levator myorrhaphy (HMLM), first described in 1988, is a vaginal surgery for vault prolapse (VP) that does not rely on mesh interposition, avoids the inherent difficulties associated with sacrospinous ligament fixation (SSLF) involving nearby vascular and neural structures, and is well-suited for middle-aged to older women [1]. Unlike the SSLF [2, 3], HMLM keeps the vagina midline, and unlike the uterosacral ligament (USL) fixation [4], HMLM can be done many years after hysterectomy when the uterosacral ligaments are no longer readily identifiable. Since its original report, there have been few published series on surgical outcomes [1, 5], none of which included long-term data. We review the technique of this procedure in detail and provide an update on our long-term experience with this technique.

Keywords Vault prolapse • Recurrence • Long term follow-up • Surgical repair

Case Presentation

A 75 year old woman presents with a vaginal bulge that she describes as “crowning” at the introitus. She has noted a need for more straining to void lately as well as a feeling of incomplete bladder emptying. She recalls an abdominal hysterectomy about 15 years ago for uterine fibroids and a retropubic suspension at that time to correct her stress urinary incontinence. She believes it was a Burch suspension but this was not confirmed since she could not obtain the original operative note. She does not leak at present but has strong urgency and frequently needs to rush to the

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Y. (Rose) Wu
Urology, UT Southwestern, Dallas, TX, USA
e-mail: yuefeng.wu@utsouthwestern.edu

P.E. Zimmern (✉)
Department of Urology, UT Southwestern Medical Center, Dallas, TX, USA
e-mail: philippe.zimmern@utsouthwestern.edu

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bathroom. On vaginal examination, her main POP-Q points were: Aa −3, Ba +2, C +4, Ap −1, Bp-1, TVL −8 (Fig. 11.1a). She is no longer sexually active and does not take vaginal hormones. For this symptomatic stage 3 anterior compartment prolapse and vault prolapse with a well-supported urethra she was offered a native tissue vaginal repair. She has a BMI of 29 and a few co-morbidities, including well-controlled diabetes and chronic asthma. She was told about a robotic mesh sacrocolpopexy, but for a variety of reasons, she is very hesitant about mesh use. We explained to her that we would reattach her vaginal vault to her levator muscles and repair her associated cystocele with an anterior colporrhaphy. If an enterocele component was noted at the time of the vault dissection, this would be closed primarily [2].

The main peri-operative surgical risks discussed with her included pelvic pain or pressure post-operatively, which originates from the muscles being pulled medially for re-apposition – these are usually mild, short lasting and controlled with PO medications; bleeding – very seldom requiring blood transfusion; infection – typically prevented by the use of broad spectrum IV antibiotics started before the surgery; ureteral injury – rare but definitively associated with enterocele repair moreso than HMLM or anterior colporrhaphy; and the need to avoid straining after the procedure, which would include the routine use of stool softeners to prevent constipation in the post-operative period, the avoidance of intense exercising, and limitation of driving to avoid any jarring.

Surgical Technique (Refer to Video 11.1 High Midline Levator Myorrhaphy (Zimmern P))

A rectal pack soaked with betadine is inserted to allow recognition of the rectum throughout the procedure [6]. Then, with the patient in Trendelenburg position, a Scott retractor to expose the vagina and a urethral catheter to drain the bladder are placed. Two sutures are placed at each vaginal vault fornix to confirm location of the vaginal apex for later repositioning (Fig. 11.1b). The dimensions of the reduced vagina are measured. A midline incision is made overlying the bulging prolapse, extending anteriorly and/or posteriorly as far distally as needed based on associated compartment prolapses when present. Vaginal flaps are raised on each side of the original incision. After opening the enterocele sac, a pack is placed to reduce the bowels. The pack in the rectum can now be palpated, as well as the medial edge of the levator muscle bordering the rectum on each side. For a right handed surgeon, a No. 1 absorbable suture is then placed into the levator musculature on the right side, and passed over the rectum and secured to the medial edge of the levator muscle on the other side. The suture is left on a stay clamp. A second suture is then placed in a similar fashion 1 cm proximal to the last suture. After this is done, the closure of the enterocele sac is accomplished. A No. 1 polypropylene purse-string suture is pre-placed circumferentially to close the peritoneal cavity and eliminate the enterocele sac. After the peritoneal packs are removed and the purse-string suture cinched down, a dye (e.g. fluorescein) is administered intravenously and cystoscopy is carried out to confirm ureteral patency.

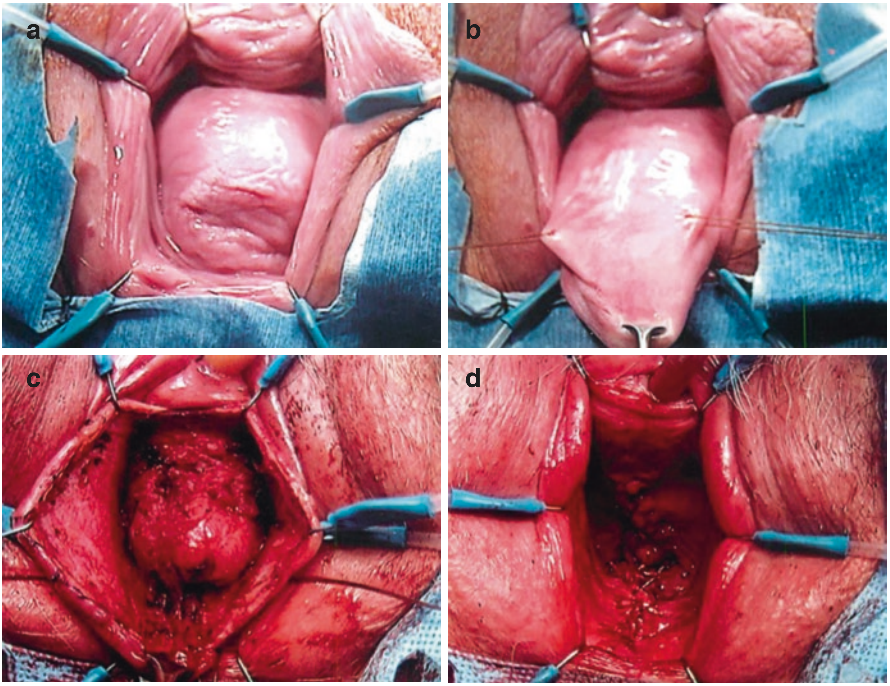

Fig. 11.1 START OF PROCEDURE. (**a**) Vault and anterior compartment prolapse (**b**) Marking sutures placed on each side at site where the vaginal cuff (dimples) was once secured to the utero-sacral ligaments. (**c**) Dissection of cystocele. (**d**) Final appearance after anterior colporrhaphy, posterior repair, with enterocele repair and vault fixation using HMLM technique

The two preplaced levator sutures are tied sequentially across the midline. These two levator sutures (proximal and distal) are then tagged with a hemostat. The end of each suture is threaded on a No. 6 curved Mayo needle and then transfixed at the new restored site of the vaginal apex from inside out, approximately 1 cm apart from each other. The proximal and distal ends of each levator sutures are then tied to each other bringing the vaginal vault down over the rebuilt levator plate just underneath the mucosa with direct tissue apposition.

If an anterior repair or anti-incontinence procedure is required, it can now be carried out (Fig. 11.1c), followed by a rectocele repair with perineorraphy when indicated (Fig. 11.1d).

Figure 11.2a illustrates the location of the uterosacral ligaments (USLs) when used to fix the vaginal vault during a hysterectomy. Several years after hysterectomy, these ligaments are no longer present. Since they represent the medial edge of the levator muscle, and a pack has been placed rectally to identify the rectum, it is easy to secure the medial edge of the levator muscle (former USLs) with two sets of absorbable sutures as shown on Fig. 11.2b. Once the enterocele defect has been closed, these high levator myorraphy sutures can be tied together in front of the packed rectum without risking a reduction in rectal lumen caliber and then they can be transfixed from inside out at the location of each apex identified by the marking

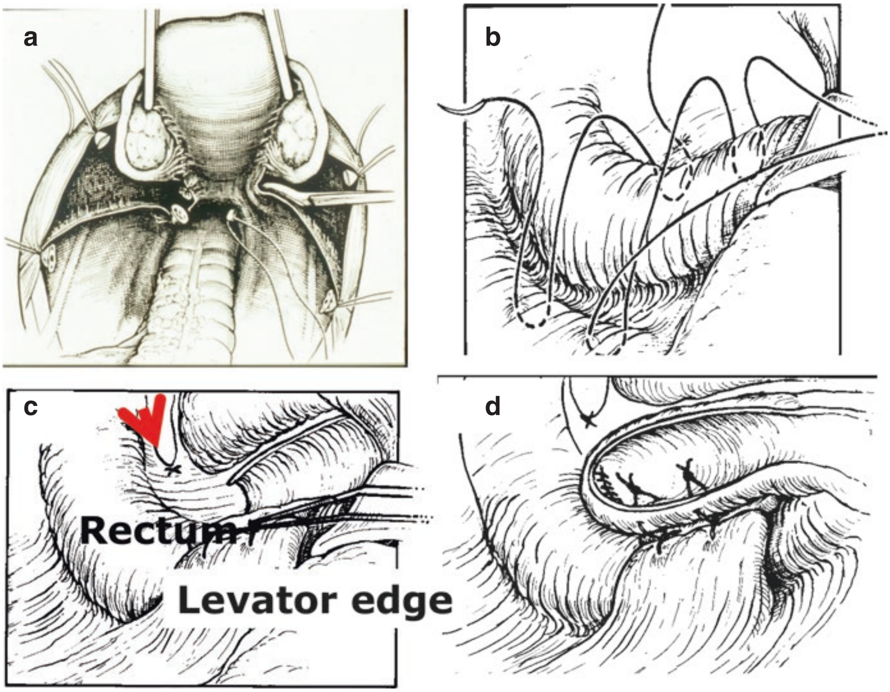

Fig. 11.2 Schematic of (**a**) abdominal view pre-hysterectomy of utero-sacral ligament securement; (**b**) placement of levator sutures on medial edges of levator muscle which correspond to the former utero-sacral ligaments; A rectal pack allows safe placement on each side of the rectum (**c**) sagittal view of upper vagina and closed enterocele sac; Levator sutures are tied across the midline, in front of the rectum, and are tagged (**d**) Levator sutures transfixed at upper vagina allowing return of the vaginal vault with direct tissue apposition over the recreated levator plate underneath at the conclusion of the procedure

sutures placed at the start of the procedure (Figs. 11.2c and 11.3a, b). Then once tied down, these sutures return the vaginal apex over the rebuilt levator plate underneath with direct tissue apposition (Figs. 11.2d and 11.3b, c). While HMLM started out as an intraperitoneal procedure, it can also be performed as an extraperitoneal procedure, thus decreasing the potential for ureteral injury.

Management of Complications

HMLM complications are rare. In a recent review of our own series (1996–2014), no intra-operative complications were reported. Ten (10.6 %) Clavien [7] I/II early complications (<30 days) were noted: temporary urinary retention/need for catheter drainage (5–7 days) (4), urinary tract infection (2), incontinence (2), bladder spasms (1), bleeding without transfusion (1).

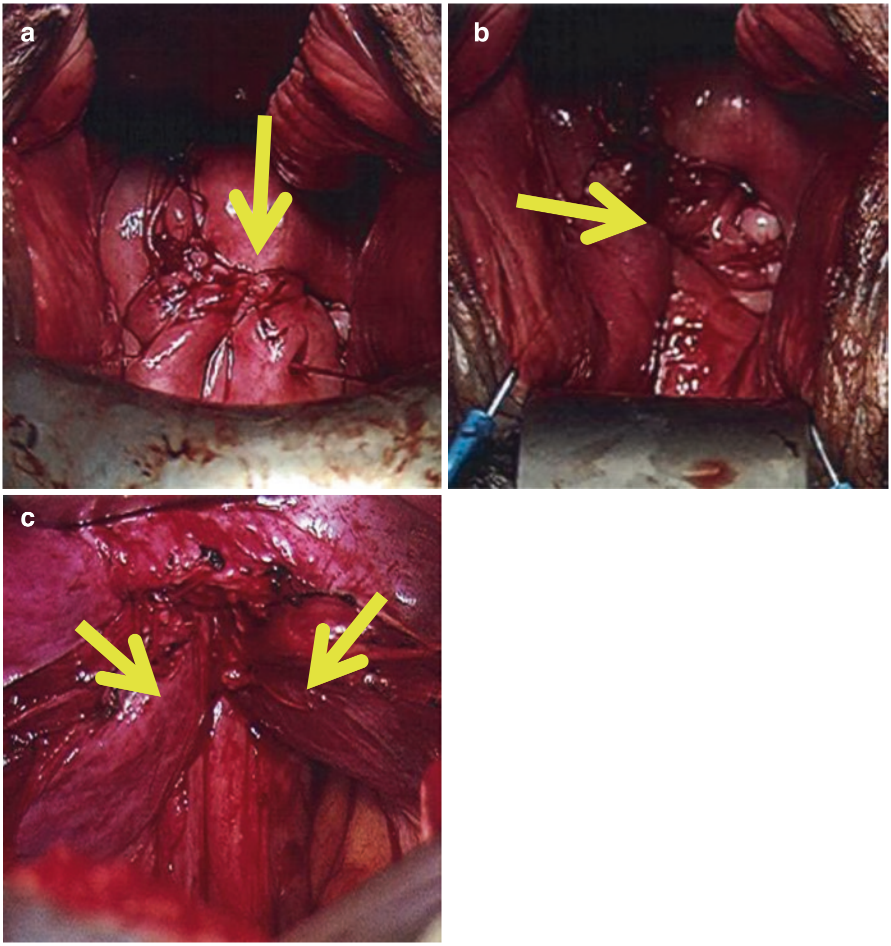

Fig. 11.3 Intraoperative views of: A/B) vault fixation sutures transfixed (**a**) then tied at apex (**b**) returning the vaginal vault over the rebuilt levator plate underneath; (**c**) laparoscopic view of the repair at the bottom of the pelvic cavity: midline re-approximation of levator muscle edges noted on same patient during laparoscopy performed to remove an abnormal ovary

Review of Literature

There is limited long-term data on this procedure reported so far in the literature [1, 8]. One long-term outcome study on a variant of HMLM was performed by Natale et al. in 2008 [5] with a mean follow-up time of 5 years. They found a 3.3 % vault recurrence and 26.8 % cystocele recurrence.

In our experience with HMLM for vault prolapse between 1996 and 2014, with a mean follow-up of 7.7 years, we found 67/94 (71 %) women were cured of vault and associated vaginal compartment prolapses. Ten women (11 %) had failure in a

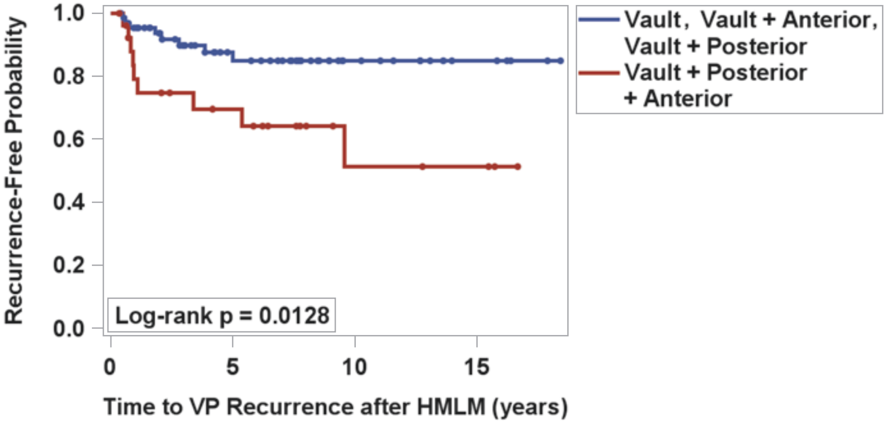

Fig. 11.4 Kaplan-Meier curve for VP recurrence-free status after HMLM procedure by indication group in recent series. Patients were divided into four indication groups for analysis: (**1**) only vault prolapse, (**2**) vault and anterior (cystocele) prolapse, (**3**) vault and posterior (enterocele and rectocele) prolapse, and (**4**) prolapse of all three compartments

compartment other than the apex and 17/94 patients (18 %) had failure at the apex. All 10 of the non-apex failures were recurrent cystoceles. Reoperation rate was 13.8 % (13/94) and 5.3 % (5/94) for vault and non-vault recurrences, respectively. Of the women who had vault failure, 33.3 % were in the Vault + Anterior + Posterior (V + A + P) repair indication group where these three compartments required repair. Smoking status, parity, hysterectomy status, presence of systemic hormone therapy, vaginal sensation/pressure, and prior POP surgery were not statistically different between women with recurrence and those without. Based on our findings, it seems that HMLM is not the best choice for complicated prolapse cases involving all three compartments, especially those who have complete eversion of the vagina (Fig. 11.4).

Overall the operation was well tolerated and the majority of patients fared well over time. Compared with other VP repair procedures that have long-term outcomes data, such as SSLF, USL vault suspension, or McCall culdoplasty, the HMLM overall surgical success rate was on par with these procedures. Moreover, the low rate of serious perioperative complications was consistent with these other vaginal native tissue repairs [9]. Although our 18 % vault recurrence rate was higher than in the Natale's group, our follow-up time was also significantly longer, with over 60 % of women followed beyond 5 years. The cystocele recurrence rate found in our study (11 %) was certainly in concordance with the Natale group's findings [5].

Conclusion

Based on our results and long-term experience with this procedure, HMLM is a valid option for women with VP and one other compartment prolapse who wish for a native tissue repair approach. Those patients with complete vaginal eversion [10] who require surgical repair of anterior, posterior and apical compartments might achieve better long-term outcomes with an alternative procedure.

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Chapter 12
Enterocele Repair

Katarzyna Bochenska and Kimberly Kenton

Abstract An enterocele is a herniation of the pelvic peritoneum and/or small bowel beyond the normal boundaries of the cul-de-sac. Endopelvic fascia supporting the anterior, apical or posterior vagina is deficient, allowing the vagina to prolapse and small bowel to fill the hernia sac. An enterocele classically causes apical and/or posterior vaginal wall prolapse as the small bowel dissects into the rectovaginal space. Anterior and/or posterior vaginal wall prolapse without concomitant apical prolapse is uncommon. Therefore, apical prolapse repair should be included in the majority of enterocele repairs. Outcome studies also show that restoration of the apex corrects nearly half of anterior vaginal wall defects and one-third of posterior defects.

Keywords Enterocele • Pelvic organ prolapse • Apical prolapse • Halban • Moschowitz

Case Presentation

A 60-year old vaginally multiparous woman presents with symptoms of a bothersome vaginal bulge. She first noted the bulge 5 years ago after undergoing a vaginal hysterectomy for abnormal uterine bleeding and states that it has progressively grown in size. The bulge is particularly bothersome when she exercises or takes long walks. She needs to reduce the bulge to completely empty her bladder, but does not report stress or urgency urinary incontinence. She does not report difficulty with defecation, splinting or fecal incontinence. Standing evaluation reveals that her anterior vaginal wall prolapses to the hymen, but her vaginal cuff and posterior

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K. Bochenska, MD (✉) • K. Kenton, MD, MS
Division of Female Pelvic Medicine & Reconstructive Surgery, Departments of Obstetrics & Gynecology and Urology, Northwestern University Feinberg School of Medicine, Chicago, IL, USA
e-mail: katarzyna.bochenska@nm.org; kkenton@nm.org

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vaginal wall prolapse 2 cm beyond the hymen. On standing bimanual exam, with one finger in the rectum and one in the vagina, small bowel is palpated as it descends into the rectovaginal space between the vagina and rectum. Standing full bladder cough stress test with the prolapse reduced is negative.

Surgical Indication

This patient has stage III pelvic organ prolapse of her vaginal cuff, consistent with an enterocele. An enterocele is a herniation of the pelvic peritoneum and/or small bowel beyond the normal boundaries of the cul-de-sac. Endopelvic fascia supporting the anterior, apical or posterior vagina is deficient, allowing the vagina to prolapse and small bowel to fill the hernia sac. An enterocele classically causes apical and/or posterior vaginal wall prolapse as the small bowel dissects into the rectovaginal space. Less commonly, an enterocele may occur anterior to the vagina resulting in anterior vaginal wall prolapse. As with most pelvic organ support defects, enteroceles are rarely isolated and typically present in conjunction with apical prolapse.

Clinical evaluation of pelvic organ prolapse relies on the patient's history and physical exam findings. An enterocele may be suspected when a patient with apical and/or posterior prolapse reports a dragging sensation in the pelvis, especially when standing or bearing down. Stretching of the small bowel mesentery is also thought to cause colicky lower abdominal pain.

Because vaginal topography does not reliably predict the location of the associated pelvic viscera [1], current terminology describes prolapse in terms of the anterior, apical and posterior vaginal walls rather than as cystocele, enterocele or rectocele [2]. While standardized systems for the clinical assessment of pelvic organ prolapse, such as the Pelvic Organ Prolapse Quantification System (POP-Q) [2], enable clinicians to reliably and reproducibly describe the extent of prolapse in each vaginal compartment [3], the underlying defects that contribute to the symptomatology of prolapse often escape visual inspection in the office. The pelvic organ behind each prolapsed vaginal segment varies [1, 4] and important defects in the levator ani musculature cannot be visualized on physical exam [5]. Fortunately, in the majority of cases, the vaginal apex is addressed during surgery and thus, a definitive diagnosis of enterocele is less important.

On physical exam, enterocele is most often mistaken for rectocele when the posterior vaginal wall is the leading edge of the prolapse. In cases of posterior vaginal wall prolapse near the apex, an enterocele may be differentiated from a distal rectocele on rectovaginal exam. Alternatively, a transverse groove separating an enterocele from a rectocele may be seen on split speculum exam. In some cases, enterocele can be difficult to differentiate from rectocele or sigmoidocele and defecography or dynamic MRI may aid in diagnosis and surgical planning. In one study of 62 women planning surgical repair for prolapse, Defecography identified an enterocele not previously detected by physical exam in nearly half of women [6]. Enterocele is diagnosed by visualizing small bowel within the rectovaginal space; however, an enlarged rectovaginal space (>2 cm) on imaging also suggests that there is a potential space for enterocele development.

Anterior and/or posterior vaginal wall prolapse without concomitant apical prolapse is uncommon [7]. Therefore, apical prolapse repair should be included in the majority of enterocele repairs. Historically, reconstructive pelvic surgeons focused on separating the vagina into distinct compartments and identifying the underlying pelvic viscera prior to surgical repair. More recent data indicate that suspension of the vaginal apex alone adequately addresses prolapse in the majority of cases [8, 9]. Outcome studies also show that restoration of the apex corrects nearly half of anterior vaginal wall defects and one-third of posterior defects [10].

Surgical Consent

Most women will not be symptomatic until the leading edge of their prolapse extends beyond the hymen [11]. Similarly, half of women presenting for routine gynecologic care with no pelvic floor symptoms have prolapse that extends to the hymen [12]. Therefore, isolated pelvic symptoms such as pressure or splinting with defecation should not be attributed to enterocele or other anatomic support defects unless the most prolapsed vaginal segment extends beyond the hymen. Women with a symptomatic enterocele should be offered the full range of options for treating prolapse, including observation, pessary and surgery.

Satisfaction after surgery for pelvic floor disorders strongly correlates with achievement of patient-selected preoperative goals, but is not associated with objective outcome measures, such as POP-Q or prolapse stage [13, 14]. Therefore, it is important to assess the level of bother and impact on quality of life caused by the patient's prolapse. The surgeon should assist the patient in setting realistic treatment goals and should take these factors into account when guiding the patient to the most appropriate treatment option.

Initial surgical counseling should include a directed conversation to identify the patient's bothersome pelvic symptoms. The patient should be encouraged to express which symptoms she hopes will be addressed with surgery. This will ensure that her expectations are aligned with the selected treatment. In addition to the common risks of pelvic surgery, the patient should be counseled regarding the risk of prolapse recurrence, recovery time associated with various routes of surgery and the impact of enterocele repair on sexual function including the risk of dyspareunia. She should also be informed of the likely need for concomitant procedures, particularly to address apical support. Because enterocele repair will often include apical prolapse repair, surgeons should thoroughly explain the alternatives, risks, benefits, complications and perioperative course associated with abdominal (open, laparoscopic, and robotic) and vaginal apical prolapse repairs, with and without mesh. Nearly all of these procedures address the endopelvic fascial defect between the anterior and posterior vaginal walls and may correct a symptomatic enterocele. Native tissue apical repairs reattach the anterior and posterior endopelvic fascia to the uterosacral ligaments or sacrospinous ligament. In both procedures, it is important to incorporate the anterior and posterior vagina to obliterate the enterocele defect. Similarly, sacrocolpopexy involves attaching synthetic mesh to the anterior and posterior vagina and suspending both walls to the anterior longitudinal ligament, thereby eliminating the anterior and posterior enterocele. Most enterocele repairs require entry into the peritoneal cavity thus, patients should be counseled regarding elective or risk-reducing bilateral salpingo-oophorectomy and/or prophylactic salpingectomy for ovarian cancer risk reduction [15, 16].

Finally, the impact of enterocele repair on urinary symptoms and continence must be addressed. In incontinent patients, surgeons should determine the incontinence subtype (stress or urgency) and need for additional treatments (surgical or non-surgical). Likewise, continent women should be advised of their risk of developing de novo stress incontinence after prolapse repair [17, 18].

Surgical Technique

It is often difficult to preoperatively distinguish an enterocele from anterior and/or posterior vaginal wall prolapse in women who have previously had a hysterectomy. We recommend including an apical prolapse procedure (vaginal uterosacral or sacrospinous ligament suspension or abdominal sacrocolopexy) for nearly all women with symptomatic enteroceles. In the unusual case when the anterior and posterior vaginal walls are well supported and an apical procedure is not planned, it is important to identify whether small bowel is herniating into the vagina and contributing to the patient's prolapse. In this scenario, apical suspension is not necessary and closure of the enterocele sac with approximation of the anterior and posterior endopelvic fascia will result in correction of the prolapse. Because enterocele repairs are typically performed in conjunction with apical suspension procedures, there is a paucity of high-quality comparative outcome studies of isolated enterocele repair.

Vaginal Enterocele Repair

A midline longitudinal incision is made in the vaginal epithelium extending from the urethrovesical junction to the vaginal apex and back along the posterior vaginal wall to the perineal body. The vaginal epithelium is sharply dissected from the underlying pelvic viscera, which allows the surgeon to easily identify the bladder, rectum, and if present, an enterocele sac containing small bowel. Placing a finger in the rectum facilitates differentiation of the margins of the rectum from the enterocele sac in difficult cases. Similarly, palpation of the Foley balloon can help guide dissection and differentiation of the enterocele sac from the underlying bladder. Some surgeons suggest retrograde filling of the bladder to help identify bladder margins; however, our experience is that this obscures visualization and does not aid in dissection. The dissection should extend laterally to the medial aspect of the levator ani muscles. Once the enterocele sac has been dissected from the rectum, vagina and bladder, the peritoneum is entered sharply and explored to ensure there are no small bowel or omental adhesions. Adequate exposure of the peritoneum and cul-de-sac can be obtained using bowel packs and long Breisky-Navratil retractors. The ureters should be visualized bilaterally on the pelvic sidewalls to ensure they are not incorporated into the repair. At this point, the technique will vary depending on whether an isolated enterocele repair or concomitant apical suspension will be performed. Apical suspension techniques include an intraperitoneal approach using the uterosacral ligaments or an extraperitoneal approach using the sacrospinous ligament (see Chaps. 8, 9, 10, and 11). In the uncommon case of an isolated enterocele repair, the orifice of the sac should be occluded by high ligation [19]. Two or three circumferential sutures should be placed through one uterosacral ligament, reefed across the posterior peritoneum, placed through the contralateral uterosacral ligament, and then reefed across the anterior peritoneum. Once all three sutures are placed, they must be tied sequentially to obliterate the enterocele sac and cul-de-sac. Typically, a delayed-absorbable suture such as polydioxanone is preferred. Importantly, the anterior and posterior endopelvic fascia at the vaginal apex should be approximated to prevent recurrence of the enterocele. Concomitant anterior and/or posterior colporrhaphy can be completed as needed. If a sacrospinous ligament suspension is planned, it should be done after ligation of the enterocele sac. If a uterosacral ligament suspension is planned, no additional enterocele repair is necessary as the technique of incorporating sutures placed through the uterosacral ligaments serially across the vaginal cuff and through the anterior and posterior endopelvic fascia effectively obliterates the enterocele sac.

Cystoscopy should be performed after ALL enterocele repairs to ensure that sutures have not been placed into the bladder and that both ureters efflux urine briskly. If a suture is seen in the bladder, it should be removed and replaced. Similarly, if a ureter does not demonstrate symmetric and brisk efflux, the enterocele repair sutures should be removed until efflux is noted.

Abdominal Enterocele Repair (Refer to Video 12.1, Enterocele Repair (Kenton MD and Bochenska MD))

Although most current outcomes research demonstrates that the enterocele is effectively corrected by simply suspending the anterior and posterior vaginal walls to the anterior longitudinal ligament with synthetic mesh [20], the cul-de-sac can also be closed via an abdominal route at the time of sacrocolopexy. Moschowitz [21] and Halban [22] described two common techniques for abdominal enterocele repair. The techniques differ in the direction of suture placement used to obliterate the cul-de-sac. Moschowitz described placing double purse-string sutures circumferentially through the anterior and posterior peritoneum to obliterate the cul-de-sac. Halban described placing several rows of vertical sutures from the vaginal apex down the cul-de-sac and up the posterior peritoneum. Although no comparative studies exist to support the efficacy of enterocele repairs, theoretical advantages of Halban's technique include decreased likelihood of ureteral kinking and prevention of suture slippage, which could allow small bowel to herniate through the purse-string sutures. Both repairs are associated with postoperative difficulties with defecation. In a large multicenter study of women undergoing abdominal sacrocolpopexy, 33 % underwent concomitant enterocele repair or obliteration of the cul-de-sac [23]. Women were divided into groups based on whether they underwent concomitant posterior repair. Women who had a culdoplasty and posterior repair reported more symptoms of obstructed defecation than those without concomitant culdoplasty. Culdoplasty did not seem to have a negative impact on obstructive defecation in women who underwent sacrocolpopexy without posterior repair.

Postoperative Care

Postoperative recovery and expectations will differ depending on route of enterocele repair (vaginal or abdominal) and performance of concomitant apical, anterior and posterior prolapse procedures. Vaginal and laparoscopic/robotic procedures are typically associated with minimal postoperative pain, short hospital stays (same day discharge or 23 h observation) and quick recovery. Patients should be given standardized instructions regarding pain control, gastrointestinal function and signs of infection or bleeding. Few studies exist to guide postoperative activity recommendations and practices are evolving with time. Traditionally, surgeons placed onerous lifting restrictions on women following prolapse repair such as advising against lifting light weights (5–10 lb) for up to three months postoperatively or avoiding heavy lifting indefinitely. Furthermore, the belief that avoidance of activity is vital to the healing process to decrease inflammation is being discredited by new evidence. In fact, orthopedic surgery literature suggests that early resumption of activity actually promotes restoration of normal function [24, 25]. Extrapolating this theory to pelvic surgery, it is possible that pelvic loading (through activity) helps to promote tissue remodeling, thereby strengthening muscle and tissue. Several questionnaire studies have demonstrated a wide variability in postoperative recommendations amongst gynecologic surgeons with respect to activity, specifically lifting, stair climbing, driving and sexual intercourse. There is also literature to suggest that commonly restricted activities have no greater impact on intraabdominal pressure than normal unavoidable everyday activities [26]. Many of these postoperative restrictions can be life altering and detrimental to quality of life. To date, no randomized controlled studies have been published supporting or refuting postoperative restrictions.

Conclusions

Enteroceles classically cause apical and/or posterior vaginal wall prolapse as the small bowel dissects into the rectovaginal space. In general, enteroceles will not be symptomatic until the leading edge of the prolapse extends beyond the hymen. Therefore, isolated pelvic symptoms such as pressure or splinting with defecation should not be attributed to enterocele or other anatomic support defects unless the most prolapsed vaginal segment extends beyond the hymen. Women with symptomatic enteroceles should be offered the full range of options for treating prolapse, including observation, pessary and surgery. Those women who choose surgical repair should be counseled on the alternatives, risks, benefits, complications, etcetera of various apical support procedures as anterior and/or posterior vaginal wall prolapse without concomitant apical prolapse is uncommon. Therefore, apical prolapse repair should be included in the majority of enterocele repairs.

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Chapter 13
Posterior Colporrhaphy (With or Without Perineorrhaphy)

Jason P. Gilleran and Natalie Gaines

Abstract Evaluation and management of posterior prolapse can be challenging, as patients with rectocele can present with a variety of non-specific complaints, including vaginal bulge, bowel symptoms such as constipation or bloating, need to splint, perineal ballooning, or pelvic pressure. Unlike the anterior compartment, symptoms do not correlate with anatomy, and thus thorough history and physical exam are critical. Pre-operative radiographic evaluation has a limited role and typically does not change management.

Indications for treatment vary, but evidence consistently recommends only treating patients with defecatory symptoms or symptoms of vaginal bulge, regardless of size of rectocele. Management is geared to improve the patient's symptoms; asymptomatic patients can typically be monitored. Patients with minimal anatomic defect but significant defecatory symptoms may benefit from biofeedback without surgical repair. For symptomatic rectocele, traditional posterior colporrhaphy (PC) is the preferred method of management. It has excellent, durable anatomic and subjective outcomes. When compared to non-native tissue repairs, PC is associated with equivalent quality of life improvement and decreased complication rates.

Keywords Rectocele • Pelvic prolapse • Defecatory dysfunction • Colporrhaphy

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J.P. Gilleran, MD (✉) • N. Gaines, MD
Department of Urology, Oakland University William Beaumont School of Medicine, Royal Oak, MI 48073, USA
e-mail: Jason.Gilleran@beaumont.org; Natalie.gaines@beaumont.org

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Introduction

Addressing posterior vaginal wall prolapse presents challenges unique to this compartment for the pelvic floor reconstructive surgeon. Subjective symptoms associated with posterior prolapse are highly variable and patient-specific, unlike the more predictable symptomatology of anterior vaginal wall prolapse. Simply put, one cannot extrapolate symptoms based on the anatomy of the posterior vaginal wall. A recent article by Hale et al eloquently states that "the only consistent symptom with posterior vaginal wall prolapse is inconsistency" [1].

The estimated prevalence of rectocele is 12.9–18.6 % [2]. Symptoms commonly attributed to a rectocele include vaginal bulge, constipation, bloating, incomplete bowel evacuation, pelvic pressure, perineal ballooning, vaginal or perineal splinting, dyschezia, anismus, tenesmus, or obstructive defecation [1]. Despite this myriad of potential symptoms, validated questionnaires such as the Colorectal Anal Distress Inventory (CRADI-8) as part of the Pelvic Floor Distress Inventory (PFDI-20) have not shown correlation with stage of prolapse. The two most commonly reported complaints by women indicating significant posterior compartment prolapse include a protruding vaginal mass and the need to splint to have a bowel movement [3].

In this chapter, we will discuss the approach to posterior prolapse repair using case presentations, each with a unique set of clinical symptoms and findings; preoperative counseling for each patient will also be explained. We will also describe a detailed surgical technique for a native tissue primary rectocele repair.

Case Presentation #1

A 63-year-old G2P2 female presents with a chief complaint of a vaginal bulge. She has a history of pelvic organ prolapse and 4 years prior underwent a laparoscopic, robotic-assisted hysterectomy, bilateral salpingo-oophorectomy as well as a concomitant mesh sacrocolpopexy and midurethral sling.

Prior to this operation, she had a grade 3 cystocele and uterine prolapse with a C point of −3, an Aa point of 0, and a Ba point of +2, with only a grade 1 rectocele, with a Bp point of −2. She recovered well from this surgery and was very satisfied with the outcome until 6 months ago, when she noted a bulge on self-exam. Her only other medical history includes hypertension and hypothyroidism, for which she is on an ACE inhibitor and thyroid replacement therapy. She is married and still sexually active and reports occasional minimal dyspareunia that she attributes to vaginal dryness. She relates a history of intermittent constipation, but states this does not occur with any regularity and is resolved with increased dietary fiber.

On examination now, she has no anterior prolapse and excellent apical support with Aa and Ba points both −3, and a C point and TVL of −9. She has a posterior wall prolapse beyond the hymen, with Ap point of 0 and a Bp point of +1, a gh of 4 and a pb of 3. Digital rectal exam reveals a posterior wall defect consistent with a rectocele, as there does not appear to be a definitive palpable enterocele sac on bimanual examination.

Preoperative Evaluation and Counseling

This case exemplifies how prolapse in the posterior compartment may develop after an apical support procedure, either as a recurrence or as a secondary finding. This may be due to an accentuation of a weakness in the rectovaginal fascia that can develop several months to years after an anterior and/or apical surgery, perhaps due to overcorrection of the vaginal axis anteriorly. In the long-term outcomes from the Colpopexy and Urinary Reduction Efforts (CARE) trial, overall composite failure for prolapse occurred in nearly 1/3 of women, with more than 2/3 involving an area other than the apex [4]. In the same study, women who underwent concomitant posterior repair presented preoperatively with worse bowel symptoms at baseline than women who did not undergo posterior repair; these bowel symptoms improved significantly after surgery [5]. In this case, the patient presented with grade 1 rectocele but was clinically symptomatic. This differs from that of a clinically asymptomatic rectocele, where the anatomic defect is identified only by the clinician at time of a follow-up physical exam after anterior repair. Counseling a woman to observe an asymptomatic stage I-II posterior prolapse is clinically appropriate.

Pre-operative evaluation includes a thorough history and physical examination. Inquiry should be directed at several different domains of symptomatology - symptoms related specifically to the bulge, including pelvic pressure and perineal ballooning; bowel dysfunction, with specific queries about bleeding, tenesmus, fecal incontinence, need to splint to have a bowel movement, and constipation; and sexual symptoms, including dyspareunia. Appropriate inspection during physical examination must evaluate for all possible defects. Ask about specific anatomic points used in women who perform splinting, such as the posterior vaginal wall, or perineum, as this may correspond to the pelvic floor defect. While using half of a vaginal speculum to completely reduce any anterior wall defects, evaluate the posterior wall during straining. By placing one finger in the rectum and one in the vagina, the rectovaginal septum can be palpated for discrete breaks. Visual inspection may show perineal body weakness, manifesting as a widened genital hiatus and shortened perineum; one should consider a planned perineorrhaphy in this case.

The role of radiographic examination of posterior prolapse remains unclear. Defecography has been historically used to determine high rectocele versus enterocele pre-operatively, but no defecographic parameters have been found to reliably predict one versus the other. Magnetic resonance imaging evaluation of rectocele has been discussed, but its use has been primarily academic [6, 7]. Occasionally, a patient may present for evaluation of a rectocele identified solely on defecography without prolapse on pelvic exam. If one considers cost as a factor, radiography likely has a limited role.

Indications for posterior repair vary, but surgical intervention should be considered when the rectocele can be attributed to symptoms of pain, pelvic pressure or heaviness, or incomplete rectal emptying. Surgical intervention for large symptomatic rectoceles has been shown to significantly improve patients' quality of life, but not all defecatory symptoms will improve [7]. Rectocele size is poorly correlated with obstructive defecatory symptoms, and thus a patient with an anatomically advanced rectocele on examination may be completely asymptomatic, whereas another woman with a lower stage rectocele can have bothersome symptoms [8–10]. Despite this, a secondary analysis of a randomized trial showed that symptoms of bothersome straining and incomplete emptying were specifically associated with anatomic success [11].

Appropriate pre-operative counseling includes a thorough discussion about the patient's expectations. If her primary complaint is defecatory dysfunction with stage I or II prolapse on physical examination, one should consider that pelvic floor dysfunction may be the driving force of her symptoms; in this patient, surgery may not be indicated or may even worsen her symptoms. This patient is more likely to benefit from non-surgical therapy, including dietary changes, and physical therapy with biofeedback. While the evidence shows that prolapse repair can improve overall sexual performance, sexually active women should be counseled that there is a higher rate of dyspareunia after posterior repair [12]. This risk is even higher when one combines posterior repair with levatorplasty and perineorrhaphy.

Case Presentation #2

A 74-year-old G4P3 Caucasian female presents with chief complaints of constipation, difficulty with bowel movements, and a vaginal bulge. She underwent a total abdominal hysterectomy in her late 40s for dysfunctional uterine bleeding. She states that defecation produces small, occasionally very thin stools, and she must perform splinting to evacuate her bowels. She is widowed and no longer sexually active. She reports symptoms of long-standing defecatory dysfunction dating back to young adulthood after a difficult vaginal delivery. On specific questioning, she notes these symptoms predate the presence of a self-discovered vaginal bulge. The severity of her symptoms are reflected in higher scores on the CRADI-8 questionnaire relative to the urinary and pelvic organ prolapse domains of the PFDI-20 questionnaire.

On physical examination, she is obese and has a body mass index of 32 kg/m^2. Pelvic exam demonstrates a grade 3 posterior wall prolapse with good support of the anterior wall. Her POP-Q score is as follows: Ap −1, Bp +2, C −5, Aa −3, Ba −3. Rectal exam demonstrates a rectocele, but also suggests the presence of an enterocele – the proximal vaginal wall is palpably thicker during a bimanual examination with one finger in the vagina and one in the rectum.

Preoperative Counseling

While this patient presents with elements similar to the first case, her history suggests that the prolapse itself may be secondary to chronic straining from defecatory dysfunction. Women with other risk factors for prolapse, such as obesity, heavy manual labor, or chronic cough due to airway disease such as asthma, or obesity, should be counseled on addressing these risk factors, if possible, either before or as an adjunct to any prolapse repair. As part of the Women's Health Initiative, Kudish et al reported that women who were obese (body mass index >30 kg/m^2) increased their risk for progression of rectocele over a 5-year period by 58 % more than healthy participants [13]. Additionally, guidance by a registered dietician to increase fiber and to promote weight loss can be helpful in motivated patients who wish to avoid or postpone surgery. As with the first case, there should be a complete discussion about patient expectations and adjunctive non-operative management should be offered.

Surgical Technique (Refer to Video 13.1, Rectocele Repair (Zimmern P))

Rectocele Repair

In the patient with chronic obstructive defecatory symptoms, use of a preoperative cleansing enema may be helpful but is not necessary. A recent study by Ballard et al randomized 150 women to cleansing saline enemas versus no intervention. The group receiving preoperative enemas reported increased abdominal symptoms and decreased satisfaction, and the authors concluded that a mechanical bowel preparation conferred no benefit in terms of surgeon's assessment of the operative field [14].

Once under anesthesia, the patient is placed in dorsal lithotomy position using standard padded Allen stirrups. Candy cane stirrups are an alternative, but in our experience, the exposure should be adequate with either. Care is taken to avoid excessive pressure on the lateral calf due to concern for a common peroneal nerve injury, as well as hyperflexion at the hips, which could precipitate a femoral nerve injury. Once prepped, rectal access can be facilitated by placing an O'Connor rectal shield to allow sterile digital rectal examinations throughout the case. Alternatively, one may insert a betadine-soaked roll gauze to fill the anorectal cavity and allow palpation intraoperatively. We prefer to use a Lone Star® self-retaining retractor with 6–7 sharp hooks to expose the vaginal canal and posterior wall (1). These hooks can be repositioned once the incision is made and dissection has started to retract the vaginal flaps. We use injectable saline for hydrodissection, but alternatively one can use a vasoconstricting agent such as 1 % lidocaine with dilute 1:10,000 epinephrine (Fig. 13.1).

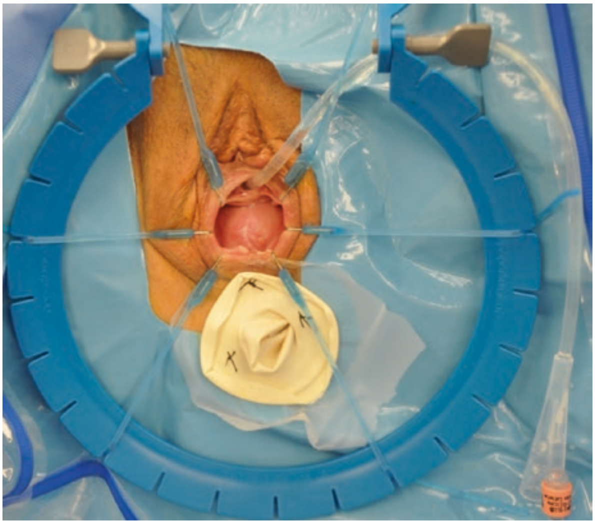

Fig. 13.1 Field preparation – O'Connor rectal shield secured with silk sutures and Lone Star® self-retaining retractor for vaginal exposure

Mark out the mucocutaneous junction at the posterior vaginal fourchette for the initial transverse incision, particularly if there are plans to correct a perineal defect at the time of surgery. Dissection of the posterior vaginal wall flap is best performed using primarily sharp dissection, with Allis clamps on the epithelial edge to retract the flap superiorly. Alternatively, a midline incision can be useful if the defect extends more proximally along the posterior wall. Digital manipulation of the rectum using the O'Connor shield can help facilitate this step by allowing the defect to be palpated, guiding further dissection (Fig. 13.2). Be prepared to encounter scar tissue during the initial dissection of the epithelium off the perineal attachments from prior prolapse and/or episiotomy repairs. At this point, an avascular plane should be identifiable between the vaginal epithelium and rectocele sac. The proper plane allows the surgeon to free the rectocele completely using blunt dissection. As the sac is dissected, identify the rectovaginal fascia and follow it laterally until its attachment at the arcus tendineus levator ani. If an isolated defect is encountered, then a "site-specific" fascial repair is indicated. Otherwise, traditional plication of the rectovaginal fascia to reduce the rectocele is most commonly performed; in this situation, we prefer to use an absorbable suture, such as 0 or 2-0 polyglactin (Vicryl®) suture, but a slow-absorbing suture (such as polydiaxonone, PDS) is also an option.

The plication consists of a series of interrupted sutures from one sulcus to the other, incorporating the rectovaginal fascia. Each suture is left untied and clamped with a mosquito clamp or hemostat. Once all the sutures are placed, they are tied one at a time, starting from proximal (deep) to distal (superficial). We use a DeBakey forceps or a narrow malleable retractor to reduce the sac while tying the sutures. A critical maneuver at this point is to avoid overtightening the plicating sutures, which may potentially introduce de novo dyspareunia. Examination of the vaginal introitus and canal after the sutures are tied to allow two fingerbreadths width easily

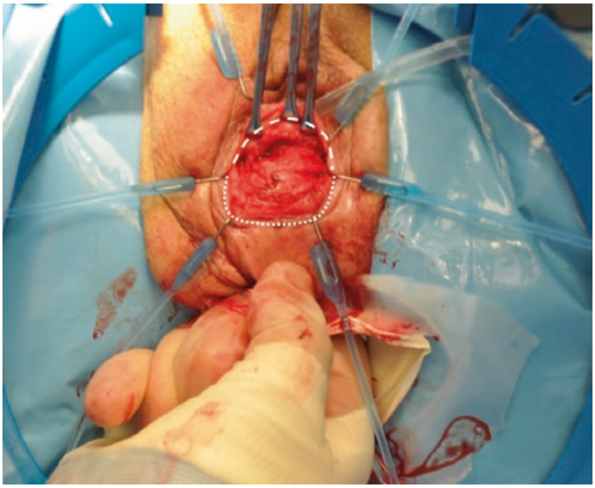

Fig. 13.2 Digital palpation through the O'Connor drape allows manipulation of the rectocele sac. The incision at the mucocutaneous junction is retracted (*dotted line*), while the vaginal epithelium is retracted upward with Alliss clamps (*dashed line*)

without any palpable "ridge" to avoid dyspareunia. Once the placating sutures are placed, any redundant or macerated epithelium can be trimmed to permit closure of fresh wound edges. The epithelium is then closed using a running 2-0 absorbable suture.

In cases with an extensive defect, prior failed native tissue repair, and/or a woman who is no longer sexually active, the high midline levator myorrhaphy (Chap. 11) is an intraperitoneal technique that can be useful not only to correct a rectocele, but also for vaginal vault fixation and to prevent enterocele recurrence [15].

Enterocele Repair

During any posterior wall repair, be mindful for a concomitant enterocele, even if one is not clinically identified on preoperative exam. In the scenario presented in case #2, a patient such as this may present with an enterocele under pressure due to obesity and chronic straining. Once the boundaries of the sac are identified, the next decision is whether to repair it via an intra- or extraperitoneal approach, which is usually based on surgeon preference and the technique used for apical support. We prefer to open the sac and reduce the contents with a moist pack, then close the sac with a purse-string suture using permanent 0 or 2-0 polypropylene suture (Fig. 13.3). After removal of the moist pack, the sac is cinched closed. Cystoscopy is done to assess for efflux from each ureter, as one or both can be kinked by the peritoneal closure. If no efflux is seen, even after intravenous methylene blue administration, one must undo the permanent suture and reassess. If, instead, the sac is left intact and the repair is done via an extraperitoneal approach, then likely a sacrospinous fixation would be an appropriate choice if apical suspension is needed.

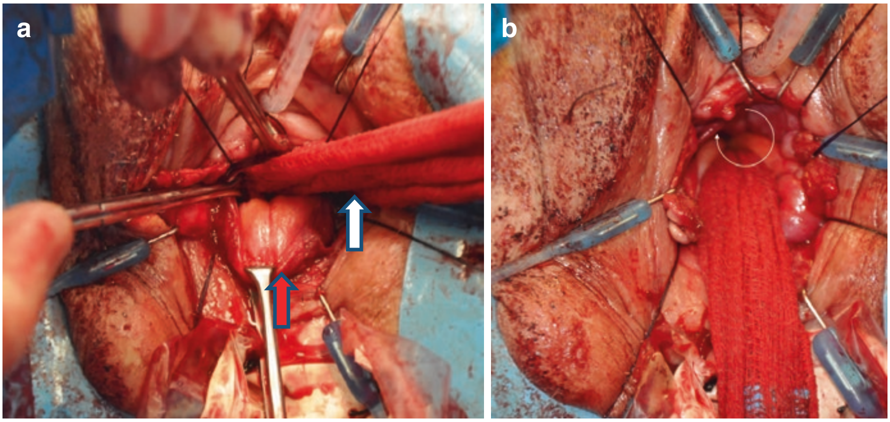

Fig. 13.3 (**a**) Allis clamps are placed on the upper and lower edge of the enterocele sac (*red arrow*) with a Kerlix gauze reducing the enterocele sac contents (*white arrow*). (**b**) The enterocele sac is closed using a purse-string suture (*circular arrow*)

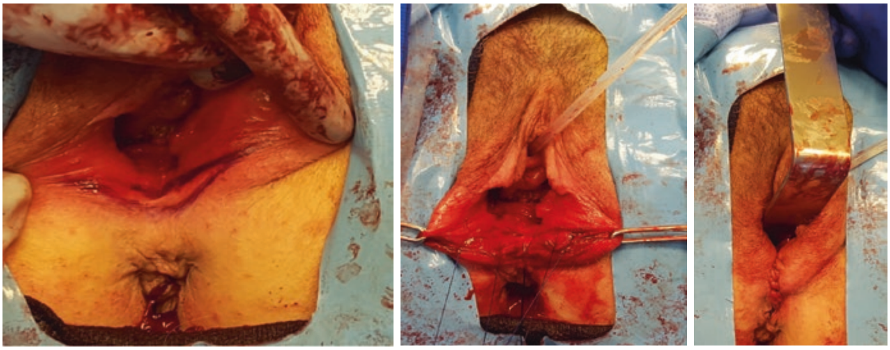

Fig. 13.4 Perineorrhaphy (from *Left to Right*): Skin marking at mucocutaneous junction for incision, after dissection of bulbocavernosus muscles with three 2-0 PDS sutures in place before tying, and after reapproximation of muscles and perineal skin closure

Perineorrhaphy

After completion of the rectocele and/or enterocele repair, evaluate the perineal body for laxity and separation of the superficial transverse perineal muscles by digitally palpating the defect on rectal exam (Fig. 13.4). We will mark out a triangle of thin perineal skin at the mucocutaneous junction for excision. Sharp dissection laterally to the perineal musculature on each side is important to allow for plication of the muscles and recreation of the perineal body. We use an absorbable suture, usually 2-0 PDS, to reapproximate the muscle in a series of interrupted mattress sutures, starting at the deepest aspect of the defect and proceeding superficially towards the vaginal introitus. The vaginal incision is closed transversely at the mucocutaneous junction, with a second closure longitudinally to reapproximate the perineal skin, using an absorbable suture; we prefer either Vicryl or chromic. In addition to a vaginal pack for the posterior repair, we will apply an external cold compress pack in recovery for pain control.

Outcomes

Traditional posterior colporrhaphy (PC) by midline plication yields excellent results in terms of both anatomic and subjective success. Maher et al, in a prospective study of 38 women, reported an anatomic cure, defined as POP-Q stage I or less, of 79 % at 24 months. 89 % reported "very high satisfaction" on subjective questionnaire, with a significant reduction in dyspareunia and straining to defecate [16].

In addition to published small cohort studies, there are notable well-designed randomized trials comparing native tissue to graft-augmented repair. Paraiso et al randomized 106 women to either PC, site-specific defect repair (Refer to Video 13.2 Rectocele Plication, Site-Specific Defect Repair, and Perineorrhaphy (De, E)), or porcine dermis graft-augmented repair. At 12 months, there was a significantly higher anatomic failure rate (Bp > −2) in the graft arm of the study (46 %); anatomic failure rates for PC and site specific were similar at 14 % and 22 %, respectively [17]. Similarly, Altman et al reported on 27 women undergoing porcine xenograft and found a 41 % stage II or greater recurrence at 3 year follow-up [18]. Sung et al randomized 160 women to PC alone using absorbable polyglycolic sutures or augmented repair with subintestinal submucosal graft, and found no difference in anatomic failure, bulge symptom failure, or defecatory symptom failure [19]. Unlike the study by Paraiso, in Sung et al, both groups showed improvement in bulge and defecatory symptoms.

More recently, randomized studies comparing PC to synthetic-augmented repair have shown similar findings. Carey et al compared midline plication with type I polypropylene mesh repair in 139 women with both anterior and posterior compartment defects. Anatomic success favored mesh repair at 1 year, but this difference was not statistically significant and findings for the posterior compartment were not specifically reported; subjective success was similar for both groups [20]. Withagen et al compared traditional midline plication with tension-free vaginal mesh repair. While the traditional repair was associated with an increased rate of recurrence based on anatomic outcomes (24.5 % versus 4.1 % in the mesh arm), patients reported improved quality of life outcomes that were similar between mesh repair and standard plication [21]. Secondary analysis by this group revealed that mesh repair was more often associated with de novo prolapse in the untreated compartment (53 %) than conventional repair (17 %) [22]. Sokol et al. randomized 65 women to either traditional midline plication or Prolift® mesh augmentation with median follow-up of 12 months. Anatomic success, defined as POP-Q stage I or less, showed that recurrence rates in the posterior compartment were similar and not statistically different; the study was stopped early when it met a predetermined cut-off for mesh extrusion after 3/32 patients in the mesh arm required reoperations [23]. Both groups had statistically significant improvements in quality of life measures by validated questionnaires. Given the findings in these studies, it is worth noting that subjective outcome after posterior repair does not correspond to objective outcomes, with one study showing patient satisfaction primarily linked to symptom relief and not to anatomic cure [24].

Conclusions

At the present time, there is no level I evidence to suggest that non-native tissue repair is superior to traditional repair with regards to subjective outcomes and anatomic success for posterior repair. Thus, the midline plication remains a viable option for repair of the symptomatic rectocele with excellent durable outcomes. Additionally, there is also evidence that PC is associated with a lower risk of complications compared to biologic or mesh graft use. Thorough preoperative counseling, identification of all posterior defects that require repair, and careful attention to surgical technique are all necessary for an overall successful outcome.

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Chapter 14
Colpocleisis

David D. Rahn

Abstract Colpocleisis is an obliterative procedure for the correction of pelvic organ prolapse that is uniquely suited to elderly women and those with multiple medical comorbidities in need of an expeditious, durable prolapse repair. Important caveats are highlighted: (1) the patient should have no desire for future vaginal coital activity; (2) if the uterus is to be retained, a preoperative assessment of the endometrial cavity is prudent; and (3) a concomitant continence procedure is frequently needed, and, thus, one should assess for overt or occult stress leakage preoperatively.

Keywords Colpocleisis • Colpectomy • Vaginectomy • LeFort • Pelvic organ prolapse • Pelvic floor disorders • Geriatric incontinence

Case Presentation

An 82 year-old gravida 4, para 4 white woman with hypertension, type-II diabetes (both well controlled), and degenerative joint disease presents with a complaint of 10+ years of vaginal pressure and bulging. An anterior colporrhaphy was performed at an outside hospital in the remote past. She has tried management with a Gellhorn pessary combined with vaginal estrogen cream application twice per week, but she finds it very difficult and painful to manipulate the pessary given her arthritic hands. Her husband used to help her with the pessary removal, but he died 1–2 years ago. She is adamant that she does not desire future coital activity, even if she were to meet another partner. She reports she used to have leakage of urine with coughing or sneezing or with position changes, but she reports, "That eventually got better." Now, instead, voiding is difficult as she has to try to manually reduce her vaginal

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D.D. Rahn, MD
Obstetrics & Gynecology, Female Pelvic Medicine & Reconstructive Surgery, University of Texas Southwestern Medical Center, Dallas, TX, USA
e-mail: david.rahn@utsouthwestern.edu

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bulge to complete urination. She denies defecatory complaints and any vaginal bleeding or discharge.

On exam, she voids 80 mL with a postvoid residual of 160 mL by scanner. A dip urine analysis is normal. On pelvic exam, stage 3 anterior and posterior prolapse is appreciated with a wide genital hiatus of 5–6 cm. With repeated Valsalva, she also has stage 3 uterovaginal prolapse. No urine leakage is noted during examination. The vaginal walls are well-estrogenized. Surgical options are reviewed, and the patient desires the quickest option for repair and recovery; she is interested in and amenable to a partial colpocleisis. Preoperative testing is completed: (1) transvaginal sonogram to evaluate the uterus and endometrial thickness, and (2) simple cystometrics to assess for occult urinary incontinence. The sonogram finds a small uterus with a thin, homogenous endometrial stripe (less than 5 mm) and normal-appearing adnexa. Cystometry confirms urodynamic stress incontinence when the prolapse is reduced and the patient is filled to 200 mL. No visible detrusor overactivity is observed. After appropriate counselling and informed consent, a plan is made for LeFort colpocleisis, concomitant continence procedure, posterior colporrhaphy, and cystourethroscopy.

Indication

Pelvic organ prolapse is a common genitourinary complaint of elderly women. For those patients selecting surgical management over observation or pessary use, there are various techniques (detailed in other chapters) designed to restore and maintain normal vaginal function and anatomy, but there is also the colpocleisis procedure, which surgically closes the vaginal vault. This obliterative approach is durable and has low complication rates, decreased blood loss, and shorter operative times compared to most other reconstructive procedures; thus, it is a particularly useful approach for patients with multiple medical comorbidities who may not be good candidates for lengthier, more involved reconstructive procedures.

Complete colpocleisis (a.k.a. total colpocleisis, colpectomy, or vaginectomy) is defined as "removal of all vaginal epithelium cephalad to the urethrovesical junction to the level of the vaginal cuff, both anteriorly and posteriorly", whereas *partial colpocleisis*, also known as a LeFort colpocleisis, involves partial removal of this same epithelium creating a longitudinal vaginal septum with bilateral vaginal epithelial tunnels [1]. For both total and partial colpocleisis procedures, the candidate patient generally has significant prolapse (beyond the hymen) of the uterus (or vaginal apex) and anterior and posterior vaginal walls. Because the vagina is effectively closed with colpocleisis, the procedure is only indicated in elderly women with no desire for future vaginal coitus.

For a complete colpocleisis, either the patient has a past history of hysterectomy or will undergo concomitant total hysterectomy with her prolapse repair. However, in the setting of a partial colpocleisis, the decision may be made to *not* perform a concomitant hysterectomy. In this case, preoperative evaluation of the uterine endometrium with either endometrial biopsy using an in-office Pipelle device or sonographic imaging is appropriate to assure no concern for endometrial pathology. Recommendations differ on the upper limits of normal for endometrial thickness: in a postmenopausal woman *with a report of bleeding* or spotting, an endometrial thickness (i.e., the combined thickness of the anterior and posterior layers together) of less than or equal to 4 or 5 mm is associated with a very low risk of endometrial disease [2, 3]. Thickness of the endometrium may be less predictive of neoplasia in the *asymptomatic* patient [4] (i.e., no bleeding or spotting) as thickness up to 11 mm corresponds to a minute cancer risk (0.002 %). Thus, certainly, a thickness of less than 5 mm (and perhaps up to 11 mm [5]) in the asymptomatic patient is reassuring. Of course, any description by the patient of recent postmenopausal bleeding necessitates workup before proceeding with colpocleisis. Likewise, suspicion of any pelvic malignancy or possible need for future pelvic irradiation would be contraindications to closure of the vaginal canal.

For either total or partial colpocleisis, preoperative evaluation for occult stress incontinence (i.e., visualization of urine leakage with stress maneuvers when the bulge is manually reduced) is a valuable test. In those women demonstrating leakage, one should consider a concomitant continence procedure with the prolapse repair. Similarly, significant prolapse may contribute to some degree of *ureteral* obstruction, so preoperative confirmation of ureteral patency (e.g., intravenous pyelogram or cystoscopy) may be considered.

Consent

The potential adverse events are those one would describe for any vaginal surgery: injury to bladder, ureter, or bowel; new or worsened urinary incontinence; urinary retention and need for prolonged catheterization; bleeding; infection; fistula formation; failure of repair with need for additional surgery; and conversion to an abdominal or laparoscopic route to correct vaginal complications. In practice, however, colpocleisis has relatively few adverse events. If a concomitant continence procedure is planned, its attendant risks and benefits are discussed with the patient.

Unique, of course, to this obliterative procedure is the loss of vaginal coital function. Thus, the decision to undergo a colpocleisis ideally involves a conversation with both the patient and her sexual partner. If the patient expresses hesitation or doubt, this should exclude her as a candidate for colpocleisis. Colpocleisis also makes the clinician unable to evaluate the cervix or uterus (e.g., cervical cytology or endometrial biopsy) by the vaginal route.

Technique (Refer to Surgical Videos 14.1 Colpocleisis (De, E) and 14.2 Colpocleisis (Carmel, M))

Patient preparation begins with a clear liquid diet the day prior to surgery and, commonly, a patient-administered enema the night before and/or morning of her procedure. This serves to minimize fecal contamination during repeated rectal examinations that typically occur during the course of surgery. Antibiotic prophylaxis is given in the operating suite before beginning surgery. Thromboprophylaxis is tailored to the specific patient, but, at a minimum, entails intermittent compression devices begun before induction of anesthesia [6, 7].

While general or regional anesthesia is the standard, complete and partial colpocleisis procedures could potentially be performed under local anesthesia with sedation. The patient is positioned in the modified dorsal lithotomy position in either candy-cane or Allen stirrups, taking care to avoid compression of lower extremity nerves. The vagina is prepped. A quick cystoscopic survey is often prudent in the setting of prolonged, severe prolapse in an elderly woman to confirm ureteral patency and efflux at the outset of the procedure so as not to erroneously conclude a complication has occurred later if efflux is sluggish or absent post-procedure. A Foley catheter is inserted following cystoscopy.

Complete Colpocleisis

The vaginal apex is delivered outside the introitus using surgical clamps. The vaginal wall is infiltrated with dilute hemostatic solution (e.g., 20 units vasopressin in 50 mL saline). Anteriorly, a transverse vaginal wall incision is made approximately 3 cm cephalad from the external urethral meatus, leaving space for a subsequent continence procedure. Posteriorly, the incision connects at a point approximately 1–3 cm cephalad from the hymenal ring.

The entire vaginal epithelium and underlying lamina propria are lifted off using a combination of sharp and blunt dissection, revealing the underlying fibromuscular layer of the vaginal wall. This thin dissection is achieved with a finger behind the vaginal wall and Metzenbaum scissors directed in parallel with the vaginal wall. Representative photos of vaginal wall dissection are seen in Figs. 14.1a, b. To replace and elevate the vaginal tube, a series of purse-string sutures will be placed using permanent or delayed absorbable suture (e.g., 2-0 Ethibond®) (Fig. 14.2). Beginning at the apex with the initial suture placement at 12 o'clock, a circumferential stitch is placed. A hemostat placed just above the knot can be used to elevate the prolapse as a second row of circumferential stitches are placed. The hemostat holding the first knot is pressed inward (i.e., elevating/replacing the prolapse) as the second knot is tied. The hemostat is removed and replaced on the second knot for use with the third ring of suture (Fig. 14.3). This series of steps repeats, commonly taking 6–8 rings of suture to completely elevate/invert the prolapsed vagina. The vaginal epithelium remaining nearest the introitus is closed with a running 2-0 delayed absorbable suture.

Partial (LeFort) Colpocleisis

As above, the vaginal apex (or cervix) is grasped with clamps and delivered as far outside the introitus as possible (Fig. 14.4). Rectangular areas of approximately equal dimensions are delineated with either marker or cautery on both the anterior

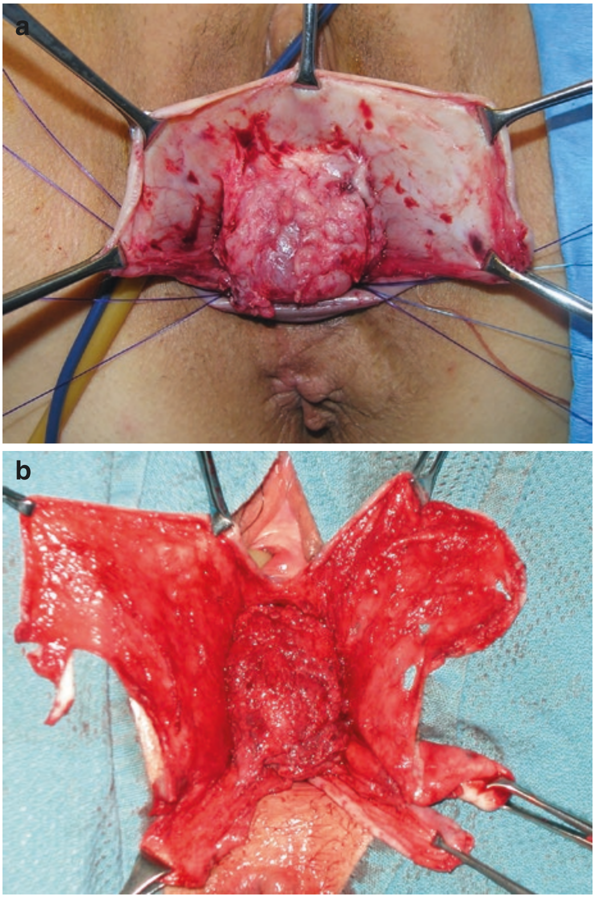

Fig. 14.1 The epithelium alone is dissected away from the underlying fibromusclar layer of the vaginal wall (**a**, **b**). (*Photo credit*: Dr. Marlene Corton, with permission)

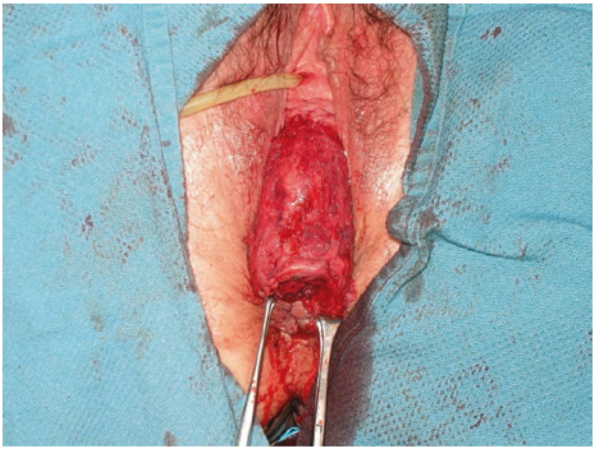

Fig. 14.2 The vaginal tube with excised epithelium has been everted. Successive purse-string sutures will begin closest to the vaginal apex, which is pushed inward with subsequent rings of suture. (*Photo credit*: Dr. Marlene Corton, with permission)

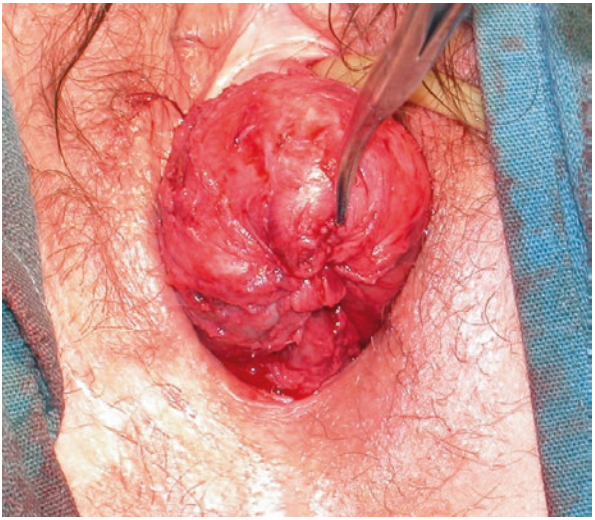

Fig. 14.3 The vaginal tube continues to be elevated with resolution of the prolapse by pushing inward/cephalad with a hemostat or similar instrument on each successive suture ring. (*Photo credit*: Dr. Marlene Corton, with permission)

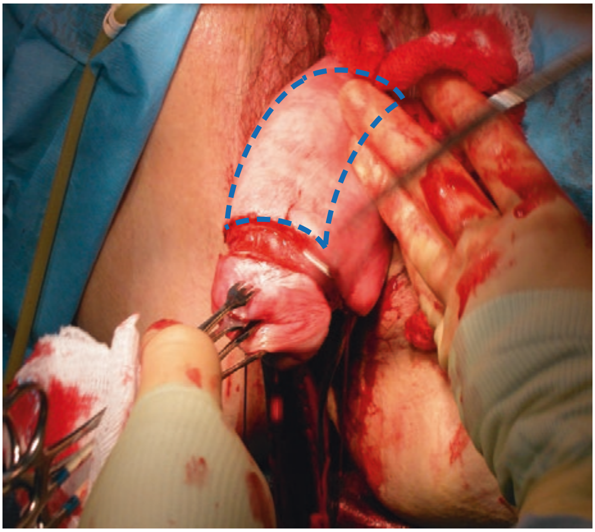

Fig. 14.4 In a partial (LeFort) colpocleisis, the vaginal apex is everted and similar-sized rectangles of epithelium (region inside hashed blue lines) are excised from the anterior and posterior vaginal walls. (*Photo credit*: Dr. Marlene Corton, with permission)

and posterior vaginal walls. The hashed blue lines in Fig. 14.4 delineate the intended region for dissection and skin excision on the anterior vagina. The length of the vaginal walls ultimately dictates the rectangles' size, but generally the transverse incisions nearest the cervix should be 1–2 cm from the os. The other transverse incisions (i.e., those nearest the distal vagina) should be made 2–3 cm from the external urethral meatus anteriorly and 2–3 cm inside the hymenal ring posteriorly. The rectangles' width should be such that 1–2 cm of epithelium remains between the longitudinal edges of the anterior and posterior vaginal wall rectangles; these will ultimately form the lateral drainage canals.

Just beneath the epithelium of the rectangular areas to be excised, infiltrate thoroughly with a dilute hemostatic solution of vasopressin. The rectangular regions are then sharply and bluntly dissected and skin excised, exposing the underlying fibromuscular layer. After the rectangles of epithelium are excised, the matching corners of the anterior and posterior rectangles are stitched together with delayed absorbable suture. Then, a row of interrupted delayed absorbable stitches are placed from anterior to posterior along the transverse edge nearest the vaginal apex (cervix), which closes the anterior and posterior fibromuscular layers over the cervix. To assure that the lateral drainage canals (next step) remain patent such that future uterocervical drainage may be detected, some surgeons will sew over a thin red rubber (or similar) catheter laid across the cervix and along these lateral canals to be developed; care is taken not to incorporate the catheter with sutures (i.e., it should "floss" back and forth during the repair), and it is removed at the completion of the procedure.

The matching longitudinal edges of the anterior and posterior rectangles are stitched together with interrupted delayed absorbable sutures, which creates lateral vaginal drainage canals.

To elevate the uterus and pelvic contents, the surgeon now incorporates successive transverse tiers of interrupted permanent or delayed absorbable suture (e.g., 2-0 Ethibond®) into the fibromuscular layers, matching the corresponding regions of the anterior to posterior rectangles to each other, beginning nearest the prolapsed vaginal apex (cervix). These progressive rows of interrupted permanent suture continue to approximate the anterior and posterior walls, turning the prolapse from "inside-out" to "right-side-in". Finally, the vaginal epithelium is closed in a running fashion using 2-0 delayed absorbable suture.

After Colpocleisis

At completion of either the complete or partial colpocleisis, a continence procedure is now often performed. A wide perineorrhaphy is also commonly performed to narrow the posterior introitus further. Cystoscopy should be completed to assure no urinary tract injury and that there is bilateral ureteral efflux.

Postoperative Care

After colpocleisis, the recovery is generally quick and without complication, but given this patient population's advanced age and medical comorbidities, overnight observation is usually warranted. The patient leaves the operating room with a Foley catheter in place, and the timing of a passive or active voiding trial depends on whether a concomitant continence procedure was performed. Patients are encouraged to resume normal physical activity except with minimal heavy lifting for several months, and constipation is to be avoided. Thus, stool softeners are prescribed in addition to oral pain medication; nonsteroidal anti-inflammatory medications usually suffice. Patients may expect a small amount of postoperative vaginal drainage or spotting which should lessen day-by-day. Patients are instructed to call their surgeon for the emergence of increasing abdominal or local/perineal pain, increasing/persistent bleeding or discharge, dysuria, or fever. The first postoperative clinic visit is within 2–4 weeks.

Results

Fitzgerald et al prospectively followed 152 women having colpocleisis and assessed exam findings and changes in urinary, prolapse, and colorectal symptoms using the Pelvic Floor Distress Inventory and Pelvic Floor Impact Questionnaire [1]. At 1 year postoperatively, 93 % of patients had prolapse stage 2 or better, and 73 % of patients had prolapse stage 0 or 1. All of the pelvic symptom scores were significantly improved, and 95 % of patients reported they were either 'satisfied' or 'very satisfied' with their surgical outcome.

In a different multicenter prospective cohort study of 90 subjects undergoing colpocleisis, 6 months after surgery, patient satisfaction was also high and regret was low. Significant improvements were observed in all pelvic floor symptoms and in body image [8]. Of the 61 subjects completing 6 month data, *regret* or dissatisfaction was expressed by just six women (9.8 %); 3 listed persistent or new urinary complaints as the reason for regret while one was dissatisfied due to recurrent prolapse and one due to postoperative complications. Only one patient expressed regret because of loss of coital function.

Complications related to colpocleisis are low. Intensive care unit admissions and mortality are approximately 3 % and 0.15 %, respectively [9]. Most often, significant postoperative complications are attributable to the baseline comorbidities of the elderly population having this repair.

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Chapter 15
Female Urethral Diverticulum

Alyssa K. Greiman and Eric S. Rovner

Abstract Female urethral diverticula are outpouchings of the urethral lumen into the surrounding connective tissue. The presentation of female urethral diverticula is diverse and can range from incidental findings to frequent urinary tract infections, dyspareunia, incontinence, or malignancy. Once the diagnosis is confirmed, the usual treatment consists of surgical excision and reconstruction. The principles of transvaginal urethral diverticulectomy include removal of the entire urethral diverticulum wall, watertight closure of the urethra, multilayered and non-overlapping closure of surrounding tissue with absorbable suture, and preservation or creation of continence. Complications of urethral diverticulectomy include urethrovaginal fistula, urinary incontinence, and rarely urethral stricture.

Keywords Female urethral diverticulum • Urethral diverticulectomy • Urethral reconstruction

Introduction

Female urethral diverticula are a rare condition that affects between 1–6 % of adult women, with a median age of 40. Urethral diverticula have been reported in 1.4 % of women who present for the evaluation of incontinence, with the diagnosis being made in up to 80 % of women who present with a periurethral mass [1–3].

Urethral diverticula (UD) are outpouchings of the urethral lumen into the surrounding periurethral connective tissue (also termed the periurethral fascia). UD are thought to arise from repeated obstruction, infection and subsequent rupture of periurethral glands into the urethral lumen, resulting in an epithelialized cavity that communicates with the urethra [1, 4]. Iatrogenic damage to the urethra may also

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A.K. Greiman, MD • E.S. Rovner, MD (✉)
Department of Urology, Medical University of South Carolina,
96 Jonathan Lucas St., CSB 644, Charleston, SC 29425, USA
e-mail: greiman@musc.edu; rovnere@musc.edu

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play a role, as up to 20 % of women with urethral diverticula are noted to have a history of prior urethral surgery, dilation, or traumatic delivery [1, 3].

Case Presentation

A 55 year old woman is referred by her gynecologist with symptoms of urinary frequency, urgency, pelvic pain and dyspareunia. She has had several urinary tract infections over the past few years. The patient states these symptoms have been present for 3 years and are progressively worsening. She denies prolapse or splinting despite a history of four vaginal deliveries. She wears one pad per day for symptoms of poorly characterized "wetness". She states that the pad is not particularly wet but smells like urine.

On physical exam fullness is noted over the distal anterior vaginal wall, and palpation of the anterior vaginal wall over the area of fullness reproduces the patient's pelvic pain. There is a drip of fluid per the urethral meatus upon stripping of the anterior vaginal wall. There is no prolapse on exam, nor is stress urinary incontinence noted with cough or valsalva. Urinalysis and urine culture are both negative for infection.

The patient brings the results of an abdominal and pelvic ultrasound that her gynecologist had obtained in evaluation of her pelvic pain; these studies demonstrate a 2.4 × 2.1 complex, partially cystic lesion on the anterior vaginal wall (Fig. 15.1a). A VCUG demonstrates a collection of contrast below the bladder neck (Fig. 15.1b). *An MRI of the pelvis confirms a proximal saddlebag urethral diverticulum* (Fig. 15.1c). *Flexible cystoscopy in the office confirms a urethral diverticulum ostia at the five o'clock position at the junction of the mid and proximal third of the urethra.*

The presentation of female urethral diverticula is diverse and can range from incidental findings on physical exam or cross sectional imaging, to frequent urinary tract infections, dyspareunia, incontinence or malignancy. The most common presentations include vaginal mass, irritative lower urinary tract symptoms, and recurrent urinary tract infections [1, 3, 5]. Up to 20 % of patients lack symptoms, with urethral diverticula being an incidental finding on imaging. The vague and overlapping nature of symptoms can delay the diagnosis of urethral diverticulum up to 2–5 years, with the mean interval between onset of symptoms and diagnosis of 5.2 years [1, 3, 6, 7].

The differential diagnosis of periurethral masses includes: vaginal wall cysts, leimyoma, Skene gland abnormalities (Refer to Videos 15.1 Excision of Skene's Gland Cyst (Zimmern P) and 15.2 Urethral Diverticulum Repair (Zimmern P)), Gartners duct abnormalities, urethral prolapse, and urethral caruncle in addition to urethral diverticulum. A thorough pelvic exam with palpation of the anterior vaginal wall for tenderness or discharge may not be sufficient in making a diagnosis. In such instances, and for operative planning, further cystoscopic and radiographic evaluation is warranted.

When urethral diverticulum is suspected, cystourethroscopy offers the opportunity to visualize the location of the diverticular ostium and to evaluate for other

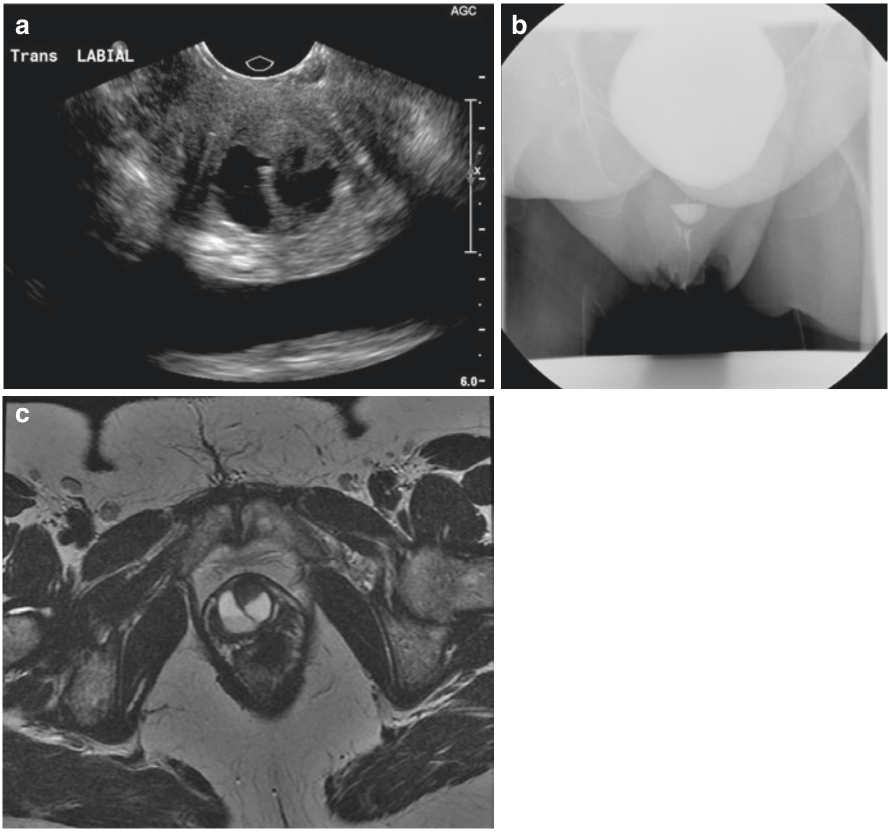

Fig. 15.1 (**a**) Transvaginal ultrasound of a proximal saddlebag urethral diverticulum. (**b**) VCUG of a proximal urethral diverticulum. (**c**) Axial T2- weighted MRI of the same proximal saddlebag urethral diverticulum

causes of irritative or obstructive voiding symptoms. Visualization of the diverticular ostium on cystourethroscopy is variable and reported in 15–89 % of cases [1, 6–9]. The ostium is usually found in a posterolateral position in the proximal or middle third of the urethra and can be visualized by slowly withdrawing the cystoscope through the urethra.

Radiologic modalities for evaluation of urethral diverticula include ultrasound, VCUG, and MRI (Fig. 15.1). Transperineal and transvaginal ultrasound have reported sensitivity of up to 95–100 % and may be useful in the intra-operative identification of the diverticulum in difficult dissections (Fig. 15.1a) [1, 6, 10]. It should be noted, however, that the sensitivity of this imaging modality is predicated on the skill of the sonographer, with some studies reporting a less than 50 % sensitivity in evaluation of known diverticula [1, 3]. VCUG offers the ability to visualize the diverticulum if the ostium is patent, with reported sensitivity of 67–95 % (Fig. 15.1b) [1, 11]. As VCUG is invasive, uncomfortable, and carries an increased risk of infection, the optimal study for diagnosis and operative planning is MRI. MRI offers excellent anatomic detail for surgical planning without radiation or catheterization. T2 weighted imaging will display the diverticulum as a bright, fluid filled entity adjacent to the urethra (Fig. 15.1c).

Urodynamics may be beneficial in patients with a urethral diverticulum who endorse incontinence to clarify if genuine stress urinary incontinence is present or if the apparent incontinence is actually due to post-void dribbling as a result of residual urine in the diverticulum after voiding.

Surgical Indications

The natural history of untreated urethral diverticula is unknown. Whether such lesions enlarge, become more symptomatic or are associated with other complications such as malignant degeneration, is unknown. Up to 10 % of diverticula show atypical pathologic findings without any obvious imaging findings [5, 12], with malignancy being found in 1–6 % of urethral diverticula [3, 8, 13, 14]. The most common malignancies reported are adenocarcinoma, transitional cell carcinoma and squamous cell carcinoma. Patients who are not surgical candidates and those who do not desire surgical excision should be counseled as to the risk of malignant transformation and should undergo continued monitoring. If malignancy is found, pelvic exenteration, lymphadenectomy and urinary diversion is pursued for curative intent when applicable. Minimally symptomatic patients and those who desire non-operative management may be placed on antibiotic prophylaxis. In such individuals, post-void stripping of the anterior vaginal wall would be expected to empty the UD cavity and potentially reduce post-void dribbling and recurrent UTIs.

Once the diagnosis is confirmed in symptomatic patients, the treatment of UD usually consists of surgical excision and reconstruction. Indications for surgical excision and reconstruction of urethral diverticula include refractory symptoms such as pelvic pain, dyspareunia, irritative voiding symptoms and recurrent urinary tract infections.

Urethral diverticulum and stress urinary incontinence (SUI) often co-exist, with reports of anywhere between 10–57 % of patients with urethral diverticulum also presenting with SUI [13, 15]. Only approximately 50 % of these patients were found to have true SUI versus post-void dribbling. On the contrary, urethral diverticulum can also mask SUI due to mass effect in 10–33 % of patients, especially when the urethral diverticulum is proximal and greater than 3 cm in size [13]. As such, there is no consensus on appropriate timing of surgical management of these two conditions. When treating concomitant urethral diverticula and stress urinary incontinence, some surgeons favor a staged procedure while others recommend simultaneous pubovaginal sling placement. Concomitant autologous pubovaginal sling placement has been found to be safe and effective for treatment of stress urinary incontinence at the time of urethral diverticulectomy and should be decided on an individualized basis [5, 15]. The use of synthetic materials as a concomitant sling material is not recommended due to the risk of erosion of the synthetic graft [16].

Surgical Consent and Discussion

Patients are counseled prior to surgery regarding the various surgical and non-surgical treatment options, expected recovery process (detailed later in this chapter) and the most common post-operative complications.

As noted previously, some patients may elect for non-operative management with low dose suppressive antibiotics and digital stripping of the anterior vaginal wall following micturition to prevent post-void dribbling and to reduce the risk of urinary tract infection due to stasis in the diverticulum. Such patients are counseled regarding the unknown natural history of untreated UD, as well as the potential for malignant change, and scheduled for routine annual follow-up.

For patients with very distal urethral diverticulum who do not desire extensive surgical reconstruction, marsupialization of the diverticulum into the vagina via a deep incision into the ventral urethra is an option (Spence-Duckett procedure). Patients are counseled that there is a risk of stress urinary incontinence as proximal incision of the ventral urethra may result in injury of the urethral sphincter and de novo postoperative SUI.

Rarely, in pregnant women or in patients with a highly symptomatic or infected urethral diverticulum in whom elective excision and reconstruction should be postponed, a transvaginal incision directly into the urethral diverticulum ("diverticulotomy") can be performed to create a temporary urethrovaginal fistula traversing the UD cavity and thereby decompress the urethral diverticulum until such time that elective excision and reconstruction can be performed. Such patients are counseled that if the UD is located proximally and/or they have an incompetent bladder neck, to expect the possibility of constant leakage of urine per the vagina through the iatrogenic urethrovaginal fistula until definitive reconstruction is performed.

Patients are extensively counseled regarding the expected postoperative course, risks of surgery, as well as potential outcomes. Surgical excision of the diverticulum with appropriate tension-free, multi-layered closure is the gold-standard treatment with most studies reporting success rates greater than 90 % [1, 3, 5, 8, 17]. There is an increased risk of recurrence in patients who have multiple or circumferential diverticula, proximal diverticula or have had prior UD surgery [1, 17].

Patients are counseled that complications may occur postoperatively. The most common complications after urethral diverticulectomy include urinary tract infection, de novo stress urinary incontinence, and de novo irritative lower urinary tract symptoms. The risk of urethrovaginal fistula and urethral stricture are less common but can be difficult to manage and may require additional surgical intervention [1, 3, 5, 6, 8, 17]. Post-operative complication and recurrence rates are highly variable in the literature and vary depending on surgeon experience, complexity of the UD anatomy, and surgical technique. These are further discussed below.

Surgical Technique: (Refer to Surgical Videos 15.1 Excision of Skene's Gland Cyst (Zimmern P) and 15.2 Urethral Diverticulum Repair (Zimmern P))

The principles of successful transvaginal urethral diverticulectomy include attempted removal of the entire urethral diverticulum wall or sac, watertight closure of the urethra, multilayered and non-overlapping closure of surrounding tissue with absorbable suture to close dead space, and preservation or creation of continence.

As with all surgical procedures, adequate visualization is important. Use of a headlight and magnification loupes is beneficial in assisting with the necessary fine dissection and reconstruction.

Appropriate, preoperative antibiotic prophylaxis is administered. If the patient has a history of recurrent UTI's, then culture specific antibiotics are given. In women with significant vaginal atrophy, application of topical vaginal estrogen cream for 3–4 weeks preoperatively may substantially improve the quality of the tissues.

The procedure can be performed under general or regional anesthesia. The patient is placed in lithotomy position with standard application of vaginal antiseptic. A 16 Fr urethral foley catheter is placed. Exposure is greatly facilitated with a weighted vaginal speculum and a Scott retractor with hooks.

An inverted "U" incision is marked out along the anterior vaginal wall proximal to the urethral meatus with the limbs extending to the bladder neck (Fig. 15.2a). The limbs of the "U" should be drawn progressively more lateral as the incision proceeds proximally to avoid ischemia of the distal lateral edges of the flap. This inverted "U" incision is preferred by some surgeons over the inverted "T" incision in that it provides superior lateral exposure at the level of the mid-vagina and can easily be extended proximally beyond the bladder neck if needed. Furthermore, the "U" incision minimizes overlapping suture lines at closure which may be associated with postoperative urethrovaginal fistula.

To facilitate dissection, normal saline is injected along the incision line beneath the vaginal wall. Although some surgeons prefer injection of vasoconstrictive agents, we feel that this can mask recognition of bleeding vessels and potentially increase the risk of delayed hemorrhage.

Initial dissection laterally for a few millimeters from the limbs of the inverted "U" incision towards the ipsilateral vaginal fornix aids in demarcation of the flap and later eases closure of the anterior flap. Dissection then proceeds medially in taking down the anterior vaginal wall flap. This dissection is performed in the potential space between the vaginal wall and the periurethral fascia. Counter-traction using Allis clamps on the flap and Debakey forceps on the periurethral fascia is especially useful during this stage to maintain a proper plane of dissection. Great care should be taken to avoid leaving the periurethral fascia on the vaginal wall flap. Blood supply to the vaginal wall flap is derived proximally from the distal branches of the vaginal artery and not the periurethral fascia. The proper plane is identified by noting the glistening internal side of the vaginal wall flap as it is developed. Preservation of the periurethral fascia is important as this will allow a multi-layered closure of deadspace and decrease the risk of diverticulum recurrence and fistula formation post-operatively.

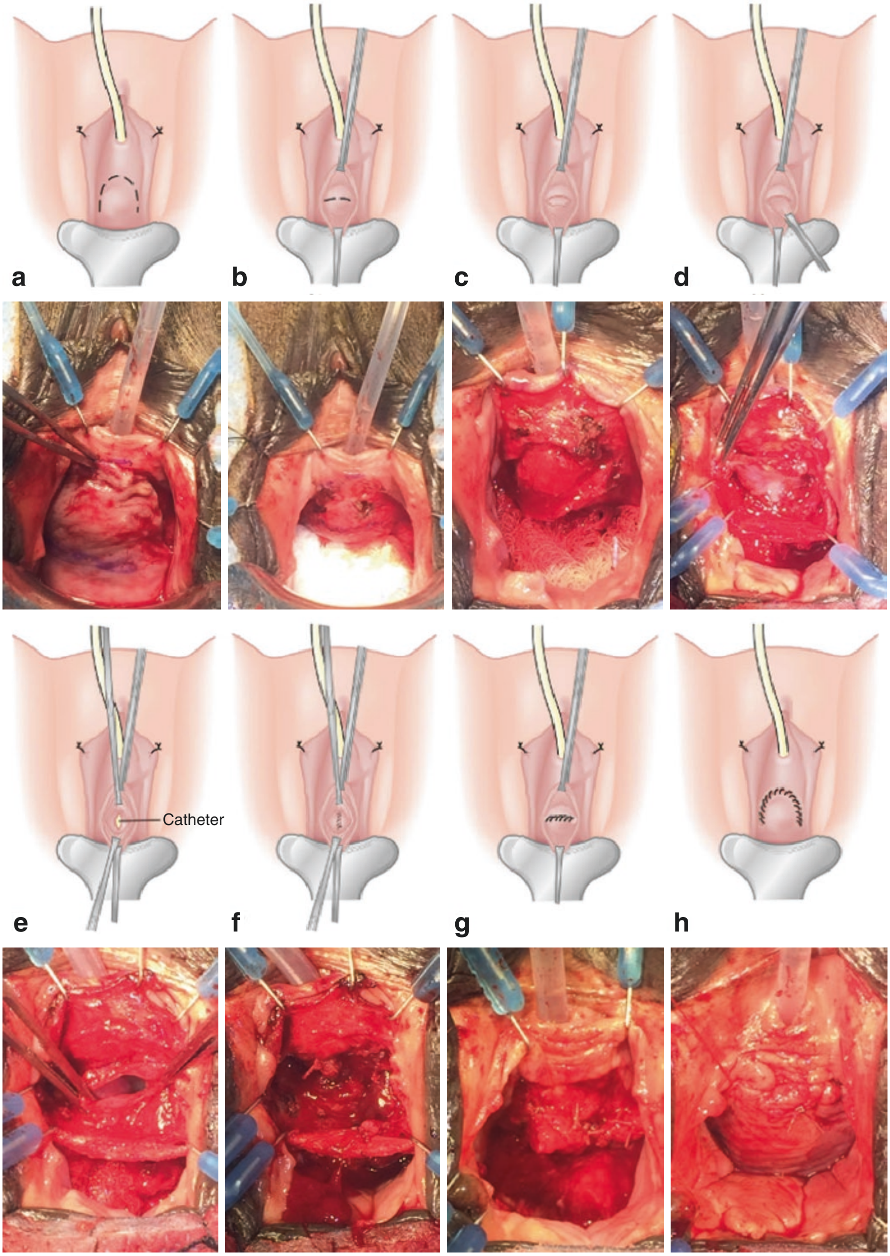

Fig. 15.2 (**a**) An inverted U incision is marked on the anterior vaginal wall. Retraction is established with a weighted vaginal speculum and a Scott retractor with hooks. (**b**) After reflection of the anterior vaginal wall, a transverse incision is made in the periurethral fascia. (**c**) The periurethral fascia is incised and dissected from the underlying urethral diverticulum. (**d**) The diverticular sac grasped and sharply dissected. (**e**) The urethral diverticulum is excised in its entirety. Often, the catheter is seen after complete excision of the diverticulum. (**f**) The urethra is closed with absorbable suture. (**g**) The periurethral fascia is closed with absorbable sutures perpendicular to the urethral closure. (**h**) The anterior vaginal wall flap is reapproximated with absorbable sutures

Once the anterior vaginal wall flap is dissected, it is packed cephalad with moist gauze deep in the vagina. The periurethral fascia is incised transversely directly over the UD and down to the external UD wall (Fig. 15.2b). The proper depth of incision can be difficult to gauge but it is important to make it deep enough to avoid entry into the UD. The overlying periurethral fascia is dissected off of the UD proximally, distally, and laterally (Fig. 15.2c). Once the margins of the UD are delineated, it is dissected back to its origin on the urethra at the level of the ostium (connection to the urethra) (Fig. 15.2d). To the extent possible, the entire mucosalized or epithelialized surface of the diverticulum should be removed in order to decrease risk of recurrence. In some difficult cases, it is technically simpler to open the UD after some initial dissection of the periurethral fascia and then dissect the UD from within the leaves of periurethral fascia. Such patients include those with large, complex diverticula or in diverticula that are friable.

In either case, it is important to identify the ostium of the diverticulum. If the ostium is difficult to locate, a simple maneuver will help to identify it. Once the UD is opened, the location of the ostium is facilitated by infusing saline through an 18 F or larger angiocath placed into the urethral meatus adjacent to the Foley catheter. During rapid infusion the Foley catheter is snugged up against the bladder neck. The urethra will distend upon injection and a jet of saline will be visualized at the ostium.

After excision of the UD, it is not uncommon to visualize the Foley catheter in the urethral lumen through the area that the ostium was removed (Fig. 15.2e). The ostium is then closed in a water tight fashion with 4.0 synthetic absorbable sutures, taking care to include the full-thickness of the urethral wall (Fig. 15.2f). The periurethral fascia is then reapproximated with 3.0 synthetic absorbable sutures in a perpendicular orientation to the urethral closure, taking care to close all dead space (Fig. 15.2g). This will minimize suture overlap and decrease risk of postoperative urethrovaginal fistula formation. Adjuvant flaps such as a Martius flap may be utilized in patients with significant inflammation, poor quality tissue, or when the periurethral fascia is absent or attenuated and a pseudodiverticum is present. This may reduce the risk of wound breakdown and urethrovaginal fistula formation. The anterior vaginal wall flap is then reapproximated with 2.0 absorbable sutures to complete a three-layer closure (four layers if a Martius flap is utilized) (Fig. 15.2h).

When complex urethral diverticula are encountered, such as saddlebag diverticula or diverticula that encircle greater than 75 % of the urethra, it may become necessary to completely transect the urethra to access the dorsal portion of the diverticulum. In these circumstances, excision of the diverticulum with subsequent end-to-end urethral anastomotic reconstruction can be performed [18].

The Foley catheter is left indwelling and an antibiotic impregnated vaginal packing is left following closure.

Post-operative Care Recommendations

Patient are generally discharged home 4–6 h postoperatively with an indwelling Foley catheter. The vaginal packing is removed in the recovery room. Discharge medications include antispasmodics, pain medications and a stool softener. In the setting of prior history of recurrent UTIs, post-operative suppressive antibiotics are also prescribed.

Patients are instructed to avoid anything per vagina for 6 weeks. A VCUG is obtained 10–14 days postoperatively, and if no extravasation is seen, the catheter is removed. If extravasation is noted, the catheter is left in place and VCUG is repeated at 1–2 week intervals until resolution is noted.

Mid and Long Term Results

Transvaginal urethral diverticulectomy is associated with relatively high success rates of between 84–98 % with reoperation rates of 2–13 % after primary repair. Mean follow-up in these studies is between 12–50 months [1, 3, 5, 6]. As expected, studies with longer follow-up report higher rates of recurrence. Patients with multiple diverticula, proximal diverticulum or prior pelvic surgery are more likely to develop recurrence. Early post-operative complications include urinary tract infection (0–39 %), de novo stress urinary incontinence (3.8–33 %), and de novo urinary retention (0–9 %), especially in the setting of concomitant placement of autologous pubovaginal sling [1, 3, 5, 6]. Urethral stricture disease is a late complication reported in between 0–2 % of cases [1, 5, 8]. Urethrovaginal fistulae can also present late in up to 6 % of cases and are associated with infection, non-overlapping suture lines, poor blood supply and poor tissue quality [1, 3, 5, 6, 8, 17]. These can be difficult to manage and often require subsequent surgical intervention in symptomatic patients.

Conclusion

Excision of urethral diverticulum can be achieved safely with reliable outcomes if standard surgical principles are followed. These include removal of the entire urethral diverticulum wall or sac, watertight closure of the urethra, and multilayered, non-overlapping closure. Continence must be preserved or established based on the preoperative picture. The first attempt at repair is the most important when tissue planes are intact, thereby obligating careful pre-operative planning.

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Chapter 16
Urethro-Vaginal Fistula Repair

Dominic Lee

Abstract Urethro-vaginal fistula (UVF) is an uncommon urological condition. Most of the causes are iatrogenic from vaginal surgeries in the developed world [1]. Contributing etiology includes urethral trauma, synthetic mid-urethral slings, urethral diverticulum and radiation. The treatment is often difficult, since the operative field is restricted usually from inflammation and/or scarring and reconstructing the urethra requires not only anatomical restoration but also achieving functional urinary continence.

Keywords Urethrovaginal repair • Urethral reconstruction • Outcomes • Surgical technique • Urethrovaginal fistula • Fistula

Introduction

Urethro-vaginal fistula (UVF) is an uncommon urological condition. Most of the causes are iatrogenic from vaginal surgeries in the developed world [1]. Contributing etiology includes urethral trauma, synthetic mid-urethral slings, urethral diverticulectomy, prolapse repair, vaginal hysterectomy and radiation [2–18]. Given the infrequent nature of the disease and variable clinical presentation, there is no consensus guideline for management. Surgical management can be curative but the treatment is often difficult, since the operative field is restricted usually from inflammation and/or scarring and reconstructing the urethra requires not only anatomical restoration but also achieving functional urinary continence. The surgical approach is variable depending on the etiology, location and the extent of the fistula. Small fistulae maybe amenable to primary closure with or without tissue interposition in contrast to larger fistulae that require major urethral reconstruction with buccal mucosal grafts or rotational flaps, autologous fascial slings and/or tissue interposition with Martius labial fat pad [2–23].

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D. Lee, MD
Department of Urology, St George Hospital, Kogarah, NSW 2217, Australia
e-mail: domi_2020@yahoo.com.au

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Case Report

Mrs. F is a 45-year-old female referred from an outside institution with a history of vaginal pain and urinary incontinence after prior tape and mesh placement 4 years ago. The patient initially had a synthetic transobturator mid-urethral sling (MUS) for stress urinary incontinence (SUI) with concomitant anterior wall prolapse repair with mesh. Following her initial surgeries she developed difficulty voiding with recurrent urinary tract infections. She subsequently had sling division for outlet obstruction. A year ago she developed recurrent SUI and was managed with a retropubic MUS following which she developed severe urinary incontinence and dyspareunia. She was unable to undergo a pelvic exam in clinic due to significant pain. Her voiding cystourethrogram was abnormal and suggestive of a urethra-vaginal fistula, which was confirmed on urethrocystoscopy (Fig. 16.1, Case study 1).

Surgical planning included removal of the synthetic sling from the fistula site and fistula closure with reinforcement of the urethral wall with an autologous fascial sling to not only decrease the risk of fistula recurrence but also to provide support to the damaged sphincteric unit and improve her incontinence.

Clinical Considerations

The clinical manifestation of a significant UVF is quite evident with severe and continuous incontinence being present. Patients with smaller fistula distal to the urinary sphincter complex may present with milder symptoms such as spraying of urinary stream or leakage of unexplained origin. Most often the diagnosis is made

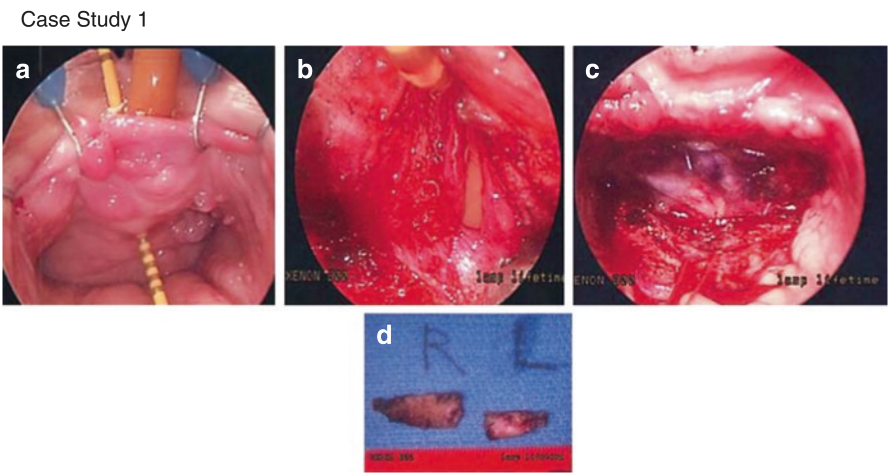

Fig. 16.1 Case study 1. (**a**) Fistula with synthetic, (**b**) Urethral defect after tape excision, (**c**) Primary closure followed by autologous fascia interposition, (**d**) Removed synthetic tape arms

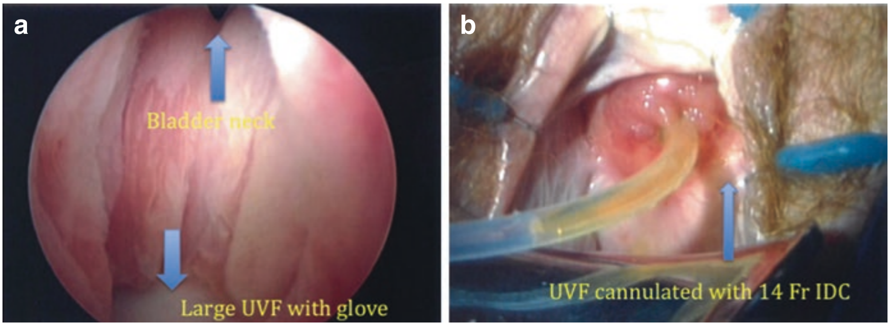

Fig. 16.2 (**a**, **b**) At cystourethroscopy: large urethral defect (glove under urethra) with bladder neck on view. Transvaginal view of large UVF cannulated with 14 Fr Foley catheter

on clinical grounds with a thorough pelvic exam. Confirmation with a voiding cystourethrogram (VCUG) and cystourethroscopy is standard (Fig. 16.2a, b). For smaller fistula, bladder distension with methylene blue dye mixed with saline can assist in the diagnosis. Urodynamics are usually not necessary unless significant irritative voiding symptoms are present.

The repair of UVF, although in principle similar to that of a vesico-vaginal fistula, has a few unique considerations that need to be taken into account. The anatomical closure depends on good tissue quality and tissue interposition, a step which is not always easy given the restricted space for reconstruction. Vaginal scarring arising from previous surgeries and the presence of an incompletely removed synthetic material like in this case can make for a difficult tension-free closure. Recurrent SUI can complicate matters when the urinary sphincter complex is involved. For these reasons, outcomes of UVF cannot be extrapolated from repairs of vesico-vaginal fistula (VVF). Even though the mechanism of injury may be the same, the outcomes can be vastly different. From a technical standpoint, we approached the repair vaginally as this is the most minimally invasive irrespective of the size and location of the fistula. It is important that a wide based U-shaped vaginal flap be raised for 2 reasons: (1) it allows for maximal sling excision in the case of MUS and (2) it allows for sufficient room to accommodate any tissue interposition that may be required in the reconstruction.

Some of the relevant repair issues include:

1. Location of fistula- those distal to the external sphincteric complex may not require a full reconstruction except perhaps a meatoplasty to incorporate the defect. Those involving the mid-urethra are likely to have impaired sphincteric mechanism and hence require a concurrent autologous fascial sling.
2. Size of defect- small to moderate defects may be amenable to primary closure without compromising the caliber of the urethra. Larger or almost total loss of mucosa may require a pedicle flap from the labia or a buccal mucosal graft or other tissue reconstruction.
3. Tissue interposition- this acts as a bolster to the repair and can increase operative success. Tissues that can be utilized include a small fascial patch or a complete

autologous sling. The use of a Martius fat pad is somewhat difficult given its bulky nature and the frequently limited stretching of the vaginal wall to cover over it, and such a tissue interposition does not aid in the continence mechanism.

Informed Consent

Given the scarcity of UVF cases, there is no consensus on management. Hence treatment success is purported by experts in this field in various case-series reports. The main risks of: (i) fistula recurrence, (ii) recurrent stress urinary incontinence, (iii) voiding dysfunction (urethral lumen narrowing, or over-tightened sling when used) (iv) vaginal pain, and (v) dyspareunia precluding return of sexual function needs to be discussed thoroughly as part of the informed consent although data on functional outcomes is lacking in this regard.

Surgical Technique

Given the potential complexity of UVF cases, the operative approach is quite variable. A general outline is provided below.

Procedure

The patient is placed in lithotomy position with Trendelenburg and adequate exposure of the vagina is obtained with a Scott retractor and a weighted speculum. Optimal lighting with headlights and surgical magnifying loupes are recommended.

Cystoscopy

Urethro-cystoscopy with a female scope or flexible scope is first performed to confirm the location of the fistula and exclude occult associated vesicovaginal fistula. The fistula can be cannulated with a fine guide wire to confirm the tract and aid in its dissection.

Harvesting of Rectus Fascia 2 × 6 cm Patch (Refer to Chapter 5 Autologous Fascial Sling for Female Stress Urinary Incontinence)

A short transverse suprapubic incision is performed just above the pubic symphysis and a segment of 2 × 6 cm rectus fascial strip is harvested. The fascial defect is closed with running 0 PDS sutures starting at each corner of the fascial incision with a final knot in the midline. The rectus fascia is secured with running #1 Prolene at each extremity and the midline of the sling is marked for orientation. Such a step is recommended when a decision for a sling for continence and fistula recurrence prevention has been discussed beforehand with the patient and she is aware of the risks of this additional step. A simple fascial patch (2 × 4 cm) may be sufficient to prevent fistula recurrence when the fistula is tiny and there is limited concern for sphincteric insufficiency. A fascia lata harvest can be considered after prior abdominoplasty or suprapubic hernia repair [22].

Cystoscopy with Suprapubic Tube Placement

The bladder is filled to capacity and a large bore suprapubic Foley catheter is placed above and away from the fascial incision used to harvest the rectus fascial sling. The goal of this additional bladder drainage is to allow complete and uninterrupted bladder drainage during the healing phase of the UVF closure.

Anterior Vaginal Flap Advancement

The fistula tract is intubated with a 5-French open-ended ureteric catheter with a 0.038 guidewire. A large anterior vaginal flap is taken down to the level of the bladder neck to expose the urethra, the site of the fistula, and the synthetic mesh. The vaginal flap opening of the fistula tract is oversewn with a fine absorbable suture. Of note the fistula's true defect size is apparent at this stage when there is no residual mesh present and no vaginal tethering.

Transvaginal Synthetic Sling Removal (Refer to Video 19.2: Vaginal Removal of Suburethral Tape (Zimmern P))

The surrounding synthetic sling arms are dissected free from the fistula tract itself to enable fistula tract closure without tension and without risk of reinfection or stone formation over residual sling segments. Removing all mesh fibers from the urethral wall tends to be easier when the mesh material is blue, but much harder when the fibers are clear. Our sling mesh technique has been previously described and published [24]. Once maximal mesh removal is completed the urethra can be gently mobilized laterally to facilitate subsequent non-tension fistula closure. Of note the urethral wall can be vulnerable to tear at this point and caution should be exercised when mobilization is performed.

Urethral Reconstruction with Pubovaginal Sling

Using a 25-French female sound to maintain suitable urethral caliber, the urethral closure of the UVF is performed with running 4-0 or 5-0 absorbable sutures started at each extremity of the urethral defect with a final knot in the midpoint in the midline. Securing each extremity is important to prevent a recurrence at that site. A few interrupted fine absorbable sutures can be further added to reinforce the repair. A watertight test of the repair is performed with an 8-French feeding tube placed alongside the wall of the urethra for flushing and gentle hydrodistension to exclude an occult small

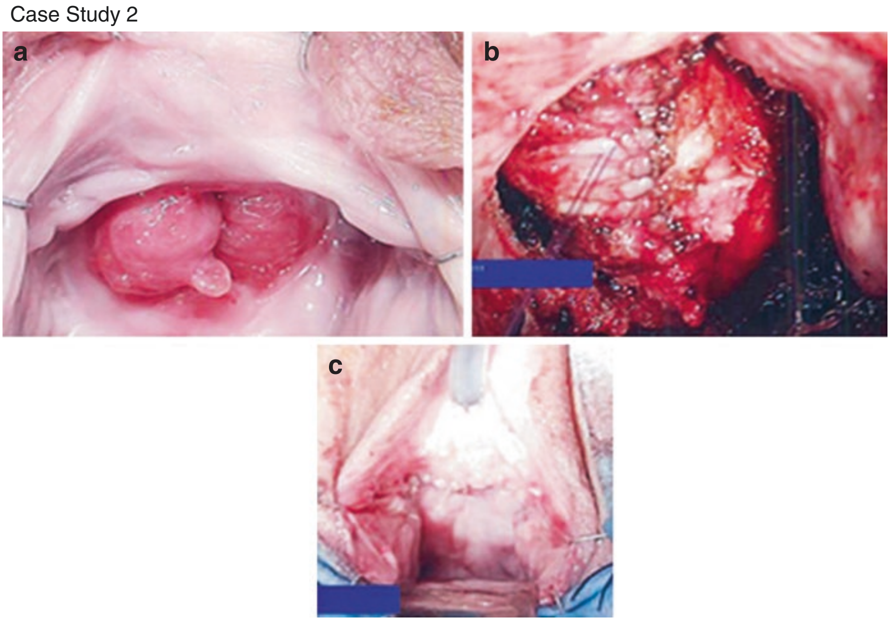

Fig. 16.3 Case Study 2. (**a**) Large UVF (2 cm). (**b**) Primary closure. (**c**) Final result after fascial interposition

leak at the site of repair. A urethro-cystoscope can also be placed at the meatus and the repair site observed while turning the flow on. The previously harvested autologous fascia is positioned underneath the urethral closure. In case of a complete sling repair, the sutures placed at each end of the fascia are transferred suprapubically with a double prong ligature carrier passed under finger control. The fascial patch is then secured to the undersurface of the urethra over the closed urethrovaginal fistula suture line using several interrupted fine absorbable sutures to provide direct apposition and minimize the risk of fluid collection or space expansion there.

The initially raised vaginal flap is advanced to close over the underlying layers of repair and secured in place with running and interrupted absorbable sutures. The suspension sutures at the end of the fascial sling are tensioned loosely leaving about 2 cm between the knot and the fascia and buried in the suprapubic fat. The suprapubic incision is closed in layers. A vaginal pack with antibiotic solution is inserted (Fig. 16.3, Case study 2).

Post-operative Care

It is our practice to recommend both a suprapubic and an indwelling urethral catheter for optimal bladder drainage. Intravenous antibiotics are continued for 24 h post surgery and transitioned to oral daily prophylaxis antibiotic coverage for the duration of the catheter time. Anti-cholinergic medications are supplemented to reduce and/or prevent bladder spasms. A postoperative voiding cysto-urethrogram (VCUG) is performed at 4 weeks to confirm urethral integrity and fistula closure before suprapubic catheter removal. If urinary leakage is present or suspected (vaginal voiding can sometimes confuse the read), the suprapubic catheter is changed and retained on drainage for a further 2–4 weeks, with or without replacing the urethral catheter.

Outcomes

Urethro-vaginal fistula (UVF) is fortunately a rare event in developed countries but still poses a significant challenge to pelvic reconstructive surgeons. The paucity of reported outcomes from surgical management presents a distinct disadvantage as there is no consensus with regards to management to guide both treating physicians and patients. Much of the current treatment and outcome is based on small case series. In contrast to developing countries, obstetric complications are rare and the majority is iatrogenic from vaginal surgery or radiation. In the last decade, there has been an increase in cases related to the use of synthetic mid urethral sling (MUS) [9–17]. This trend is not surprising given the increase in MUS procedures and their complications. The estimated risk for sling erosion from MUS in the general literature varies from 0.07 to 1.5 %. Various attributable factors have been proposed including tissue factors with vaginal atrophy and estrogen deficiency, although technical factors may also be involved such as submucosal placement and excessive sling tension. Some authors suggest that fibrosis resulting from the rejection process around the prosthetic material is a factor in the occurrence of urethral erosion [17]. During MUS removal, a urethral injury can occur and may not be recognized, leading to secondary incontinence from a UVF. This diagnosis is not always easily recognized unless the clinician has a high index of suspicion. Lateral view voiding urethro-cystogram and urethroscopy are both very useful to confirm the UVF diagnosis.

The anatomical closure success rate in the literature varies between 78 and 100 % and the use of tissue interposition for repairs is variable depending on the surgical centers and surgeon's experience [2–10]. Table 16.1 summarizes the major case series of UVF outcomes. In our center, we used mainly autologous rectus fascia as it allows for coverage of the urethrotomy defect and also to prevent secondary SUI associated with intrinsic sphincter defect induced by the UVF. Combination grafts with rectus fascia and MFPG (Martius fat pad graft) interposition is seldom required unless there is a large urethral defect or poor vascularity compromising healing. Okcrim et al. have reported that the major determinant of success in their series was fistula size (>3 cm) and quality tissue interposition [7].

The rate of urinary incontinence post-surgical UVF repair in the absence of a concurrent autologous pubovaginal sling is estimated to be between 20 and 70 % although this is not done in a systematic fashion and it is unclear whether incontinence was directly related to sphinteric deficiency or detrusor overactivity

Table 16.1 Urethrovaginal fistula repairs and outcomes

Study	N	Etiology	Follow-up (months)	Surgery	Outcome				
					Anatomical closure	SUI (cure/improved)	OAB	BOO	Sexual function
Keetel et al. [2]	24	Various	–	UVF repair/Martius	87.5	–			
Blaivas et al. [3]	24	Various	9–84	UVF repair/fascial sling	79.0	79			
Goodwin et al. [4]	8	Various	–	UVF repair	95.0	–			
Lee et al. [5]	53	Various	–	UVF repair/fascial sling	100.0	–			
Hilton et al. [6]	4	MUS	6–48	UVF repair	100.0	100	Y not stated		
Ockrim et al. [7]	9	MUS (7)/Diverticulum (2)	–	UVF/Martius	89.0	–	–		
Puskhar et al. [8]	71	Various	99.6	UVF repair/fascial sling	98.6	92		5.6	
Blaivas et al. [9]	7	MUS	26.0	UVF repair/fascial sling	78.0	71	75	–	
Lee et al. [10]	18	Various	52.0	UVF repair/fascial sling/Martius	95.0	82		5.9	40

[2–10]. Pushkar et al. published a heterogeneous UVF series on 71 women including obstetric cases. Twenty-one women had mean follow-up of 99.6 months and only 9 had MFPG as part of their reconstruction. Primary success was 90 % with a postoperative SUI rate of 52 % (37 patients), all of whom proceeded to an anti-incontinence surgery [8]. Certainly from a reconstructive and functional standpoint, concurrent autologous pubovaginal sling at the time of repair is worth considering, although staged repairs have been performed after successful anatomical closure.

The functional outcome is problematic for the management of UVF. Although most patients are amenable to anatomical closure, the same cannot be said of their functional outcomes. In those with pubovaginal sling placement, success for regaining urinary continence ranged from 71 to 100 % depending on the series with a mean estimate at 85 % [9, 10]. This is comparable to a recent retrospective review of 66 women who underwent autologous pubovaginal sling with rectus fascia after 1 or more failed synthetic mid urethral sling with a cured SUI rate of 69.7 % [25]. Why this is remains debatable but the history of multiple surgeries with cumulative damage to the urethra wall and sphincter complex is most likely the dominant factor. In a recent study, Stav et al. reported a higher incidence of urodynamically-confirmed intrinsic sphincter deficiency (ISD) in patients with repeat synthetic sling (77 patients) as compared to those who had primary slings (1035 patients) (31 % vs. 13 %, $p < 0.001$) suggesting worsened urethral outlet function in those with repeat surgeries [26].

We have recently examined our cohort of UVF outcomes from different etiologies (sling vs. non-sling) utilizing validated questionnaires, which is lacking in most surgical series. Our results from the UDI-6 demonstrated a higher rate of voiding dysfunction in the sling group. This is somewhat alarming that many of these women continued to have symptoms even at a mean of 4 years following their repair. We postulated that these persistent complaints resulted from either undiagnosed bladder outlet obstruction following initial sling placement and/or a direct consequence of the surgery itself, predisposing women to persistent storage and voiding symptoms [10]. Bladder dysfunction despite adequate urethrolysis in patients with bladder outlet obstruction (BOO) following sling surgery may become persistent. Leng et al. have reported their findings of worsened functional outcomes with persistent voiding dysfunction in those with delayed vs. early urethrolysis suggesting that this may be associated with irreversible bladder dysfunction [27]. Similarly Starkman et al. retrospectively evaluated 40 patients undergoing urethrolysis for iatrogenic bladder outlet obstruction following anti-incontinence surgery and reported that overactive bladder symptoms may remain refractory in >50 % of patients despite an effective urethrolysis procedure. These OAB symptoms impacted negatively on quality of life and the impression of improvement after surgery [28].

With respect to sexual function there is inadequate data from lack of assessment in the postoperative setting and further research is necessary to address this issue [10].

Conclusions

With relatively few published series on UVF repair, the available data indicates a high anatomical closure rate, generally supplemented with tissue interposition, and argues for an acceptable functional outcome after a successful UVF repair. However, given the lack of long-term outcome measures in most UVF series, further research is warranted in this field.

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Chapter 17
Vesicovaginal Fistula Repair

Christopher K. Payne

Abstract Vesicovaginal fistula is a rare but feared complication of hysterectomy and other major pelvic surgery in the developed world; it is a devastating complication of obstructed labor in the developing world. This chapter presents a representative case and reviews the preoperative evaluation and surgical technique required to assure successful repair. Vesicovaginal fistula presents an ideal challenge to the surgeon versed in native tissue repairs as traditional, time-honored procedures remain the gold standard.

Keywords Vesicovaginal fistula • Vaginal fistula • Obstetric fistula • Postoperative complication • Labor complication

Case Presentation

A 47 yo G3P3 female presents with abrupt onset of continuous urinary incontinence 2 weeks after a laparoscopic assisted vaginal hysterectomy.

The past medical history is notable for moderate obesity and type II diabetes treated medically for 2 years. The indication for the hysterectomy was menometrorrhagia persisting after thermal uterine ablation. The operative note from the hysterectomy noted a difficult dissection and troublesome bleeding around a small cervical fibroid but no complications were observed. Gross hematuria was noted in the recovery room but cleared overnight. The catheter was removed on postoperative day 1 and the patient was discharged to home.

The patient had a slow but satisfactory recovery in the first week. She then began noting some abdominal bloating and constipation that did not respond to fiber supplement. On the evening of post-operative day 10 she started noticing some low grade incontinence. She awoke that night with her bed saturated and experienced

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C.K. Payne, MD
Emeritus Professor of Urology, Stanford University Medical School, San Jose, CA, USA
e-mail: drpayne@vistaurology.com

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continuous leakage thereafter. On presentation to her surgeon urine was noted in the vagina and a Foley catheter was replaced.

The patient was referred for urologic evaluation. A CT urogram was obtained prior to the visit and showed normal upper urinary tracts with good visualization of the distal ureters and a decompressed bladder with the catheter. The patient reported a 90 % decrease in leakage with the catheter but was still changed 3 damp pads/24 h. Examination revealed laparoscopy incisions healing normally with mild, appropriate tenderness. There was good support for all the pelvic organs. At speculum exam the cuff suture line showed disruption at the left edge with a few millimeters of necrotic tissue. On filling the bladder with methylene blue solution there was immediate appearance of blue fluid from this disrupted area with less than 50 cc infused. Cystoscopy revealed an estimated 6–8 mm fistula just cranial to the intraureteric ridge and slightly to the L of the midline. There was surrounding erythema and some granulation tissue on the L side of the tract.

The patient was scheduled for surgery at 4 weeks post-hysterectomy. A repeat cystoscopic exam/speculum exam showed essentially complete resolution of the inflammatory post-operative changes. A transvaginal repair was performed in two layers with insertion of a suprapubic tube; both the urethral catheter and suprapubic tube were left to gravity drainage. The patient was observed in the hospital overnight and discharged on post-operative day 1 in good condition. The urethral catheter was removed on post-op day 5 due to bladder spasms. A voiding cystogram was performed at 2 weeks after surgery showing no extravasation and complete emptying. The suprapubic tube was removed. At follow-up 6 weeks after surgery the patient reported normal bladder function with no incontinence, urinalysis was negative, post-void residual was 25 cc by ultrasound and exam showed a normal vagina with good depth and caliber. She was encouraged to resume all activities without restriction and a 6 month follow-up check was scheduled.

Surgical Indication

Vesicovaginal fistulae are surgical disorders; there is limited utility of conservative management. When a VVF is suspected in the early postoperative period a Foley catheter should certainly be replaced. Some small VVF will close with additional catheter drainage. Kursh suggested a cutoff of 3 mm and that cauterization to freshen the edges may increase success [1]. Any ongoing leakage despite catheter drainage represents a fistula that will not heal with a catheter. Surgery should be performed as soon as the patient is fully evaluated, inflammation of the local tissues has resolved adequately, and the patient is medically and psychologically ready to proceed. As the bulk of Western VVF occur after abdominal hysterectomy, repair can usually be entertained around 3 weeks post-op based on the appearance of the bladder at cystoscopy and the vaginal cuff by speculum exam. There is no good evidence that additional delay of the repair will improve outcome. Other approaches—fibrin glue, vaginal screw, etc.—are unproven and not in common use. Delay of surgery is primarily indicated for compromised patients--e.g., those who suffered pelvic abscesses and sepsis after hysterectomy—and for patients with prior pelvic radiation.

Counseling

The pre-operative evaluation includes a bladder instillation "blue-dye" test, cystoscopy, speculum exam and whatever contrast imaging is necessary to exclude associated ureteral injury/fistula. In the Western world, this evaluation will generally demonstrate a single fistula of no more than 1 cm in diameter in healthy non-irradiated tissues. If so, the patient can be counseled that a single standard transvaginal operation will be successful in closing the fistula in ≥95 % of cases with an experienced fistula surgeon. In rare cases a urodynamic study may be attempted if there is a strong suspicion of significant associated stress urinary incontinence, bladder outlet obstruction (from prior incontinence surgery), or neurogenic bladder. However, the inherent difficulty of performing and interpreting a urodynamic study in the presence of a bladder fistula limits the utility of such investigations.

An abdominal (including minimally invasive) approach is indicated for simultaneous ureteral injury and VVF, for simultaneous bladder stones or other bladder pathology best addressed from above, and when there is no surgeon with expertise in vaginal reconstruction available. The success rate of an abdominal approach is equal but the early preoperative morbidity is significantly higher. In cases when a VVF occurs in a woman who has never carried a pregnancy and access to the vaginal cuff is difficult an episiotomy will generally provide appropriate exposure of the fistula. The patient should be referred to a specialist with experience in VVF repair and the best approach is that with which the surgeon is most comfortable.

As VVF nearly always arises from surgical injury the medicolegal implications are always in the background. The patient should be counseled about the risks and expected outcome. The goal is to inform the patient and not to frighten a woman who has already been through the trauma of a major operation and that of a major complication, especially given that surgical repair is almost always the logical choice. Provide an outline of the surgical approach and expected post-operative course, the basic risks, and allow generous time for questions. Some patients will need to understand every detail whereas others will only want the essentials. Respect the patient's preference.

The medical risks of VVF surgery are similar to that of other major pelvic surgery but the vaginal approach allows for early ambulation minimizing DVT and pulmonary complications. Blood loss is rarely a clinical issue except when the patient has anemia from blood loss from the prior operation (hysterectomy or other). Urinary tract infection and urosepsis are of somewhat greater concern than in most elective urinary tract surgery because the patients will generally not have sterile urine, even when pre-operative antibiotics are used. However, this is an uncommon complication with slightly more aggressive prophylactic antibiotics.

The most common specific complication of VVF repair is ureteral injury. As mentioned, ureteral anatomy must be evaluated before surgery and an abdominal approach selected if ureteral reimplantation may be required. While intestine can be stuck to the vaginal cuff bowel injury during VVF is a rare complication. The bottom line is that the primary "complication" of VVF repair is failure/persistent fistula.

These observations/recommendations do not apply to patients with complex fistula—those resulting from radiation therapy in the Western world and obstetric fistula in the developing world. The approach to counseling and treatment of these patients is beyond the scope of this chapter (interested readers may refer to a special supplement of the International Journal of Gynecology & Obstetrics in 2007, Volume 99 dedicated to obstetric fistula to begin exploring the many issues involved). Suffice it to say that they should only be cared for by surgeons with specific experience and expertise in the area.

Transvaginal Technique for Simple Fistulae (Refer to Video 17.1 Vesicovaginal Fistula Repair (Lee D, Dillon B, Zimmern P))

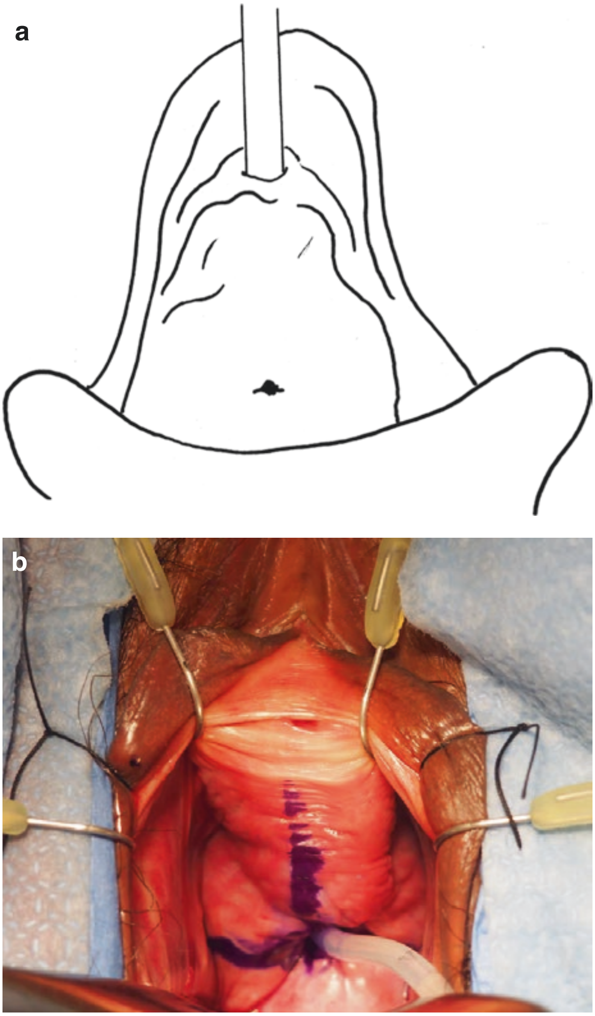
Preparation—

- Antibiotics: No fistula patient has sterile urine. Suggest full loading dose of broad spectrum antibiotics (ampicillin + gentamicin, or similar) followed by one dose after surgery.
- Bowel prep: unnecessary for simple fistula cases where bowel function is normal
- Positioning: high lithotomy
- Instruments/equipment: Headlight, Ring retractor, fine Metzenbaum scissors and "full curve" or "right angle" scissors, fine smooth forceps for handling the bladder, sturdy toothed forceps for the vagina.
- Cystoscopy to evaluate fistula, place ureteral catheters if fistula too close to ureteral orifices (<5 mm). If preoperative upper urinary tract imaging has not been performed or was inadequate to rule out associated ureteral injury then retrograde pyelography is performed at this point.
- Place suprapubic tube (not mandatory but provides more secure drainage, allows earlier removal of urethral catheter when bladder spasms are problematic, and facilitates a post-operative voiding cystogram
- Use a weighted speculum and ring retractor with hooks to maintain exposure and advance the fistula closer to the introitus (Fig. 17.1a).

Fistula closure—

- Define the fistula by blue dye test if not done prior to OR. It is imperative to confirm that there is only a single tract and that it is well visualized.
- Dilate the tract and place a Foley catheter into the tract. This is accomplished using small curved male sounds. Although the tissues of the apex often have

Fig. 17.1 (**a**) Fistula exposure. (**b**) Foley catheter within fistula can apply traction. Note the inverted T incision



limited mobility due to scarring, the Foley catheter can provide some useful traction, especially during the initial dissection (Fig. 17.1b).

- Inject vasoconstrictor (epinephrine or vasopressin) around the fistula and make a circumscribing incision (Fig. 17.2).
- From the initial circumscribing incision extend an inverted T incision to the lateral side walls and anteriorly as far as needed to achieve good mobilization. Many other authors suggest creating a distal U flap and a proximal inverted U flap. While this works well for the typical simple fistula the author has found it to be cumbersome for larger and more complex fistulae. The secret of adequate mobilization is the lateral dissection; this is emphasized and facilitated by the inverted T incision.

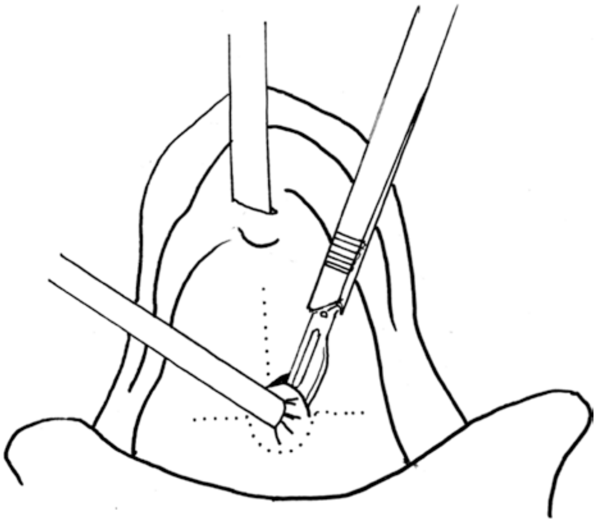


Fig. 17.2 Circumscribing incision of fistula tract

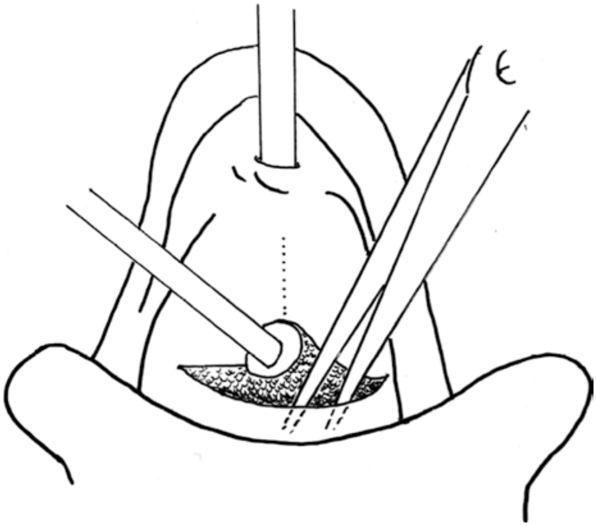


Fig. 17.3 Dissection of proximal flap

- Dissect the proximal flap back to the apex of the vagina (Fig. 17.3)
- Dissect the two anterolateral flaps to achieve a minimum 2 cm radius around the tract (Fig. 17.4). The dissection must extend far enough so that the fistula tract can be closed with absolutely no tension. If there is any question, extend the dissection!
- Evaluate the edges of the fistula. If there is excessive scar tissue it should be trimmed. There is no evidence, however, that complete excision of the tract back to fresh tissue improves outcome; the author strongly counsels against this approach which tends to increase the size of the fistula and the blood loss.

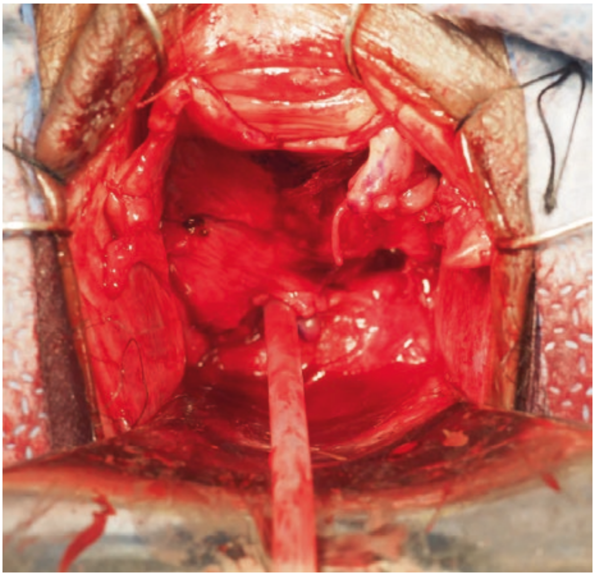


Fig. 17.4 Proximal flap is dissected to the apex and lateral flaps to the pelvic sidewall. Observe the 2 cm radius around the fistula

On the contrary, the epithelialization of the edges provides a strong site for suture placement and decreases pull-through.

- Close the fistula with a single layer of full-thickness, interrupted absorbable sutures (3–0 Vicryl or similar), 4–5 mm back from the edge and 5 mm apart. Start with the stitches at each end of the repair taking care to ascertain ideal placement with secure placement including bladder mucosa (Fig. 17.5a, b). The closure is typically transverse but should be oriented in the direction of minimal tension.
- Repeat the blue dye test after this first layer of suture. The repair should be watertight to 200–250 cc. If not, add additional suture or take the repair down and redo. When the first layer is watertight there is rarely a failure. If the first layer is not watertight there is a high rate of recurrence regardless of catheter drainage, additional layers, or tissue interposition.
- For the typical small fistulae seen in the Western world the author will then perform a second layer bringing the perivesical fascia over the closure. For the larger fistula seen in the developing world this is rarely possible; experience with such patients has informed us of the critical importance of the first layer. It has been argued that a second layer should be perpendicular to the original suture line ("non-overlapping"); while this is reasonable when the mobility of the tissues allows it is the author's experience that creating a second layer under tension is much worse than not having one at all. So a simple overlapping second layer is sometimes the best compromise. Again, the key to success is a watertight primary repair.
- In the uncommon case when the integrity of the repair is in question—persistent leak with first layer, repair under tension—tissue flap intervention can be

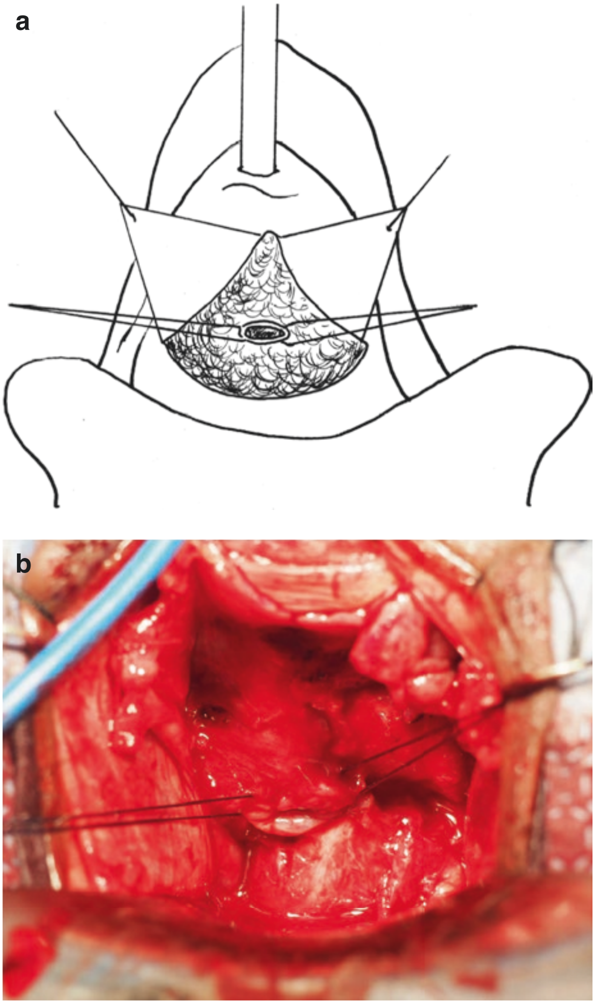


Fig. 17.5 (**a**) Beginning fistula closure. (**b**) Full thickness sutures are placed at each pole of the fistula closure, taking care to include the bladder mucosa. The orientation is chosen so as to optimize a low tension closure. Interrupted sutures are then continued to complete the closure

added. Most surgeons agree that tissue interposition should also be used routinely for those patients with prior radiation therapy even in the absence of visible radiation effects. There is no evidence that routine use of tissue interposition otherwise improves results. Traditionally the flap is obtained from the labial fat pad (Martius) which is a reliable source. However, the author finds the peritoneal flap described by Raz to be equally available and much quicker to harvest.

- Vaginal skin flaps are then inspected and any tissue of questionable viability is excised prior to skin closure. The posterior flap can generally be advanced to completely cover the repair. In typical cases this is the third layer (1. Primary repair, 2. Fascial reinforcement, 3. Skin) (Fig. 17.6).

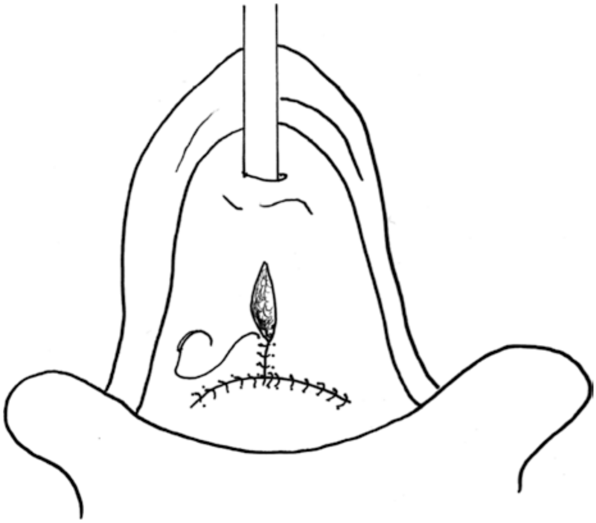


Fig. 17.6 Skin closure. In many cases the posterior flap can be advanced much farther anteriorly when there would otherwise be inadequate skin to close without tension. Always debride any questionably viable skin edges

Transabdominal Approach

The transabdominal technique is indicated when ureteral reimplantation is (or may be) required and when there is no surgeon available with adequate vaginal reconstructive experience. The early morbidity—pain, bladder spasms, blood loss, etc.—is greatly increased with an abdominal approach, particularly with the classic O'Connor transvesical technique [2]. In some cases it may be possible to expose and repair the fistula using an entirely extravesical technique which appears to moderate the morbidity.

Tissue interposition is mandatory with the abdominal approach. This should be considered in planning the operation. An omental flap is most commonly employed and a vertical midline incision is required to be certain of being able to access the omentum. A local peritoneal flap can often be mobilized to cover the repair when the omentum is not available.

Minimally invasive surgical approaches (both laparoscopic and robotic) have been reported with good success rates [3]. As the next generation of surgeons performs more and more operations with MIS techniques the morbidity of such may prove to compare well with the standard vaginal approach.

Post-operative Care

Ambulation is expected on the day of surgery and the diet is advanced as tolerated. Complete urinary diversion by catheter drainage is essential. It is important to avoid bladder spasms which may put undue tension on the repair; bladder spasms may be very problematic with the transvesical abdominal approach. The author routinely uses oxybutynin ER 10 mg daily (or a similar anticholinergic) up until the day prior to planned catheter removal (along with a fiber supplement to prevent constipation). Hydration is emphasized to keep the urine dilute and free-flowing, avoiding formation of blood clots that may obstruct the catheter.

The duration of catheterization should be commensurate with the difficulty of the repair and expectation of success. A randomized controlled trial of "simple obstetric fistula repair" (a "simple" obstetric fistula is still considerably more difficult than a typical post-hysterectomy fistula) found no difference in success rate with 1 vs. 2 weeks catheterization (Engender Health Study) [4]. The author typically schedules follow-up at 10–14 days post-op with a voiding cystogram for straightforward cases and at 3 weeks for complex cases. An empiric course of antibiotics is prescribed to begin the day prior to planned catheter removal.

The suprapubic tube is only removed when the cystogram shows complete healing of the fistula and adequate bladder emptying. If there is even contained extravasation at the fistula site an additional 1–2 weeks of catheter drainage is recommended. If the fistula is closed but the patient is not emptying well the suprapubic tube can be plugged for home voiding trial and removed when residuals are consistently low. Bladder dysfunction after hysterectomy is not rare and poor emptying may contribute to breakdown of an initially successful closure.

Results

Almost all post-hysterectomy VVFs should be successfully closed in a single repair; case series typically show 90–100 % success with both vaginal and abdominal techniques. Our knowledge of the long-term effect of a VVF on bladder and sexual function is woefully inadequate. It is the author's experience that nearly all patients who had normal bladder function prior to the hysterectomy and who undergo a successful vaginal repair are able to regain normal bladder function rapidly after catheter removal. Overactive bladder symptoms are much more common after transvesical, transabdominal repairs but generally respond to standard therapies. One paper investigating these issues showed no differences between urinary outcomes in patients undergoing a single vs. multiple repairs but did suggest impaired sexual function for those undergoing abdominal repair or multiple repairs [5]. More research in this area would be welcome.

Summary

A VVF is a devastating complication of pelvic surgery, particularly hysterectomy. However, early repair by an experienced surgeon will minimize the morbidity and almost always produce a good functional outcome for the patient. Meticulous attention to surgical technique with adequate mobilization and achieving a watertight closure is the key to success.

Acknowledgements Thanks to Jeannette M. Potts, MD for her original artwork.

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Chapter 18
Martius Labial Fat Pad procedure

Dominic Lee and Philippe E. Zimmern

Abstract The Martius labial fat pad (MLFP) is a pedicle graft of fatty tissue which is harvested from the labia majora. The procedure is rather simple, takes typically 15' or so, and produces a well vascularized fat pad of variable length (average 8–12 cm) based on where it will ultimately be positioned. This fat pad can be used as an interposition layer during a variety of vaginal procedures. We describe a typical indication for MLFP, then the technical steps at length. Complications are infrequent. We present the limited information available from the literature

Keywords Martius graft • Female • Surgical reconstruction • Vesico-vaginal fistula • Urethrolysis

Case Presentation

A 62 year old G2P2 woman presents with a long history of chronic retention after a Burch suspension (at time of an abdominal hysterectomy for uterine fibroids) performed 10 years ago necessitating daily use of intermittent catheterization. She is able to void sometimes but has to stand up or lean forward to do so. She is having frequent urinary tract infections and would like to explore the possibility of taking down her Burch procedure with the hope of voiding again. She was voiding normally before the procedure. She is worried that intermittent catheterization may become more difficult as she ages. A urodynamic testing was obtained which confirmed a very obstructed voiding pattern with elevated voiding pressures. Her voiding cystourethrogram confirmed a trabeculated bladder with 500 ml capacity, no reflux, a very much overcorrected fixed urethra with a negative urethral angle at rest

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D. Lee, MD
Urology, St. George Private Medical Centre, Sydney, NSW, Australia
e-mail: domi_2020@yahoo.com.au

P.E. Zimmern, MD (✉)
Department of Urology, UT Southwestern Medical Center, Dallas, TX, USA
e-mail: philippe.zimmern@utsouthwestern.edu

P.E. Zimmern, E.J.B. De (eds.), *Native Tissue Repair for Incontinence and Prolapse*, DOI 10.1007/978-3-319-45268-5_18

of 30°, a mild cystocele, and a large post-void residual (>300 ml). Her evaluation for recurrent urinary tract infections was negative with normal upper tracts by renal ultrasound and normal cystoscopy when she was not clinically infected.

A transvaginal urethrolysis was discussed. Risks of residual obstruction, persistent voiding dysfunction, and secondary incontinence were all discussed. To decrease the risk of secondary re-scarring in the retropubic space, the use of a MLFP was suggested to fill the space around the urethra.

Indications

MFLP has been used in the repair of uro-genital fistulae (vesico-vaginal fistulae [1, 2], less frequently in urethrovaginal fistulae [3] because of limited space beneath the vaginal flap) or after the closure of a recto-vaginal fistula [4–6]. It has also been used after the repair of an iatrogenic bladder injury [7], especially after a vaginal hysterectomy if the defect was large and the vascularization uncertain. Other indications include after an extensive urethral diverticulum repair (for example multi-loculated horseshoe diverticulum) [8, 9] when the repair layers are tenuous, a urethral or bladder defect after a mesh sling or a mesh for prolapse removal procedure as a prevention against a secondary fistula, or a trans-vaginal bladder neck closure in neurogenic patients with a completely destroyed outlet to reinforce the closure (See surgical Videos 18.1 and 18.2). Rare indications have also been reported such as after a vaginally placed artificial urinary sphincter to avoid a secondary exposure, after a neo-bladder-vaginal fistula repair [10, 11], or for vaginal reconstruction with skin attachment in case of narrow vagina or vaginal wall closure defect [12, 13].

Surgical Technique with Film [14] (Refer to Video 18.1 Martius Labial Fat Pad Graft (Zimmern P, Lee D, Lemack G))

As seen in the movie, the MLFP was harvested after the completion of the trans-vaginal urethrolysis when the presence of a dense retropubic scarring was confirmed justifying this added procedure (Image 18.1). There are times when the MFLP is harvested first to avoid additional retropubic or vaginal bleeding during the time it takes to do this MFLP procurement. The prompt placement of the MFLP can fill the space where the bleeding takes place. This is a logistic detail which needs to be discussed for each case individually.

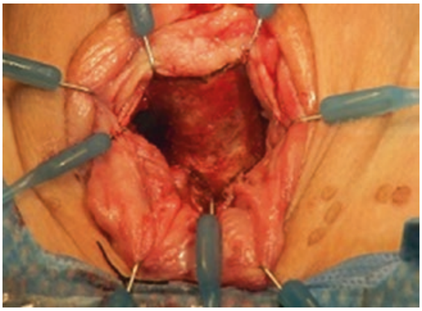

Image 18.1 Completed urethrolysis

Image 18.2 Right labia incision

Step 1: A vertical incision (average 8 cm) is made over the labia majora from the level of the mons pubis down towards the level of the fourchette (Image 18.2). The length of the incision depends on the length of fat pad required. It can always be extended upwards towards the mons pubis to gain more length. Although some authors recommend the use of local anesthetic agents to diminish post-operative pain and potentially long-term chronic labial pain, this has not been our practice to do so.

Image 18.3 Fat pad exposure

After placement of the LoneStar retractor to hold the skin edges open (Image 18.3), the dissection is started on each side to separate the labial fat pad in the center of the incision from the skin edges. It is important to leave enough fat underneath the skin on each side to avoid labial distortion, especially medially (Image 18.4).

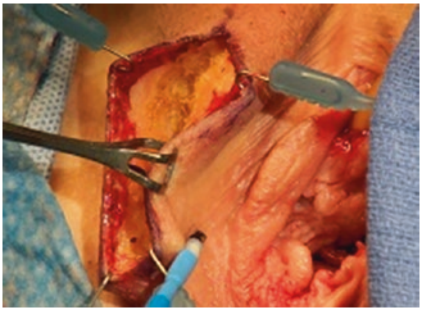

Image 18.4 Avoid labial distortion

Step 2. The labial fat pad can be gently grasped with a Babcock clamp (Image 18.5) and mobilized on an inferior pedicle supplied by a postero-inferior branch from the external pudendal artery. Although not our preference, a superior blood supply can also be considered. The dissection is continued medially first, with attention to keep sufficient fat attached underneath the medial

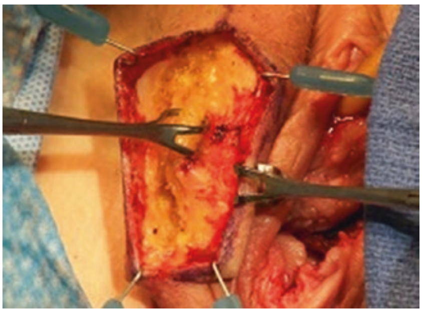

Image 18.5 Mobilize MLFP

labial edge (Image 18.6 and 18.7); then it proceeds superiorly aided by a small retractor which exposes the tip of the fat pad at the mons pubis. When a sufficient length has been freed, the fat pad is divided superiorly (Image 18.8). This can be done by using the bovie cautery or suture ligating the pedicle when larger blood vessels are present.

Image 18.6 Complete medial flap mobilization

Image 18.7 Continued upward mobilization MFLP

Image 18.8 MFLP superior part divided

Step 3. Once divided at its extremity, the fat pad needs to be freely mobilized. To achieve this goal, the dissection then extends in depth until reaching the white shiny fascia covering the underlying ischiocavernosus and bulbocavernosus muscles (Image 18.9). There is no need to go deeper into the muscle. Next the dissection of the back side of the fat pad allows its gradual freeing and elongation (Images 18.10 and 18.11). While progressing, one must keep in mind to preserve a broad base inferiorly and avoid damaging the lateral branch of the obturator artery to preserve the fat pad vascularity.

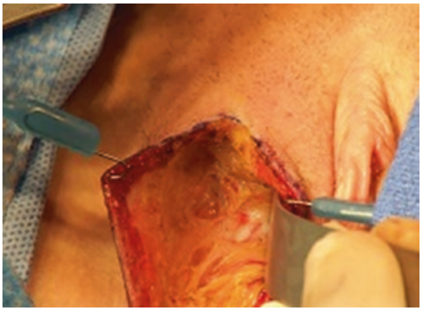

Image 18.9 Identify bulbocavernosus muscle

Image 18.10 Begin flap elevation

Step 4. After completing the fat pad mobilization, the extremity of the flap is secured with a figure of eight absorbable suture (Image 18.12) which will allow its transfer alongside the vaginal wall and then anteriorly around the urethra. The MFLP can be measured (Image 18.13). Then, a vaginal tunnel is created with long Metzenbaum scissors (Images 18.14 and 18.15) and/or a ring forceps beneath the ipsilateral vaginal wall. This tract is widened to accept at least two fingers to avoid compressing the fat pad and compromising its blood supply. Once tunnelled (Image 18.16), the suture

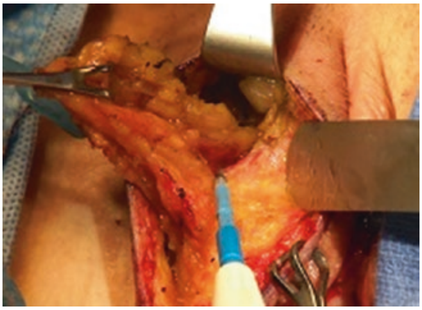

Image 18.11 Release medial tethering

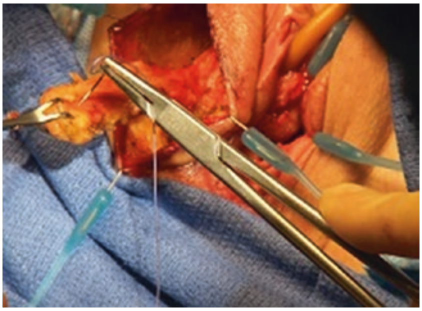

Image 18.12 Secure flap extremity with holding suture

Image 18.13 Measure flap length

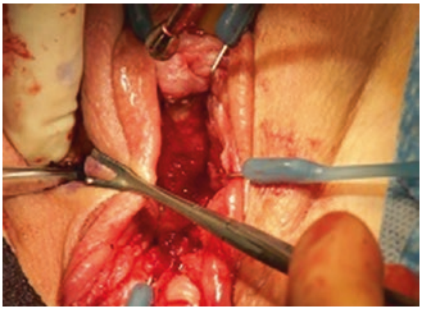

Image 18.14 Tunnel flap created

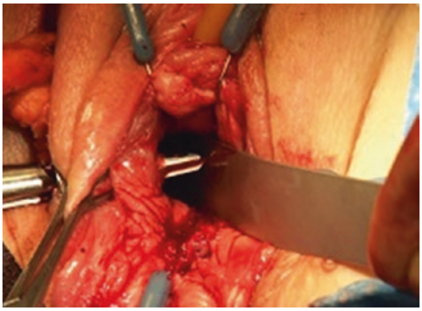

Image 18.15 Widening of tunnel to accept flap

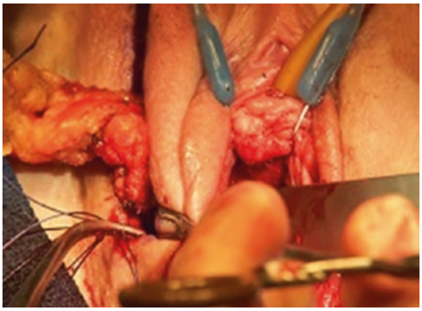

Image 18.16 Flap tunnelled with clamp alongside vaginal wall

at the end of the fat pad graft is grasped and the MFLP is delivered in the vagina (Image 18.17a, b). Next, with a curved short Satinsky clamp (Image 18.18), the suture at the end of the MFLP is grasped (Image 18.19) and the MFLP is pulled from right to left in front of the urethra and bladder neck area (Image 18.20) to serve as an interposition layer so that the urethra does not get attracted back by scar tissue to the back of the pubic bone.

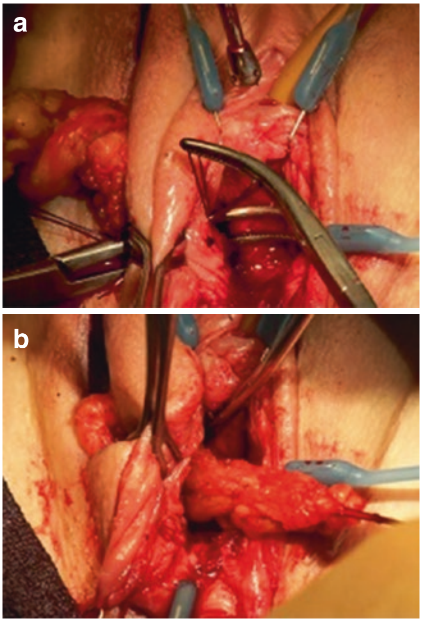

Image 18.17 (**a**, **b**) Flap tunnelled and delivered vaginally

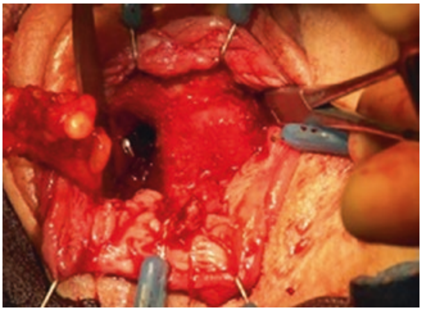

Image 18.18 Satinsky clamp around urethra to transfer MFLP

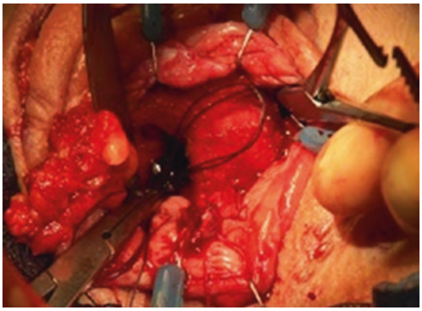

Image 18.19 Flap placed around urethra

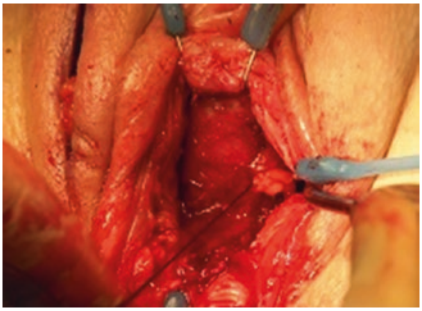

Image 18.20 Final flap position anterior to urethra and bladder neck

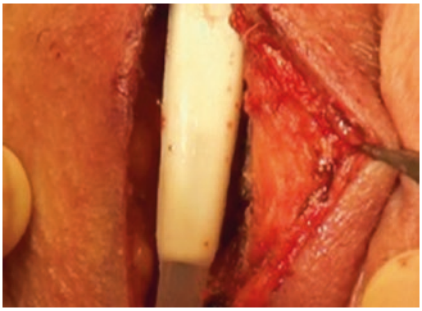

Image 18.21 Labial incision drain

Step 5. The labial incision is closed in layers over a small labial drain to prevent a secondary hematoma (Image 18.21). This small drain is usually removed within 24 h postoperatively (Image 18.21). The vaginal incision is now closed with running sutures and the vagina is packed at the end (Image 18.22). A tight dressing is placed over the labia to avoid labial swelling post-operatively. We usually cover the skin incision with a vaseline gauze covered by fluffs and an ABD dressing secured with paper or silk tape over the fluffs to maintain them in place. Ice packs can be used as well.

Image 18.22 Final incision closure with no labial deformity

Complications

Hematoma or Seroma

One of the benefits of this graft as a tissue interposition is its vascularity, but this also contributes to the risk of bleeding and hematoma formation. Thus, maintaining and ensuring achievement of hemostasis at the site of harvest as well as on the pedicle graft itself is of utmost importance in preventing hematoma formation. In addition to meticulous hemostasis at the time of surgery, the use of a drain (Penrose or Jackson-pratt) postoperatively may also decrease the likelihood of hematoma formation.

Typically, seromas and hematomas when they occur will resolve on their own over time without any intervention.

Infection

The incidence of wound infection after MFLP is reportedly very rare. The use of a drain postoperatively may decrease the risk of infection as may the use of broad spectrum peri-operative antibiotics. In case of labial erythema and/or purulent drainage from the incision, prompt drainage is indicated.

Pain and/or Numbness

Some pain is expected in the immediate postoperative period and will usually last a few days until the drain is removed and the swelling decreases. Ice packs, loose underwear, and avoiding direct contact with a catheter (suprapubic tube can be useful to avoid a catheter rubbing over the labia initially) can be suggested initially. Chronic pain from a possible nerve injury during the MFLP resulting in discomfort all the times or with intercourse, and/or excessive labial sensitivity is a rare complication as well but can be very debilitating [9].

Sexual Dysfunction

Sexual dysfunction secondary to a MFLP is a complex matter because this interposition is used in re-operative situations where the vaginal wall can already be compromised by scar and some element of pre-existing denervation. Theoretically, it should add better blood supply and lessen the re-scarring process, thus preventing or aiding in correct any degree of dyspareunia. However, the baseline data on patient's sexual function or dysfunction is seldom available, which complicates the post-operative determination of its causal participation in any remaining elements of sexual dysfunction.

Labial Distortion

The displacement of this fat pad from the labia majora can raise concerns for labial asymmetry or distortion later on. A fairly lateral incision to avoid distorting the medial aspect of the labia majora and preservation of enough fat underlying the skin edges are practical technical solutions to avoid a distorted and retracted labia majora in the long-term (Fig. 18.1).

Results from Our Recently Reported Series

Between 1996 and 2011, 122 women were entered into a prospective surgical database and met inclusion criteria, with 25 excluded for lack of follow up details beyond 6 months or death. Patients were contacted by mailed survey and/or

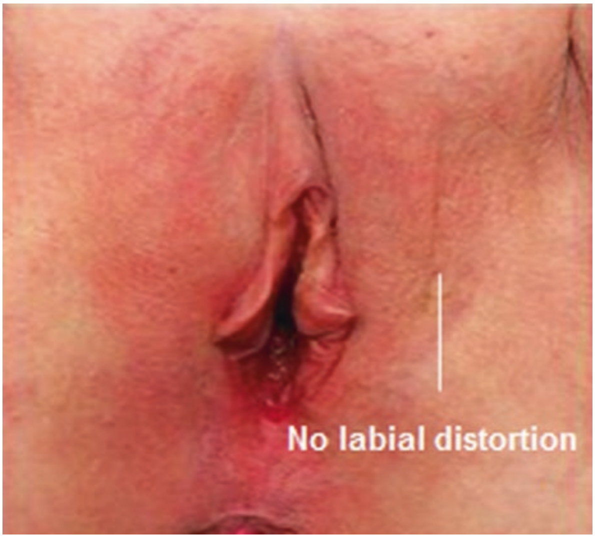

Fig. 18.1 Healed labia 1 year later. Discrete scar with no bothersomeness reported by patient, including with sexual activity

structured telephone interview with Quality of Life score, validated FSFI questionnaire and a specific question addressing Martius harvest site i.e. 'pain or numbness in labia'. Mean age was 54 years (19–78), with mean BMI 28 (19–43) and mean follow-up of 85 months (6–202). Indications for MLFP included vesicovaginal fistula (20), bladder outlet obstruction requiring urethrolysis (60) and others (17) (bladder neck closure, urethral diverticulum, excision of duplicate urethra). No peri-operative complications were recorded. In this long-term outcome series, 79/97 women (81 %) had normal labial sensation at last visit, with 5 (5 %) reporting some pain and 13 (14 %) variable degrees of labial numbness. Of the 29 women reporting sexual activity, only 26 (27 %) responded to FSFI questionnaires with equivalent sexual function outcomes between all 3 surgical groups [9].

Conclusion

Harvesting a MFLP is part of the armamentarium of the pelvic reconstructive surgeon. It is a very traditional procedure which has a multitude of indications. In our experience, the morbidity, both early and late, is very limited with rare labial distortion, permanent pain, or impact on sexual function. However, although uncommon, these complications should be clearly explained and discussed pre-operatively with the patient. And despite these recognized limitations, MFLP remains a very versatile and useful native tissue interposition graft which merits consideration in specific instances.

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Chapter 19
Intraoperative Complications of Vaginal Surgery

Michael J. Belsante and Philippe E. Zimmern

Abstract Pelvic reconstructive surgery is not devoid of complications, some minor and some more serious. This chapter covers the most common injuries ranging from positioning nerve damage to bladder, ureteral, rectal, or urethral injury. A movie on the vaginal repair of a bladder injury during a laparoscopic vaginal hysterectomy illustrates some of the key steps to achieve a complete repair. The vaginal surgeon should be attentive to pre-existing factors that may place the patient at risk and have a game plan to deal with any complications should they arise.

Keywords Vaginal surgery • Complications • Bladder injury • Ureteric injury

Introduction

As a matter of perspective on this topic, one needs to appreciate that up to 33 % of women undergoing pelvic reconstructive surgery will have some form of peri-operative complication [1]. Strikingly, approximately 70 % of iatrogenic injuries to the genitourinary tract are not recognized at the time of operation [2]. Such injuries can contribute to long-term sequelae including ureteral obstruction with loss of renal function or fistula formation. In fact, in the US today, it is estimated that surgery for benign gynecological conditions is responsible for 74 % of genitourinary fistulas and over 90 % of vesicovaginal fistulas [3]. Although vaginal procedures are attractive to the urologist and urogynecologist to correct stress urinary incontinence (SUI) and/or pelvic organ prolapse (POP) because of easy access and low

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M.J. Belsante, MD (✉)
Urology, Urology Associates, Nashville, TN, USA
e-mail: mjbelsante@ua-pc.com

P.E. Zimmern, MD
Department of Urology, UT Southwestern Medical Center, Dallas, TX, USA
e-mail: philippe.zimmern@utsouthwestern.edu

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morbidity, specific risk factors such as previous pelvic surgery, obesity, pelvic inflammatory disease, endometriosis and pelvic irradiation can result in decreased organ mobility and impaired healing should an injury occur [4]. In a large retrospective series of women who underwent surgery for POP with or without hysterectomy, short term complications including bleeding, infections, surgical injuries, pulmonary complications, and cardiovascular complications were seen in 14.9 % of patients and were associated with medical comorbidities and hysterectomy (OR 11.2 and 1.5 respectively) [5]. The awareness of these risk factors for GU injury, as well as the adoption of a few simple intraoperative precautions can aid in the prevention and eventual early recognition of perioperative complications.

Therefore, this chapter will focus on the intraoperative recognition and management of injury to the bladder, urethra, ureters and rectum. Additional suggestions and recommendations for avoiding and managing the more common pitfalls encountered during transvaginal procedures, such as bleeding and lack of adequate exposure will also be presented.

General Preoperative Considerations

A number of preventative strategies aimed at minimizing the chance of complications should be employed when performing vaginal surgery. If surgical misadventure does occur, then these simple precautions should allow the problem to be handled in an expeditious fashion (Table 19.1).

The general medical condition of the patient must be taken into account when planning any elective surgical procedure. Consultation and clearance should be sought from anaesthetic and medical services whenever the patient has a condition which may decrease her ability to tolerate an anaesthetic or may adversely affect the surgical outcome. In some situations, the patient's general health may influence the

Table 19.1 Preoperative considerations in transvaginal surgery

General considerations	Vaginal surgery considerations
Health and ability to tolerate anaesthetic	Enemas to clear the rectum
Jehovah's Witness with refusal of blood and blood products	Antibiotic douches to decrease vaginal bacterial count
Preoperative antibiotics	Deep vein thrombosis prophylaxis
Discontinuation of anti-platelet agents and/or anticoagulants	Positioning in dorsal lithotomy position with proper padding
	Perineal retractor
	Labial retraction sutures or Lonestar retractor
	Headlight
	Trendelenburg position
	Continuous bladder drainage
	Vaginal packing

type of anaesthetic administered (spinal vs. general), or in the case of a Jehovah's Witness, may dictate the nature of the resuscitation which can be employed in the intraoperative and postoperative periods. Some have reported on the use of preoperative EPO administration in Jehovah's Witnesses or postoperatively in those with acute blood loss anemia [6, 7].

Antibiotic prophylaxis with a 1st or 2nd generation cephalosporin, aminoglycoside plus metronidazole, or clindamycin should be administered to decrease the likelihood of postoperative infection [8, 9]. Surgical Care Improvement Project (SCIP) protocols have been implemented in many institutions. In our institution, hysterectomy/vaginal surgery patients should receive cefoxitin, cefazolin, or Unasyn as prophylactic antibiotics, or, in the case of concomitant bowel surgery, cefoxitin, Unasyn, or ertapenem. Several studies have demonstrated that perioperative cleansing of the vagina with saline can increase the risk for infection, and no studies have demonstrated the effectiveness of douches or other method of vaginal cleansing for prevention of infection [10, 11]. There is no consensus regarding method of prophylaxis for deep-vein thromboembolism (DVT). Some advocate for prophylaxis in the form of low-dose subcutaneous heparin given before and every 12 hours after surgery [12] until the patient is ambulatory, as well as intermittent pneumatic calf compression devices (SCDs) employed in the same manner [2, 12–14]. Multiple studies have shown the rate of DVT after pelvic reconstructive surgery to be low, between 0.3 and 2.2 % [15, 16]. In a prospective randomized trial assessing SCDs versus heparin, the rate of DVT was equivalent in both groups [17].

Every effort should be made to minimize the risk of bleeding. Antiplatelet agents such as aspirin should be discontinued at least 7–10 days before surgery. Patients on long-acting anticoagulants should cease taking these medications until their coagulation parameters return to the normal range. If the risk of a thromboembolic event is too high to allow discontinuing anticoagulation, they should be switched to a short-acting agent such as low-molecular weight heparin which can be stopped 18 to 24 hours before surgery and resumed fairly promptly afterwards. In patients for whom a heparin drip is required, the drip can be stopped 6 hours prior to surgery.

Candy-cane or Allen stirrups can be used to place the patient in the dorsal lithotomy position. Potential nerve injuries include the femoral, lateral femoral cutaneous, obturator, sciatic, and common peroneal nerves. Femoral and obturator nerves can be injured from prolonged lithotomy position. Lateral femoral cutaneous injury arises from compression beneath the inguinal ligament. Common peroneal injury occurs with direct compression of the lateral aspect of the proximal fibula, most commonly secondary to direct contact of the leg with the pole of a candy cane stirrup. Sciatic nerve injury is especially uncommon but arises with abduction, external rotation and over-flexion of the hip joint. Care should be taken to avoid over-flexion or overextension of the lower extremities, and all pressure points should be padded to avoid peripheral nerve injury secondary to positioning. The use of an egg crate mattress should be considered in patients with neurologic problems, particularly if the procedure will take several hours. Prepping and draping for vaginal surgery should encompass not only the perineum but the lower abdomen up to the level of the umbilicus as well in case an abdominal incision has to be made to repair an unexpectedly large bladder laceration or a ureteral injury. Vaginal exposure can be facilitated by the use of a weighted speculum in conjunction with a Lone Star, Scott, or Turner Warwick retractor [18]. A headlight improves visualization in patients with a narrow and/or deep vagina and/or a hyper-elevated urethra and bladder neck. Placing the patient in Trendelenburg position serves to better expose the anterior vaginal wall and allows the abdominal contents to fall backwards, thereby making suture carrier or trocar passage less likely to cause bowel injury.

The bladder should be decompressed by placing a urethral catheter to straight drainage at the beginning of the procedure. In and out catheterization should be discouraged since the bladder can refill quickly with intraoperative intravenous fluid administration. The injection of sterile water, diluted epinephrine or lidocaine beneath the anterior vaginal wall in patients who have had previous vaginal surgery causing scarring, may help define the plane of dissection, thereby decreasing the risk of urethral, bladder or rectal injury during the initial phases of vaginal wall dissection.

Vaginal packing and absorbable suture should be opened and included on the surgical set-up from the start of the procedure in case the vaginal incision has to be closed and packed quickly to control excessive bleeding. A fine absorbable suture should be readily available to stop any bleeding from periurethral or vaginal vessels that cannot be controlled with electrocoagulation. Surgicel® should also be on hand for temporary packing, if needed, for hemostasis.

Excessive Bleeding

The proportion of patients who require transfusion as a consequence of excessive bleeding from a vaginal procedure is less than 2 % in most contemporary series [19–22], but the potential for massive blood loss should always be acknowledged preoperatively and reinforced at the time of the consent. Sources of blood loss include periurethral vessels as well as vaginal and retropubic venous plexuses. Discrete arterial bleeders can be electrocoagulated or ligated with fine absorbable suture. Profuse bleeding from the urethra when separating the perivesical or periurethral fascia from the anterior vaginal wall is often an indication that one is not dissecting in the correct plane. The area of dissection should be re-evaluated once blood loss is controlled to exclude an injury to the urethral wall (spongy tissues) or bladder, and to redirect the course of the surgery.

Injury to the cavernosal veins, dorsolateral to the urethra can occur as the retropubic space is being cleared to pass a ligature carrier during the performance of a needle suspension procedure, or during urethrolysis. Bleeding from the ischiorectal fossa during rectocele repair may also be difficult to control. *A good strategy to minimize blood loss during vaginal surgery is to perform those steps of the procedure which are at low risk for bleeding first, leaving those steps which are potentially associated with more bleeding until the end.* For instance, when performing a urethrolysis with a Martius labial flap placement, harvest the flap first before entering the retropubic space to perform the urethrolysis. In the case of a combined cystocele repair and sling procedure, fix the cystocele first, harvest and/or ready the sling material, then enter the retropubic space to transfer the sling sutures or material.

Since profuse venous bleeding from the retropubic space is unlikely to respond to attempts at ligation or electrocoagulation, in the case of bleeding the best course of action is to complete any transfer of sutures or material that must occur, then close the vaginal incision with a running absorbable stitch and pack the vagina. Blood will collect within the confines of the retropubic space and compress the injured venous plexuses. Should further work need to be done through the vaginal incision, the packing and sutures can be removed later on once the bleeding is under better control and the patient is stabilized. The anesthetist should be kept informed of excessive blood loss through the vaginal incision to manage resuscitative efforts accordingly. The vagina should remain packed at the end of surgery for 24–48 h to help tamponade bleeding. Compression of venous bleeders can also be achieved by temporarily inflating a Foley catheter within the vaginal space [23]. Aungst and Wagner reported control of excessive retropubic bleeding from retropubic sling insertion by placing a Foley catheter along the trocar insertion path and inflating the balloon within the space of Retzius [23]. A nationwide analysis of retropubic sling complications in Finland reported rates of blood loss over 200 ml and retropubic hematoma of 19 per 1000 cases [24]. The majority of these complications can be managed conservatively with intensive hemodynamic monitoring, and in some cases, transfusion. Open drainage of a retropubic hematoma caused by venous plexus bleeding should be avoided, since such a maneuver may promote more hemorrhage. Major vessel injury, a rare complication of retropubic sling insertion, should be treated with open ligation or embolization performed by an interventional radiologist via percutaneous approach [19, 25]. Patients with delayed bleeding after a vaginal procedure should be managed with vaginal packing, and, failing this, with embolization of the offending vessels by interventional radiology. Reoperative management via the vagina, depending on the initial procedure performed, is often very difficult due to the elusive nature of the bleeding vessels and should be attempted only in extreme cases where more conservative management has failed.

Bladder Injury

Case Presentation (Refer to Video 19.1 Vaginal Repair of Bladder Injury During Vaginal Hysterectomy (Zimmern P))

A 57-year-old woman underwent an uneventful laparoscopic assisted vaginal hysterectomy. The uterus was large with an anterior fibroid mass. The patient had a history of 2 prior C-sections. The dissection was difficult in the plane between cervix and bladder base. Blood was noted in the urine drainage bag thus prompting a cystoscopy. A bladder laceration had occurred fairly high up over the back wall of the bladder and away from the ureteric orifices as shown in the movie provided in

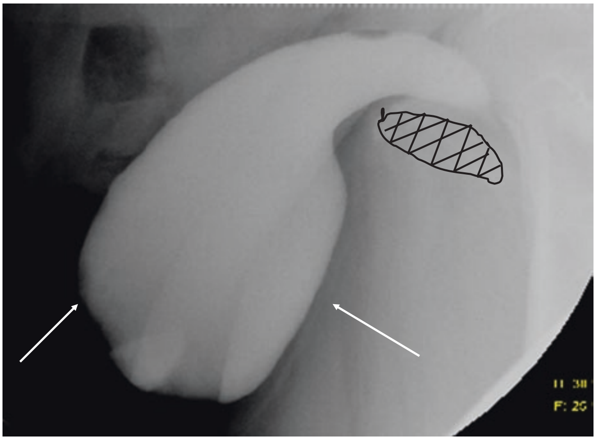

Fig. 19.1 Lateral view of voiding cystourethrogram showing anterior wall of bladder overhanging pubic symphysis. Such anatomy suggests adherence of the bladder to the back surface of the pubic bone, with the potential for accidental cystotomy when entering the retropubic space during sling or suspension surgery

the attachment (Refer to Video 19.1 Vaginal Repair of bladder injury during vaginal hysterectomy (Zimmern P)). The movie describes the steps of repair, which follow the guidelines for vesicovaginal fistula repair when performed transvaginally.

Bladder injury can occur during transvaginal surgery while dissecting in the plane between the anterior vaginal wall and the perivesical fascia, but more commonly occurs when attempting to clear the retropubic space or pass a suture carrier or trocar during incontinence surgery. Bladder laceration can also occur when entering the vesicovaginal space during vaginal hysterectomy [4].

Patient risk factors for bladder injury include previous retropubic surgery such as paravaginal repair or Marshal-Marchetti-Krantz/Burch colposuspension, previous caesarian-section, prior history of myomectomy, and bladder overhanging pubic symphysis (Fig. 19.1). According to Mathevet et al., the incidence of bladder injury as a consequence of vaginal hysterectomy is approximately 1.7 % [4]. The risk of bladder perforation during transvaginal sling procedures ranges from 5 to 24 % for the retropubic synthetic sling to less than 5 % for a conventional pubovaginal sling [26–29]. A Cochrane Review of Mid Urethral Sling Placement found a significantly higher bladder perforation rate for retropubic versus transobturator slings (4.5 % vs. 0.6 %) [22]. The relatively high risk of bladder injury is not necessarily due to previous surgery in the case of the retropubic sling, but is secondary to blind passage of the trocar through the retropubic space. Surgical experience has also been noted to be a factor for both bladder injury and recognition of said injury [26, 30]. Cystotomy during anterior repair for anterior compartment POP is rare, and in a Cochrane review has been noted to be more likely when mesh is used than not (2.4 % vs 0.3 %) [31]. Anterior vaginal wall needle suspension procedures for the treatment of incontinence and anterior compartment prolapse are also associated with low rates of bladder injury (1.9 %) [32].

An intraoperative bladder injury is usually detected by the presence of bloody urine draining from the Foley catheter or urine leaking into the operative field, although neither of these signs may be present. On other occasions, the Foley bulb may be seen within the vaginal incision [33]. Cystotomy during vaginal hysterectomy

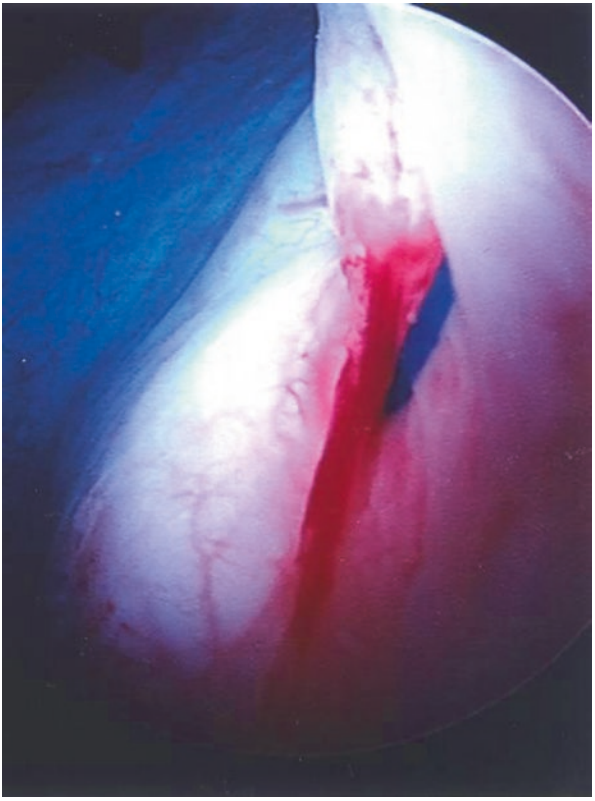

Fig. 19.2 Perforation of the lateral bladder wall detected on cystoscopy after passage of sutures through the retropubic space. Note the blue prolene suture within the cystotomy site

usually occurs at or above the trigone. If an injury is suspected, especially if it is small, its presence, extent and location may have to be confirmed with the bladder filled with irrigation fluid mixed with indigo carmine or methylene blue. Intraoperative cystoscopy should be performed routinely when performing retropubic sling placement [26]. Cystoscopy should be performed with a 70° lens or a flexible scope to inspect the anterior bladder wall (Fig. 19.2). This angle may detect unsuspected cases of sling arm or suture perforation since such an event is not always accompanied by hematuria. The non-absorbable sutures employed in pubovaginal sling or bladder neck suspension should be removed and repositioned more laterally. When overlooked, this iatrogenic bladder injury will result in stone formation over the exposed foreign body that perforated the bladder, as well as recurrent urinary tract infections, pain, and irritative voiding symptoms (Table 19.2). It is important to fully distend the bladder during cystoscopy lest the bladder wall fold over the perforation and obscure the injury.

Extraperitoneal injuries such as perforation with a suture carrier or a trocar usually heal spontaneously without any further treatment, although some surgeons leave a Foley catheter in the bladder for a few more days postoperatively. Again, these injuries are dealt with by removing the offending suture, redirecting the suture

Table 19.2 Principles of transvaginal cystotomy repair

Determine size, extent, location and number of bladder perforations
Rule out ureteral and trigonal involvement
Suprapubic tube placement
Adequate exposure of the perforation margins
2-layer tension-free watertight bladder closure with interposition of well vascularized tissue
Antibiotic prophylaxis and anticholinergics
Uninterrupted, prolonged postoperative bladder drainage

carrier more laterally away from the margin of the bladder wall, and draining the bladder transurethrally or suprapubically. More extensive cystotomies should be closed transvaginally in order to prevent vesicovaginal fistula formation (Fig. 19.5), whereas bladder injuries involving the trigone and ureters should be repaired via an open approach rather than through the vagina [34] because of the frequent need for ureteral reimplantation.

The main principles to follow when repairing a cystotomy transvaginally include: (1) evaluation of the extent of bladder injury by determining the size, location and number of perforation(s) and determination of trigonal and/or ureteral involvement (retrograde pyelogram can be performed and if the ureters are involved, open repair is indicated); (2) identification and exposure of the margins of the perforation (3) a 2-layer, tension-free water-tight bladder closure with a consideration for an interposition flap of well-vascularized tissue (Martius labial fat pad, perivesical fat pad, omentum); (4) the use of postoperative antibiotic prophylaxis and anticholinergics to decrease the risk of infection and bladder spasms [33, 35]; and (5) prolonged uninterrupted postoperative bladder drainage for 2–4 weeks, facilitated by the intraoperative placement of a large bore suprapubic catheter in addition to the urethral Foley catheter (Table 19.2). The use of two catheters for bladder drainage is not always mandatory but is often recommended to maximize bladder drainage and avoid bladder distension should one catheter get kinked or not drain well, and to allow monitoring of bladder function via the suprapubic tube once the urethral Foley catheter has been removed. Adherence to these tenets should help prevent the occurrence of a secondary vesicovaginal fistula.

The first step in transvaginal cystotomy repair is to place a small Foley catheter in the perforation to exert downward traction and bring the margins into better view. (Fig. 19.3a) Catheter placement can be facilitated by threading it over a guidewire placed intravesically through the perforation during cystoscopy. Next, a suprapubic tube should be inserted. Since the bladder perforation will preclude bladder distention for placement of a punch trocar, using the curved Lowsley retractor (with the patient in steep Trendelenberg) may be the best solution to insert the suprapubic tube safely at the bladder dome [35]. Alternatively, an open suprapubic catheter can be placed in cases with a history of prior abdominal surgery. When the margins of the bladder perforation have been identified, they should be tagged with traction

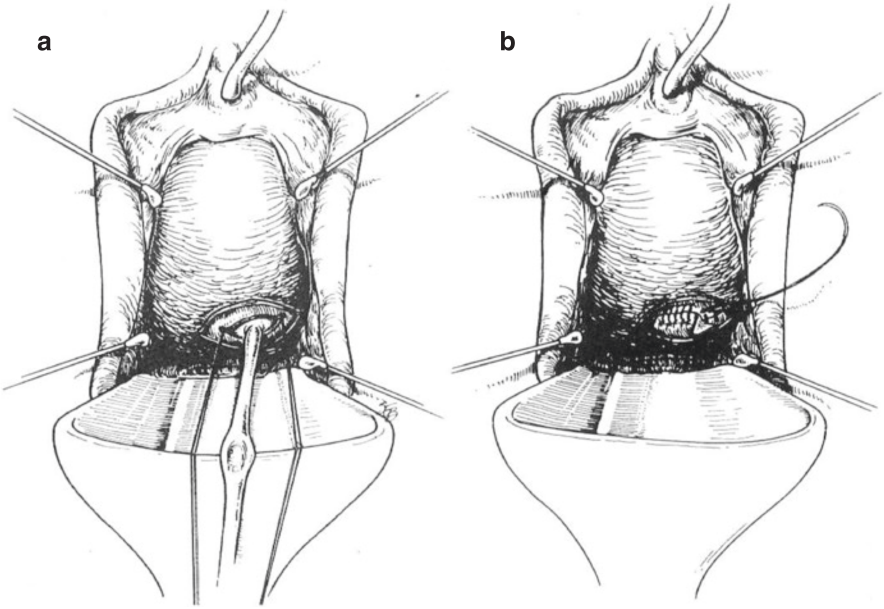

Fig. 19.3 Illustration showing transvaginal repair of bladder perforation. (**a**) A Foley catheter placed in the perforation can be used to exert downward traction to bring the margins of the defect into better view for placement of corner sutures. (**b**) The defect should be closed in 2 layers using fine absorbable suture. Suture lines should be non-overlapping (See Video 19.1)

sutures. Devitalized tissue is rare in the case of iatrogenic injury, but if present, should be excised before starting the repair. The bladder laceration should be mobilized from surrounding vaginal tissue in order to facilitate a tension-free closure using running, fine absorbable suture. The watertightness of this first line of repair should be checked by filling the bladder under gravity via the suprapubic tube. Reinforcing sutures may be needed if a small leak site is identified. Then a second layer consisting of interrupted, imbricated Lembert sutures through the muscularis at right angles to the underlying first layer closure can be placed. (Fig. 19.3b) Advancement of the anterior vaginal wall over the repair site helps to prevent overlapping suture lines, thus decreasing the risk of a secondary vesicovaginal fistula [35]. In the case of a large laceration or in patients with a history of pelvic radiation or previous bladder/vaginal surgery which may decrease blood flow to the bladder and/or vaginal wall, a Martius flap (Chap. 18) may be interposed between the bladder repair and the vaginal wall closure [36]. Cystocopy should be repeated at the conclusion of the bladder repair after injecting the patient with an ampule of fluorescein or other IV dye to make sure there is no ureteral compromise [37]. The bladder has a good blood supply and usually heals rapidly, provided that the mucosal edges are reapproximated and uninterrupted bladder drainage is maintained. Anticholinergic bladder relaxants and antibiotics should be given postoperatively to prevent spasms causing tension at the suture line and bladder infection respectively, both of which can compromise proper healing of the fistula closure tract. The Foley catheter can be removed after 5–7 days in uncomplicated cases. If the injury is extensive, or the patient has a history of pelvic irradiation, a more prolonged course of bladder drainage is indicated. A voiding cystourethrogram with lateral voiding views to evaluate the bladder base should be considered to document bladder integrity prior to suprapubic tube clamping/removal.

Ureteral Injury

Case: A 48-year-old female undergoes an uncomplicated vaginal hysterectomy. The decision is made to proceed with uterosacral ligament vault suspension. Sutures are placed in the uterosacral ligament and these sutures are secured to the vaginal cuff and are tied down. During cystoscopy, prompt efflux of urine is seen from the right ureteral orifice. The left orifice is seen to peristalse, but no efflux is observed. One cc of a 10 % preparation of fluorescein is injected. There is prompt efflux of fluorescein from the right ureteral orifice, but none from the left. The distal (lateral) uterosacral suture is cut and cystoscopy is repeated, confirming prompt drainage of fluorescein from the left side. The remainder of the procedure is performed as per routine and a stent is not left in place.

Injuries to the ureter are rare during transvaginal surgery and are generally the result of obstruction secondary to kinking or suture entrapment. Stanhope et al reported the incidence of ureteral obstruction to be 0.35 % (18/5179) for benign gynecologic surgery [38]. Other investigators have found ureteral injury to occur in 2.5–11 % of benign gynecologic operations and 3–6 % of Burch procedures [13, 35, 39, 40]. Unfortunately, most ureteral injuries are diagnosed postoperatively [41]. Delayed diagnosis is associated with ureterovaginal fistula formation [42], pyelonephritis, and renal obstruction that can in the worst cases lead to loss of the kidney.

Ureteral obstruction can occur secondary to kinking at the ureterovesical junction during uterosacral ligament plication, when sutures are placed too deeply and laterally during cystocele repair at the level of the trigone, or during transvaginal enterocele closure using a Moschowitz type repair with purse-string suturing. Such sutures, when tied over the midline, may draw the ureters medially and kink them closed. This is often suggested on cystoscopy by distortion of the bladder base or trigone, which makes visualization of the ureteral orifices more difficult, or by the decrease (puffing rather than a jet) or absence of ureteral efflux. Rarely, ureteral lacerations may occur when dissecting past the level of the trigone deep along the anterior vaginal wall.

Preoperative stenting in patients who are at higher risk of ureteral injury or who have a solitary kidney should be considered to aid in identification of the ureters during surgery. Women with conditions which tend to distort the bladder trigone such as very large cystoceles or prior anterior colporraphy may benefit from this strategy, although stent placement in these patients can be a challenge (manual

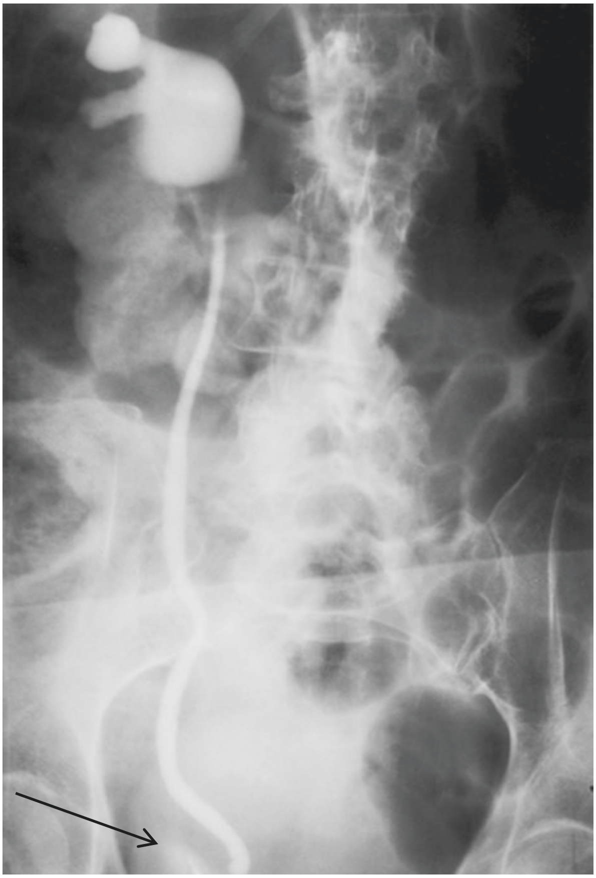

Fig. 19.4 Intraoperative retrograde pyelogram showing ureteral kinking as a consequence of placing plication sutures too laterally during the performance of high levator myorraphy

reduction of the cystocele facilitates placement). Ultimately the stents have to be removed after the repair to document proper ureteral drainage. In addition, the stents in and of themselves can lead to edema and hematuria.

Many vaginal surgeons advocate cystoscopy with intravenous dye to increase the detection rate of ureteral obstruction [43, 44]. Indigo carmine is no longer available, methylene blue has a slow metabolism, phenazopyridine has to be administered orally preoperatively, and so IV fluorescein is currently used when there is doubt regarding adequate ureteral jet or efflux. Harris et al. found the incidence of unsuspected bladder and ureteral injuries diagnosed by intraoperative cystoscopy to be 4 % after vaginal surgery and Burch colposuspension [44]. Detractors of routine cystoscopy include the increased operative time and cost, the possibility of causing urinary tract infection, and the extra training required for some gynecologists. Others point out that cystoscopic bladder inspection does not guarantee the recognition of all lower urinary tract injuries, and is dependent on the expertise and thoroughness with which the examination is carried out [45].

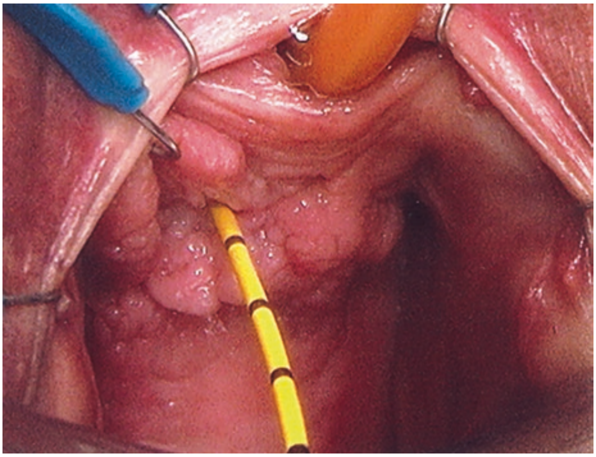

Fig. 19.5 Urethrovaginal fistula secondary to unrecognized urethral injury during vaginal removal of mesh sling

Cystoscopy is carried out after passing sutures or a trocar through the retropubic space or after placing plication stitches. It should be performed after each maneuver which places the ureters at risk of injury so that one can more effectively detect the source of ureteral compromise and correct it before moving on to the next step in the procedure. In the case of patients who have had previous abdominal surgery such as total abdominal hysterectomy or abdominal-perineal rectal resection (in which the ureters may be injured or tied off), thought should be given to performing renal ultrasound or cystoscopy before the vaginal procedure to exclude a previously unrecognized silent ureteral injury. The appearance of a ureteral jet may take some time, particularly in dehydrated patients, older women, women with a large cystocele which may have caused ureteral kinking, or in cases of chronic renal insufficiency. Obstruction should definitely be suspected if ureteral peristalsis is observed with the absence of urine efflux or poor urine efflux. A weak puff of urine should not be reassuring, and the orifice should be observed until a full jet can be seen. Applying traction to the sutures (e.g. in uterosacral ligament vault suspension) during retrograde pyelogram (Fig. 19.4) can help determine which of them lies in close proximity to the obstructed ureter. The offending suture(s) should be removed and the ureter re-examined for urine outflow. More broadly, intraoperative ureteral imaging in the form of retrograde pyelography or intravenous urography can also be used to diagnose complete ureteral obstruction or laceration (Table 19.2). Intravenous urography is performed by injecting the patient with 60 cc of contrast media and taking a 10 min film on the surgical table to look for hydroureter or extravasation of contrast into the pelvic or abdominal cavity. Management of ureteral injury may involve stenting, percutaneous nephrostomy tube insertion or ureteral reimplantation. Secondary complications such as ureteral stricture and ureterovaginal fistula may necessitate more complex reconstructive procedures such as Boari flap or ileal ureter which are beyond the scope of this review.

Urethral Injury

Transvaginal injury to the urethra usually occurs while dissecting in the plane that is between the anterior vaginal wall and periurethral fascia, during sling placement or sling removal (Fig. 19.5) or during urethral diverticulectomy, particularly in patients who have had previous vaginal surgery (Refer to Video 19.2, Vaginal removal of suburethral tape. (Zimmern P)). It is a relatively uncommon complication with reported rates of <1 % [46, 47]. In most cases, urethral damage can be avoided by infiltrating under the anterior vaginal mucosa with normal saline, diluted epinephrine or local anesthetic to enhance the dissection plane. Such injuries can be identified by performing intraoperative urethroscopy with a female urethroscope and 0, 5, 25 or 30° lens [33] or a flexible cystoscope, or with retrograde filling as described below. Large urethral lacerations, however, can be recognized by the appearance of the catheter in the incision.

Small urethral injuries should be repaired over a 25 Fr sound to avoid urethral narrowing using fine absorbable sutures. Loupe magnification may aid in identifying the edges of the injury and placement of sutures. The urethral mucosa repair should be checked for water-tightness by retrograde filling alongside the catheter through a 5 or 8 F feeding tube or with gentle urethroscopy. If identified, the overlying periurethral muscular layer should then be reapproximated using fine absorbable suture. Before final vaginal closure, larger defects may require interposition of a Martius labial fat pad or fascial graft interposition to prevent a secondary urethrovaginal fistula. Because the labial fat pad is more bulky than an autologous sling, it is not always possible to use it in repairs where the initial vaginal wall flap is thin or short, and will not be able to be pulled to cover over the additional layer. Prolonged urethral catheter drainage is recommended, sometimes associated with a suprapubic tube catheter which should be placed before the start of the urethral repair. A voiding urethrogram with lateral views is suggested prior to removal of the catheter for larger repairs to evaluate for possible extravasation or early urethro-vaginal fistula. Vaginal reflux of contrast can make this reading difficult at times.

Rectal Injury

The incidence of rectal injury during vaginal surgery is, fortunately, infrequent. In one series, the authors noted a 0.7 % rate of injury to the rectum for a variety of vaginal procedures over an 11-year period [48]. Mathevet et al. found the incidence of rectal injury to be 0.5 % in 4/285 consecutive cases of vaginal hysterectomy for benign conditions, 69 % of which occurred during posterior repairs done in conjunction with hysterectomy [4]. These investigators found no post-operative complications related to rectal injury. All injuries were repaired in 2 layers using running absorbable suture without leaving a drain. Twenty-five percent of patients who sustained injuries to the rectum had had a previous posterior repair compared with 2.5 % of the overall case series. Placement of a pack in the rectum before posterior vaginal wall surgery can aid in its identification, thereby helping to prevent rectal tear. Some surgeons digitalize the rectum with an extra glove or an O'Connor drape to aid in the dissection. Many surgeons, including the editors, employ a bowel prep prior to posterior repair. If an injury to the rectum is suspected, the area should be examined with a finger in the rectum as such. Alternatively, the vaginal cavity can be filled with irrigation fluid and air instilled into the rectum using a catheter or a Toomey syringe. The presence of bubbles in the fluid on injection of air through the rectum indicates a breach in the rectal wall. Rectal injuries should be repaired at the time of discovery to avoid recto-vaginal fistula formation.

Conclusion

In summary, the vaginal surgeon should be equipped with a comprehensive knowledge of how to deal with the occurrence of bladder, ureteral, urethral or rectal injury. Pre-existing factors which may put the patient at higher risk for surgical complications should be identified, and meticulous planning should be carried out to minimize their occurrences. The principles of transvaginal repair of injuries to the bladder, ureters, urethra and rectum are a tension-free closure in multiple layers with non-overlapping suture lines, with interposition of well-vascularized tissue when indicated, and adequate bladder drainage. Adherence to these tenets will help prevent fistula formation.

Although an extensive discussion of the medico-legal implications of surgical misadventure is beyond the scope of this chapter, some general points should be mentioned. A thorough preoperative discussion with the patient and her family about the potential complications of vaginal surgery will ensure that they are well-informed of the surgical risks, and will help prepare them for any adverse event that may occur. This discussion should be documented carefully. The importance of obtaining immediate consultation in the form of a senior colleague or the appropriate surgical specialist cannot be over-emphasized when an intra-operative complication is suspected or recognized. This will minimize adverse sequelae for the patient and satisfy legal requirements for the standard of care. Furthermore, immediate disclosure of the event, the intra-operative steps taken to repair an injury, and the experts consulted should be clear and detailed to maintain patient trust.

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Chapter 20
Native Tissue Repair After Failed Synthetic Materials

A. Lenore Ackerman, Seth A. Cohen, and Shlomo Raz

Abstract In the setting of an emerging patient population suffering from recurrent pelvic floor symptoms after mesh removal, the principles and practices of native tissue repair have taken on a new, ever-important position in vaginal reconstructive surgery. This chapter provides a case-study of a patient who undergoes complex mesh removal, with improvement in her constellation of presenting symptoms. Although she improves significantly, she goes on to develop recurrent prolapse in the setting of persistent stress urinary incontinence (SUI). Description of her management details techniques for surgical intervention that we have used successfully after mesh removal to treat deficient, attenuated, atrophied, and scarred pelvic floor tissues.

Keywords Double-pronged passer • Omega sling • Spiral sling • Fascia lata • Perivesical fascia • Periurethral fascia • Four-corner suspension

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OR Illustrations Please note, at the appropriately identified point in the chapter, all figure references are directly from the recent "Atlas of Vaginal Reconstruction Surgery," published by Springer in 2015. These figures should be used here as well. Thank you (Raz S. Atlas of Vaginal Reconstructive Surgery. New York: Springer; 2015 Oct 8).

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A.L. Ackerman, MD, PhD
Assistant Professor, Department of Surgery, Division of Urology,
Urologic Reconstruction, Urodynamics, and Female Urology, Cedars-Sinai Medical Center,
99 N. La Cienega Blvd., Suite 307, Beverly Hills, CA 90211, USA
e-mail: a.lenore.ackerman@cshs.org

S.A. Cohen, MD
Assistant Clinical Professor, Division of Urology and Urologic Oncology,
Department of Surgery, Pelvic Medicine and Reconstructive Surgery, Hope, CA, USA
e-mail: sethcohen@coh.org

S. Raz, MD (✉)
Division of Pelvic Medicine and Reconstructive Surgery, Fellowship Program
in Pelvic Medicine and Reconstructive Surgery, 200 UCLA Medical Plaza, Suite 140,
Los Angeles, CA 90095, USA
e-mail: sraz@mednet.ucla.edu

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Introduction

Recent data have found that the long-term impact of vaginally-placed mesh for pelvic organ prolapse may actually be associated with previously unreported harms, with up to 25 % of patients experiencing complications [1]. For many this can lead down a path of multiple surgeries for revision/excision of graft material [2]. In those women experiencing dyspareunia and pelvic pain, anywhere from one-third to one-half of patients may find no relief of their symptoms despite mesh removal [3, 4]. Even so, for those suffering from mesh-related adverse outcomes, previous efforts have shown that a significant portion of this population will benefit [5]. Subsequent to mesh removal, a subset will go on to develop recurrent pelvic floor symptoms. For example, data has demonstrated that at 1-year follow up after synthetic mid-urethral sling removal, up to one-third of patients may have recurrent stress urinary incontinence (SUI) requiring an anti-incontinence procedure [6]. Many of these patients are mesh-averse secondary to their previous experiences. It is important to be able to provide native tissue repairs for these complex patients, often in dire need of improvements in their quality of life. In this chapter, we present a case-study of a patient post-mesh removal, with subsequent descriptions of native tissue repairs encompassing prolapse of the three compartments in addition to recurrent SUI.

Case Presentation

A 55 year-old woman, gravida two, para two, with a history of uterine malignancy status post total abdominal hysterectomy and bilateral salpingo-oophorectomy 12 years ago, with subsequent anterior and posterior vaginal wall prolapse, status post mesh repair 3 years ago, with recurrent bothersome prolapse status post laparoscopic sacrocolpopexy 1 year ago, presented with intermittent vaginal bleeding, progressive vaginal pain, dyspareunia, recurrent urinary tract infections (UTIs), and SUI (using three pads a day). On exam, she was found to have a 1 cm (cm) area of mesh extrusion at the apex, a 2 cm area of mesh extrusion and significant induration/tenderness to palpation at the anterior vaginal wall (AVW), and a 1 cm mesh extrusion posteriorly.

Cystoscopy found no gross mesh erosion to the bladder, however, on translabial ultrasound the mesh did appear intramural (in continuity with the wall) of the proximal urethra. She was counseled that mesh removal may not result in symptom improvement, and that she could potentially experience worsened pelvic organ prolapse and urinary incontinence. Desperate to improve her pain and reclaim intimacy in her relationship, she desired surgical intervention. In such significant cases of mesh complications, these patients undergo complex vaginal and abdominal explorations for complete mesh removal. It was discussed with her that she could potentially undergo an autologous fascia sacrocolpopexy at the time of mesh removal, if there was no evidence of gross abscess/infection, in efforts to prevent recurrent apical prolapse. Thus, she underwent exploration transvaginally, with para-vesical dissection and complete removal of the anterior and posterior mesh products. She also underwent a concomitant laparotomy, sacrocolpopexy mesh excision, and autologous fascia sacral colpopexy.

Surgical Description

For patients with previous sacrocolpopexies, removal of the sacrocolpopexy mesh will lead to recurrent prolapse as no other apical support exists. To prevent such recurrence at the time of the mesh removal, repeat sacrocolpopexy with a native tissue graft is preferred. A low midline incision in the skin is made to facilitate removal of the sacrocolpopexy mesh. The anterior rectus fascia is then divided in the midline. The peritoneal cavity is entered, and the small bowel reflected superiorly to expose the sacrocolpopexy mesh. After opening the peritoneum over the mesh segment, the mesh is exposed to its attachment at the sacral promontory. The mesh is then amputated at this location, with care to avoid the pre-sacral vessels. Two #1 delayed-absorbable sutures are then pre-placed at this location, and the needles left in place to facilitate later attachment of the fascial graft. Mild traction on the mesh is used to isolate the mesh to the level of the vagina. The mesh is separated anteriorly and posteriorly from the vaginal apex. As complete removal of sacrocolpopexy mesh is only indicated after extrusion, the vaginal cuff and any additional area of mesh exposure should be removed. The vaginotomy is then closed with a 2-0 absorbable suture. Typically, this can be performed without significant vaginal shortening. After the mesh has been removed, three #1 delayed absorbable sutures are pre-placed at the midline and bilateral margins of the vaginal apex for later anchoring of the autologous graft.

We prepare the strip of fascia after the mesh is removed from the apex. An 8 cm by 2 cm segment of anterior rectus fascia is harvested longitudinally along the fascial incision. The harvested fascial segment is then configured into an “L” shape, with the superior aspect sutured to the sacral promontory and the inferior aspect sutured along the vaginal apex using the previously placed #1 delayed absorbable sutures. The fascia should be placed without tension; it should lay down over the curve of the sacrum without stretching. The peritoneum is closed over the fascia to prevent possible bowel incarceration, and the abdominal incision closed in standard fashion.

Use of an “L”-shaped repair minimizes the abdominal incision size and the length of the fascial harvest, reducing the resultant morbidity that would be necessary if enough fascia were harvested to create a “Y” shaped graft. The “Y” shape, typically employed in the classic mesh-based sacrocolpopexy, serves both to support the cuff and to correct any concomitant cystocele or rectocele; in this case, the “L”-shaped graft is sufficient to support the vault. If necessary, we may also close the cul de sac with delayed absorbable suture to prevent the recurrence of posterior enterocele sliding behind the graft.

This approach for concomitant removal of sacrocolpopexy mesh and repair using autologous fascia can also be performed robotically using a similar approach. For a robotic approach, use of a segment of autologous fascia lata harvested as described later in the chapter is preferred to allow adequate abdominal expansion for proper visualization and maintenance of pneumoperitoneum; if unable to use fascia lata, however, anterior rectus fascia can be harvested and the fascia closed prior to docking of the robot with adequate results. While cadaveric tissue can be used for sacrocolpopexy with biologic graft, in our experience, these procedures have poor long-term durability due to reabsortion of the cadaveric tissue without regeneration.

In patients with recurrent prolapse who have already undergone mesh removal, a vaginal approach to prolapse repair is preferred. The classical approaches to vault suspension, such as sacrospinous ligament fixation, are effective treatments for recurrent vault prolapse. We use an intraperitoneal approach for vault prolapse repair, a modification of an intraperitoneal suspension with fixation of the vaginal apex just caudad to the sacrospinous ligament. With the patient in lithotomy position, an Allis clamp is used to grasp the vaginal cuff, and an interrupted 2-0 absorbable suture used to mark the vaginal cuff. For patients who require a concomitant cystocele repair, a vertical incision is made from the neck of the bladder to the cuff of the vagina, and the anterior repair completed prior to the vault suspension. For patients requiring vault suspension only, a vertical incision is made at the cuff just past the bladder base to enter the peritoneal cavity (Fig. 20.1). After extensive dissection of the vaginal cuff off of the enterocele sac, the peritoneal cavity is entered (Fig. 20.2). Two laparotomy pads are inserted into the peritoneal cavity, and the bladder retracted anteriorly.

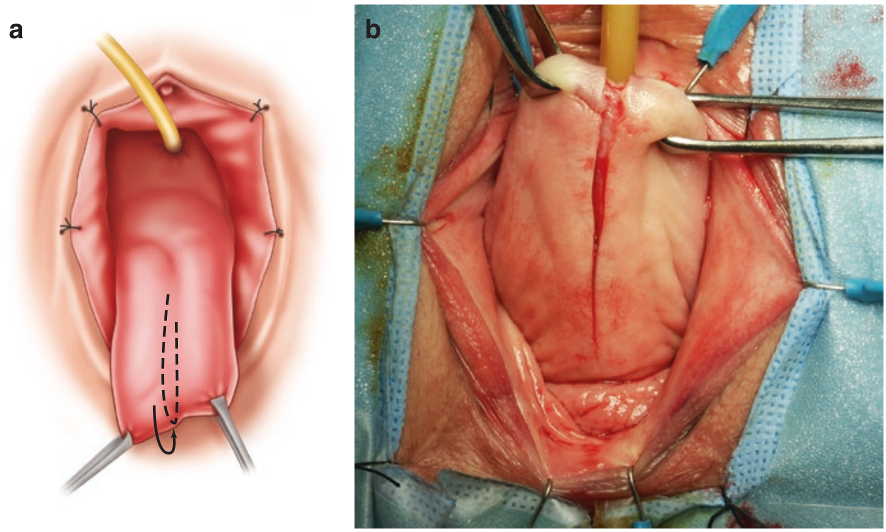

Fig. 20.1 (**a**, **b**) A vertical incision is made over the vaginal wall, extending anterior to the bladder base and posterior to the prerectal area

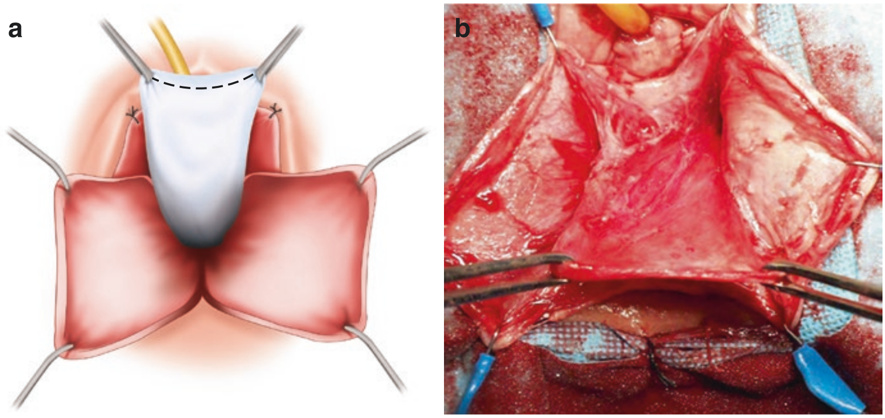

Fig. 20.2 (**a**, **b**) Using sharp dissection, the peritoneal sac is dissected free from the vaginal wall, posterior from the rectum and anterior toward the bladder base. The dissection is extended to isolate the base of the sac. Care should be taken to avoid bladder injury during the anterior dissection or rectal injury during the posterior dissection. A rectal finger can help during this phase of the surgery. Illumination of the bladder lumen with a cystoscopic light can help to define the bladder base. In case of doubt, the bladder should be irrigated in order to rule out perforation. Branches of the uterine artery are very often found at the base of the enterocele sac; they must be coagulated or suture ligated

For our suspension, we prefer polydioxanone (PDS II™, Ethicon) sutures as they are the longest-lasting absorbable suture readily available. #0 delayed absorbable suspension sutures are first placed through the posterolateral vaginal wall, in the area previously marked 3 cm lateral to the vaginal incision (Fig. 20.3). Next, the suture is passed through the pre-rectal fascia to provide additional posterior support of the rectal wall. The suture is then placed at the origin of the sacrouterine ligament approximately 10–12 cm from the introitus (Fig. 20.4). The site of fixation is distal to the sacrospinous ligament, medial to the levator muscle, lateral to the sacrum, and posterolateral to the rectum (Fig. 20.5). This location is free from vessels or nerves that can be damaged during the placement of the suspension sutures. The sutures must be placed just lateral to the sacrum as incorporating tissue from the lateral or anterior segments can compromise the ureters either by direct injury or kinking. After incorporating a strong bite of tissue, the suspension suture is then brought back through the vaginal wall 1–2 cm from the original entrance and placed aside, to be tied after all other vaginal repairs are completed (Fig. 20.6). Placement of the suspension suture is then repeated on the contralateral side, and the suture placed aside.

Two purse-string sutures of #0 delayed absorbable suture, preferably polydioxanone, are then placed through the prerectal fascia (Fig. 20.7), the distal residual sacro-uterine ligament, and perivesical tissue at the bladder base (pubocervical fascia) (Fig. 20.8) to close the peritoneum after removal of the laparotomy pads (Fig. 20.9). The vaginal cuff is then closed in running fashion. The suspension sutures are then tied with an Allis supporting the vaginal cuff to secure the apex in its final position. This fixation suspends the vaginal cuff at a physiologic position

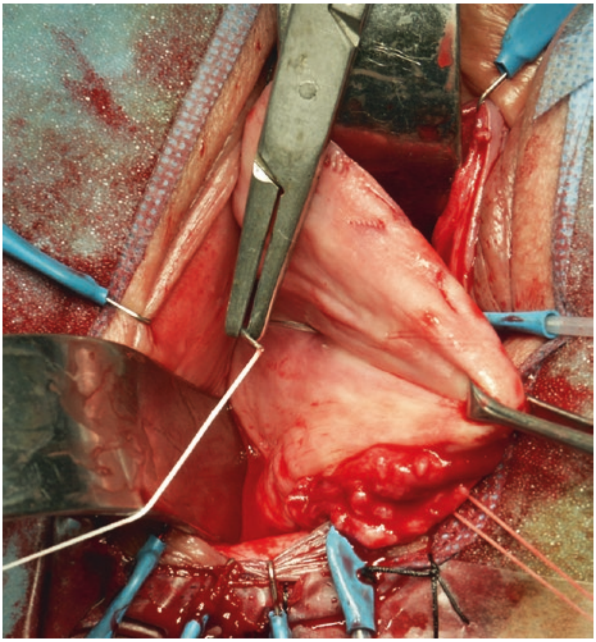

Fig. 20.3 A #1 PDS suture is inserted in the right posterior lateral aspect of the vaginal cuff

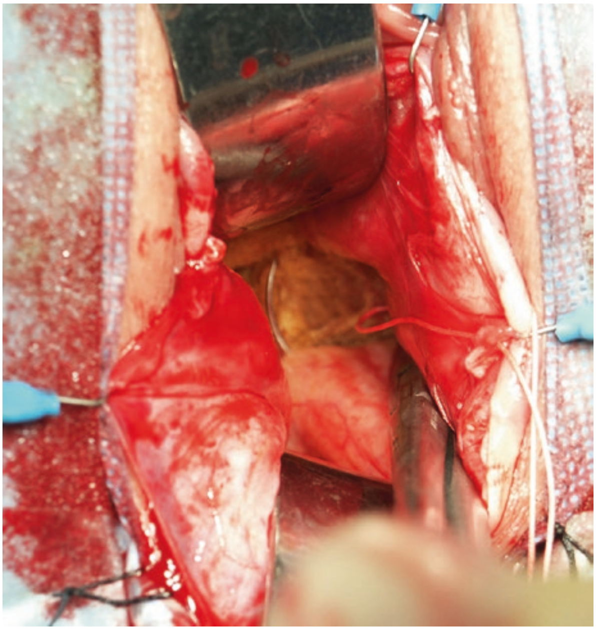

Fig. 20.4 The needle is transferred lateral to medial, distal to the sacrospinous ligament, lateral to the sacrum, lateral to the rectum, and medial to the iliococcygeus muscle. At least two passes of the needle are done to provide a strong anchoring point

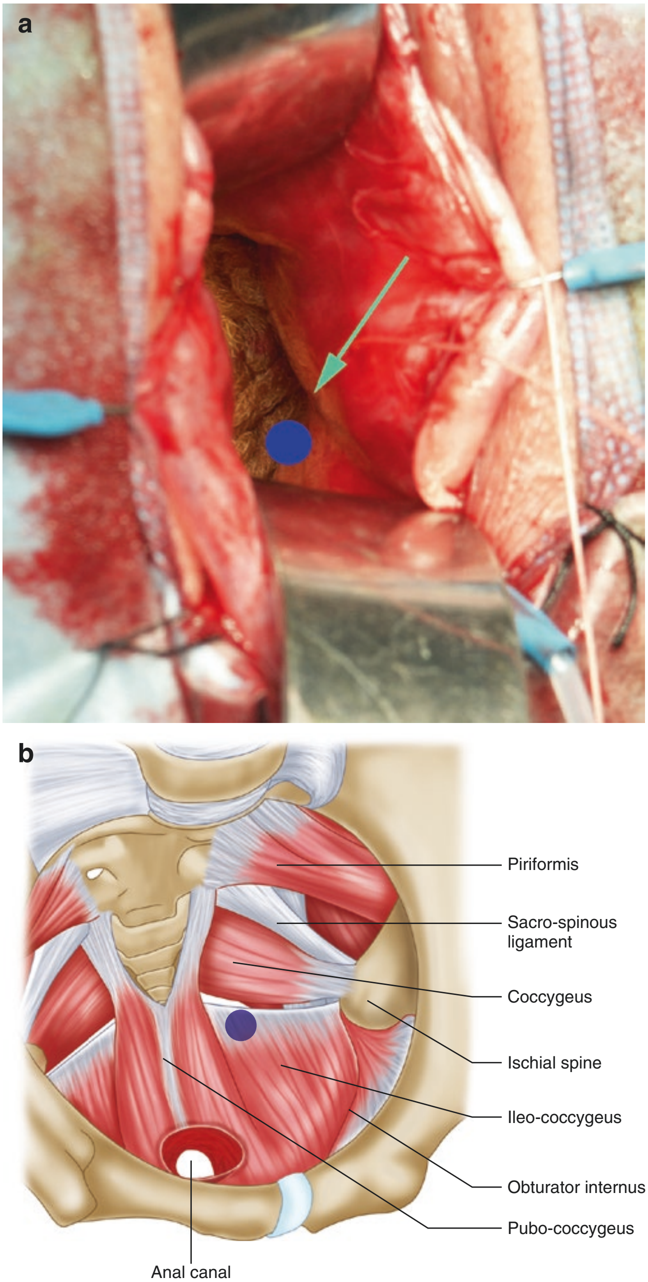

Fig. 20.5 (**a**) The point of anchoring sutures for the vault suspension (*blue dot*) will be 12–14 cm from the introitus in the groove lateral to the sacrum, medial to the iliococcygeus muscle, and distal to the sacrospinous ligament. The suture will incorporate the origin of the sacrouterine ligaments just distal to the coccygeus, providing a fibrous, strong anchoring tissue that will not cause postoperative pain; there are no vessels or nerves in the area. (**b**) Anatomical drawing showing the point of insertion of the vault suspension sutures, distal to the sacrospinous ligaments, lateral to the sacrum, and medial to the iliococcygeus muscle

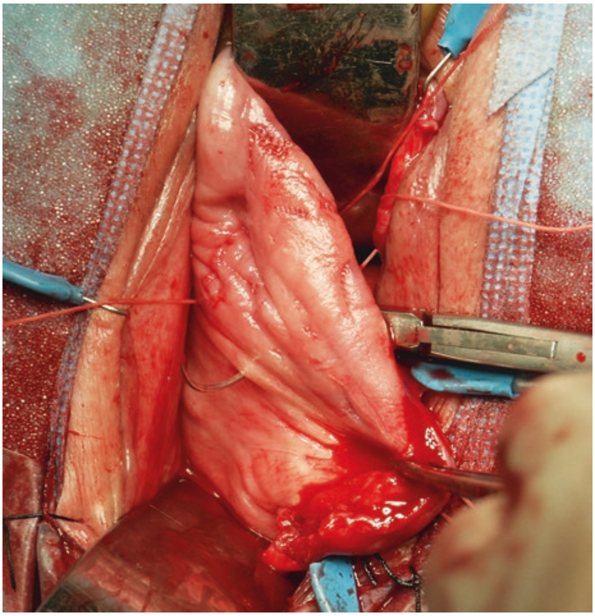

Fig. 20.6 The needle is transferred from the peritoneum to outside the vaginal wall, at least 1 cm from the original entrance

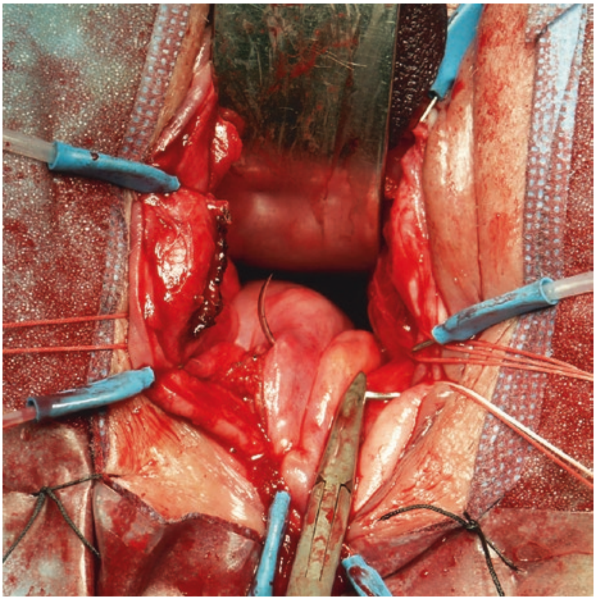

Fig. 20.7 Two #1 PDS sutures will be used to apply a purse-string suture to close the vaginal cuff. The first pass of the suture includes the prerectal fascia posterior to the distal segment of the cuff

restoring the axis of the vagina to sacral vertebral bodies four through five, with a banana-shaped curve posteriorly, similar to the native anatomy (Fig. 20.10). This procedure requires no specialized equipment and can be performed without inpatient admission if without concurrent hysterectomy. When hysterectomy is performed concurrently, a short inpatient stay is recommended. Patients experience good cosmetic outcomes, without any abdominal incisions.

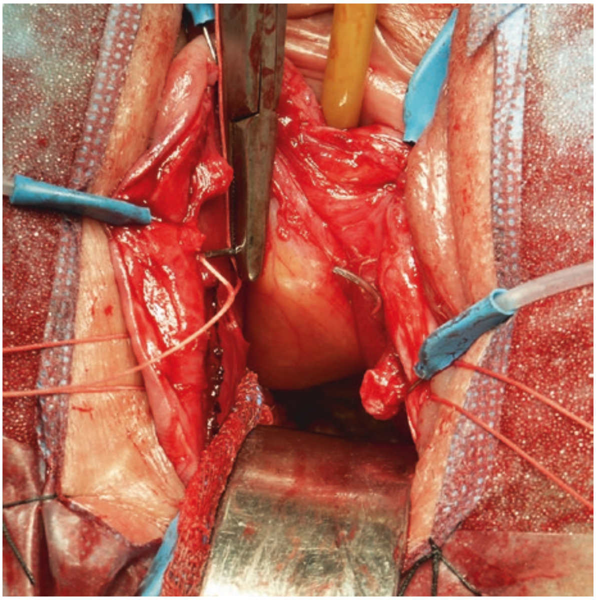

Fig. 20.8 After including the lateral peritoneum, the needle incorporates the bladder base to include the peritoneum and the pubocervical fascia. A large segment of tissue is incorporated

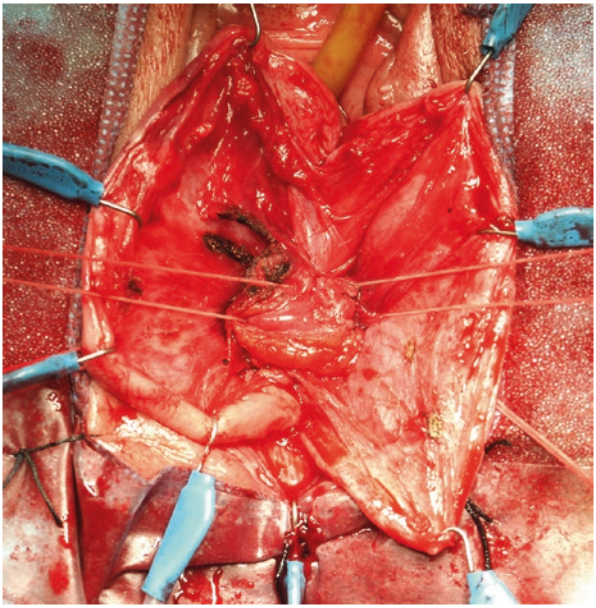

Fig. 20.9 After removal of the laparotomy pads from the peritoneum, traction is applied to the purse-string sutures, and they are tied individually. Optionally, the excess of peritoneum can be excised. Any posterior vaginal wall defect should be repaired at this time

Case Presentation

Six months later, our index patient's vaginal bleeding, vaginal pain, dyspareunia, and recurrent UTIs were resolved. While she felt like much of her life had been reclaimed, she now complained of persistent urinary incontinence, desiring intervention for her SUI (currently 5 pads a day). On exam, she had hypermobility of the

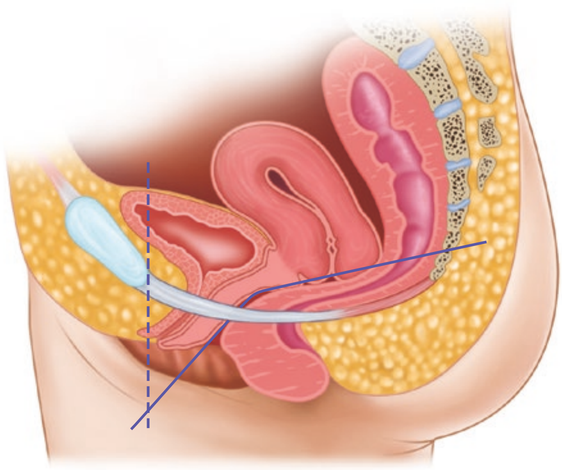

Fig. 20.10 Diagram of the posterior vaginal anatomy, with the distal third of the vagina in a 45-degree angulation and the proximal vagina in a more horizontal axis ending at the sacrococcygeal area

urethra and grossly visualized incontinence per meatus with Valsalva; there was minimal laxity of the anterior and posterior vaginal walls, with a well-supported apex. She underwent a video-urodynamic study, secondary to her complex history, which confirmed SUI; no evidence of fistula was seen on fluoroscopic imaging.

Surgical Description

Depending on the degree of incontinence, patients can undergo surgical correction of SUI with either suture bladder neck suspension/vaginal wall sling or variants of sling utilizing a fascial graft. While not useful for patients who have severe incontinence or patients with prior surgical failures, radiation, neurogenic incontinence, or resting incontinence, bladder neck suspension/vaginal wall sling can be effective for patients with mild, bothersome SUI. The idea is to create a hammock of vaginal wall and nonabsorbable sutures. With the patient in lithotomy position, two oblique incisions are made in the distal vaginal wall on either side of the urethra (Fig. 20.11). After entering into the retropubic space sharply and freeing any adhesions in that location, the urethropelvic fascia is separated from the arcus tendinous fascia pelvis (Fig. 20.12). The first pass of the suspension suture of #0 nonabsorbable (preferably polypropylene) suture incorporates the free edge of the urethropelvic fascia and then the suburethral periurethral fascia to create a helical stitch extending almost to the midline underneath the urethra (Fig. 20.13). A second pass encompasses the periurethral fascia at the mid urethra and the perivesical fascia at the bladder neck, extending to the midline (Fig. 20.14). After placing the suture, traction is applied to confirm a strong anchor of tissue of the anterior urethra and bladder neck. A second suspension suture is placed in similar fashion contralaterally

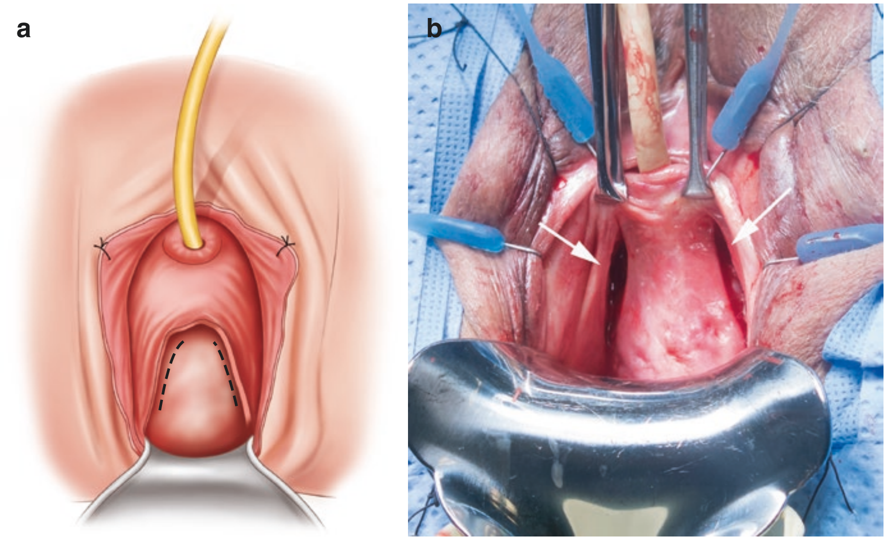

Fig. 20.11 (**a**) Two oblique incisions are made in the anterior vaginal wall, extending a few centimeters proximal to the bladder neck. The incision is made 1 cm from the lateral vaginal wall. (**b**) Two Allis clamps are placed on each side at the apex of the incisions (*arrows*) for traction and improved exposure

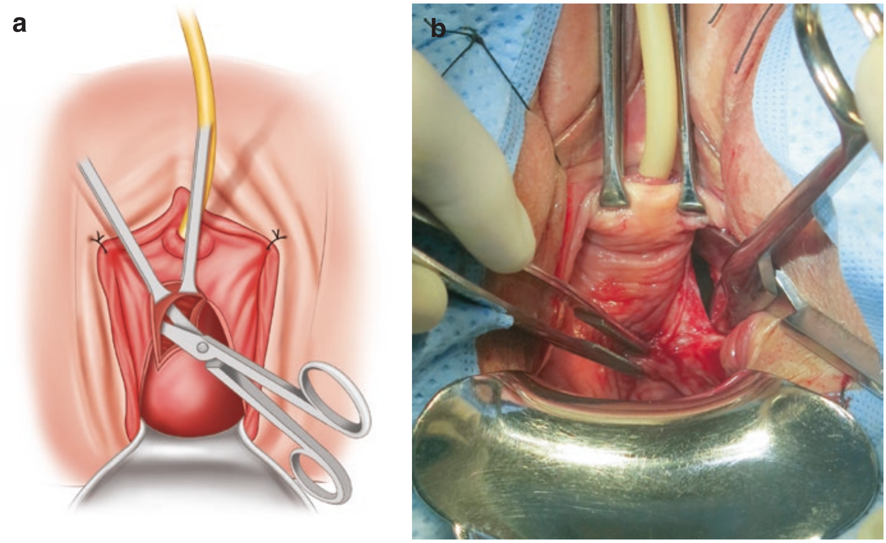

Fig. 20.12 (**a**, **b**) To enter the retropubic space, curved scissors are placed parallel to the urethra, under the pubic bone and in an upward direction, abutting the pubic bone at all times

(Fig. 20.15). The suture is again extended towards the midline in close proximity to the suture from the contralateral side to create a hammock of support of suture and the vaginal wall from the midurethra to the bladder neck. A small stab incision

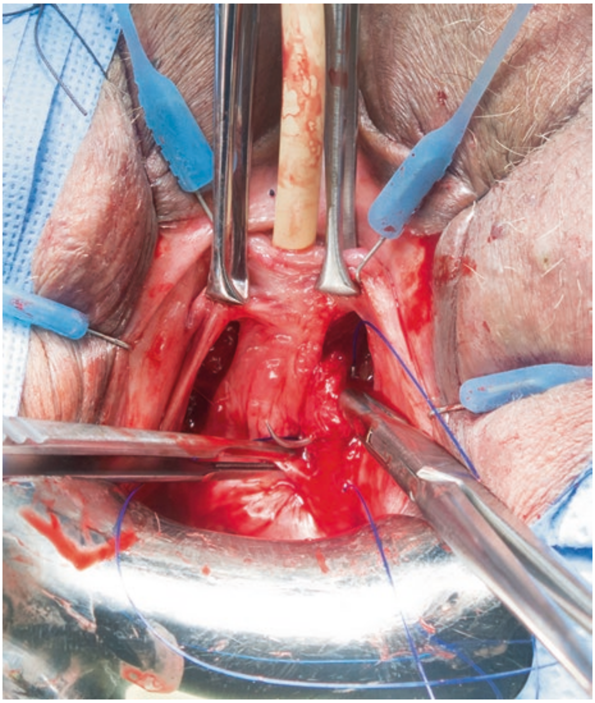

Fig. 20.13 A #0 monofilament nonabsorbable suture is used to incorporate the lateral margin of urethropelvic fascia. Care should be taken not to insert the needle deeply, to avoid penetrating the wall of the bladder or urethra

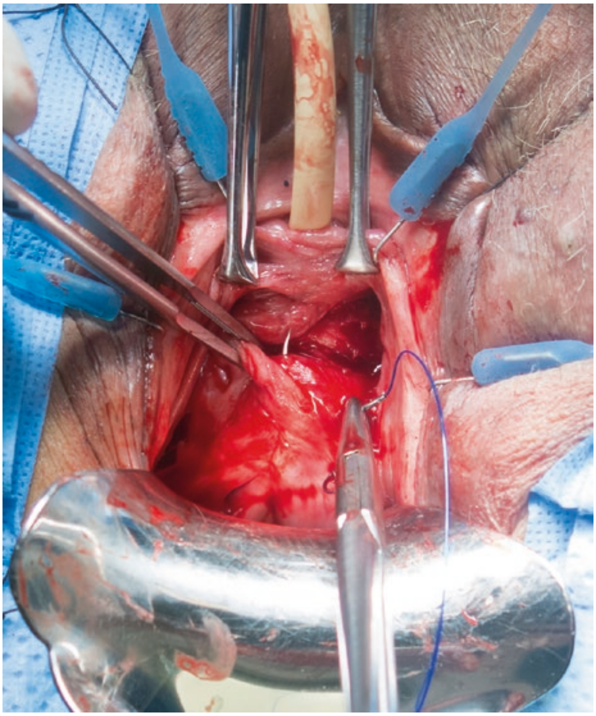

Fig. 20.14 The periurethral and perivesical fasciae are also included

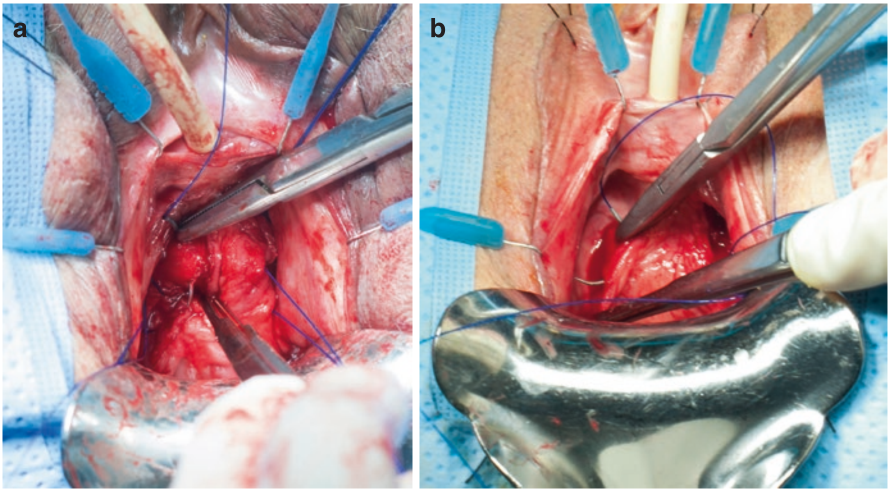

Fig. 20.15 (**a** , **b**) The same procedure is performed again on the contralateral side

1 cm above the superior ramus of the pubis on the abdomen is made. A double-pronged ligature carrier (Raz needle passer) is then transferred from this incision under direct finger guidance through the retropubic space and brought out of the vaginal incision (Fig. 20.16). After capturing the ipsilateral suspension suture, withdrawal of the passer from the suprapubic incision transfers the suspension suture retropubically (Fig. 20.17). This procedure is repeated contralaterally. Traction of the sutures will produce elevation of the urethra and bladder neck. There is no specific maneuver that can help to identify the appropriate tensioning of these sutures while tying over the anterior rectus fascia; we use the cystoscope to guide tensioning. After cystoscopy to rule out bladder injury, the instrument sheath is kept in the urethra at a 45° angulation, and the sutures are tied without tension in the suprapubic area (Fig. 20.18). The vaginal incisions are then closed with 2-0 absorbable suture, taking care not to incorporate the suspension sutures in the closure.

For patients with urethral trauma, radiation, failed surgeries, prior mesh removal, or significant incontinence with a fixed, non-mobile urethra, a bladder neck suspension/vaginal wall sling is not indicated. Mesh and mesh removal will cause sufficient damage to the periurethral tissues and support structures such that a fascial sling will be necessary. While other biologic materials are available for use, the use of autologous fascia provides far superior results than other biologic grafts; patients with cadaveric grafts experience high rates of recurrence and reoperation [7]. The decrease in durability may result from increased resorption of the graft; re-exploration of cadaveric allografts at re-operation for failure reveals severe or complete degeneration [8]. Cadaveric tissue also demonstrates increased rates of vaginal extrusion in multiple studies in comparison to the near-zero rates seen with autologous fascial grafts [9, 10].

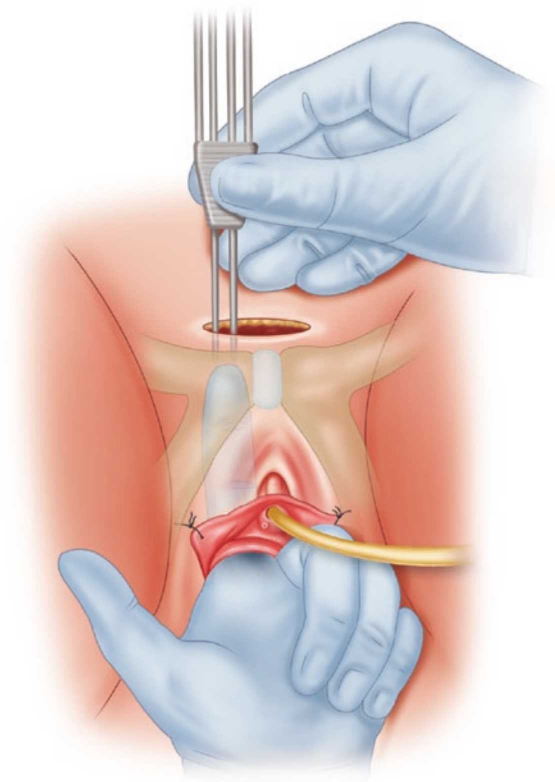

Fig. 20.16 A double-pronged ligature carrier (Raz needle passer) is used to transfer each of the Prolene® sutures from the vagina to the suprapubic region. Under finger control, the tips of the passer are transferred from the suprapubic incision to the vaginal incisions

A wide range of xenografts are also available for commercial use, the most common being porcine dermal and small intestine submucosa (SIS) grafts, both cross-linked and non-cross-linked. The non-cross linked forms of these tissues are rapidly degraded after implantation, losing most of their mechanical integrity within 3 months, without any tissue regeneration or reorganization. Cross-linking of these xenografts confers increased tensile strength and resistance to degradation. Long-term data is still lacking, but several studies have detailed inflammatory complications and extrusions at similar rates to those experienced with mesh products [11, 12]. Given the high cost of these products and their uncertain safety and efficacy, we highly recommend the use of autologous tissue grafts whenever possible.

Most surgeons harvest abdominal rectus fascia for use in native tissue anti-incontinence surgeries because it is easier and faster to harvest. We, however, have abandoned the use of rectus fascia in favor of harvesting tensor fascia lata (iliotibial band). This technique is significantly less morbid and provides improved cosmesis for patients. The technique is particularly useful in obese patients in whom accessing the rectus fascia is more challenging and in patients with prior abdominal surgeries when adequate graft may be difficult to obtain due to scarring. In our experience, harvest of rectus fascia is associated with increased pain at the harvest site, a slower return to normal activities due to the increased tension of the abdominal wall fascial closure, and an increased risk of post-operative complications, such

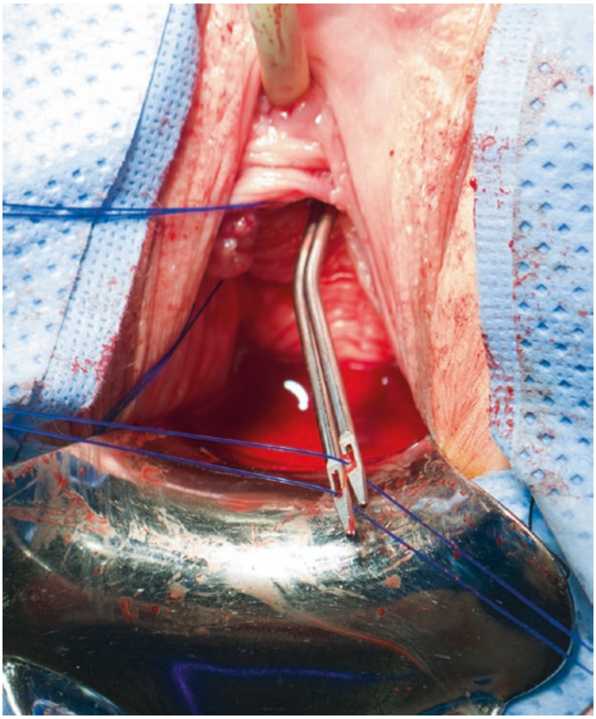

Fig. 20.17 The sutures are transferred through the eyes of the needle and retracted to the suprapubic area

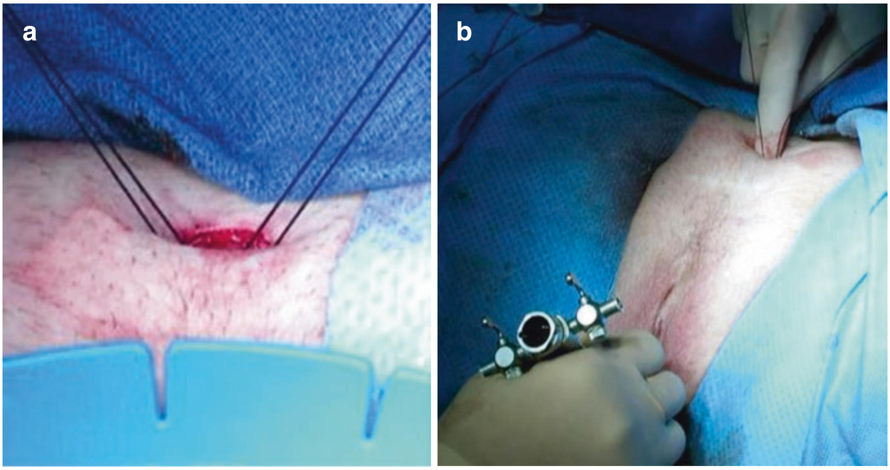

Fig. 20.18 (**a**) The suprapubic incision and sutures are seen. (**b**) Cystoscopy will be performed, the sutures will be tied using two Allis clamps to keep the sling in an horizontal plane and the anterior vaginal wall will be closed with several delayed absorbable sutures

as abdominal wall hernia, that frequently require re-operation to correct. Although this technique does require repositioning of the patient during surgery, the complications are rare and preventable, such as thigh hematoma or wound infection, almost all of which can be managed non-operatively.

For fascia lata harvest, the patient is placed in a lateral decubitus position with flexion of the knees, along with elevation of the thigh and knee using pillows (Fig. 20.19). We prefer the left leg in all patients when possible to allow the patient to return to driving with less discomfort. A transverse incision is made approximately 3–4 cm above the knee over the palpable iliotibial band, which is marked on the patient prior to surgical preparation. The tendinous section of the fascia is then exposed, and two parallel incisions are made in line with the fascial fibers approximately 1 cm apart. A right-angle clamp is used to develop the plane beneath the fascia and to separate it from the underlying musculature (Fig. 20.20). The fascial segment is transected inferiorly and a #1 delayed absorbable suture placed at this margin with multiple passes to anchor the stitch without fraying the fascial border (Fig. 20.21). Using a combination of sharp and blunt dissection, the fascia is separated from the subcutaneous tissue and underlying musculature for approximately 10 cm cephalad to the skin incision. This can be accomplished mostly with the Crawford stripper, used to separate and transect the 10 cm segment (Fig. 20.22). Alternatively, the incisions in the fascial tendon can be extended cephalad and the fascial strip transected at its most proximal aspect using a right angle scissors, such as a Jorgenson scissor. The suture and the caudad margin of the fascial strip is passed through the tip of the stripper, and the stripper advanced 10–12 cm along the direction of the fascial fibers. The device is then activated to transect the cephalad margin of the fascial strip, and a second anchoring #1 delayed absorbable suture is placed at this fascial margin (Fig. 20.23). The fascial strip is then placed in antibiotic solution until later use. Prior to closure, the wound is irrigated extensively with antibiotic solution and immaculate hemostasis obtained. The incision is closed in two layers in standard fashion. A pressure dressing using self-adherent elastic wrap, such as Coban™ (3 M, St. Paul, MN), is used to prevent hematoma formation. Placement of a fascial sling using anterior rectus fascia is identical to that described here for fascia lata; the harvest procedure for abdominal fascial harvest can be found in cited sources (see Chap. 5) [13].

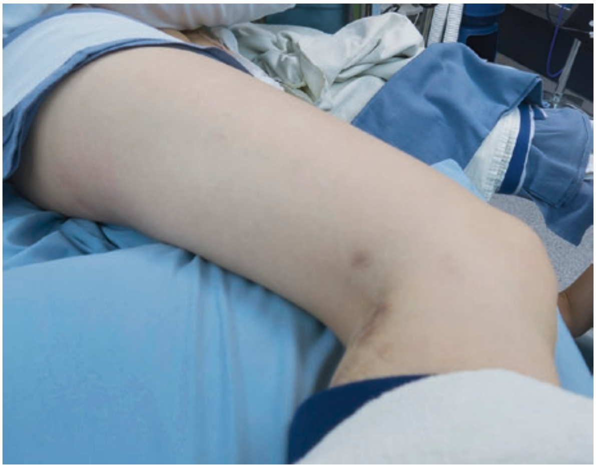

Fig. 20.19 The first part of the surgery is the retrieval of the fascial segment. The patient is placed in the tort position with elevation of the thigh and knee over a pillow. The inferior part of the lateral thigh and knee is prepared and draped

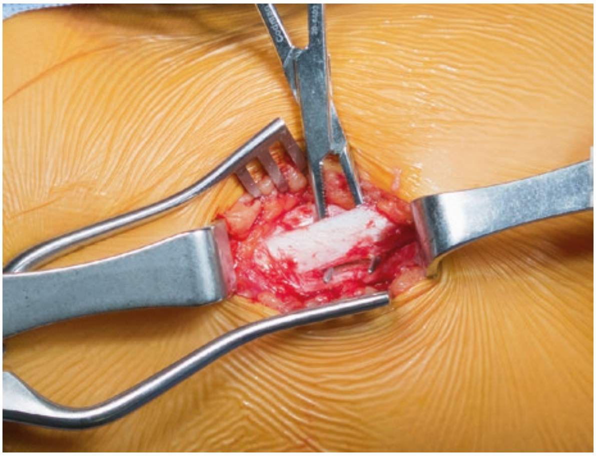

Fig. 20.20 A right-angle clamp is used to isolate the strip of fascia from the underlying musculature

Fig. 20.21 Sharp and blunt dissection is used superior to the fascia to separate the fascia from the subcutaneous tissues for a distance of 10 cm. The fascia is also dissected sharply and bluntly from the underlying lateral musculature to facilitate the fascial incision

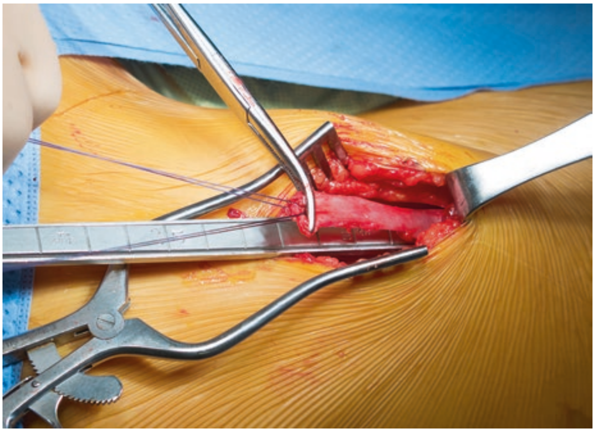

Fig. 20.22 A clamp is applied to the end of the fascial segment to provide countertraction at the time of the advancement of the stripper

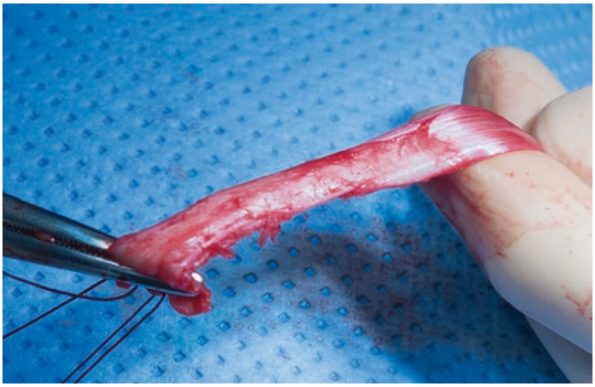

Fig. 20.23 The fascial strip is removed and another #1 delayed absorbable suture is applied to the free end. The fascia lata segment is placed in antibiotic solution. The wound is closed in two layers of #2-0 delayed absorbable sutures in the subcutaneous and #4-0 in the skin

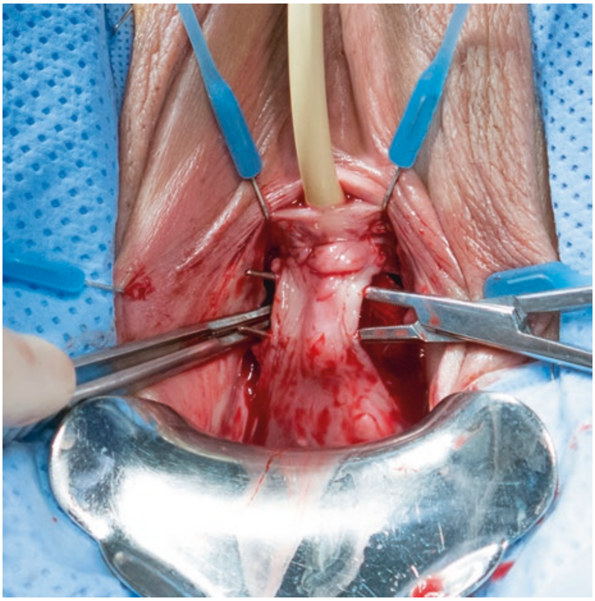

Fig. 20.24 Two oblique incisions are made in the distal lateral vagina. The retropubic space is entered in each side and all adhesions are freed. A tunnel is made under the vaginal wall, 2 cm from the external meatus

To place a sling, two oblique incisions are made lateral to the urethra on the distal vaginal wall. The retropubic space is entered, and all retropubic adhesions freed. A right-angle clamp is then used to create a tunnel underneath the vaginal wall suburethrally (Fig. 20.24). The fascial strip is transferred through this tunnel (Fig. 20.25). The fascia is sutured in place to the periurethral tissue unilaterally to prevent displacement of the sling. A small puncture is made approximately 1 cm above the pubic symphysis. Passage of the double-pronged sling passer from this incision to the vagina through the ipsilateral retropubic space allows transfer of the sling and suture retropubically (Fig. 20.26). This procedure is repeated contralaterally. Gentle countertraction is applied by two Allis clamps on the sling lateral to the urethra

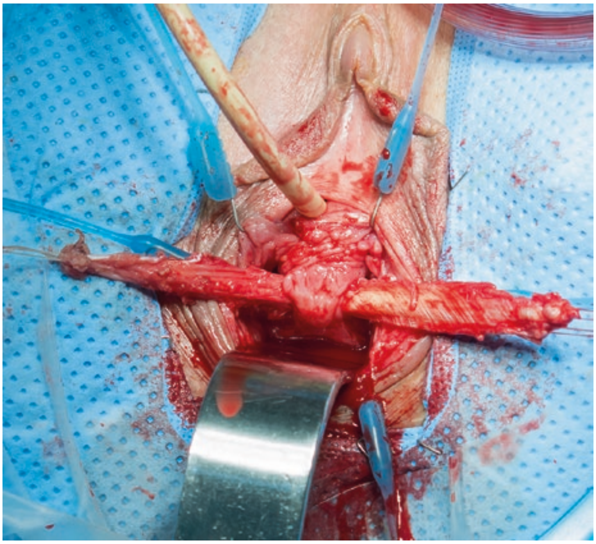

Fig. 20.25 A small incision is made in the suprapubic area. Using a double-pronged passer, under finger control in the retropubic space, the sutures are transferred from the vagina to the suprapubic puncture area

Fig. 20.26 The double-pronged passer is transferred to the vaginal area. The absorbable sutures at the end of the fascial strip are transferred through the eyes of the passer. The passer is retracted up and removed through the suprapubic incision, bringing with it the sutures attached to the sling. Proper positioning of the sling in the retropubic space must be confirmed, as outlined in the text

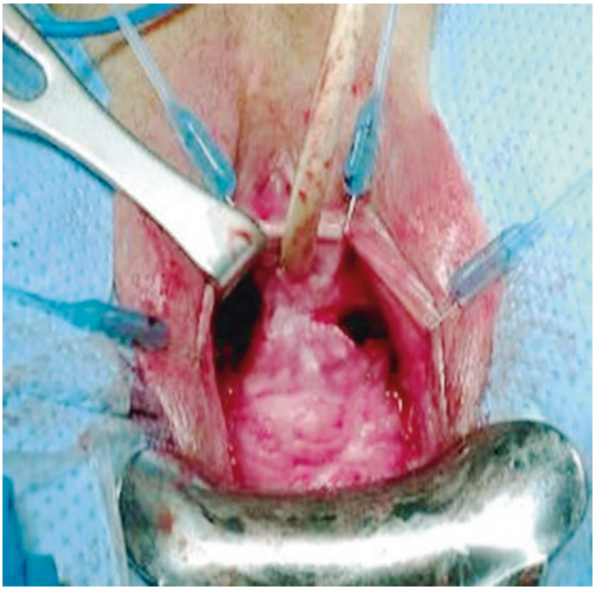

Fig. 20.27 Two oblique incisions are made in the anterior vaginal wall. The retropubic space is entered and all adhesions of the bladder and urethra are freed

bilaterally; they are maintained in a horizontal plane while the suspension sutures are tied to the anterior rectus fascia without tension. The vaginal wall is then closed and cystoscopy performed to rule our iatrogenic bladder or urethral injury.

For patients who have failed a prior repair or who have severe, nearly continual stress incontinence, it may be indicated to provide increased closure or coaptation of the urethra using an omega or spiral sling with autologous fascia for better results. The fascial harvest proceeds similarly, but a longer (15 cm) segment is required. In these modifications of the standard pubovaginal sling, after the distal vaginal incisions are made bilaterally, a complete urethrolysis is performed, removing all adhesions of the urethra to the inferior surface of the symphysis pubis (Fig. 20.27).

For an omega-shaped sling, two small punctures are made in the suprapubic area approximately 2 cm lateral to the midline, just above the symphysis (Fig. 20.28). The double-pronged passer is then transferred from the right suprapubic incision to the left vaginal incision through the retropubic space anterolateral to the urethra. After capturing the suture on one end of the fascial strip, the sling is transferred to the suprapubic incision. This procedure is repeated on the contralateral side such that the double-pronged passer is brought through the left suprapubic incision to the right vaginal incision, anterolateral to the urethra, capturing the suture on the end of the fascial strip. When this suture is transferred back to the left suprapubic incision, the fascial graft now surrounds the urethra, crossing anterior to the urethra, creating an omega-shaped compression of the urethra (Fig. 20.29). Thus, the omega fascial sling is actually passed through two separate suprapubic punctures.

For a spiral sling, an angulated clamp, such as a Derra, is passed through one incision into the retropubic space, between the pubic bone and the urethra, to the

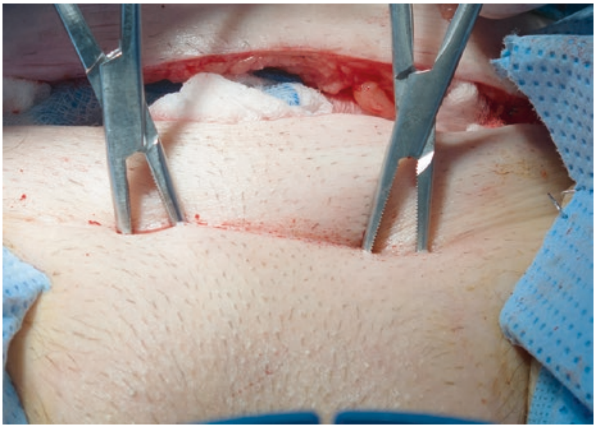

Fig. 20.28 Two punctures are performed in the suprapubic area, 10 cm apart. A clamp is used to create a subcutaneous pocket

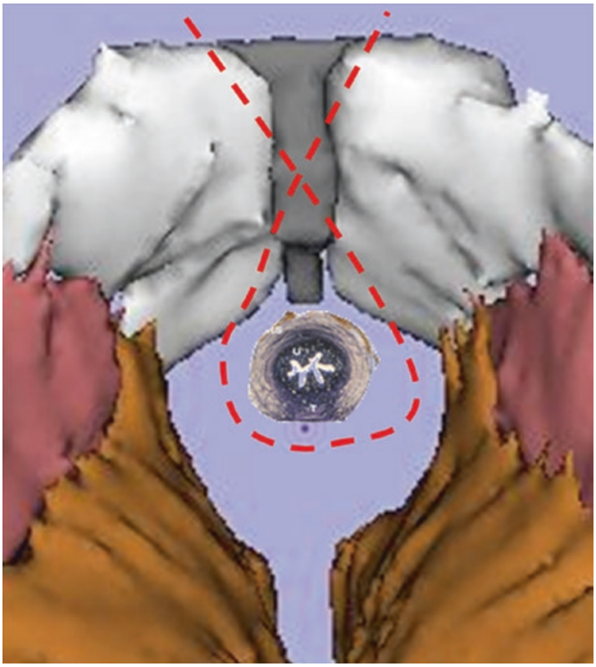

Fig. 20.29 Diagram of the omega-shaped fascial sling: the fascial strip is crossed in the retropubic space anterior to the urethra

other incision (Fig. 20.30). The clamp is then used to transfer the fascial graft from this incision back through the contralateral incision, with the graft traversing the retropubic space between the urethra and pubic bone (Fig. 20.31). A tunnel is then made between the vaginal wall and the urethra 2 cm from the external meatus. A right-angle clamp is inserted through this tunnel and is used to transfer the fascial strip from right to left (Fig. 20.32). This step is repeated on the contralateral side, transferring the left margin of the fascia to the right such that the fascial graft now completely surrounds the urethra circumferentially (Fig. 20.33), overlapping at the

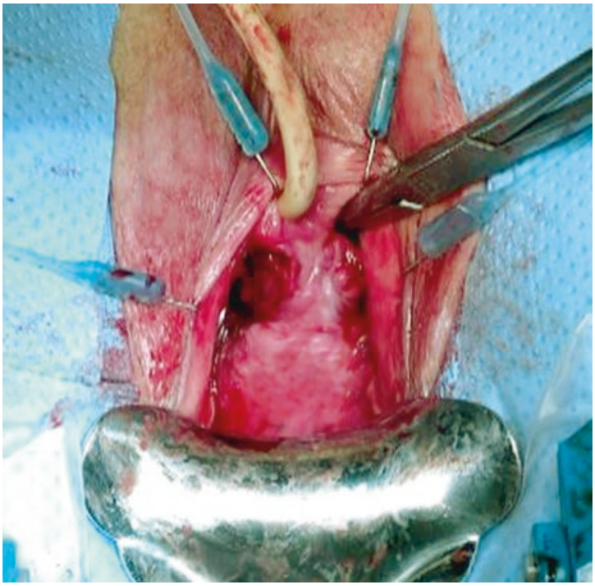

Fig. 20.30 Under finger control in the retropubic space just anterior and distal to the urethra, the clamp is transferred through the retropubic space from the left vaginal incision to the right side

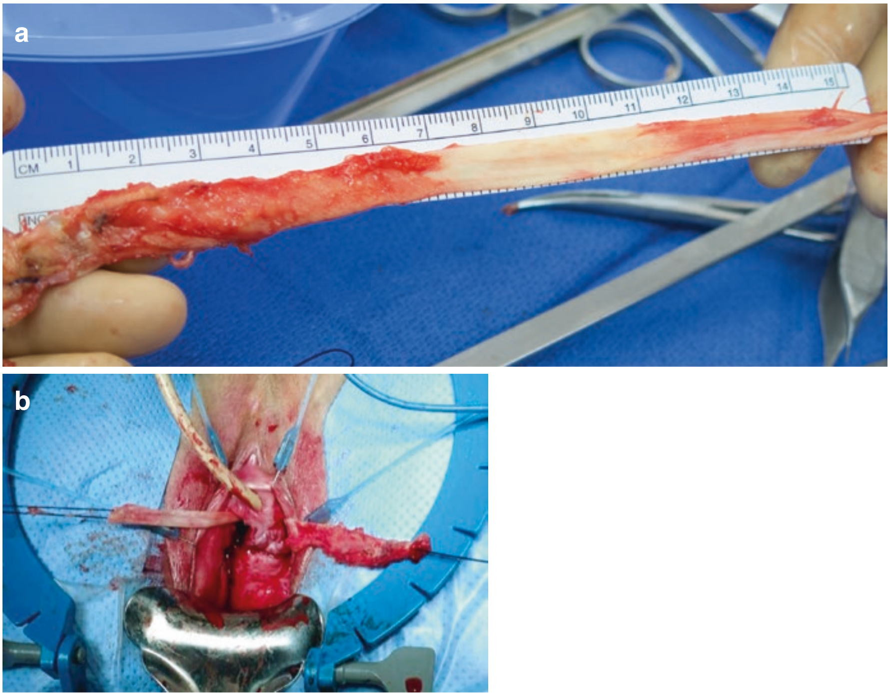

Fig. 20.31 (**a**) A 15 × 1 cm segment of fascia lata is prepared. At each end, a #1 delayed absorbable suture is applied. (**b**) The fascia is transferred through the retropubic space between the urethra and the pubic bone

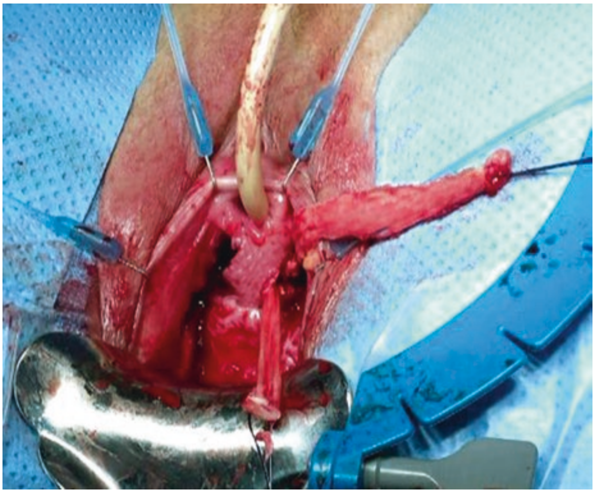

Fig. 20.32 The right side of the fascia is transferred under the vaginal tunnel to the left side

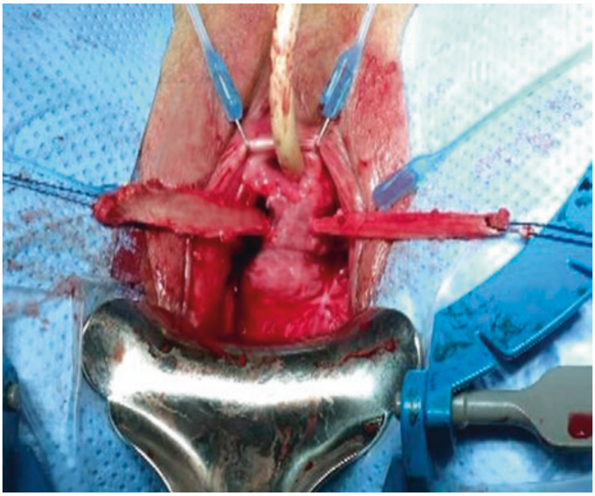

Fig. 20.33 Both ends of the fascial segment have been transferred, completing the circle around the urethra

suburethral portion of the vagina (Fig. 20.34). The sutures on the ends of the fascial strip are then transferred to the suprapubic area, through the suprapubic puncture site, and tied down.

Both the omega and spiral slings confer a slightly increased risk of temporary retention after surgery. Placement of two Allis clamps on the fascial strip lateral to the urethra and mild counter-traction while securing the suspension sutures will minimize this risk (Fig. 20.35). In select patients, retention can be the goal of the surgery; the spiral or omega sling can be tensioned to achieve outlet obstruction. This approach is only used in desperate situations, such as patients with neurogenic bladder or a scarred, open, incompetent urethra after multiple failed repairs, in whom the only hope of continence is urinary retention with intermittent catheterization.

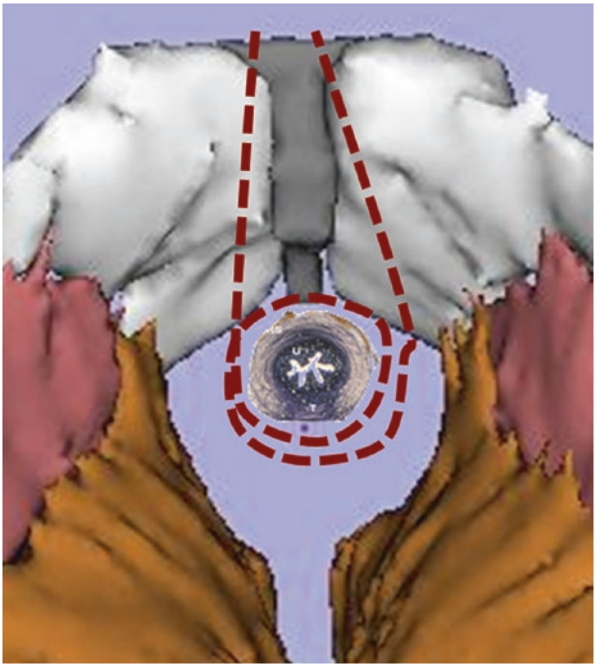

Fig. 20.34 Diagram of the spiral fascial sling: the sling surrounds the urethra in a circular fashion, providing the best possible urethral compression

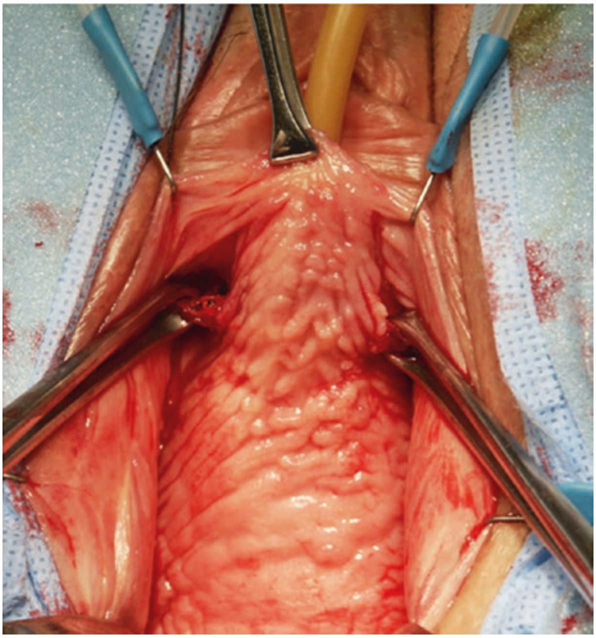

Fig. 20.35 Two Allis clamps are placed vaginally at each side of the mesh to prevent migration of the sling. The suprapubic delayed absorbable sutures (DAS) are tied individually, and the mesh is kept under slight traction to prevent excessive tensioning of the sling and urethral obstruction

For all anti-incontinence procedures, decompression of the bladder with foley catheter drainage during the procedure is essential. Cystoscopy is always performed at the completion of these procedures despite the use of native tissues to ensure there has not been any damage to or entry into the bladder or urethra during the sling procedure that might necessitate prolonged foley catheter placement. During cystoscopy, to help determine the optimal tension on the sling suspension sutures, the cystoscope can be placed at the distal urethra while gradually applying increased tractioning to the sutures. Optimal tension is achieved at the minimal tension needed to obtain urethral coaptation visually. The patient in the case presentation underwent placement of an autologous fascia lata pubovaginal sling.

Case Presentation

Nine months later, our index patient presents with significantly improved urinary incontinence (using less than 1 pad per day), but with a recurrent bothersome vaginal bulge. On exam, she had advanced anterior vaginal wall (AVW) and posterior vaginal wall (PVW) prolapse; the apex was still well supported. She was offered a pessary for conservative management, but considering all she had gone through to date, she desired a definitive surgical repair. We traditionally contemplate four surgical approaches for native tissue repair of moderate to severe AVW prolapse: (1) The first choice is an anterior colporrhaphy in those with robust vaginal wall and no prior surgeries; excision of a midline elliptical segment of the anterior vaginal wall is performed exposing the underlying perivesical fascia. The midline incision is then closed with plication of the underlying perivesical fascia using multiple figure-of-eight PDS sutures. In contrast, most surgeons will perform a vertical incision of the anterior vaginal wall, dissecting the vaginal wall laterally, plicate the underlying perivesical fascia, then close the overlying vaginal wall incision; we perform the excision of the midline vaginal wall and plication in one closure; (2) cystocele repair using interlocking sutures of polypropylene (CRISP), in those patients with lateral and central defects, (3) four-corner bladder neck and bladder suspension, in those with lateral defects. The four-corner can be used as a single procedure for only lateral defects with additional central defect repair when indicated (if central defect present). To repair the lateral defects, the bladder and bladder neck are then supported to the superior rami of the pubic bone, using nonabsorbable sutures. Four #0 monofilament polypropylene sutures are used to incorporate the urethropelvic and periurethral fascia at the bladder neck and the vesicopelvic and perivesical fascia at the bladder base, providing lateral support to the AVW, with sutures transferred and tied at the suprapubic site; (4) lateral and central defect repair using autologous vastus lateralis fascia. As described in the above options, none use mesh grafts; all use permanent sutures (monofilament polypropylene), delayed absorbable sutures, and/or autologous fascial graft. Women with recurrent AVW prolapse after previous surgeries (including mesh removal), and/or significant anterior vaginal atrophy are frequently extremely challenging to reconstruct secondary to deficient, attenuated periurethral and perivesical fascia. Thus, it may be that to improve the sensation of vaginal bulge in women with recurrent AVW prolapse after mesh removal, considering the weakened, deficient tissues, repair using autologous fascia provides the most robust opportunity for desired outcome. Cormio et al. recently describe their outcomes of cystocele repair, using rectus fascia, finding it a safe, effective technique for repair [14]. We modified this technique, to use the harvest of fascia from the leg, secondary to the previously described morbidities of rectus fascial graft harvest. For PVW prolapse repairs after removal of failed synthetic materials, we do not alter our traditional posterior native tissue repair; rather, we are even more cognizant of ensuring that the tissue is meticulously handled, to avoid any additional scar or vaginal narrowing.

Surgical Description

The CRISP Procedure is a native tissue repair of the AVW using interrupted monofilament polypropylene sutures; it can be used for both lateral and central defects [15]. The lateral defect is repaired by passing sutures through the lateral arcus tendineus fascia pelvis to incorporate the lateral margin of the bladder wall (vesicopelvic fascia). The central defect is repaired by using mattress monofilament sutures from the bladder neck to the bladder base; the sutures are tied after interlocking each of them with the laterally placed sutures. The result is a net of a monofilament sutures supporting the lateral and central defects (Fig. 20.36). In the past, occasionally monofilament polypropylene sutures had extruded through the delicate, attenuated tissues of patients with histories of mesh complications, thus, more commonly,

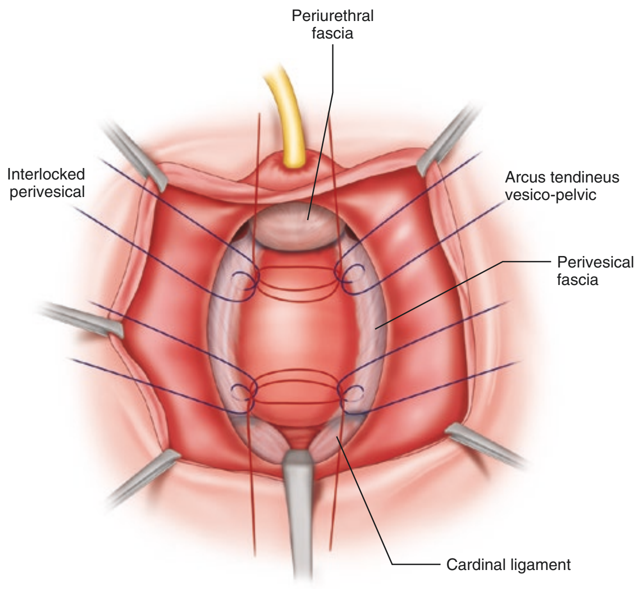

Fig. 20.36 Diagram showing the principles of the CRISP surgical procedure. The lateral sutures (*black–blue*) are applied to the vesicopelvic fascia and the arcus tendineus fascia pelvis and the central sutures (*red*) to the perivesical fascia

this population of patients is treated with a four-corner bladder and bladder neck suspension or an autologous fascia cystocele repair.

The four-corner bladder and bladder neck suspension for a lateral defect cystocele can be used most effectively for patients with moderate AVW prolapse, with a mainly lateral defect, but can be combined with a central defect repair as well. More specifically, if a central defect is present, as described previously, an elliptical segment of AVW is excised to expose the underlying perivesical fascia from the bladder neck to the bladder base. The edges of the vaginal wall and underlying perivesical fascia are then plicated in a one-layer closure using horizontally-placed figure-of-eight PDS sutures. The central defect repair is performed initially, to prevent accidentally cutting the four-corner lateral suspension sutures.

To address the lateral defects, two oblique incisions are then made laterally from the midurethral area to the bladder base. Curved Mayo scissors are applied to the inferior aspect of the pubic bone, parallel to the urethra, pointing the tip superiorly; they are inserted into the retropubic space as far lateral as possible, parallel to the urethra in a superior direction, just behind the posterior aspect of the pubic bone, detaching the urethropelvic and vesicopelvic fascia from the arcus tendineus fascia pelvis (Fig. 20.37). At this time, #0 monofilament nonabsorbable sutures are applied to the bladder base, the bladder neck, and periurethral area (Fig. 20.38). Starting at the bladder base, long forceps are used to retract the vaginal wall medially (Fig. 20.39), exposing the detached vesicopelvic fascia and #0 nonabsorbable mono-

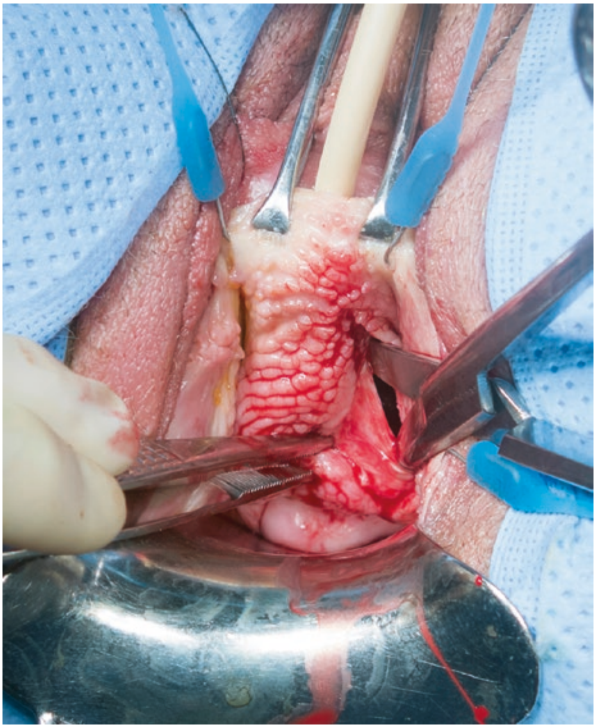

Fig. 20.37 Dissection is carried out around the periurethral fascia toward the inferior rami of the pubic bone. A pair of curved scissors is inserted as far lateral as possible, parallel to the urethra in a superior direction, just behind the posterior aspect of the pubic bone

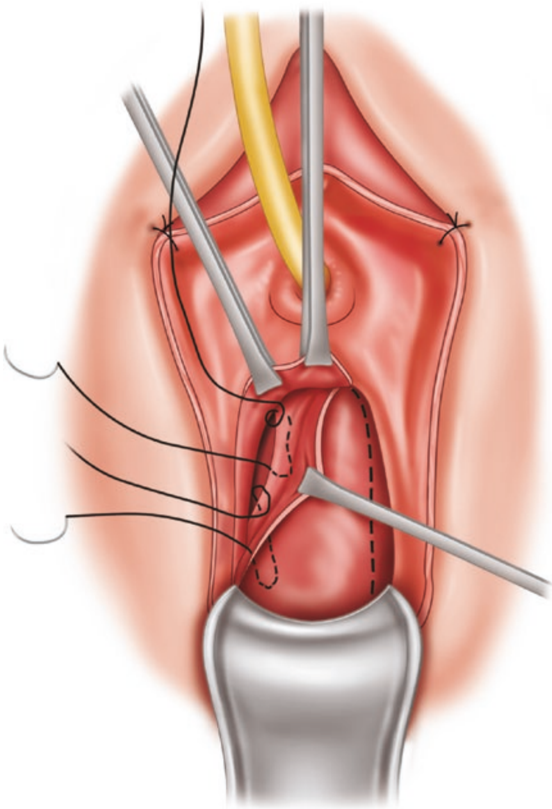

Fig. 20.38 Diagram showing the application of four #0 nonabsorbable monofi lament sutures. At the bladder base, the sutures incorporate the vesicopelvic fascia in the retropubic space and with a wide passage of the needle under the vaginal wall to incorporate the perivesical fascia medial to the incision and at the bladder base. At the level of the bladder neck, the sutures incorporate the urethropelvic fascia in the retropubic space, the perivesical fascia at the level of the bladder neck, and the periurethral fascia at the level of the proximal and midurethra

filament sutures are incorporated into the vesicopelvic fascia in the retropubic space with a wide passage of the needle under the vaginal wall, also incorporating the perivesical fascia medial to the incision (Fig. 20.40). A wide segment of the perivesical fascia is incorporated at the bladder base; multiple passes of the needle incorporate the vesicopelvic and perivesical fascia (Fig. 20.41). At the level of the bladder neck, forceps in the retropubic space expose the detached urethropelvic fascia (Fig. 20.42); the sutures incorporate the urethropelvic fascia in the retropubic space (Fig. 20.43), the perivesical fascia at the level of the bladder neck, and the periurethral fascia at the level of the proximal and mid-urethra (Fig. 20.44). Four sutures (two at the bladder base and two at the bladder neck/urethra) are used in total and transferred from the vagina to the suprapubic area using a double-pronged passer (Figs. 20.45, 20.46, and 20.47). With placement of permanent sutures at each of the 4-corners through the described tissues, the surgeon should be able to move the patient's pelvis to and fro on the table, confirming an appropriately strong anchor. Prior to passing the double-pronged passer from the suprapubic to vaginal spaces,

Fig. 20.39 A long forceps is used to retract medially the vaginal wall, exposing the vesicopelvic fascia detached from the arcus tendineus fascia pelvis

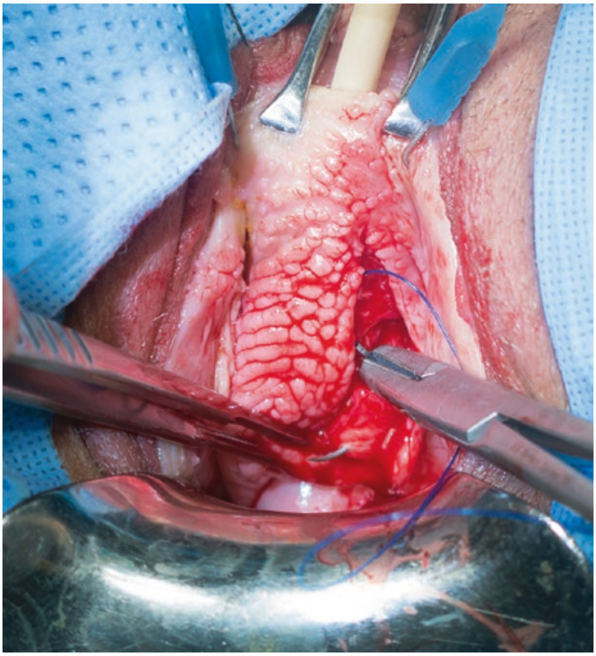

Fig. 20.40 At the bladder base, #0 monofilament nonabsorbable suture is used to incorporate the detached vesicopelvic fascia from the arcus tendineus

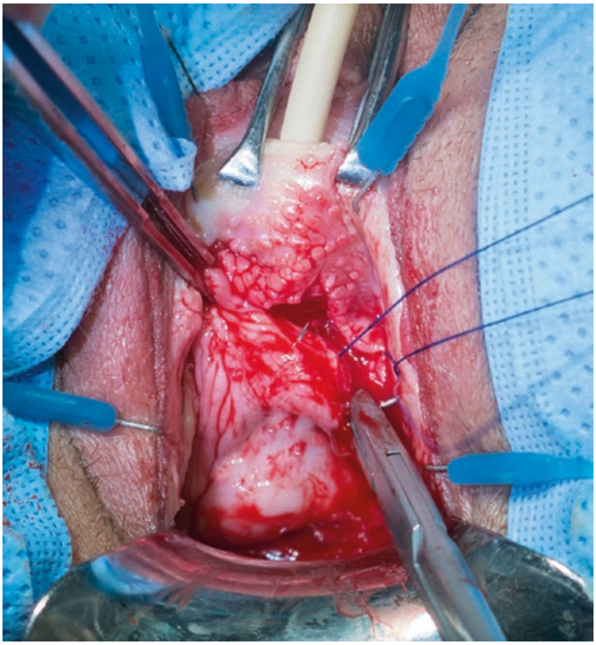

Fig. 20.41 A wide segment of the perivesical fascia is incorporated at the bladder base. Multiple passes of the needle incorporate again the vesicopelvic and perivesical fascia

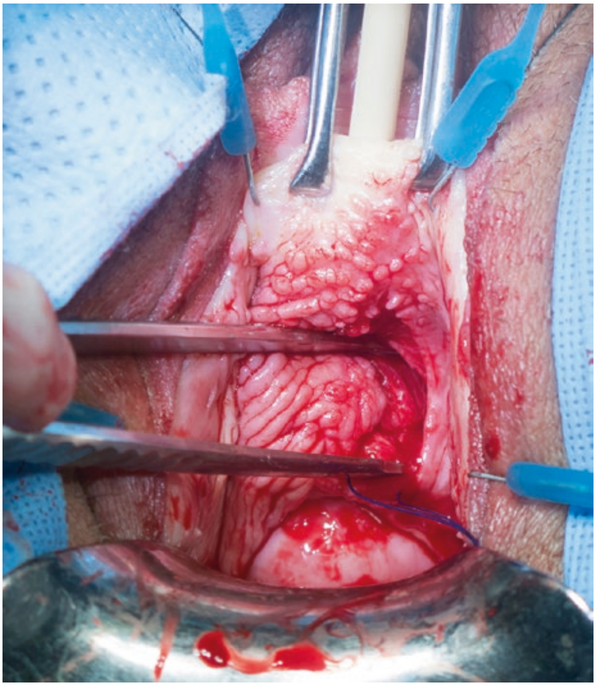

Fig. 20.42 A forceps in the retropubic space exposes the detached urethropelvic fascia at the level of the bladder neck

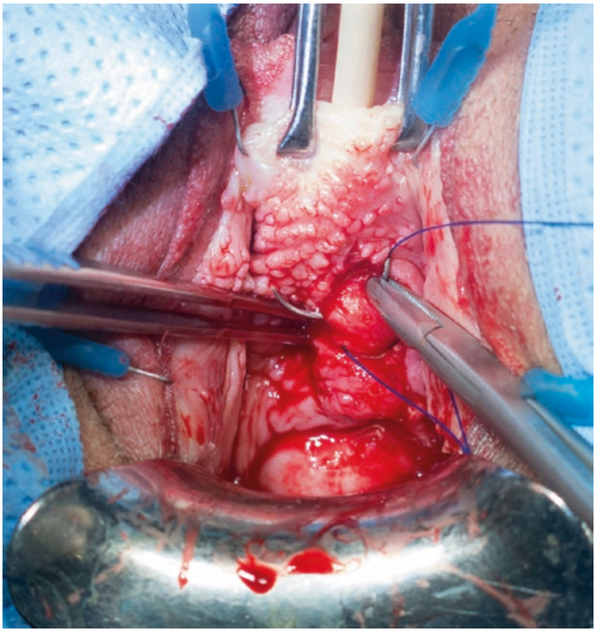

Fig. 20.43 At the level of the bladder neck, a #0 monofilament suture incorporates the urethropelvic fascia

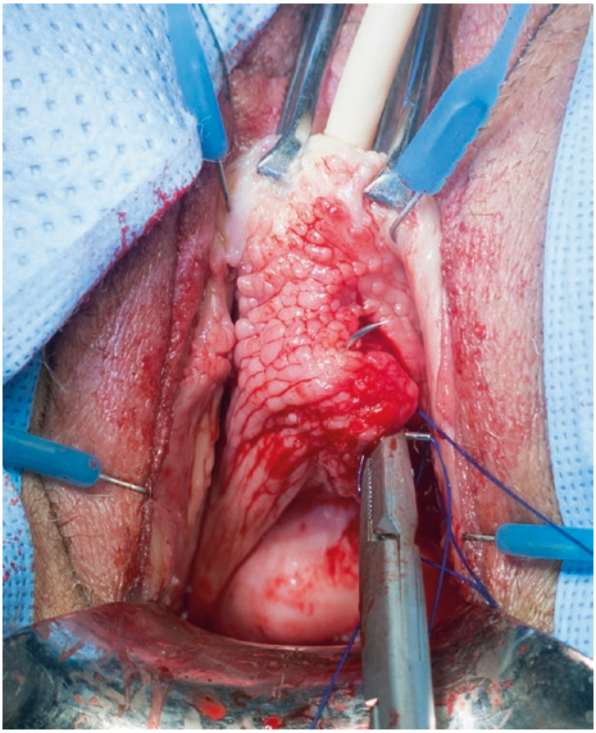

Fig. 20.44 The perivesical fascia at the bladder neck and the midurethral periurethral fascia are incorporated with the suture

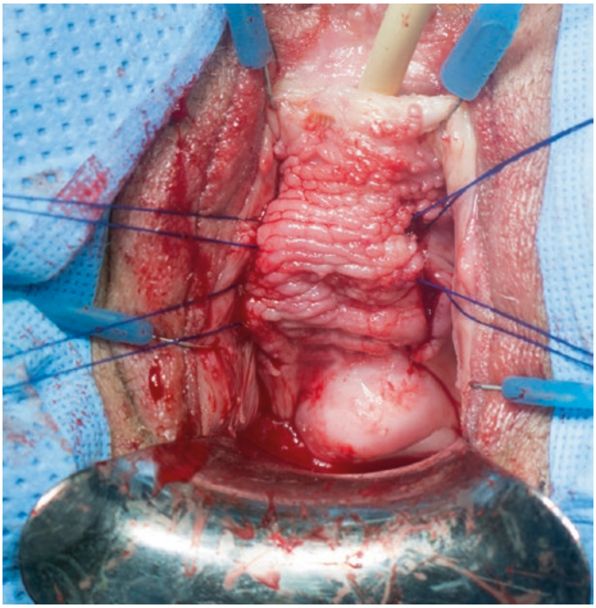

Fig. 20.45 The four sutures have been applied: two at the bladder base and two at the bladder neck and urethra. Pulling the sutures should confirm a strong anchor of tissue, to the point that the patient can be moved over the table

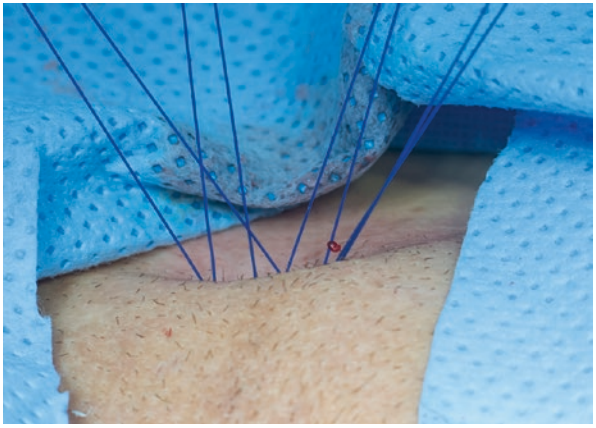

Fig. 20.46 The four sutures have been transferred to the suprapubic puncture area

ensure the bladder is empty (to avoid perforation). The AVW is closed with interrupted #2-0 delayed absorbable sutures. Cystoscopy is performed after intravenous injection of dye to ensure no entry into the bladder wall with the nonabsorbable sutures. The suprapubic sutures are tied sequentially at the suprapubic space, keeping the cystoscope sheath in the urethra at a 45° angle (Fig. 20.48), to prevent unnecessary over-correction of the urethral angle. The sutures are tied without tension, so the knots are 2–4 millimeters (mm) below the skin. Suprapubic pain/discomfort is a rare complication and could be secondary to nerve entrapment, tight knots, or infection. By transferring the sutures more midline, this can prevent ilioinguinal nerve injury. A vaginal packing soaked with antibiotics is inserted into the vagina. The suprapubic puncture site is closed with a #4-0 delayed absorbable suture.

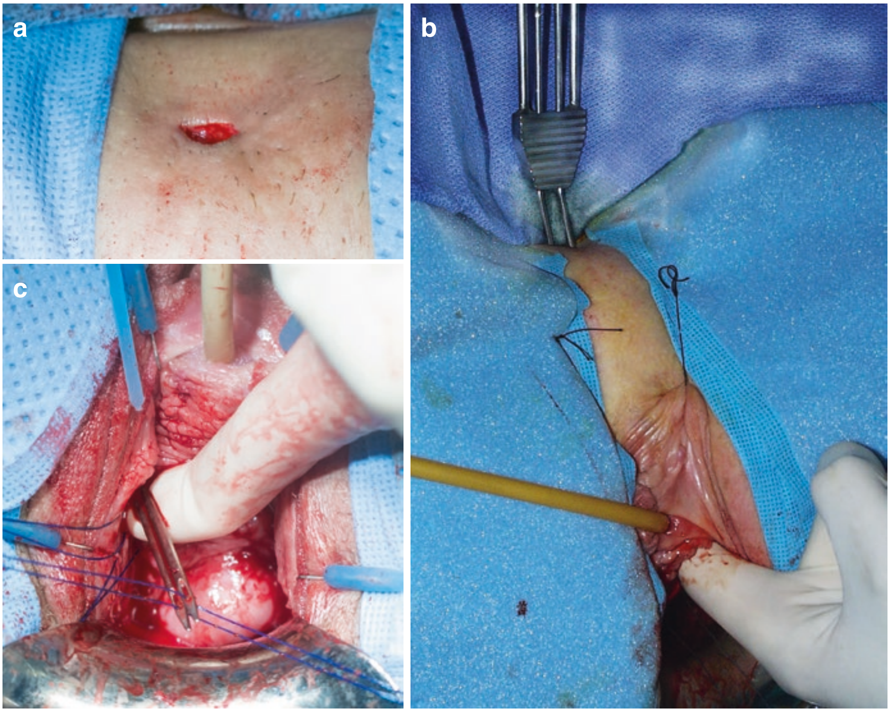

Fig. 20.47 (**a**) A small puncture is performed in the suprapubic area. (**b**) Under finger control in the retropubic space, a double-pronged passer is transferred from the suprapubic to the vaginal area. (**c**) The double passer is brought outside the vaginal incision, and the sutures will be transferred through the needle holes

Fig. 20.48 Cystoscopy is performed after injection of indigo carmine. Keeping the cystoscope in a 45-degree angulation, the sutures in the suprapubic area are tied sequentially without tension. A vaginal packing soaked in antibiotics is inserted

For those patients with significant vaginal atrophy, deficient/attenuated periurethral and perivesical fascia, a history of multiple pelvic surgeries, and/or recurrence of AVW prolapse we offer a fascial graft reconstruction [16]. More specifically, a 4 cm by 4 cm fascia lata graft is harvested from the fascia lata and condensation of fascia overlying the vastus lateralis for placement at the AVW (Refer to Video 20.1 Native Tissue Repair after Failed Synthetic Materials (Oliver JL, Cohen SA, Kreydin EI, Ackerman AL, Chaudhry Z, Nguyen MT, Kim J, Raz S)). Exposure for the harvest site is obtained in a fashion similar to that which was previously described in this chapter. Instead of using the Crawford stripper device, the square-shaped fascial graft is excised with sharp dissection and cautery (of note, we had previously used the Crawford stripper and plicated two fascial strips at midline to form the graft, but found the square-shaped patch to be more consistent in application to the AVW). On either side of the graft, #1 delayed absorbable suture is applied. The graft is then placed in an antibiotic solution, while the AVW dissection takes place. An elliptical incision is made in the anterior vaginal wall from the bladder neck to the bladder base. AVW flaps are dissected off the underlying attenuated periurethral and perivesical fascia, in a medial to lateral direction. At this time, simple-interrupted delayed absorbable sutures are placed, plicating the attenuated perivesical fascia at the midline, repairing the central defect. The retropubic space is entered bilaterally with curved Mayo scissors, in a fashion similar to that described above (Fig. 20.49). One should consider making two (instead of one) separate suprapubic incisions for guidance of the double-pronged passer if midline adhesions are likely to be present in the setting of previous attempts at reconstruction (Fig. 20.50). Under finger control in the retropubic space, the double-pronged passer is transferred from the suprapubic to the vaginal surgical field (Fig. 20.51). The

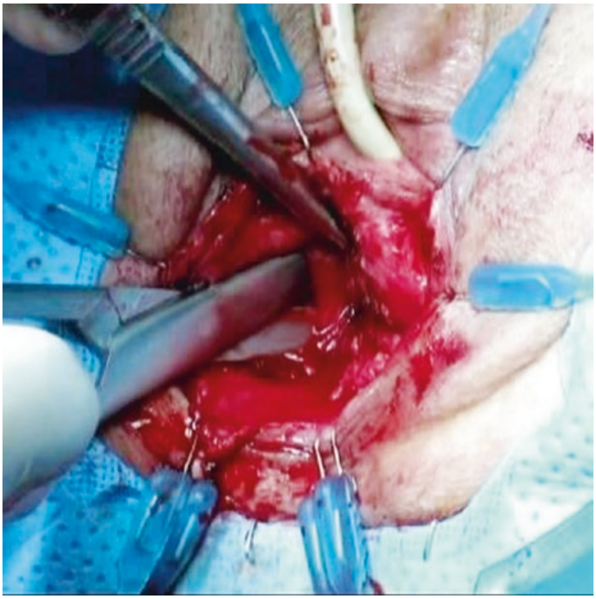

Fig. 20.49 Using scissors, the paravesical space is entered in each side and all adhesions are freed

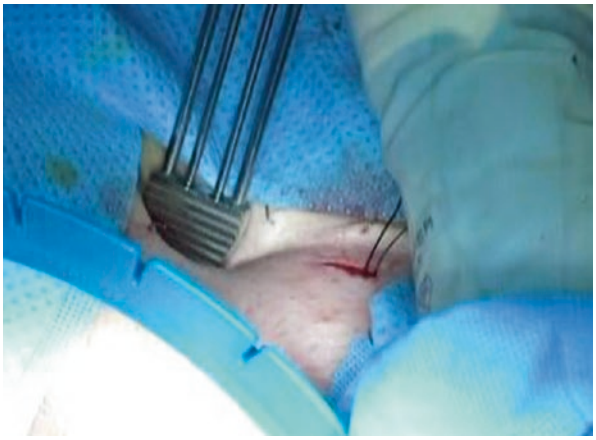

Fig. 20.50 Due to significant adhesions of the bladder in midline, two small punctures are performed in the suprapubic area. Under finger control in the retropubic space, a double-pronged passer is transferred from the suprapubic to the vaginal area

Fig. 20.51 The delayed absorbable sutures at the end of the fascial construct are transferred through the eyes of the needle passer. The passer is pulled back to the suprapubic area

delayed absorbable sutures applied to the fascial graft are transferred through the eyes of the needle passer and the passer is pulled back to the suprapubic area. The graft is fixated to the perivesical fascia at the bladder base and bladder neck with several interrupted #3-0 delayed absorbable sutures, preventing displacement (Fig. 20.52). The AVW is closed with interrupted #2-0 delayed absorbable sutures (Fig. 20.53). The suprapubic sutures are tied down leaving the knots 2–4 mm below the skin, allowing the graft to provide the central and lateral defect support for the AVW (Fig. 20.54). A vaginal packing soaked with antibiotics is inserted into the vagina. The suprapubic puncture sites are closed with #4-0 delayed absorbable sutures.

When addressing the PVW laxity, the goal is to restore the vagina's natural proximal axis extending towards sacral vertebral bodies four through five, along with a smoothly angulated elevation of the distal vaginal axis; avoid leaving ridges in the

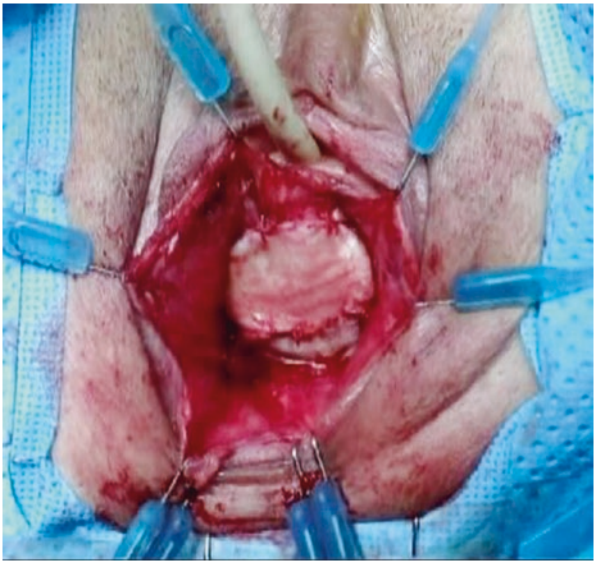

Fig. 20.52 Several #3-0 delayed absorbable sutures are used at the bladder base and bladder neck to secure the fascial segment to the perivesical tissues and prevent displacement

Fig. 20.53 The anterior vaginal wall is closed with delayed absorbable sutures

Fig. 20.54 View of the suprapubic punctures after the sutures are tied. The skin will be closed with a delayed absorbable suture

PVW, over-resection of vaginal tissue, and/or placing sutures directly into the levator musculature. To obtain the appropriate exposure, we always retract the AVW cephalad to prevent any unnecessary PVW excision, which can lead to stenosis of the vaginal canal. Generally, two Allis clamps are used to elevate the redundant PVW at midline; cautery is used to excise an elliptical strip of this redundant vaginal wall (width depending on the size of the defect), extending from the apex of the posterior vagina towards the distal vagina (where a triangular island of vaginal wall has been excised overlying the prerectal fascia and extension of the perineal membrane into the posterior distal vagina) (Figs. 20.55 and 20.56). Using Haney retractors, the AVW is retracted upward while the PVW is retracted downward, creating excellent tension/counter-tension; this maneuver for exposure of the prerectal and pararectal fascia is important, as it facilitates the repair by reducing the rectocele and protecting the rectum (Fig. 20.57). The prerectal and pararectal fasciae are incorporated with running, locking #2-0 delayed absorbable sutures, extending from the apex of the posterior vagina towards the levator hiatus (Figs. 20.58 and 20.59). Each passage is only through the edge of the vaginal wall, with a wider lateral excursion beneath the wall, to incorporate the prerectal and pararectal fasciae bilaterally. This suture closure stops at the triangular excision of the vagina (3–4 cm from the introitus). Here, interrupted figure-of-eight delayed absorbable sutures are placed, incorporating the perineal membrane, providing a narrower levator hiatus, elevating the distal vagina, and rebuilding the perineum (Fig. 20.60). The superficial skin at the perineum is approximated with a vertical line of delayed absorbable sutures. A vaginal packing soaked with antibiotics is inserted into the vagina.

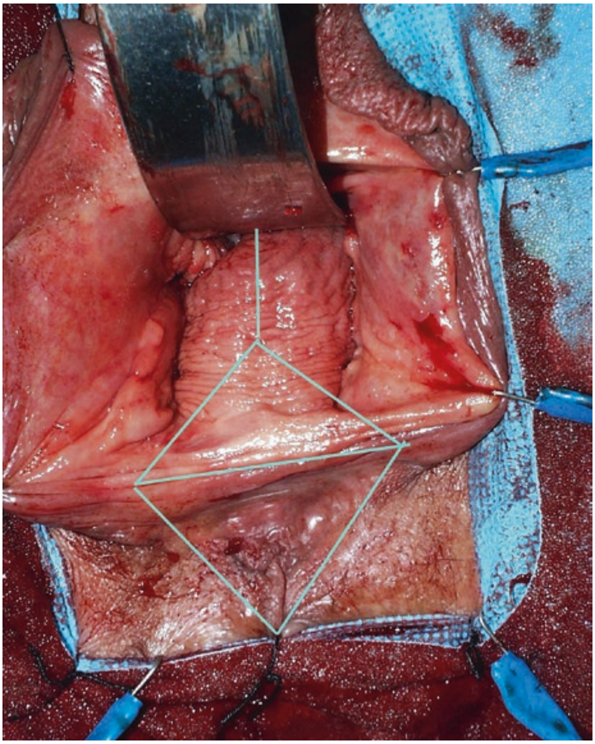

Fig. 20.55 Surgical picture outlining the surgical incisions: (1) a V-shaped incision in the perineum; (2) an inverted V-shaped incision in the vaginal wall, with the tip reaching 3 cm from the introitus (the level of the levator hiatus); (3) a straight incision extending to the vaginal cuff

Our patient in the case presentation underwent autologous vastus lateralus fascia cystocele repair (harvesting fascia from her right lower extremity this time, since her left lower extremity was used for the previous pubovaginal sling harvest). She also underwent PVW repair. Within 4 months of this reconstruction, her vaginal sutures had dissolved, and she was very satisfied with the quality of her life as a result of these surgical interventions.

General Statement Regarding Interposition Flaps

Patients who have undergone prior mesh removal who now require prolapse or anti-incontinence surgeries are at high risk of significant vaginal scarring, which can result in dyspareunia, vaginal pain, as well as vaginal shortening and stenosis and can exacerbate incontinence. When performing a secondary surgery to repair the complications of a prior mesh removal, such as recurrent prolapse repair or anti-incontinence surgery, vaginal function as well as width and depth should be assessed. In a patient with redundant apical or posterior vaginal wall, extension of the vaginal incision unilaterally can provide adequate mobilization to allow for the harvest of a rotational flap from the apex or posterior vaginal wall to cover the

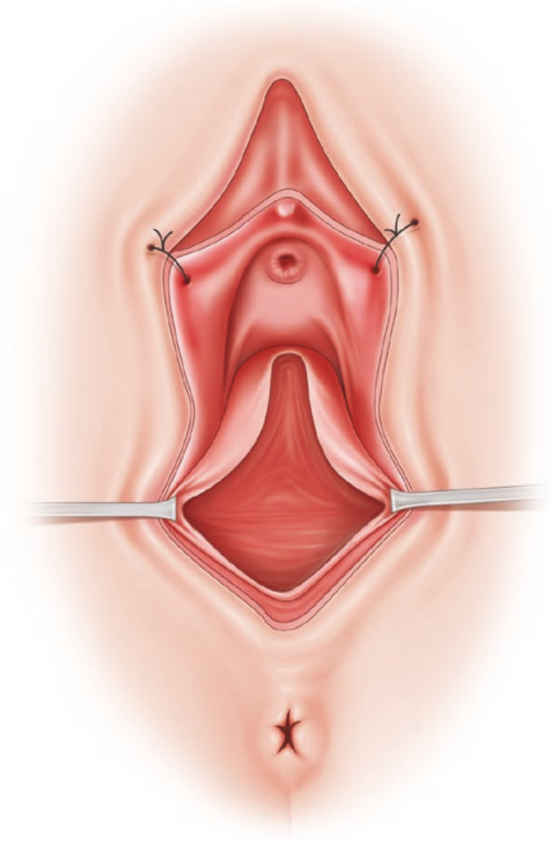

Fig. 20.56 Diagram of the posterior vaginal wall after excision of the strip

affected area. If there is significant scarring, the use of an interposition flap between the revised repair and vaginal closure prevents scar progression, optimizes postoperative vaginal function, and improves tissue vascularity and healing. When pelvic floor disorders present with concomitant vaginal stenosis, use of a rotational or island flap consisting of both fibrofatty tissue and epithelium can be used to cover the surgical repair and correct the stenosis concurrently (for review of some of these options, see [17]).

General Statement Regarding Patient Positioning

For these vaginal surgeries, patients are traditionally placed in lithotomy positioning, with lower extremities in candy-cane stirrups, unless a fascia lata graft is to be harvested for the reconstruction; in that case, the patient is placed in a lateral decubitus position to start, to access the fascia lata. The patient is then repositioned, the

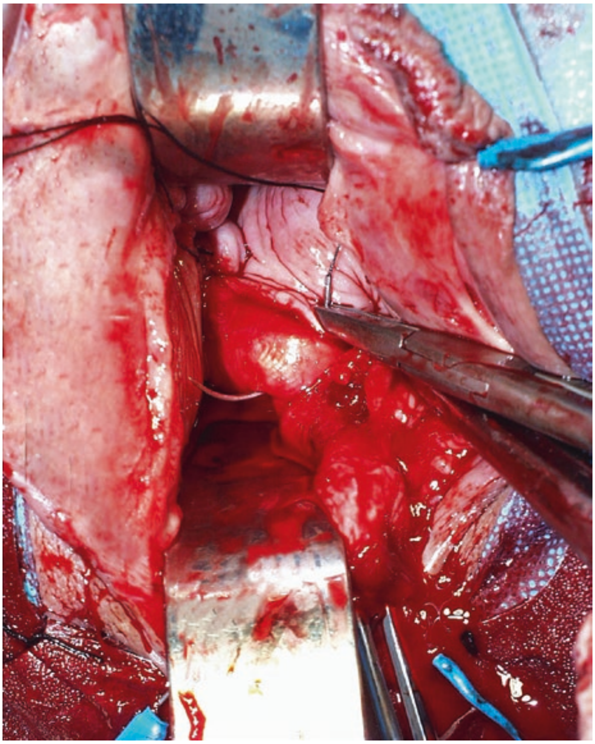

Fig. 20.57 Surgical photograph demonstrates the closure of the rectocele defect. The anterior vaginal wall is retracted upward, and the posterior rectal wall is retracted downward, both with the use of Haney or right-angle retractors. This maneuver facilitates the repair by protecting the rectum, reducing the rectocele, and allowing exposure of the prerectal and pararectal fasciae. The rectocele repair is undertaken by incorporating the prerectal and pararectal fasciae from the apex of the posterior vagina toward the levator hiatus, using a running, locking #2-0 slow absorbable suture. Each needle passage incorporates only the edge of the vaginal wall and generous amounts of the prerectal and pararectal fasciae bilaterally. The suture stops at the level of the triangular excision in the distal vagina, usually 3–4 cm from the introitus

perineum is prepped and draped, and at the start of the vaginal portion of the case, an indwelling urethral catheter is placed. For the sacrocolpopexy mesh removal and autologous sacrocolpopexy, the patient is placed in a low lithotomy position, with lower extremities in stirrups, ensuring both abdominal and vaginal/perineal access.

General Statement Regarding Post-operative Care

The care for these patients after surgery is usually straight-forward. With the exclusion of the laparotomy (for sacrocolpopexy mesh removal, autologous sacrocolpopexy), all patients are monitored for 23 h and discharged home in the morning. Vaginal packing, placed intra-operatively, is removed prior to discharge. The

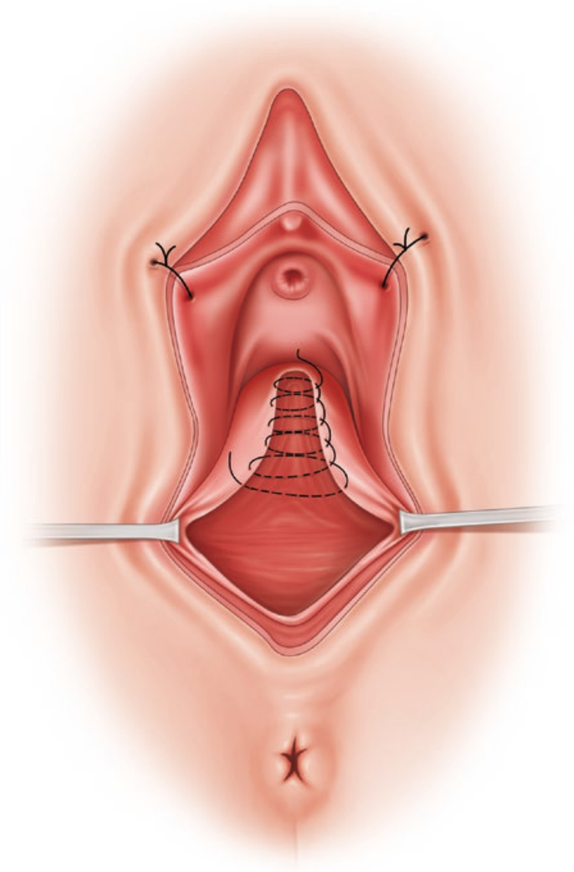

Fig. 20.58 Diagram of the closure of the rectocele defect using multiple running, locking #2-0 slow absorbable suture. We incorporate the edge of the vaginal incision; after insinuating the needle under the vaginal wall, strong segments of the pararectal and prerectal fasciae are incorporated

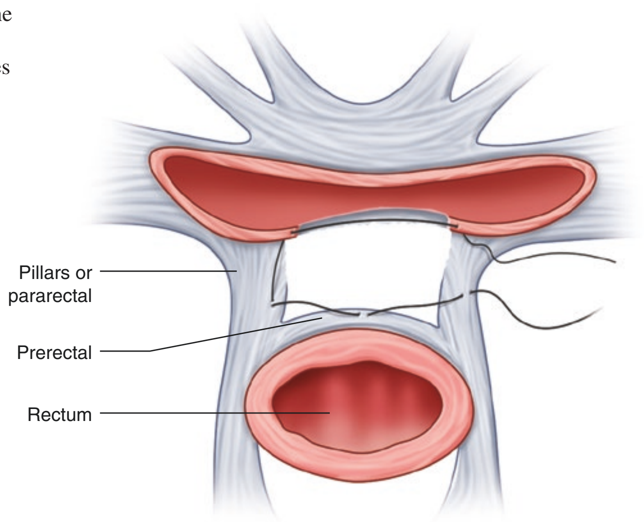

Fig. 20.59 Diagram of the closure of the rectocele defect. The suture includes the edge of the vaginal wall, the prerectal fascia, and the pillars of the rectum (pararectal fascia)

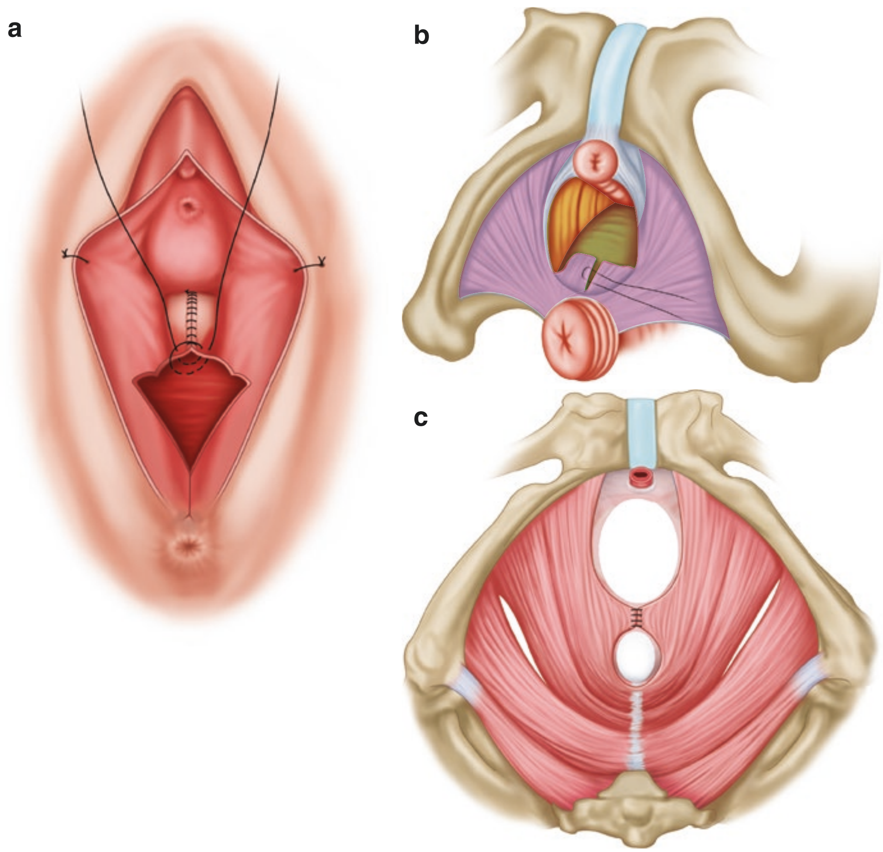

Fig. 20.60 (**a**) Diagram of the application of interrupted figure-of-eight sutures over the distal vagina, incorporating the perineal membrane and resulting in a narrower levator hiatus. Usually two or three sutures are required. They will elevate the distal vagina and rebuild the perineum. (**b**) Diagram depicting the repair of the distal vagina with figure-of-eight sutures approximating the perineal membrane and narrowing the levator hiatus. (**c**) Diagram of the reconstructed and narrowed levator hiatus. The levator muscles are not directly incorporated in the sutures

urethral catheter is removed by the patient usually 2–7 days after surgery (although the patient is welcome to come to clinic for catheter removal, if she is local), depending upon the extent of the surgical dissection. Urinary retention can be managed with reinsertion of an indwelling catheter; if persistent at 2 weeks post-operatively, she should start clean intermittent catheterization until this resolves. For the laparotomy patient, vaginal packing is removed in the morning of post-operative day one. These patients are encouraged to ambulate and use non-narcotic analgesia. When passing flatus, diet is advanced. At the time of discharge, patients are given anticholinergics, analgesics, and stool softeners. Typical activities of daily living are permitted, i.e., walking, driving (if not using narcotic analgesics), climbing stairs, showers, and baths; no heavy lifting (more than five pounds) or straining for 3 months after surgery.

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Chapter 21
Validated Outcomes Measures to Assess the Results of SUI and POP Procedures

Sarah A. Adelstein and Kathleen C. Kobashi

Abstract The pelvic floor literature on surgical trials and research utilizes heterogeneous outcomes measures that render interpretation and comparison of results between groups challenging. This chapter comprises a selected review of objective and subjective outcomes measures that are used to assess stress urinary incontinence (SUI) and pelvic organ prolapse (POP) procedures. The methodology of patient-reported outcome (PRO) instrument validation is briefly reviewed.

The International Continence Society (ICS) and the International Urogynecologic Association (IUGA) have published extensive standardization guides regarding the appropriate terminology and reporting processes for outcomes measures in pelvic floor research. Still, no universally accepted definitions of cure or success currently exist. Consequently, the advisory bodies have suggested using composite outcomes measures, which should include multiple subjective and objective instruments to comprehensively document the full impact of pelvic floor disorders and therapeutic interventions. However, there is no consensus on which instruments are optimal, how these measures should be used in clinical practice, or how the extensive surveying suggested for clinical trials can be reduced and refined effectively. As PROs in the pelvic floor literature continue to evolve, it is beneficial for the pelvic floor surgeon to be knowledgeable about the instruments available to assess these outcomes.

Keywords Patient goals • Patient-reported outcomes • Validated self-assessment instrument • Surgical outcome measures • Pelvic organ prolapse • Stress urinary incontinence

S.A. Adelstein, MD
Urology, Seattle, WA, USA

K.C. Kobashi, MD (✉)
Urology, Virginia Mason Hospital, Seattle, WA, USA
e-mail: kathleen.kobashi@virginiamason.org

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Introduction

Pelvic floor disorders (PFD) are a group of anatomic and functional disorders of the pelvic organs and their sexual and excretory systems. Specifically, PFDs include both functional and anatomic conditions that can result in urinary incontinence (UI), voiding dysfunction, pelvic organ prolapse, fecal incontinence, defecatory dysfunction, and/or sexual dysfunction. PFDs are associated with poor quality of life (QOL), and compromised physical, social, and mental well-being [1, 2]. About one quarter of American women are estimated to have a symptomatic PFD. Higher prevalence is associated with increased age and parity [3], and consequently, as the population ages, PFD evaluation and treatment will likely become more common. It is projected that annual procedures performed for SUI and POP will reach 310,050 and 245,970, respectively, by 2050 [4].

The proper method for measuring efficacy of treatment for PFD is a question of great interest for the pelvic floor surgeon. A substantial body of literature exists around this point, and in this chapter, the outcomes measures for SUI and POP will be reviewed.

Traditional methods for assessing treatment efficacy were the so-called objective outcomes measures, such as physical examination and pad weight. However, a growing body of PFD literature has suggested that these measures are insufficient and suboptimal for representing the symptom severity as experienced by patients, or the multidimensional impact of these symptoms on women [5]. A broad field of outcomes measures—for PFDs and in healthcare generally—has grown to address these gaps and continues to evolve.

Subjective measures, particularly patient-reported outcomes (PRO), play an increasingly important role in assessment of PFD treatment efficacy. Clinicians and researchers now recognize that the impact of patient goals and experience of morbidity in overall patient satisfaction is key to determining efficacy of what is often considered "lifestyle surgery." Formally developed outcomes questionnaires measure disease burden and severity, and/or impact on quality of life. The individual measures, as well as the field of PRO and its standards of instrument development, have expanded and evolved over the last 15 years.

Despite the rapid expansion of available tools for the pelvic floor surgeon and researcher, there is no consensus on the optimal subjective outcome instruments. The multitude of PRO measures applied in the PFD literature limits interpretation and comparisons across studies. Each measure has its own strengths and weaknesses, broadness of scope, and focus on symptom burden versus life-impact. Overall limitations of the data on PRO measures include ambiguity in reporting, inadequate follow-up, lack of standard definitions for treatment success or failure, lack of sufficient power, and lack of complications data.

The goal of this chapter is to provide an overview of selected tools available to assess outcomes of SUI and POP procedures. A complete review of validated measures available for all PFDs are beyond the scope of this review.

Objective Outcomes Measures

Objective outcomes measures, sometimes called "anatomic" measures, are used to quantify or assess the severity of pelvic floor symptoms independent from patient or clinician perception. Anatomic outcomes are a subset of these objective measures; the term is somewhat of a misnomer since some of the tests do involve clinician judgment or patient compliance, and, in fact, most of these measures are not validated. However, these tools are included here for completeness since they are frequently reported outcomes.

Stress Incontinence

SUI is clinically diagnosed by patient history and exam, and often treatment may be initiated without further assessment. Objective demonstration is required as part of the diagnostic evaluation of SUI by the guidelines of the International Urogynecological Association (IUGA), International Consultation on Incontinence (ICI) and International Continence Society (ICS) [6, 7].

Stress Test, Urodynamics, Pad Test, Bladder Diary

Most commonly, demonstration of SUI is accomplished by the cough stress test (CST), which should be performed with a full bladder. If the CST is negative in the supine position, then the maneuver is repeated with patient standing. Urodynamics and abdominal leak point pressure can demonstrate and characterize SUI, and are often utilized in PFD surgical outcomes trials..

Adjunctive testing such as a 24-h pad test has been used primarily in the diagnostic evaluation. The pad test has demonstrated limited validity compared to self-assessment questionnaires. The 1-h pad test is a less accurate evaluation tool and is not recommended by the ICI. The 3-day bladder diary has been shown to be a feasible, reliable, valid measure [8] pre-intervention, though it may be difficult to report change after intervention given its complexity.

Bladder diaries and frequency-volume charts are highly recommended by the ICS as diagnostic tests to document micturition frequency, voided volumes, incontinence episodes, and pad use. Incontinence episodes, as recorded on a bladder diary, are an outcomes measure for SUI and overactive bladder (OAB), often used for OAB pharmaceutical trials. A recent industry-sponsored study proposed that reduction of incontinence episode frequency by at least 40–50 % is necessary for patients to appreciate a change with therapy [9]. This is an important outcomes research concept, called the minimum clinically important difference (MCID).

Pelvic Organ Prolapse

Pelvic organ prolapse is a clinical diagnosis of urogenital organ descent or laxity. Treatment is generally reserved for symptomatic women. Traditional outcome measures for POP attempt to capture severity of maximum anatomic support defect and assess pelvic floor muscle function by physical exam.

POP-Q, S-POPQ and Pelvic Floor Muscle Strength

POP Quantification (POP-Q) staging was jointly developed and adopted by the ICS and AUGS as the standard, validated physical exam system utilized in the PFD literature [6, 10–12]. Six defined landmark points along the vaginal walls are measured in relation to the hymen during maximal straining. The vaginal length and the lengths of the perineal body and genital hiatus are recorded at rest. The exam should be performed with an empty bladder and rectum and in a position of the patient's choice that she feels demonstrates maximal descent of her pelvic organs. It should also be noted that intraoperative exams or exams after pessary removal may alter the degree of POP. Barriers to clinical use of the formal POP-Q include its time-consuming nature and clinician unfamiliarity or confusion with the system. The simplified POP-Q (S-POPQ) has only four defined vaginal points but is still a valid system for documenting anatomic severity of prolapse, and likely is more representative of many physicians' examinations. Nevertheless, the ICS and IUGA have established that objective measures, such as POP-Q, should be fully tabulated (not summarized) for proper documentation of outcome measures in surgical trials of POP [11].

Urinary and Defecatory Function Tests, Imaging Studies

A full evaluation of POP includes measurements of prolapse impact on urine storage, micturition, sexual, and defecatory function. A post void residual is commonly performed to objectively rule out voiding dysfunction, and can be used as an outcome measure. Investigative trials and clinical evaluations may utilize other assessments of concurrent PFD including functional studies (urodynamics, anal manometry), imaging studies (ultrasound, cystogram, defecography, magnetic resonance imaging), pelvic floor muscle strength assessment, or bowel diary.

Subjective Outcomes Measures

Introduction to Validated Outcomes Measures

As the surgical PRO literature evolved over the last 20 years, physicians and researchers have struggled with the quality of outcomes measure reporting. Reported "cure rate" varied depending on how outcomes were measured and did not correlate well with patient satisfaction or self-assessment of symptoms. Objective measures, like POP-Q or dry rate, did not comprehensively capture the full extent of symptom burden or multidimensional life impact of PFDs. Nor did the outcomes measures employed sufficiently reflect patient goals for surgery [5]. PFD researchers, and healthcare researchers in general, responded to this need by creating and improving validated PRO instruments.

Development of the rigorous, standardized scientific methodology for producing valid PRO instruments has occurred with the collaboration of epidemiologists, statisticians, psychologists, and physician scientists [13, 14]. This process ensures that the PRO is reliably measuring what it is intended to measure, and that the PRO is appropriate for use in the population under investigation. A comprehensive review of the process for developing validated PRO instruments is beyond the scope of this chapter, but can be found in the Report on the 5th International Consultation on Incontinence [15].

In brief, the process begins with patient input, such as focus groups or structured interviews, to produce concept maps. Identified themes undergo factor analysis by experts to develop and refine symptom burden or QOL questionnaires. The questionnaire's psychometric properties are rigorously tested to establish internal consistency, reliability (reproducibility), validity (degree to which an instrument measures its aim) of content and construct, stability (over time), and sensitivity to change within the relevant population.

The method of outcome measure development is important to clinicians and researchers using these measures because the instrument should be administered according to how it was validated. For example, a written questionnaire validated in English-speaking women with SUI is not valid or reliable if administered in another language, by telephone, to incontinent men, or to women with defecatory dysfunction, until studies have explicitly demonstrated the questionnaire's validity within those populations.

A plethora of validated outcomes assessment instruments have been developed in response to the identified need to improve upon our ability to quantify the effects of PFD surgery. It behooves the clinician to be familiar with these instruments, since they vary in strengths, scope and applicability, and limitations with regard to approximating the true symptom burden, QOL impact, and patient goals or satisfaction. Furthermore, there is still no consensus on the optimal outcomes measures for POP or SUI surgery, nor is there consensus on establishing the MCID detected by these outcome measures [16].

A selected review of the subjective validated outcomes instruments used to evaluate SUI and POP surgery is presented below. Some non-validated outcomes measures important to the PFD literature are included for completeness and context. Validated outcomes instrument characteristics are summarized in Table 21.1.

Generic Measures

Generic outcomes measures are not specific to PFDs, and can be utilized for a number of health assessments. These instruments allow comparison of symptom distress or health impact across different health conditions. However, PFD researchers have

Table 21.1 Summary of validated outcome instrument characteristics

Instrument	Primary target symptom	POP	UI	LUTS	Sexual	Bowel	Pain	Symptom impact or QOL measure	Number of items	ICI Grade	Availability
POP-Q	POP	+							9	N/A	Published[a]
S-POPQ	POP	+							4	N/A	Published[a]
SF-36	Generic						+	+	36	N/A	By license
SF-12	Generic						+	+	12	N/A	by license
PGI-I	Generic								1	A	Published[a]
ISS	UI		+						8	A	Published[a]
UDI	UI	+	+	+		+	+		19	A	Published[a]
UDI-6	UI		+	+			+		6	A	Published[a]
IIQ	UI	+	+		+			+	30	A	Published[a]
IIQ-7	UI	+	+					+	7	A	Published[a]
ICIQ-UI Short Form	UI		+						4	A	By license
ICIQ-UIqol	UI		+		+			+	22	A	By license
ICIQ-FLUTS	Urinary		+	+			+	+	12	A	By license
ICIQ-FLUTS Long Form	Urinary		+	+			+	+	18	A	By license
ICIQ-LUTSqol	Urinary		+	+	+		+	+	20	A+	By license
OAB-q	Urinary		+	+				+	33	A	Published[a]
PFDI	POP	+	+	+	+	+	+		46	A	Published[a]
PFDI-20	POP	+	+	+		+	+		20	A	Published[a]
POPDI-6	POP	+		+		+			6	–	Published[a]
CRADI-8	Bowel	+				+	+		8	–	Published[a]
UDI-6	Urinary		+	+			+		6	–	Published[a]

PFIQ	POP	+		+	+	+		+	93	A	Published[a]
PFIQ-7	POP	+		+		+		+	7	A	Published[a]
ICIQ-VS	POP	+			+	+	+	+	14	B	By license
POP-SS	POP	+		+		+			8	–	Published[a]
P-QOL	POP	+	+	+	+	+	+	+	20	A	Published[a]
ICIQ-FLUTSsex	Sexual		+	+	+		+	+	4	A	By license
PISQ	Sexual	+	+		+	+	+		31	B	Published[a]
PISQ-12	Sexual	+	+		+	+	+		12	B	Published[a]
PISQ-IR	Sexual	+	+		+	+	+	+	6/13–15[b]	–	Published[a]
FSFI	Sexual				+		+		19	B	Published[a]
FIQL	Bowel				+	+		+	29	A	Published[a]
ICIQ-B	Bowel				+	+	+	+	19	A+	By license

[a]Six items for patients who answer "Not sexually active." 13 and 15 items for sexually active patients without and with active partner, respectively
[b]Permission should be obtained from the publisher

shown that condition-specific QOL instruments are more responsive than generic QOL tools [17], and accordingly, these generic measures should not be used exclusively.

SF-36, PGI-I

The Short Form (36) Health Survey, SF-36, is a multidimensional short form health questionnaire that is designed to profile functional health and well-being, and assess outcomes of interventions. It yields eight subscales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health. Depending on the subject of study, a researcher might prefer a weighted outcome of the SF-36: the Physical or Mental Component Summary Measures. The ICI recommends the more abbreviated form, SF-12, as a generic QOL measure. These questionnaires can estimate disease burden and compare disease-specific benchmarks with general population norms. While they are sensitive to change after intervention, the condition-specific PFD instruments may be even more responsive to change.

The Patient Global Impression of Improvement (PGI-I) scale is a 7-point Likert scale that measures patient perception of improvement or worsening of symptoms. The PGI-I is not specific to PFDs per se, but has been validated as a qualitative PRO in the POP population [18]. The Expectations, Goal setting, Goal achievement and Satisfaction (EGGS) mnemonic [19] provides a thorough guide for qualitative evaluation of satisfaction by emphasizing communication around patient goals and measuring how many pre-specified goals are achieved post intervention. Recent IUGA and ICS guidelines for reporting surgical outcomes recommends using a satisfaction scale in conjunction with a symptom scale [11].

Stress Incontinence

Subjective dry rate can be used as a measure of cure, though this is not a psychometrically validated measure. A number of formal PRO instruments have been developed for evaluation of incontinence and incontinence interventions. Of note, most of these instruments were developed in females with incontinence, but are not specific to SUI.

ISS

The Incontinence Symptom Severity Index (ISS) [20] is a commonly utilized validated PRO instrument to evaluate severity of female urinary storage and voiding symptoms. It has 8 items and was tested against bladder diaries, post void residual measurement, and pad tests.

UDI, UDI-6, IIQ, IIQ-7

The Urogenital Distress Inventory (UDI) and Incontinence Impact Questionnaire (IIQ) were rigorously developed together as the first female incontinence-specific PRO instruments in 1994 [21]. The UDI measures the degree to which symptoms associated with incontinence are troubling to women. It encompasses three symptom subscales including irritative, obstructive/discomfort, and stress. The IIQ assesses the impact of incontinence on various activities, roles, and emotional states. The same three subscales are utilized. The authors intended these measures for paired use in order to provide detailed information on the effect of incontinence on health-related QOL. Short forms of each instrument were validated shortly thereafter (i.e. the UDI-6 and IIQ-7), facilitating adoption in the clinical setting. Statistical analyses using more contemporary validation techniques have confirmed the test-retest reliability of these foundational PRO questionnaires.

ICI Modular Questionnaires (ICIQ)

The ICI modular Questionnaires (ICIQ) are a collection of validated PRO instruments adopted by the ICI examining various aspects of incontinence and voiding dysfunction [22]. The focus of each instrument is slightly different, including measures of such variables as symptom burden, QOL impact, and impact on sexual function. All modules hold a "Grade A" highly recommended assessment by the ICI for the quality of the instrument's published psychometric testing. The ICI questionnaires related to SUI are outlined below.

The ICIQ-urinary incontinence (ICIQ-UI) short form was developed and validated according to the strict methodology outlined above for use in outcomes and epidemiological research. It is a brief and robust three-item questionnaire assessing the prevalence, frequency, and its impact on everyday life, as well as a fourth unscored item for self-diagnosis of the perceived cause of UI [23]. The ICIQ-Lower Urinary Tract Symptoms Quality of Life (ICIQ-LUTSqol) module, derived from the King's Health Questionnaire [24], which was appropriately validated as a condition-specific QOL assessment for women with incontinence (the ICIQ-LUTSqol, on the other hand, can be used for men and women). It was designed as an outcomes measure for clinical trials and does not incorporate any symptom scales.

The ICIQ-Urinary Incontinence Symptoms Quality of Life (ICIQ-UIqol) module, was derived from the I-QOL [25], which was developed as an incontinence QOL measure for use in clinical trials. After a rigorous development process, it was validated in women with both stress and mixed urinary incontinence. This test was validated against other QOL questionnaires as well as objective measures such as the pad weight test. The authors of I-QOL further published an MCID of 2–5 % in association with those measures. The ICIQ-UIqol is intended for use in both genders, and scores reflect symptom impact on QOL.

The ICIQ-Female Lower Urinary Tract Symptoms (ICIQ-FLUTS) and ICIQ-FLUTS Long Form modules are both derived from the Bristol Female Lower

Urinary Tract Symptoms (BFLUTS) questionnaire, which was developed as an instrument for symptom severity (especially incontinence and impact on sexual function), QOL impact, and evaluation of treatment outcome. The validation was performed in women undergoing urodynamic assessment. The ICIQ-FLUTS is a short, 12-item symptom impact scale for incontinence as well as dysfunctional voiding symptoms, while the corresponding Long Form module has 18 items and no scoring system. The ICIQ-FLUTS Long Form provides a detailed summary of the level and impact of urinary symptoms for outcomes assessment.

The sexual impact of incontinence is not well captured in traditional incontinence impact or QOL instruments. The ICIQ-Female Sexual Matters associated with Lower Urinary Tract Symptoms (ICIQ-FLUTSsex) module is also derived from the BFLUTS questionnaire. It contains four items to assess sexual dysfunction and impact of urinary symptoms (not restricted to the UI population).

PISQ, PISQ-12, PISQ-IR

The Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ) is a 31-item condition-specific validated assessment instrument with the specific focus of evaluating sexual function in women with POP or UI. The questionnaire was designed by expert review and extrapolation on existing instruments, and then validated against other validated outcome assessments (both condition-specific measures and generic sexual health measures) in women with POP or incontinence. A short form instrument, the PISQ-12, was later developed based on the original dataset. Most recently, the questionnaire was updated and published as PISQ, IUGA-Revised (PISQ-IR) with extensive validation and psychometric testing (including patient input toward concept gaps with cognitive interviews) for use in sexually active and inactive women with PFDs [26]. The PISQ-IR items better capture symptom impact than prior iterations.

Pelvic Organ Prolapse

PFDI, PFIQ, PFDI-20, PFIQ-7

The Pelvic Floor Distress Inventory (PFDI) and Pelvic Floor Impact Questionnaire (PFIQ) are condition-specific QOL instruments for POP [27]. They were developed by extrapolating the structure and content of the UDI and IIQ onto multiple domains related to POP. The resulting PFDI questionnaire included three scales to cover symptom distress, including the UDI, a POP Distress Inventory (POPDI), and a Colorectal-Anal Distress Inventory (CRADI). Similarly, the PFIQ was expanded respectively into three scales assessing symptom impact. The PFDI and PFIQ were then validated in women with subjective complaints of a vaginal bulge using objective and subjective measures. Short form instruments, the PFDI-20 and

PFIQ-7 were later validated from the original dataset. The subscales of the PFDI are also useful clinically and in research given their more narrow scope, though only the UDI and UDI-6 have been independently validated (albeit with slightly different scoring).

ICIQ-VS

The ICIQ-Vaginal Symptoms (ICIQ-VS) is a 14-item ICI modular questionnaire for assessment of severity and impact of vaginal symptoms and related sexual matters, as well as evaluation of treatment efficacy in women with POP [28]. The instrument was developed through expert consultation and included structured interviews with patients. The questionnaire was validated in an outpatient population that included a group of controls without POP. It is intended for clinical use and epidemiologic research. An ICI QOL module for vaginal symptoms is under development.

POP-SS

The Pelvic Organ Prolapse Symptom Score (POP-SS) is a seven-item scale developed with expert consultation and modeling on existing ICIQ instruments, and qualitative patient interviews were utilized [29]. An eighth item elicits patient identification of her most bothersome symptom. The POP-SS was then administered alongside validated instruments as an experiment that included women at risk for POP, presenting with POP symptoms, and undergoing surgery for POP. Post hoc validation studies were then performed, and an MCID for the measure was established (change in score with range 0–28 by −1.5 points).

P-QOL

The prolapse quality of life questionnaire (P-QOL) assesses severity of symptoms and QOL impact in women with urogenital prolapse [30]. The P-QOL was developed based on expert consultation, literature review, and patient interviews. The 20-item questionnaire includes multidimensional assessment of symptom impact on life, relationships, sleep, emotions, and other items. It was administered to symptomatic and asymptomatic women presenting to gynecology clinic. Validation statistics were performed, and a strong correlation was demonstrated with POP-Q findings.

Given the multidimensional nature of POP and its ability to impact the urinary, sexual, and defecatory organs, validated measures assessing these particular domains of POP are frequently used in the surgical literature. A limited review of available instruments is included herein for completeness.

OAB-q

Outcomes instruments for voiding dysfunction, such as the Overactive Bladder Questionnaire (OAB-q) [31], may be utilized in the POP literature. The OAB-q (and its 19-item short form) is a validated measure of symptom bother and QOL impact that was validated in women and men. A plethora of other validated instruments in the OAB literature may be applicable to POP-related voiding dysfunction [15], but are beyond the scope of this discussion.

FSFI

The Female Sexual Function Index (FSFI) was developed by experts and then validated in women with female sexual arousal disorder, as well as matched controls [32]. It is a comprehensive assessment with six different domains. This instrument has not been validated in the POP or SUI population, though it has been used as a sexual function measure in validation studies of the PISQ-IR, for example. The PISQ instruments were validated in the POP population, and are discussed in detail above.

Wexner, Vaizey Scales

The Wexner Continence Grading Scale and Vaizey Severity Score [33] are standardized instruments that capture severity of fecal incontinence symptoms. These instruments were not developed via the psychometric PRO methodology described above, but they were validated against clinical assessments and scored 28-day bowel diaries.

FIQL, ICIQ-B

The 29-item Fecal Incontinence Quality of Life (FIQL) is a validated QOL instrument containing four subscales: Lifestyle, Coping/Behavior, Depression/Self-Perception, and Embarrassment [34]. The ICIQ-Bowel (ICIQ-B) is a comprehensive, validated symptom severity and QOL measure for fecal incontinence, recently updated for the ICI modular Questionnaires [35]. It contains 17 scored items in three domains (Bowel Pattern, Bowel Control, and QOL), as well as unscored items on other symptoms and sexual impact. The ICIQ-B was recently validated in American English and in an electronic web-based form [36]. Further outcomes measures for bowel dysfunction related to POP are under development by the ICI.

Composite Outcomes

Despite the proliferation of PFD-specific validated outcomes measures for symptom severity and QOL impact, consistency of surgical outcomes reporting and thus, uniform assessment of interventions, remains a challenge. Furthermore, the quality of reporting randomized clinical trials in the PFD literature has recently been challenged for failing to comply with numerous methodological standards [37].

The ICI has suggested that POP and incontinence surgery studies should report subjective, objective, and QOL outcomes to address this need for quality comprehensive assessments that can be compared between trials [6, 15]. At this point, there is no gold standard measure for evaluating success of anti-incontinence procedures or prolapse repairs. Current thinking suggests that each component of multidimensional outcomes data will contribute meaningfully to the overall comprehension of patient well-being. Thus, researchers are supporting the idea of using composite outcomes measures. Pelvic floor researchers will need to thoughtfully select their outcomes measures, and balance and refine the components of these composite measures so that the collection of a large quantity of data does not drive the measures to be too broad in scope to capture important changes in the patient experience.

IUGA and the ICS have released a joint report on terminology for reporting surgical outcomes in POP [11]. Beyond terminology, specific guidelines were outlined for methodology (power calculations, avoiding bias, following established research guidelines such as Consolidated Standards of Reporting Trials, or CONSORT). Regarding choice of measures, IUGA and the ICS propose that outcomes reporting of POP surgery should include validated PRO questionnaires (guided by SMART–specific, measurable, appropriate, realistic, timely–criteria), qualitative patient satisfaction scale, appropriate and fully validated quality of life instruments, specific reporting of objective outcomes, timelines, cost analysis, secondary PFD outcomes, and complications reporting [38].

Conclusions

The outcomes measures available for reporting on SUI and POP procedures have rapidly expanded in the last 20 years. Familiarity with PRO instrument validation methods and characteristics of available instruments will assist the clinician and researcher in selecting and reporting appropriate and valid outcomes measures.

Future PFD outcomes research should focus on optimization (in terms of reflecting patient preferences and the ability to define and detect MCID), standardization, reaching consensus on definition of surgical success, and better applying outcomes measures in both the research and clinical setting.

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