Selection of Concomitant Vaginal Procedures

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Introduction

The abdominal approach to vaginal vault prolapse repair, abdominal sacral colpopexy (ASC), was first introduced by Lane et al. in 1962 [1]. The procedure has since evolved in terms of the introduction of graft to decrease vaginal tension, choice of graft material, retroperitonealization of synthetic graft, extent of graft attachment to vagina and sacrum, and choice of suture material. ASC is associated with superior anatomic outcomes compared to vaginal repair of pelvic organ prolapse (POP), as well as lower recurrence and reoperation rates, longer time to recurrence, and lower rate of dyspareunia; thus, sacrocolpopexy is widely acknowledged as the gold standard procedure for vaginal vault prolapse. However, it has a longer procedure time; longer recovery time; higher cost compared to vaginal surgery; and a different risk profile of surgical complications related to the intra-abdominal exposure, anatomy, and graft material [2, 3]. Most recently, the rise of robotic technology has allowed the adaptation of a minimally invasive robotic-assisted laparoscopic approach to the sacrocolpopexy (RASC). This technique has been adopted by surgeons almost more rapidly than the literature has materialized to support its optimal implementation [4]. Theoretically, RASC achieves the benefits of open sacrocolpopexy results while mitigating its risks and morbidity.

POP is a complex pelvic floor disorder with apical, anterior, and posterior vaginal defects which result in varying degrees of anatomic loss of support and related symptoms. Despite advances in technique, technology, and evidence, some surgeons would argue that ASC or RASC may or may not adequately address multicompartment prolapse. Concomitant anterior or posterior colporrhaphy at the time of vault suspension can be employed by pelvic floor surgeons. However, the data for or against concomitant vaginal repair is limited, and the choice is often driven by surgeon preferences and patient-specific anatomy. The objective of this chapter is to review and discuss the available literature on this topic. Since the data and direct evidence on factors impacting selection of concomitant vaginal surgery at the time of RASC is limited, we will also review some of the prerobotic ASC data that support our discussion of the theory behind multi-compartment defects and levels of support and outcomes of sacrocolpopexy by compartment.

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Background

Weakness in the musculofascial support of the pelvic floor related to age, estrogen status, parity, and other factors is manifested by POP. A useful paradigm for conceptualizing the complex anatomic weaknesses that may occur is the three vaginal compartments: the anterior, apical, and posterior compartment defects which can be described as cystocele, vault prolapse or enterocele, and rectocele and/or perineal descent, respectively. Pelvic reconstruction for prolapse must often address defects in multiple compartments. Apical support is a vital part of restoring pelvic floor anatomy, which contributes to the key role that sacrocolpopexy plays in surgical reconstructive options.

POP may occur in up to 50% of parous women, and one in every 12 American women may require reconstructive surgery for prolapse by age 80 [5]. In order to treat patients with safe, effective, and durable procedures, pelvic floor surgeons must carefully select a repair technique to minimize the need for repeat procedures. Historically, based on 1997 data, the recurrence rate after POP repair is reported as high as 30% with prolapse persistence or recurrence rates at 1 year up to 60% [6]. However, this data was based on strict anatomic outcomes. Re-analysis using varying definitions of success demonstrates that there is a great deal of variability related to prolapse surgical outcomes [7].

A variety of urinary, bowel, and sexual symptoms may be associated with POP [3] and should be taken into account when selecting concomitant procedures. Indeed, recent evidence has emphasized the importance of patient-driven and composite outcomes measures as the appropriate end point for prolapse surgery [8, 9]. Contemporary systematic reviews of ASC and laparoscopic sacrocolpopexy (LASC) using composite outcomes measures report median reoperation rates for prolapse at 1.2–4.4% (ranges 0–31%) with less than 4 years of follow-up [10–12].

Advanced POP results from multicompartment defects. DeLancey first described anatomic findings of POP from cadaveric studies in 1992. He described three levels of support (Fig. 3.1) [13]. The upper third of the vagina is suspended from the pelvic wall by the vertical fibers of the paracolpium, including the cardinal ligament and the uterosacral ligaments. He coined the term Level I support and hypothesized that Level I forms the critical factor that differentiates vaginal eversion (high-grade prolapse) from isolated cystocele, rectocele, or enterocele. The middle third of the vagina (Level II) is supported by lateral paracolpium attachments to the arcus tendineus and the levator ani fascia and is the location of defects causing isolated cystocele and rectocele. Finally, Level III, the lower third of vaginal support, contains the perineal body, perineal membrane, and levator ani muscles that prevent perineal descent. By integrating these concepts, the surgeon can appreciate that isolated vault suspension may contribute to, or even independently achieve, reduction of cystocele that prolapses beyond the hymen (Fig. 3.2).

While most surgeons would agree that all compartments need to be addressed in some way to achieve successful reconstruction, they may differ on whether concomitant vaginal repair in women undergoing abdominal apical suspension is necessary. Some advocate restoring topography

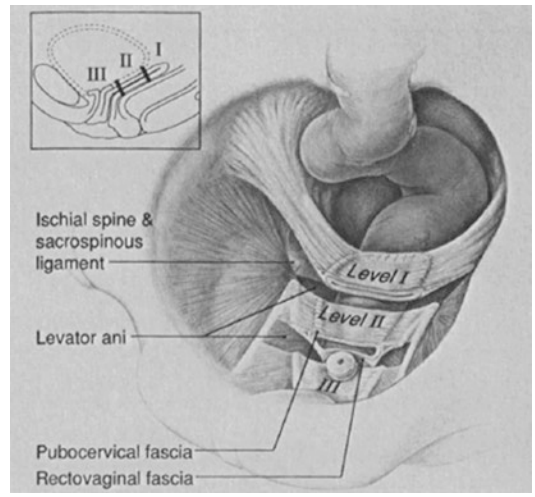

Fig. 3.1 DeLancey's levels of vaginal support. Reprinted from American Journal of Obstetrics and Gynecology, Vol. 166 No. 6 (1), John O.L. DeLancey, Anatomic aspect of vaginal eversion, page 1719, Copyright (1992), with permission from Elsevier

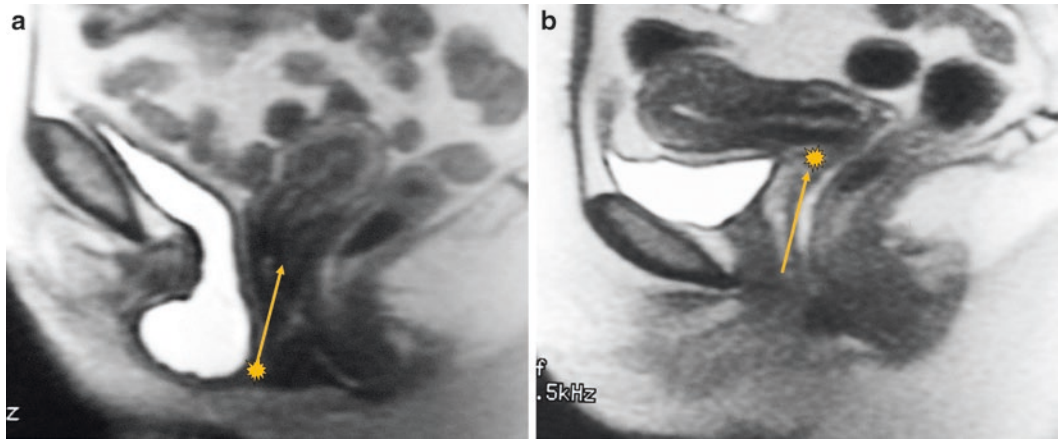

Fig. 3.2 (**a**) Magnetic resonance image (MRI) of multicompartment ureterovaginal prolapse, sagittal view. (**b**) MRI of normal anatomic position. Star and arrow represent theoretical focal point and vector of suspension to achieve reduction of prolapse. Images provided courtesy of Dr. Shlomo Raz, Department of Urology, University of California Los Angeles, Los Angeles, CA

with a vaginal repair at the time of colposuspension [2, 14], while others suggest that adequate apical suspension will correct an anterior or posterior wall defect [15, 16].

According to DeLancey's concept of vaginal support, the sacrocolpopexy mesh aims to restore Level I support to the vaginal apex. While restoring vaginal anatomy from the level of the apex may reduce laxity in the anterior and posterior walls of the vagina, individual defects in Level II and III support are not specifically addressed by traditional sacrocolpopexy. There is no consensus in the literature as to the best approach to multi-compartment defects at the time of ASC/RASC for apical repair. Much of the evidence regarding concomitant vaginal procedures is observational and inherently biased by the practice preferences of experts. Further complicating the development of evidence for best practices are the complex outcomes reporting needs in POP surgery [8]. The objective anatomic outcomes, subjective symptom and quality of life (QOL) outcomes, related measures of voiding, sexual and defecatory function, patient preference, as well as surgical durability and risks, all must be factored into the decision for or against concomitant vaginal procedures.

There are limited short-term data demonstrating comparable outcomes between ASC and LASC/RASC in terms of anatomic outcomes, patient satisfaction, QOL, and complications [3, 10, 11, 14, 17–19]. Given this data and the conceptual similarity in anatomic restoration of the vaginal apex between ASC and RASC, the surgeon must consider how to address other compartmental defects in either case. Thus, evidence from both ASC and LASC/RASC studies can inform the decision-making process and patient counseling around concomitant vaginal surgery.

How Well Does RASC Address Anterior Compartment Defects?

A study of more than 300 physical exam findings in women with POP demonstrated a strong association and linear relationship between the pelvic organ prolapse quantification (POP-Q) points C (at the cervix or vaginal cuff) and Ba (the most prolapsed point of the anterior wall). The corresponding posterior wall point, Bp, was also associated with C, but not as strongly [20]. Thus, when advanced apical prolapse is present, anterior wall defects are very likely to be present simultaneously.

The converse may be true as well; that is, a pelvic exam on women with advanced POP (54% stage 3 POP) with simulated apical support

Table 3.1 Summary of studies reporting anterior compartment recurrence after sacrocolpopexy with and without concomitant repair demonstrates limited follow-up, variability of technique and reporting, objective anterior recurrence rates, minimal symptom recurrence, and rare subsequent anterior repair

Anterior compartment studies (*n*)	Mean or median follow-up (years)	Concomitant anterior repair (%)	Mesh technique	Objective anterior recurrence (%)	Symptom recurrence (%)	Subsequent anterior repair (%)
Brubaker 1995 (65)	0.25	0	Posterior mesh, distal extent NR	29	3	NR
Maher 2004 (47)	2	0[b]	Distal anterior	13	6.5[a]	0
Benson 1996 (40)	2.5	30	NR	NR	16[a]	10
Guiahi 2008 (149)	1	0	Distal posterior	15.4	NR	0.7
Snyder 1991 (116)	5	Yes, NR	Distal posterior to level of levator ani	21[a]	0–29[b]	0
Culligan 2002 (245)	2	2.4	Anterior and posterior, extent NR	9	NR	1.6[a]
Linder 2015 (70)	5	0	Y mesh, extent NR	NR	NR	2.9
Germain 2013 (52)						
Hach 2015 (101)	1.8	0	Propylene Y mesh, extent NR	NR	25[b]	0
Mueller 2016 (448)	0.25	0	Distal anterior and posterior polypropylene	NR	NR	0
Barboglio 2010 (92)	1	2.2	NR	8	NR	2.2

NR = not reported
[a]Did not report outcome by compartment
[b]see text for details

accomplishes significant reduction in point Ba. Lowder et al. reported a series of nearly 200 POP-Q exams before and after simulated support (achieved by positioning posterior blade of a standard Graves speculum over the posterior vagina to lift the apex) which revealed mean change in point Ba of 3.5 cm with apical suspension. This achieved Ba above −1 station in over half of patients [21]. By contrast, the maximum point of posterior prolapse, Bp, changed significantly less, by 1.9 cm ($p < 0.001$), with simulated apical support.

These two studies highlight DeLancey's theory of the critical role of Level I vaginal support on the anterior and posterior compartments, and particularly the former. A discussion of anterior compartment outcomes with ASC/RASC follows below and is summarized in Table 3.1.

Anterior Compartment Recurrence Without Concurrent Anterior Repair

The strong link between anterior and apical vaginal prolapse is well-demonstrated in the literature—both in their coexistence and in the ability of apical repair to improve anterior wall defects. Many surgeons feel that the reduction of cystocele accomplished with apical suspension is enough to obviate the routine need for concomitant anterior colporrhaphy when both defects are present. Modification in mesh anchoring techniques may contribute to improved cystocele reduction. Particularly during RASC, which can have longer operating room times than LASC or ASC [19], the positioning changes and maneuvering of multiple surgical access points for sub-

sequent colporrhaphy adds to prolonged patient time in lithotomy and its associated risks. Many surgeons suggest that concurrent repair can be avoided. It may achieve more optimal anatomic outcomes, but patient relief of bothersome vaginal bulge symptoms can be achieved with reduction of prolapse proximal to the hymen [6]. Recent literature has demonstrated that, while objective anatomic outcomes are important to incorporate, definitions of surgical success should also incorporate subjective patient-based outcomes, such as relief of bothersome vaginal bulge symptoms. With such a staged approach, the number of symptomatic patients requiring a second surgery may be minimal and perhaps better selected.

Two ASC series used mesh that was broadly attached to the vagina posteriorly, as distal as the rectal reflection [22, 23]. Anatomic persistent or de novo anterior wall prolapse was noted in 25–29% of women with short-term follow-up. However, in one study prolapse symptoms were only present in 3%, and no subjective or QOL outcomes were reported in the other. Subsequent anterior repair was reported in zero patients at 3 months and one (0.7%) at 12 months in the two series. The authors concluded that cure rates for apical support were excellent with this distal posterior mesh technique, but anterior wall recurrences were common and warranted further study for optimal management. More studies are needed on patient factors and optimal surgical techniques for multi-compartment prolapse.

One randomized trial of ASC compared to vaginal vault repair with sacrospinous ligament fixation (SSLF) demonstrated similar rates of vault suspension above the hymen and relief of prolapse symptoms at 2 years [14]. One third of the 47 women in the ASC group had colposuspension for stress incontinence (SUI), which does provide some degree of anterior wall support. None of these women went on to have a subsequent repair of anterior wall defects, and three (7%) had asymptomatic grade two or higher cystocele. The cumulative risk of anterior and vault prolapse recurrence was significantly lower in the ASC group (13% vs. 45%, $p = 0.01$). An important technique point in this ASC series was the application of a polypropylene mesh along the anterior vaginal wall to the level of the bladder trigone.

Four series of RASC without concomitant vaginal repair and with short or intermediate follow-up have recently been published [24–27]. Three of these specifically described a technique with distal anterior anchoring of mesh. Distal landmarks included the trigone or as low as the level of the urethrovesical junction. Two of these studies enrolled women with high-grade apical prolapse; the others include women with only 50–73% vault prolapse. The outcomes were heterogeneous and incompletely reported, in part due to limited follow-up. One study reported subjective outcomes using validated symptom questionnaires that met pre-defined criteria for success in 75%, and symptom scores were improved over baseline at median 2 years follow-up [25]. Another study reported symptomatic persistent or recurrent prolapse in 6% of 52 women at a median of 42 months [24]. Subsequent anterior colporrhaphy was later performed in 0–2.9% of patients at median follow-up of 13 weeks to 5 years. Higher recurrence rates coincided with longer follow-up [24, 26, 27]. These RASC-only reconstructions appear to confirm DeLancey's theory and others' observations that apical suspension is paramount, and in some cases the only repair needed, for anterior wall defects.

Anterior Compartment Recurrence After Concomitant Anterior Repair

Despite the strong link between anterior and apical vaginal prolapse, only a concomitant vaginal procedure allows the surgeon to directly address that individual compartment. Early pioneers of the ASC recommended routine concurrent anterior colporrhaphy [1, 12]. Indeed, most published series do include vaginal repairs per the surgeon's discretion. The guiding rationale and impact of this subjective expert judgment on outcomes are difficult to parse out in published trials and series. This represents an inherent systematic bias that cannot be measured without direct comparison to a series without routine colporrhaphy.

Benson et al. published a series of 40 ASC for vault and anterior wall prolapse with 30% concomitant anterior colporrhaphy [2]. At 2.5 years, 84% had resolution of symptoms, and four (11%) underwent subsequent anterior colporrhaphy. A larger series of ASC with six (2.4%) concomitant anterior repairs had only four (1.9%) subsequent prolapse repairs at 2 years [28]. This variability may be related to the inclusion criteria that favored more significant baseline anterior (as opposed to vault) prolapse, small numbers, different rates of concomitant repairs, or the mesh anchoring techniques that were not well-described in either study. Unfortunately, neither study differentiated whether any anterior wall recurrences happened in those who underwent concomitant anterior repair up front. Snyder and Krantz published one of the first series utilizing mesh anchoring distal to the apex for procidentia in 1991 by fixing polytetrafluoroethylene or dacron graft along the "full extent of the rectovaginal septum" posteriorly. Ninety-eight percent of patients were post-hysterectomy. An unspecified fraction of concomitant anterior colporrhaphies were performed per surgeon discretion, and they reported no reoperation for prolapse and 24 (21%) asymptomatic anatomic recurrences (compartment not specified) at mean 5 years follow-up [15]. Targeted investigations evaluating the effects of concomitant repair stratified by patient-specific and surgical factors have not been performed.

An RASC series by Barboglio et al. with 12 months' follow-up was published for 92 women, of whom two (2.2%) underwent concomitant anterior colporrhaphy. Ultimately, seven (8%) had anterior compartment prolapse, and two (2.2%) underwent subsequent prolapse repair (baseline performance of concomitant anterior compartment repair was not reported). The relative absence of robotic series utilizing concomitant vaginal repairs may be the result of a change in surgeon preference with time and the adoption of robotic techniques. Comparative studies, and long-term studies with uniform outcomes and follow-up, are needed to ascertain the value of anterior colporrhaphy at the time of RASC.

Regardless of whether concomitant anterior repair is used at the time of ASC, the rates of subsequent anterior repair are overall low. Whether there is a difference in the rate of reoperation for prolapse between these groups cannot be determined from these series, not only because much of the data is retrospective and not comparative, but also because the different inclusion criteria and procedure selection introduce significant bias that must be acknowledged when reviewing the outcomes. It appears that, if the anterior vaginal wall is supported by the colpopexy mesh, and the graft is attached distally, anterior repair is unlikely to be needed in many patients. An exception would be the patient desiring uterine preservation. If a posterior strip sacrocolpopexy is performed (without an attachment to the anterior vaginal wall or cervix), the anterior vaginal wall may be at higher risk of recurrence.

How Well Does RSC Address Posterior Compartment Defects?

Seventy-six percent of women with multicompartment defects have a posterior defect [6]. In response to evidence that apical suspension may address anterior compartment defects better than posterior wall defects [2], some surgeons modified the mesh attachment technique to target that anatomy [16]. While traditional posterior colporrhaphy plicates the posterolateral rectovaginal fascia into the midline in a compensatory reconstruction that imposes a barrier between rectum and vagina, distal mesh anchoring on the vagina during sacrocolpopexy can restore the normal fascial continuity between level III and level II supports, as described by DeLancey [29]. Pulling the perineal body superiorly toward the apex will repair some types of rectocele and perineal descent. However, if the defect is a disruption of the lateral attachments of the perineal membrane (urogenital diaphragm), this cannot be addressed from an abdominal approach and may need to be approached vaginally.

Some surgeons advocate for traditional posterior repair with perineorrhaphy or defect-directed

repair by the vaginal approach at the time of ASC [30, 31]. Others have proposed that posterior support can be adequately achieved from the abdominal approach alone with distal mesh anchoring [15, 16]. Unfortunately, discrete comparative data to clarify outcomes by a particular approach are muddled by the surgeon practice preferences utilized in retrospective sacrocolpopexy series. The available evidence outcomes for ASC/RASC on the posterior compartment are reviewed below (summarized in Table 3.2).

Posterior Compartment Recurrence Without Concomitant Posterior Repair

Two series reported outcomes for ASC-only repairs performed using distal anchoring of synthetic mesh to the rectovaginal junction in 116 women and to the rectal reflection in 149 women [15, 23]. The former series stated 93% of patients had "restoration of a functional vagina … and nonrecurrence of presenting symptoms" at

Table 3.2 Summary of studies reporting posterior compartment recurrence after sacrocolpopexy demonstrates limited follow-up, variability of technique and reporting, higher rates of concomitant posterior repair, low need for subsequent posterior repair

Posterior compartment studies (*n*)	Mean or median follow-up (years)	Concomitant posterior repair (%)	Mesh technique	Objective posterior recurrence (%)	Symptom recurrence (%)	Subsequent posterior repair (%)
Maher 2004 (47)	2	23	7–8 cm along posterior wall	33	6.5[a]	2.1
Condiff 1997 (19)	0.2	10.5	Distal to posterior vaginal fascia or perineal body	0	0[b]	0
Snyder 1991 (116)	5	0	Distal posterior to level of levator ani	21[a]	0–29[b]	0
Benson 1996 (40)	2.5	45	NR	NR	16[a]	5
Guiahi 2008 (149)	1	0	Distal posterior	8.1	NR	0.7
Culligan 2002 (245)	2	25	Anterior and posterior, extent NR	5.7	NR	1.6[a]
Linder 2015 (70)	5	0	Y mesh, extent NR	NR	NR	1.4
Germain 2013 (52)	3.5	0	Two prolene strips, distal posterior	1.9	1.9	1.9[a]
Hach 2015 (101)	1.8	0	Polypropylene Y mesh, extent NR		25[b]	0
Mueller 2016 (448)	0.25	0	Distal anterior and posterior polypropylene	NR	NR	0.9
Crane 2013 (70)	1	27	Distal anterior to perineal body	NR	18.2	11.7
Aslam 2015 (125)	1	37	Distal anterior and posterior	12.8	NR	0
Matthews 2012 (85)	0.5	39	Distal posterior	5.9	NR	1.2

NR = not reported
[a]Did not report outcome by compartment
[b]See text for details

5 years follow-up. There were 24 (21%) single compartment anatomic recurrences without symptoms and no patients underwent subsequent reoperation. The latter series reported that 12 (8%) had persistent posterior compartment prolapse and one (0.7%) had a subsequent vaginal repair at 1 year. The authors concluded that apical suspension, as achieved using distal mesh anchoring, could restore the posterior compartment anatomy.

Four robotic series reported outcomes without concurrent posterior colporrhaphy. Median satisfaction on a 10-point Likert scale was 10 at 7 years follow-up in one series of 70 patients with stage III–IV POP [26]. Subsequent posterior colporrhaphy rates for RASC when the distal extent of mesh attachment was not described were 0–1.4% at a median of 2–5 years [25, 26]. Reoperation rates for the posterior compartment with mesh attached 2–3 cm proximal to the perineal body were 0% at 3 months [27]. Symptomatic posterior wall recurrence was reported in 1/52 (1.9%) at a median 3.5 years follow-up after RASC by a similar technique [24], but it was seen in up to 25% at 22 months in a heterogeneous group (only 73% vault POP at baseline) without a clear description of the distal mesh anchoring point [25]. The authors concluded that concomitant vaginal repairs do not improve outcomes and could feasibly be performed in a staged manner, if necessary, after RASC or LASC.

Posterior Compartment Recurrence After Concomitant Posterior Repair

Rates of concomitant posterior colporrhaphy at the time of ASC range in the literature from 10.5 to 45% [2, 14, 16, 28]. This variability reflects the differences in study populations and subjective surgeon preferences. The inclusion criteria for the studies vary markedly; one study included vault prolapse patients with 74% having at least grade two rectocele [14], another had predominantly high-grade POP, but all patients exhibited perineal descent on defecography [16]; and another included predominant anterior wall or vault prolapse but half of the patients also exhibited perineal descent [2]. The distalmost mesh anchoring point ranged from 7 to 8 cm distal to the vaginal apex on the posterior vaginal [14] to anchoring on the perineal body [16], or was not described [2, 28, 32]. Anatomic recurrences in the posterior compartment were reported in 5.7–33% [14, 28] at a mean of 2 years depending on the definition used. The distal point of posterior wall prolapse (Bp) was reported to improve from 0 to −3 cm ($p = 0.009$) after surgery in one series [16] and was not significantly different between ASC with or without concomitant repair in another (−2.0 vs. −3.0, $p = 0.18$) [32]. Selection bias may contribute to the latter finding. Symptomatic prolapse was present in 6–16% at a mean of 2–2.5 years [2, 14], and subsequent posterior colporrhaphy was performed in 1.6–5% at a mean of 2–2.5 years [2, 14, 28].

Several robotic series have been published with concomitant posterior colporrhaphy or perineorrhaphy per surgeon discretion. Again, the impact of the surgeon-selected treatment algorithm on the outcome is difficult to ascertain from retrospective studies. Furthermore, the study populations and outcomes measures are heterogeneous not only in the entire body of sacrocolpopexy and concomitant repair literature, but within the robotic series specifically.

Concomitant posterior colporrhaphy was performed in 27–39% of RASC cases [33–35]. The distal attachments of sacrocolpopexy mesh were described as far as the perineal body [33, 35] and as a “deep dissection” of both anterior and posterior vaginal walls to address all three compartments [34]. One RASC series compared anatomic outcomes of RASC with concomitant vaginal repair for the posterior compartment to vaginal POP repair alone and demonstrated slightly less support in the former group (Bp −2.5 vs. −3.0, $p = 0.01$), though the clinical significance of that difference is unclear [33]. Anatomic recurrence was 5.9–23% at 6–12 months [34, 35], with one series reporting no difference between RASC alone or concomitant repair (with prolapse beyond the hymen as the endpoint, $p = 0.88$) [34]. Baseline POP stage IV did predict anatomic failure ($p < 0.001$). Symptomatic recurrence was

reported in 18% at 1 year and there was again no difference between RASC alone and the concomitant repair cohort [33]. Zero to 11.7% of patients in these series ultimately had reoperation for posterior colporrhaphy at 6 months to 1 year [33–35].

Finally, a meta-analysis of RSC series with a total of 577 patients and mean follow-up of 27 months found the reoperation rate for prolapse was 3.3%, with 2.5% being nonapical [36]. The majority of those reoperations were for posterior repair, despite an overall rate of 18.5% concomitant posterior repairs in the combined analysis. The authors suggested that a posterior colporrhaphy at the time of RSC may be indicated for patients with significant posterior compartment defects to avoid subsequent surgery. However, it was not clear from the available evidence whether these posterior compartment defects were present at baseline or developed de novo. The decision to perform a concomitant posterior repair should be a shared one with the patient, specifically discussing the risk of dyspareunia that may develop with a posterior repair.

Impact on Genital Hiatus

Enlarged genital hiatus is thought to reflect levator injury or dysfunction and may be both a risk factor for POP and the result of longstanding POP [37, 38]. DeLancey described how the levator ani muscles relieve connective tissue stress on the perineal body and membrane [29], but a large gap in the levator ani permits further connective tissue trauma and thereby POP progression.

The genital hiatus size is specifically believed to contribute to posterior compartment symptoms and reflect the degree of perineal descent [16, 39]. Fialkow et al. measured perineal descent by comparing the position of the perineal body during strain with an imaginary line connecting the ischial tuberosities. They found that posterior compartment symptoms in prolapse were associated with an enlarged genital hiatus >3 cm, resulting in perineal descent >2 cm. Thus, some surgeons have proposed that pelvic floor reconstruction that decreases the hiatus reflects restoration of Level III perineal support, and this may be associated with improvement in posterior compartment symptoms [16].

Several investigators have demonstrated a decrease in genital hiatus size after ASC and selective posterior colporrhaphy or perineorrhaphy [16, 28]. Interestingly, Guiahi et al. found that posterior wall topography was restored from ASC with distal mesh anchoring and no concomitant posterior colporrhaphy or perineorrhaphy. Specifically, there was a decrease in genital hiatus size from 4.0 to 3.0 cm ($p = 0.001$) and no significant change in perineal body measurement ($p = 0.395$) after surgery [23]. They suggested that ASC restored posterior wall and perineal topography without a concomitant vaginal procedure and questioned the necessity of a separate vaginal repair which is associated with unique risks.

In contrast, Crane et al. published a series of RASC with posterior colporrhaphy as indicated and compared the outcomes of women with and without concomitant posterior repairs [33]. Both groups had a decrease in genital hiatus size after surgery, though the concomitant repair group had a significantly smaller hiatus size (3.0 vs. 3.5 cm, $p = 0.01$). Perineal body measurements were similar. It is difficult to ascertain the impact of posterior repair since some difference in baseline factors prompted the surgeon to select colporrhaphy; enlarged hiatus itself was one cited indication for concomitant vaginal repair. Yet even the RASC-only group of 56 patients had a decrease in genital hiatus from mean 5.0 to 3.5 cm (no statistics reported).

Furthermore, Aslam et al. reported a series of 125 RASC with a distal mesh anchoring technique and posterior colporrhaphy in 37% of patients [34]. Prolapse beyond the hymen defined anatomic failure in this cohort and occurred in 23% at 1 year. The authors noted that genital hiatus size was larger in the failure group compared to the success group (5.1 vs. 4.6 cm, $p = 0.05$). Altering the genital hiatus is an option. Many women will do well with robotic apical suspension alone. Alternatively, an enlarged genital hiatus can be addressed and options discussed. When offered, some women, especially those

who are sexually active, may choose to narrow an enlarged genital hiatus and provide support to an area weakened by childbirth injury. Therefore, perineorrhaphy with or without distal rectocele repair to narrow genital hiatus and restore support can be discussed when discussing the risks and benefits of surgery.

Bowel Symptom Impact

Functional disorders of the gastrointestinal tract are common in advanced POP and pelvic floor disorders [40]. Constipation, straining to defecate, need for splinting, and prolonged pudendal nerve terminal motor latency (an objective sign of pudendal neuropathy related to incontinence) are all more commonly found in women with POP or pelvic floor disorders than in women without POP or pelvic floor disorders. It is not clear, however, whether prolonged defecatory dysfunction might contribute to prolapse development, or whether POP may lead to defecatory dysfunction by an obstructive mechanism. Likewise, surgeons have postulated that ASC might benefit or compromise defecation. If the etiology of dysfunction is obstructive, a vault suspension might alleviate blockage and eliminate the need for straining. The contrary argument states that extensive dissection between the vagina and rectum might exacerbate or even cause defecatory dysfunction. A 2004 review of ASC literature described that the data on defecatory dysfunction are limited due to the paucity of prospective studies, poorly described baseline bowel function, variability in surgical technique and follow-up duration, as well as the confounding effects of age, estrogen status, and comorbidities [12]. Data on constipation and ASC are conflicting, with some studies reporting improvement and others reporting de novo or worsening constipation after surgery [12, 14].

An analysis of baseline symptoms of the CARE trial participants, a landmark multicenter randomized trial of ASC with or without Burch colposuspension (an anti-incontinence procedure), found that prolapse stage does not directly correlate with bowel symptoms [41]. Women with advanced POP reported bowel symptoms that included constipation, straining to defecate, splinting, and anal incontinence. However, validated bowel symptom questionnaires, POP stage, and POP-Q exam measurements were not associated across multiple analyses except that the Colorectal-Anal Distress Inventory (CRADI) obstructive subscale scores were actually higher (indicating more bother) in stage II compared to stage III and IV ($p = 0.01$).

One year after ASC with or without posterior colporrhaphy, >80% of CARE trial participants reported resolution of their bowel symptoms including: need for splinting, incomplete defecation, fecal incontinence, and pain prior to defecation [32]. These symptoms may result not only from posterior vaginal prolapse, but associated enterocele or perineal body descent, which may or may not be addressed with isolated posterior colporrhaphy. And remarkably, vault suspension with ASC resolved the majority of bowel symptoms whether or not this concomitant repair was performed. Thus, even though symptoms and prolapse stage could not be directly linked in a cross-sectional analysis, the outcome that vault suspension resolves most of the bowel symptoms does imply an association with moderate to severe POP. Similar findings were reported in smaller series [16, 42], while others have reported minimal impact of ASC on defecatory dysfunction [14, 43].

Crane et al. reported bowel symptoms in a series of RASC with posterior colporrhaphy per surgeon discretion [33]. Over half of the women reported baseline outlet constipation (sensation of incomplete bowel emptying with need to strain or splint). One year after surgery, 56% of outlet constipation resolved and 44% was persistent and there was no difference between RASC with or without colporrhaphy. De novo outlet constipation was reported in 14%. The authors concluded that there was a high rate of persistent outlet constipation and moderate de novo outlet constipation. Over half of baseline defecatory symptoms resolved, and concomitant posterior colporrhaphy did not appear to significantly impact these outcomes. Another RASC series by Lewis et al. had similar findings in a series of 423 patients, though the authors noted a significant

difference in baseline symptoms between RASC patients with and without colporrhaphy (CRADI 25.0 vs. 20.1, p = 0.049) [44]. This suggests selection bias may be an important factor present in this study and others. Further prospective analysis and rigorous reporting are needed to illuminate whether posterior colporrhaphy with RASC is beneficial for bowel symptoms.

Sexual Function Impact

One classically cited risk of vaginal surgery is the development of scar, pain, and subsequent dyspareunia or other negative effects on sexual function. Posterior colporrhaphy is associated with a 17–19% risk of postoperative dyspareunia [45, 46]. The impact of combined abdominal and vaginal procedures on sexual function is difficult to assess because of the interaction of multiple possibly confounding factors such as vault tension and axis, mesh anchoring, vaginal scar, prior surgery, etc. Adding this separate risk to any changes occurring with abdominal vault suspension is a theoretical concern when considering concomitant vaginal surgery. Most women who are sexually active before ASC remain so afterwards (including ASC with concomitant posterior colpoperineorrhaphy) [12, 14]. Common study design flaws in sexual function outcomes are failure to capture dyspareunia when it causes a woman to cease sexual activity, underestimating the problem, non-utilization of validated sexual function instruments, and discrepancies in using the entire cohort as a denominator versus only sexually active women at the relevant time point. Besides the presence of all of these confounders, few researchers have looked at sexual function as a primary outcome. The evidence for impact of ASC/RASC with or without concomitant vaginal repair is limited and contradictory.

A systematic review of vaginal and abdominal apical suspension complications cited a low rate of dyspareunia with either approach (1.5%) [10]. It was not specified if this represented de novo occurrence. Other retrospective studies support the finding of no significant difference between dyspareunia rates in ASC and vaginal approach sacrospinous ligament fixation [2, 14], or between RASC and vaginal approach uterosacral ligament suspension, including concomitant repairs in both groups [47]. There were significantly more sexually active women in the RASC group (83% vs. 42%, p = 0.001), which reflects a commonly encountered selection bias in these studies.

In contrast, a Cochrane review of ASC and vaginal vault suspensions (the analysis combined both sacrospinous and uterosacral ligament suspensions) reported a lower rate of dyspareunia after ASC (RR, 0.39, p = 0.019) [3]. This review included trials utilizing concomitant compartment repairs in both groups.

Retrospective studies of pain with intercourse found a 13–32% prevalence of postoperative dyspareunia after ASC (8.7–10.5% de novo), but resolution of 56–89% of preoperative dyspareunia [14, 48]. Comparably high rates of resolution of dyspareunia and moderate rates of de novo occurrence have been reported after isolated colporrhaphy [46]. It is difficult to draw any linear conclusions for expected sexual function outcomes with the current literature addressing dyspareunia in RASC with or without vaginal repairs. The relationship is complex. Regardless of surgical approach, it appears possible to improve, worsen, or not change dyspareunia and sexual function. All of these possible outcomes should be discussed with the patient during surgical counseling.

Mesh Anchoring Techniques

Many pelvic floor surgeons have adapted the principles of ASC with a distal mesh anchoring technique in an attempt to address Level II or III support at the time of apical suspension [12]. Mesh anchoring with no anterior fixation may be associated with anatomic recurrence in as many as one third of patients [22]. No direct or prospective comparisons of these techniques have been published.

Different opinions exist on whether the support achieved obviates the need for concomitant vaginal repair. Distal dissection and synthetic mesh graft placement between the rectum or

bladder and vagina may be of concern to the pelvic floor surgeon given the controversy surrounding transvaginal mesh. Rapid adoption of synthetic mesh-augmented prolapse repairs in a short period of time led to relatively high rates of complications requiring surgical intervention [49]. Although current evidence suggests transabdominal placement of synthetic mesh grafts is relatively safe, the distal mesh anchoring technique warrants close attention with regard to intraoperative injuries or postoperative pain. The risk of sacrocolpopexy mesh erosion into the bladder is a concern that should be considered, as there is a small but known risk of erosion into adjacent organs. These types of erosions may require major reconstruction to manage the serious nature of a sacrocolpopexy mesh erosion into the bladder; particularly if located near the trigone. The location and extent of the mesh placement may require significant reconstruction including cystorrhaphy, ureteral reimplantation, and even possibly urinary diversion. Long-term follow-up is warranted to monitor for erosion rates and other complications.

A few RASC/ASC series with distal mesh anchoring reported visceral complications and open conversion rates. Cystotomies were repaired intraoperatively in 1.3–5.3% of cases where anterior dissection was performed to the level of the trigone [14, 16, 27, 35, 50]. Intraoperative bowel injuries occurred in 0–2.3% and were also managed intraoperatively in cases where the posterior dissection extended just proximal to the perineal body [27, 35]. About 0–5% of cases were converted to open laparotomy [27, 35, 50] and 1.2% had a ureteral injury [50]. Postoperatively, 1.2–4.3% suffered bowel complications (small bowel obstruction, ileus, or port site hernia), and up to half of these required reoperation [14, 27, 50]. Matthews et al. [35] found that prior reconstructive pelvic surgery was a risk factor for intraoperative injury in their series and suggested that less extensive distal dissection would be reasonable in patients with significant scar tissue from prior pelvic surgery. Not all RASC/ASC series described the distal extent of their vaginal dissection and mesh anchoring.

There are no comparative or long-term trials that describe the impact of mesh anchoring technique on reoperation rates or symptoms. Distal attachment appears to be safe based on observational data and has conceptual plausibility as an alternative approach to other compartmental defects during vault suspension compared to concomitant vaginal surgery. Anchoring techniques allow options for individualizing the apical suspension to support a particular patient's pelvic floor defects—more distal dissection and anchoring may target Level II or III weaknesses when present. However, rigorous comparative study would be required to confirm any practical benefit of distal mesh anchoring techniques. The effect of tensioning on prolapse outcomes, complications, and recurrence is also difficult to measure. Surgeons vary their tensioning of sacrocolpopexy mesh from loosely placed to neutral to somewhat taut. Adjusting the placement of the apex of the mesh can also vary the resulting support. Patient factors also vary, including multi-compartment defects versus loss of primarily apical support, symptoms and goals of treatment, the elasticity of the tissues, vaginal length, and pelvic and sacral dimensions. Some surgeons feel that an adequately tensioned sacrocolpopexy results in elimination of cystocele defects, provides relief of symptoms and support, and prevents prolapse recurrence. Sacrocolpopexy mesh tensioning is an art which is achieved with experience and with a deep understanding of the anatomy, consideration for patient symptoms, and possible complications associated with the procedure including pain, dyspareunia, vaginal exposures, and erosions of mesh into the bladder.

Conclusions

Long-term (greater than 4-year) comparative data on RSC outcomes is lacking in the literature. The populations included in published series are heterogeneous, as are the surgical approaches used to treat them. Although outcomes are grossly similar and demonstrate positive surgical outcomes, prospective comparative trials would be needed to clearly establish whether an algorithm

including selective concomitant vaginal surgery is beneficial or not. Furthermore, many studies do not differentiate between persistent and recurrent prolapse, or between symptomatic or asymptomatic recurrence. These points must be clearly distinguished to establish best practice patterns for complex pelvic floor disorders. Inconsistent reporting of anatomic versus functional outcomes measures limits the comparability of published series. The relevance of objective outcomes to patient satisfaction has also been called into question [6]. Recent guidelines [8] and consensus statements by pelvic floor researchers advocating improved quality of POP outcomes studies [51] should lead to improved uniformity and applicability of outcomes measures in the future.

The impact of RSC with or without concomitant vaginal repair on voiding, defecatory, and sexual function is unclear. Multiple confounding variables and the limitations of retrospective studies using different study inclusion criteria and primary outcomes measures limit the quality of the literature on these important outcomes.

The best advice for surgical decision-making with the available options and literature is to individualize the choice to the patient's needs and goals. Relevant clinical factors including age, health, fertility status, sexual activity, presence of dyspareunia, and vaginal length should be considered [52]. In the pelvic floor outcomes literature, the paramount importance of patient goals and expectations for surgery is being recognized and utilized as a benchmark to define surgical success [6, 9, 53]. There is a great deal of data on anatomic single compartment recurrence rates, but this measure has gradually become less relevant to patients and surgeons as an outcome because it may not correlate with patient's bother and satisfaction [54]. The evidence for and against concomitant vaginal procedures at the time of RSC is heterogeneous and poses additional research questions. The ultimate choice of whether or not to pursue concomitant vaginal repairs should be based on a discussion of patient goals and expectations for surgery, the known risks and benefits of available surgical approaches, and should ultimately rest on the shared decision-making of patient and surgeon.

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