Uterine preservation vs hysterectomy in pelvic organ prolapse surgery: a systematic review with meta-analysis and clinical practice guidelines

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OBJECTIVE: We aimed to systematically review the literature on apical pelvic organ prolapse surgery with uterine preservation compared with prolapse surgeries including hysterectomy and provide evidence-based guidelines.

DATA SOURCES: The sources for our data were MEDLINE, Cochrane, and clinicaltrials.gov databases from inception to January 2017.

STUDY ELIGIBILITY CRITERIA: We accepted randomized and nonrandomized studies of uterine-preserving prolapse surgeries compared with those involving hysterectomy.

STUDY APPRAISAL AND SYNTHESIS METHODS: Studies were extracted for participant information, intervention, comparator, efficacy outcomes, and adverse events, and they were individually and collectively assessed for methodological quality. If 3 or more studies compared the same surgeries and reported the same outcome, a meta-analysis was performed.

RESULTS: We screened 4467 abstracts and identified 94 eligible studies, 53 comparing uterine preservation to hysterectomy in prolapse surgery. Evidence was of moderate quality overall. Compared with hysterectomy plus mesh sacrocolpopexy, uterine preservation with sacrohysteropexy reduces mesh exposure, operative time, blood loss, and surgical cost without differences in prolapse recurrence. Compared with vaginal hysterectomy with uterosacral suspension, uterine preservation in the form of laparoscopic sacrohysteropexy improves the C point and vaginal length on the pelvic organ prolapse quantification exam, estimated blood loss, postoperative pain and functioning, and hospital stay, but open abdominal sacrohysteropexy worsens bothersome urinary symptoms, operative time, and quality of life. Transvaginal mesh hysteropexy (vs with hysterectomy) decreases mesh exposure, reoperation for mesh exposure, postoperative bleeding, and estimated blood loss and improves posterior pelvic organ prolapse quantification measurement. Transvaginal uterosacral or sacrospinous hysteropexy or the Manchester procedure compared with vaginal hysterectomy with native tissue suspension both showed improved operative time and estimated blood loss and no worsening of prolapse outcomes with uterine preservation. However, there is a significant lack of data on prolapse outcomes >3 years after surgery, the role of uterine preservation in obliterative procedures, and longer-term risk of uterine pathology after uterine preservation.

CONCLUSION: Uterine-preserving prolapse surgeries improve operating time, blood loss, and risk of mesh exposure compared with similar surgical routes with concomitant hysterectomy and do not significantly change short-term prolapse outcomes. Surgeons may offer uterine preservation as an option to appropriate women who desire this choice during apical prolapse repair.

Key words: hysteropexy, pelvic organ prolapse, surgery, transvaginal mesh, uterine preservation

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Approximately 74,000 hysterectomies are performed annually for pelvic organ prolapse (POP) in the United States.[1,2] Because of an aging population, the rates of POP surgery and associated hysterectomy are expected to further increase.[1,3,4] In a survey investigating women's goals for POP surgery, up to 36% reported preferring uterine preservation, provided that outcomes were equal.[5] Women may want to preserve their uterus for a variety of reasons, ranging from a desire for fertility to a sense of femininity or wholeness conferred by a uterus.

In general, the purpose of hysterectomy at the time of surgery for POP is to gain access to tissues used for apical suspension. However, hysterectomy adds surgical time, costs, and morbidity to many surgical procedures.[6-9] Furthermore, the uterus has a passive role in prolapse,[10] and studies have suggested that hysterectomy itself may be associated with an increased risk of POP.[11,12] Proponents of uterine preservation during POP repair espouse the benefits of decreased morbidity and higher patient satisfaction without sacrificing efficacy.[6-9,13]

The decision to perform hysterectomy at the time of prolapse repair is complex and must encompass surgical efficacy, perioperative morbidity, surgical access, patient autonomy, treatment of concomitant uterine disease, and cost. Despite patient interest in this topic and accumulating data that uterine preservation may have advantages, there is a paucity of high-quality data comparing uterine preservation prolapse surgery to procedures with concomitant hysterectomy.[7,13] Furthermore, few studies focus on uterine preservation in obliterative procedures, despite the fact that these procedures are excellent choices for some women.[14]

Objectives

The Society of Gynecologic Surgeons (SGS) Systematic Review Group aimed to perform a systematic review and create evidence-based clinical practice guidelines that address the relative risks and benefits of uterine preservation during apical surgical repair of POP. These guidelines would be developed, considering the quality of the existing literature and all the possible present and future benefits and harms of uterine preservation on which available data exist. We hypothesized that uterine preservation in apical POP surgery would improve operating time and morbidity but would increase prolapse recurrence risk.

Eligibility criteria, information sources, and search strategy

The SGS Systematic Review Group, which consists of practicing female pelvic surgeons and a methodology expert in systematic reviews, performed a search to identify studies comparing surgical procedures for apical POP that preserved the uterus with surgical interventions for POP that removed all or part of the uterus. This review was conducted using standard systematic review methodology.[15] MEDLINE, clinicaltrials.gov, and Cochrane Central Register of Controlled Trials were searched from their inception until June 2016, and the search was updated in January 2017. The search included multiple terms for POP presentation and surgeries available for POP in current practice (Supplemental Material).

Study selection

We selected studies based on a priori population, intervention, comparator, outcomes, study design (PICOS) criteria determined by the review group. Our population of interest was adult women (≥18 years old) with a uterus and symptomatic POP who underwent surgical, apical repair of prolapse, including both reconstructive and obliterative procedures.

We also excluded studies that were exclusively of women with prior partial or total hysterectomy, known gynecological malignancy, pathology such as fibroids or endometriosis, or common indications for hysterectomy such as cervical dysplasia or abnormal uterine bleeding. Studies could include some women with uterine pathology as long as the number was specified and they were not study inclusion requirements.

Our intervention of interest was surgery for apical POP that included the preservation of the entire uterine body and fundus, with or without preservation of the fallopian tubes and/or ovaries. Studies that did not specify the number of women with uterine preservation or did not separate outcomes by uterine preservation were excluded. We also excluded studies in which the uterine preservation POP surgery did not address the vaginal apex (eg, anterior colporrhaphy alone).

Relevant comparators were any surgery that suspended the vagina for the treatment of POP and removed all or the majority of the uterus (ie, total hysterectomy, supracervical hysterectomy). We excluded studies that were entirely of women undergoing surgery for a primary indication other than prolapse (eg, stress incontinence procedures). We also excluded studies focused on surgical prolapse procedures not involving the vagina (ie, rectal prolapse repairs).

Studies had to have published data on 1 or more relevant outcomes (complete list in Supplemental Table) and compare this outcome between uterine preservation and a comparator. Outcomes were divided into 4 categories: prolapse outcomes, other pelvic floor outcomes, perioperative outcomes, and adverse events.

We accepted study designs that included randomized controlled trials (RCTs) and prospective or retrospective nonrandomized comparative/cohort studies (nRCs). Studies could be published in any language or any format (eg, poster, abstract) from which eligibility could be determined and outcome data extracted (see Supplemental Material).

Data extraction

The abstracts and full texts were screened for eligibility based on the abovementioned PICOS criteria by 12 group members. Abstract screening was performed in duplicate with the assistance of Abstrackr software (http://abstrack.cebm.brown.edu/).[16] If a discrepancy arose between 2 reviewers regarding abstract inclusion, the tie was broken by a third reviewer. Data extraction was then completed by the same 12

independent reviewers, with each study extracted by 2 reviewers, at least one of which had prior experience in the systematic review process.[17,18]

Assessment of risk of bias

We assessed the methodological quality of each study using predefined criteria from a 3-tier system based on recommendations by the Agency for Healthcare Research and Quality.[19] Studies were graded as good (A), fair (B), or poor (C) based on scientific merit, the likelihood of biases, and the completeness of reporting. The quality of individual outcomes was separately graded within each study based on adequate description of the outcome, outcome reproducibility and reliability, and importance of the outcome to the patient. The qualities of outcomes could vary within a study and be discrepant with the quality of the study from which they came.

Data synthesis

We grouped extracted data into relevant comparisons between pairs of surgical interventions. For clarity, the term hysteropexy refers to any surgery in which the uterus is preserved and suspended, with more specific types (eg, sacrohysteropexy, which suspends the uterus to the sacrum) specified as needed. The Manchester procedure is a transvaginal hysteropexy in which a trachelectomy is performed, the uterine body is left in place, and the uterosacral/cardinal ligaments are sutured together across the midline to suspend the uterus.[20]

The final comparisons were as follows: (1) mesh sacrohysteropexy vs hysterectomy plus mesh sacrocolpopexy (open or laparoscopic approach); (2) mesh sacrohysteropexy (open or laparoscopic approach) vs vaginal hysterectomy with uterosacral suspension; (3) laparoscopic hysteropexy (nonsacrohysteropexy) vs hysterectomy with reconstruction; (4) transvaginal mesh hysteropexy vs transvaginal hysterectomy with mesh suspension; (5) transvaginal native tissue hysteropexy vs vaginal hysterectomy with native tissue suspension; (6) Manchester procedure vs total vaginal hysterectomy with native tissue repair; and (7) LeFort colpocleisis vs vaginal hysterectomy and colphorrhaphy.

For each of these comparisons, random-effects model meta-analyses were conducted for analyses with adequate data from at least 3 studies with continuous (mean difference) or categorical (odds ratio) data. For each meta-analysis, the measure of data consistency (I^2 and p-heterogeneity) and the relative contribution of the study to the overall effect were also calculated.

For each surgical comparison, we created summary tables to review the overall strength of evidence comparing outcomes between the intervention and the comparator. For each comparison pair, an evidence profile was generated by grading the quality of evidence for each outcome (eg, prolapse recurrence, repeat prolapse surgery, blood transfusion, urinary incontinence) across studies. We considered methodological quality, consistency of results across studies, directness of evidence, and other factors such as imprecision or sparseness of evidence to determine an overall quality of evidence in accordance with the Grades for Recommendation, Assessment, Development, and Evaluation system, which categorizes based on the following 4 quality ratings: high, moderate, low, and very low.[21]

We developed guideline statements incorporating the balance between benefits and harms of the compared surgeries while taking into account the strength of the evidence in the relevant studies and the quality of the outcomes that contributed to those benefits/harms. Each guideline statement was assigned a level of strength (strong or weak) based on the quality of the supporting evidence and the size of the net medical benefit.

The strength of a recommendation indicates the extent to which one can be confident that adherence to the recommendation will do more good than harm. Strong recommendations are worded as "we recommend" and indicate that benefits do outweigh risks, burden, and costs (ie, what most practitioners would do in a given clinical scenario). Weak recommendations are worded as "we suggest" and imply that the magnitude of the benefits, risks, burden, and costs are less certain. In either case, support for recommendations may come from high-quality, moderate-quality, or low-quality studies (A, B, and C).

The review and guidelines were presented for public comment at the Society of Gynecologic Surgeons 43rd annual scientific meeting in March 2017 and posted on the Society of Gynecologic Surgeons web site in July 2017, after which comments were solicited for 2 weeks.

Results

Study selection

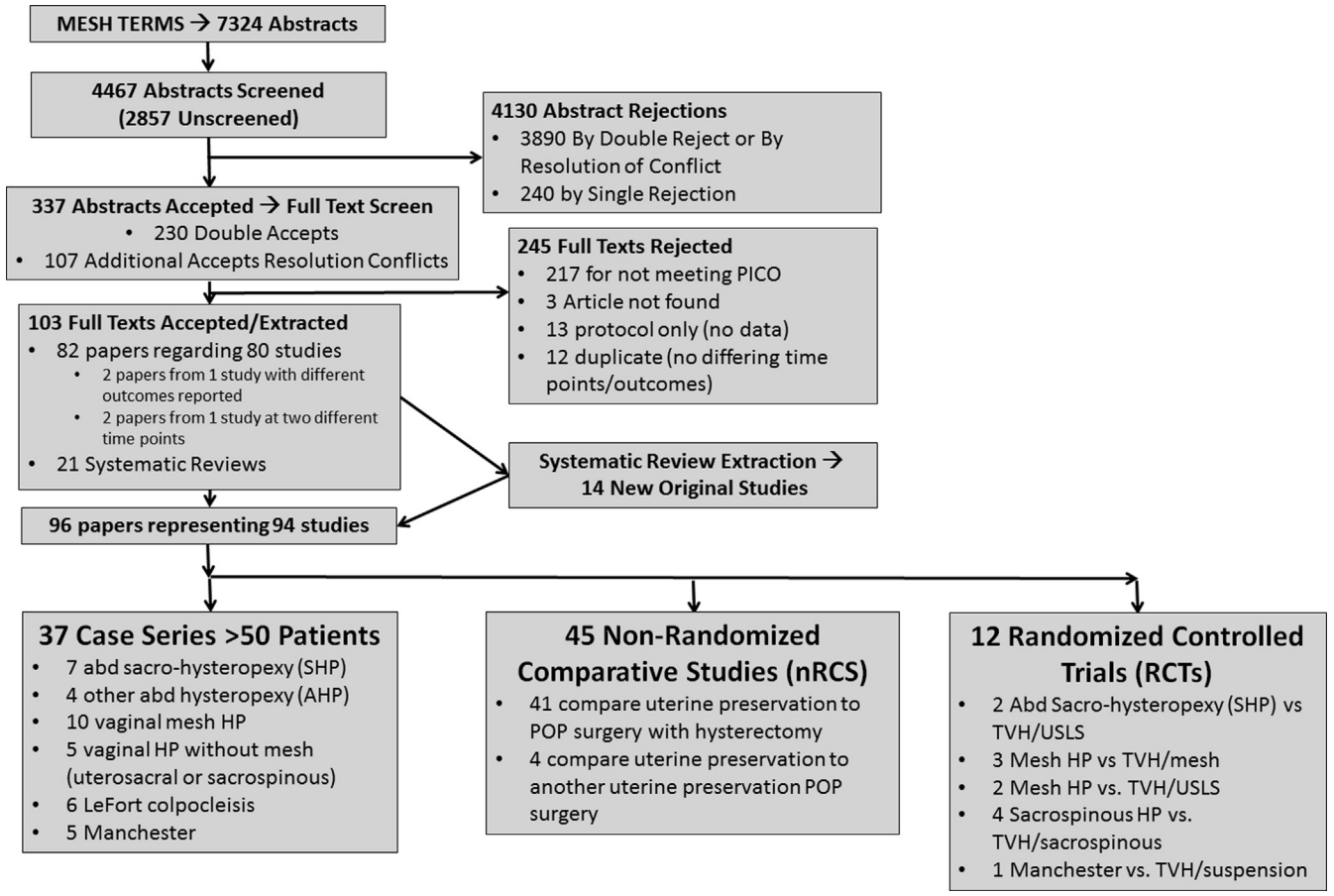
Our search and screening results are displayed in Figure 1. Our MEDLINE, clinicaltrials.gov, and Cochrane database search yielded 7324 citations, of which 4467 of the most relevant abstracts were screened and resulted in 337 abstracts that had the full texts reviewed. One hundred three full texts were accepted, of which 82 articles were original research. There were 21 citations that were relevant systematic review articles, of which 19 could be located and were not duplicates.[13,22-39]

After repeat screening of systematic reviews for possible additional citations, our study included 96 papers representing 94 original studies that met our PICOS and had data extracted for this review. Two citations were from the same study with different outcomes reported,[40,41] and 2 citations were from the same study reporting outcomes at 12 months and 24 months.[42,43]

Study characteristics

Fifty-seven of the 94 original studies were comparative studies: either RCTs (n = 12) or nRCs (n = 45). Of these 57 comparative studies, 53 (12 RCTs and 41 nRCs) compared prolapse surgery with uterine preservation (PRES) with prolapse surgery involving hysterectomy (HYST). These 53 studies are the cohort of interest in this review. A summary of surgical comparisons reviewed, overall level of evidence for the comparison, the number of women in studies with these comparisons, and main results of the review are summarized in Table 1.

FIGURE 1
Screening and extraction of study publications based on the PICOS



HP, hysteropexy; *PICOS*, population, intervention, comparator, outcomes, study design; *POP*, pelvic organ prolapse; *TVH*, total vaginal hysterectomy; *USLS*, uterosacral ligament suspension.

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Mesh sacrohysteropexy vs hysterectomy plus mesh sacrocolpopexy

There were 9 studies (all nRCs) that compared mesh sacrohysteropexy with hysterectomy with mesh sacrocolpopexy via a laparoscopic or open abdominal approach.[8,44-51] The nature of these studies is reviewed in Table 2. Three were laparoscopic in surgical approach,[8,47,51] and 6 were open.[44-46,48-50] Two of these 9 studies[47,51] included supracervical hysterectomy with sacrocervicopexy as part or all of the hysterectomy group.

Estimated blood loss (EBL; mean difference, −63.6 mL, 95% confidence interval [CI]. −133.8 to +6.7 mL),[8,46,49] operating room time (mean difference, −22.7 minutes, 95% CI, −31.9 to −13.4 minutes),[8,44-47,49,51] surgical cost (total cost, $13335 ± $3139, PRES vs $15853 ± $4045, HYST and surgical cost, $2688 ± $651, PRES vs $3803 ± $637 HYST),[8] and mesh exposure (odds ratio [OR]. 0.16, 95% CI, 0.03−0.97, Figure 2)[8,44,46,47,49,51] all favored mesh sacrohysteropexy over hysterectomy with sacrocolpopexy. Hospital time (mean difference, −0.024 days, 95% CI, −0.238 to +0.784 days) was similar.[8,44-46,51]

Hemoglobin drop significantly favored hysterectomy in 1 study, but this was a difference of only 0.71 g/dL, less than half a standard deviation for these data.[45] Only 3 studies contributed to the analysis of mesh exposure,[44,46,49] although 6 studies measured this outcome[8,44,46,47,49,51] because the other 3 had no mesh exposures in either group.[8,47,51]

There was no significant difference in resolution of prolapse symptoms (89% PRES vs 88% HYST; OR, 0.95; 95% CI, 0.86−1.03)[8,48,49]; 1 of these studies did not contribute to the data because of 100% resolution in both groups.[51] There was also no significant difference noted in the objective success of prolapse treatment (OR, 2.21, 95% CI, 0.33−14.67),[45,46,49] although the measures used were quite heterogeneous (Table 2).

In 1 study, prolapse symptom recurrence was higher in the uterine preservation group (15% PRES vs 0% HYST, $P = .01$), although reoperation for prolapse (2% PRES vs 0% HYST, $P = .66$) and anatomic cure (72% vs 88%, $P = .07$) were similar in the same study.[8] In this study by Pan et al,[8] Pelvic Floor

TABLE 1
Summary of overall results for comparisons of apical prolapses surgeries with uterine preservation vs a comparator surgery that involved hysterectomy

Surgeries compared	Results favoring uterine preservation	Results favoring hysterectomy	Study population (number of women) and study types	Longest length of follow-up	Overall quality of evidence
Abd mesh Sacrohysteropexy (open or LS) vs Hyst (total or supracervical) plus sacrocolpopexy or sacrocervicopexy (open or LS)	• Less mesh erosion • Less EBL • Shorter OR time • Lower surgical cost	• Improved pelvic floor quality-of -life questionnaires	n = 745 9 nRCs	39 mo	Moderate
LS mesh sacrohysteropexy vs TVH plus USLS	• Higher POP-Q point C • Less EBL • Shorter hospital stay • Lower 24 hour post-operative pain scores • Faster return to normal activities • Longer total vaginal length	• Less OR time • Less minor repeat procedures (ie, colporrhaphy), but no difference overall repeat surgery for prolapse	n = 100 1 RCT	12 mo	Moderate
Abd mesh sacrohysteropexy (open) vs TVH plus USLS	• None significant	• Improved quality-of-life questionnaires • Less bothersome urinary symptoms • Improved mobility • Less postoperative pain	n = 82 1 RCT	8 y	High
LS hysteropexy (nonsacrohysteropexy) vs hysterectomy with reconstruction (native tissue repair or sacrocervicopexy)	• Less EBL • Shorter OR time • Less pain medication (1 study) • Longer total vaginal length	• Less prolapse recurrence in 1 study (no difference overall) • Less apical prolapse recurrence • Higher POP-Q point C	n = 446 4 nRCs	3 y	Moderate
Transvaginal mesh hysteropexy vs TVH plus transvaginal mesh suspension	• Less mesh erosion • Lower reoperation for mesh exposure • Shorter OR time • Lower EBL (1 study) • Less hematoma (1 study) • Higher POP-Q point Bp • Longer total vaginal length	• None significant	n = 1381 4 RCTs, 9 nRCs (1 nRCs, 2 citations as published, 12 and 24 mo follow-up)	30 mo	Moderate
Transvaginal native tissue hysteropexy (SSHP or USHP) vs TVH with native tissue suspension (SSLF or USLS)	• Shorter OR time • Less EBL	• None significant	n = 1449 4 RCTs, 9 nRCs	26 mo	Moderate
Manchester procedure vs TVH with native tissue repair (eg, USLS)	• Less blood transfusion • Less EBL • Shorter OR time • Longer time to prolapse recurrence (1 study) • Smaller GH, longer PB (1 study)	• None significant	n = 1126 1 RCT, 5 nRCs	31 mo	Moderate
LeFort colpocleisis vs TVH with reconstructive surgery (anterior-posterior colpoperineorplasty)	• Shorter OR time	• None significant	n = 63 1 nRCs	25 mo	Low

Abd, abdominal surgical approach; *EBL*, estimated blood loss; *GH*, genital hiatus; *hyst*, hysterectomy; *HYST*, hysterectomy; *LS*, laparoscopic; *nRC*, nonrandomized comparative study; *OR*, operating room; *PB*, perineal body length; *POP-Q*, pelvic organ prolapse quantification; *RCT*, randomized controlled trial; *SSHP*, sacrospinous hysteropexy; *SSLF*, sacrospinous ligament fixation; *TVH*, total vaginal hysterectomy; *USHP*, uterosacral hysteropexy; *USLS*, uterosacral ligament suspension.

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TABLE 2
Studies investigating open abdominal or laparoscopic uterine suspension or hysteropexy procedures against other prolapse surgeries involving hysterectomy

Study	Study design	Study quality	Mean age of subjects, y, ±SD or (range)	Mean BMI of subjects, kg/m^2, ±SD or (range)	Surgeries compared	Women, n	Length of follow-up (actual or mean/ median)	Definition of POP recurrence
Bai et al, 2005[44]	Retr nRCs	C	65 (33–85)	23.3 (17.6–31)	Open abd mesh SCP vs TAH/mesh SCP	39 (29 included as 10 prior HYST; 10 PRES)	12 m	POP stage (0 or 2)
Cvach et al, 2012[46]	Retr nRCs	C	49 (28–71)	25.1 (19.7–35.3)	Open abd mesh SHP vs. TAH/mesh SCP	27 (18 PRES)	17 mo PRES (10-26); 27 mo HYST (12-33)	POP-Q points ≤−2; absence of symptoms
Bojahr et al, 2012[47]	Retr nRCs	C	56.7 ± 10.2 (33–81)	25.2 ± 3.51	LS SHP vs TLH or LSSCP with mesh SCP or SCerP	310 (30 PRES)	7–9 mo	Recurrence not clearly defined; measured reoperation
Zucchi et al, 2008[48]	Pros nRCs	B	52.9 ± 10	24.7 (20.1–29.2)	Open abd mesh SHP vs TAH/mesh SCP	37 (15 PRES)	39 mo (16–84)	Apex ≥ −6 and POP ≥stage 2 POP-Q; absence of symptoms
Costantini et al, 2005[49]	Pros nRCs	B	61 ± 12	24.4 (18.6–31.2)	Open abd mesh SHP vs TAH/mesh SCP	72 (34 PRES)	12 mo	Apex ≥−6 and POP ≥stage 2 POP-Q; absence of symptoms
Costantini et al, 2013[50]	Pros nRCs	C	58 ± 8.9 (27–76)	24.9 (19–30.2)	Open abd mesh SHP vs TAH/mesh SCP	68 (32 PRES)	12 mo	POP=Q ≥stage 2
Jeon et al, 2008[45]	Retr nRCs	B	63.8 ± 13.03	23.84 ± 2.97	Open abd mesh SHP vs TAH/mesh SCP or TAH/abd USLS	168 (35 PRES)	36 mo (1–84)	POP-Q ≥stage 2
Gracia et al, 2015[51]	Pros nRCs	B	45 ± 6	24.8 ± 4	LS or robotic mesh SHP vs LSSCH/mesh SCerP	45 (15 PRES)	12 mo	POP-Q ≥stage 2
Pan et al, 2016[8]	Retr nRCs	B	42.69 ± 9.94	24.15 ± 2.59	LS mesh SCP vs TLH/ mesh SCP	99 (65 PRES)	33 mo	POP-Q ≥stage 2; symptoms on POPDI
Bedford et al, 2013[58]	Retr nRCs	B	58 (27–87)	ND	LS USLS with uterus vs TLH/LS USLS	264 (104 PRES)	34.4 mo PRES (1.5–146); 21.7 mo HYST (1.5–133)	POP-Q ≥stage 2
Rosen et al, 2008[57]	Pros nRCs	B	60 (30–79)	25.6 (20.5–37.8)	LS USLS with uterus vs TLH/LS USLS	64 (32 PRES)	24 mo	POP-Q ≥stage 2

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TABLE 2
Studies investigating open abdominal or laparoscopic uterine suspension or hysteropexy procedures against other prolapse surgeries involving hysterectomy *(continued)*

Study	Study design	Study quality	Mean age of subjects, y, ±SD or (range)	Mean BMI of subjects, kg/m^2, ±SD or (range)	Surgeries compared	Women, n	Length of follow-up (actual or mean/median)	Definition of POP recurrence
Diwan 2006[59]	Retr nRCs	B	45.3 (32–76)	ND	LS USLS with uterus vs TVH/USLS	50 (25 PRES)	26 wk PRES (1–105); 46 wk HYST (1–146)	Postoperative symptoms of prolapse (not further defined); measured reoperation for POP
Roovers et al, 2004[40] and 2005[41]	RCT	A	57.9 ± 8.8	25.1 ± 3.0	Open abd SHP vs TVH/vag USLS	82 (41 PRES)	8 y	Repeat surgery for POP, planned or performed
Rahmanou et al, 2013[54]	RCT	B	64 ± 7.5	26.0 ± 3.6	LS mesh SHP vs. TVH/SSLF	100 (50 PRES)	12 mo	Repeat surgery for POP

abd, abdominal; *hyst*, hysterectomy; *HYST*, prolapse surgery with hysterectomy; *LS*, laparoscopic; *LSSCH*, laparoscopic supracervical hysterectomy; *nRC*, nonrandomized comparative study; *POP*, pelvic organ prolapse; *POPDI*, pelvic organ prolapse distress inventory; *POP-Q*, pelvic organ prolapse quantification; *PRES*, prolapse surgery with uterine preservation; *pros*, prospective; *RCT*, randomized controlled trial; *retr*, retrospective; *SCP*, sacrocolpopexy; *SCerP*, sacrocervicopexy; *SHP*, sacrohysteropexy; *SSLF*, sacrospinous ligament fixation; *TAH*, total abdominal hysterectomy; *TLH*, total laparoscopic hysterectomy; *TVH*, total vaginal hysterectomy; *vag*, vaginal/transvaginal; *USLS*, uterosacral ligament suspension.

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Impact Questionnaire-7 scores (mean difference, 1.0 point, $P = .04$), and Pelvic Floor Distress Inventory-20 scores (mean difference, 1.66 points, $P = .04$) also favored hysterectomy, but this difference was below the minimally important difference thresholds of 14–45 points set by past studies of these validated questionnaires.[52,53]

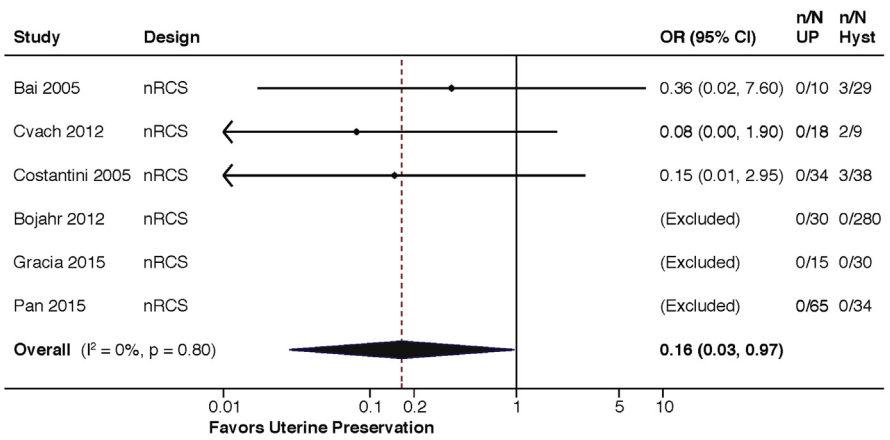
Mesh sacrohysteropexy vs vaginal hysterectomy with uterosacral suspension

Two RCTs compared open or laparoscopic mesh sacrohysteropexy with vaginal hysterectomy with uterosacral suspension.[40,41,54-56] Rahmanou et al[54,56] used laparoscopic sacrohysteropexy, whereas Roovers et al[40,41,55] investigated an open abdominal sacrohysteropexy approach (Table 2).

The pelvic organ prolapse quantification (POP-Q) point C, indicating the cervix or the vaginal cuff, favored uterine preservation (change in point C from preoperative to postoperative, 6.8 cm PRES vs −5.0 cm HYST, mean postoperative point C, −5.4 cm [+2.9 cm preoperative] PRES vs −4.3 cm [+1.9 cm preoperative] HYST, $P < .01$ for point C change).

The total vaginal length (TVL) also favored uterine preservation, with a shortening of 1.2 cm in uterine preservation vs 3.5 cm with hysterectomy and a mean postoperative TVL of 8.35 cm vs 6.5 cm ($P < .01$) for TVL change.[54,56] In the same study, EBL (19.6 mL PRES vs 82.1 mL HYST, $P < .01$), 24 hour postoperative pain scores (3.6 of 10 PRES vs 4.6 of 10 HYST, $P < .01$), return to normal activity (5.6 days PRES vs 6.8 days HYST, $P < .01$), and length of hospital stay (2.1 days PRES vs 2.5 days HYST, $P < .01$) all significantly favored uterine preservation.[54,56] However, this study found that uterine preservation (laparoscopic sacrohysteropexy) had a longer operating room time (39.5 minutes PRES vs 28.1 minutes HYST, $P < .01$), and repeat mild prolapse procedures (ie, either performed or planned anterior and/or posterior colporrhaphies) were higher in the preservation group at 12 months (5 of 50, 10%, vs 0 of 50, 0%, $P = .02$).

FIGURE 2
Mesh exposure in mesh sacrohysteropexy vs hysterectomy with mesh sacrocolpopexy



Mesh exposure in abdominal (laparoscopic or open) mesh sacrohysteropexy vs hysterectomy with mesh sacrocolpopexy, with outcomes favoring uterine preservation (sacrohysteropexy) to the left.

CI, confidence interval; *Hyst*, groups with pelvic organ prolapse procedures involving hysterectomy; *n/N*, number of mesh exposures/number analyzed; *nRC*, nonrandomized comparative study; *OR*, odds ratio; *UP*, groups with pelvic organ prolapse procedures with uterine preservation.

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However, the overall repeat surgery rate for prolapse (colporrhaphy, apical repair, trachelectomy) between the 2 groups was similar (8 of 50, 16%, PRES vs 7 of 50, 14%, HYST, relative risk [RR], 1.14, 95% CI, 0.45−2.91), as was the repeat surgery of a more invasive type such as trachelectomy or sacrocolpopexy (3 of 50, 6%, PRES vs 7 of 50, 14%, HYST, $P = .19$).[56]

At 8 year follow-up in the study by Roovers et al,[41] the repeat surgery rate for open sacrohysteropexy vs vaginal hysterectomy/native tissue apical repair did not significantly differ (11 of 42, 26%, PRES vs 6 of 42, 14%, HYST, RR, 1.83, 95% CI, 0.75−4.50, $P = .26$). However, the 36 item Short Form domains of mental health, health change, and bodily pain and the Urinary Distress Inventory domains of obstructive voiding, overactive bladder, and urinary pain all significantly favored hysterectomy.[41]

Furthermore, days of bodily pain (4.5 ± 0.35 PRES vs 4.0 ± 0.35 HYST, $P = .01$), days with impaired mobility (3.7 ± 0.25 PRES vs 2.9 ± 0.28 HYST, $P < .01$), days of pain medication use (5.5 ± 0.3 PRES vs 4.1 ± 0.4 HYST, $P < .01$), and acetaminophen use per day (1943 ± 162 mg PRES vs 1334 ± 173 mg HYST, $P = .01$) all favored vaginal hysterectomy and reconstruction over open abdominal sacrohysteropexy.[40] There was no significant difference in operating room time; the authors did not report on blood loss.[40]

Laparoscopic hysteropexy (nonsacrohysteropexy) vs hysterectomy with reconstruction

There were 4 nRCs that investigated some form of laparoscopic uterine suspension (PRES) other than sacrohysteropexy and compared it with a hysterectomy and reconstructive procedure (Table 2).[57-60] One study compared a laparoscopic colpouterine butterfly suspension (mesh suspending the cervix to the anterior abdominal wall) with laparoscopic supracervical hysterectomy and mesh sacrocervicopexy,[60] and the unusual nature of this procedure rendered it unable to contribute to overall analysis.

Two studies compared laparoscopic uterosacral suspension of the uterus with laparoscopic hysterectomy with uterosacral ligament suspension (USLS).[57,58] The fourth investigation compared laparoscopic uterosacral suspension of the uterus with a vaginal hysterectomy with uterosacral suspension.[59]

In one of the studies that compared laparoscopic uterosacral hystereopexy with laparoscopic hysterectomy with USLS, there was more prolapse recurrence within 2 years (stage ≥2) with uterine preservation (52.9% PRES vs 37.5% HYST, $P = .02$).[58] However, in combination with the other trial comparing these surgeries and investigated outcomes at 2 years,[57] the difference in prolapse recurrence became nearly insignificant (RR, 1.31, 95% CI, 1.00−1.71, $P = .05$). Operating room time was shorter with uterine preservation in both of these studies (difference, −23.7 minutes, 95% CI, −36.7 to −10.7 minutes, $P < .01$), and EBL was slightly but significantly less (−10 mL, 95% CI, −19 to −1 mL, $P = .03$).[57,58] Morphine milliequivalent (mEq) use was notably and significantly less (median 10 mEq PRES vs median, 15 mEq HYST, $P = .02$) with preservation in the study that investigated pain control.[57]

POP-Q point C was improved with hysterectomy in the study comparing laparoscopic hysteropexy with a vaginal hysterectomy with reconstruction (−5.8 cm PRES vs −7.6 cm HYST, $P < .01$).[59] TVL in the POP-Q examination favored uterine preservation in this same study (9.9 cm PRES vs 9.1 cm HYST, $P < .01$).[59] Apical recurrence of prolapse as defined by POP-Q stage ≥2 was significantly less (OR, 2.34, 95% CI, 1.17−4.68) with hysterectomy in the study on laparoscopic uterosacral suspension.[58,60] There was no significant difference in repeat surgery for prolapse in these studies (OR, 1.2, 95% CI, 0.69−2.08).[58,59]

Transvaginal mesh hysteropexy vs transvaginal hysterectomy with mesh suspension

There were 13 studies that compared transvaginal mesh hysteropexy with a vaginal hysterectomy with a similar transvaginal mesh suspension (Table 3).[42,43,61-73] POP-Q point Bp favored uterine preservation in these studies,[61,63,66,67,72,73] but only 2 had adequate data to combine in describing this small but statistically significant difference (difference, −0.094 cm, 95% CI, −0.021 to −0.168).[63,72] The TVL (difference, +0.81 cm, 95% CI, +0.55

TABLE 3
Studies investigating transvaginal mesh uterine suspension or hysteropexy procedures against other transvaginal mesh surgeries involving hysterectomy

Study	Study design	Study quality	Mean age, y, of subjects ±SD (range)	Mean BMI, kg/m^2, of subjects ±SD (range)	Surgeries compared	Women, n	Length of follow-up (actual or mean/ median)	Definition of POP recurrence
Lopes et al, 2008[64]	RCT	B	ND	ND	Vag MHP vs TVH/VMS	32 (16 PRES)	6 mo	POP-Q points (as continuous outcomes)
Juneja et al, 2011[66]	RCT	B	62	28	Vag MPH with posterior coccygeal mesh vs TVH/ VMS with posterior coccygeal mesh	16 (7 PRES)	12 mo	Repeat surgery
Malandri et al, 2012[65]	RCT	B	58 (47–70)	ND	Vag MHP vs. TVH/VMS	61 (30 PRES)	5 years	Uterine descent stage $\geq$ 2, recurrent POP complaints, or repeat POP surgery
Carramao et al, 2009[67]	RCT	A	67.1 (53–77)	23.8 (18–27)	Vag SS MHP vs TVH/SS VMS	31 (16 PRES)	9 mo	Apical recurrence not clearly defined; measured repeat surgery for POP
Urdzik et al, 2011[61]	Retr nRCs	B	61 (47–79)	ND	Vag SS MHP vs TVH/SS VMS (mesh placed anterior or posterior compartment)	11 (67 PRES; 63 anterior and 4 posterior mesh)	12 mo	POP-Q $\geq$stage 2 in compartment mesh was not placed in
Neuman et al, 2006[62]	Pros nRCs	C	51 $\pm$ 10	ND	PIVS MHP vs	79 (35 PRES)	29.8 mo	POP-Q $\geq$stage 3 (>1 cm beyond hymen)
Huang et al, 2015[63]	Retr nRCs	B	67.1 $\pm$ 9.1	24.22 $\pm$ 3.9	Vag MHP vs TVH/VMS (both with Prolift)	102 (24 PRES)	30.1 mo	Prolapse recurrence not clearly defined; measured repeat POP surgery
Sun et al, 2011[68]	Retr nRCs	B	65.4 $\pm$ 9.8	24.0 $\pm$ 2.8	Vag MHP vs TVH/VMS (both with Xiehle procedure)	277 (60 PRES)	12 mo	Return POP based on POP-Q (not more clearly defined)
Wu et al, 2013[69]	Pros nRCs	C	66 $\pm$ 9.29 (43–86)	24.64 $\pm$ 3.63 (12.49–32.89)	Vag MHP vs TVH/VMS (both with Prolift)	89 (69 included because 20 had prior HYST; 52 PRES)	35 mo	POP-Q $\geq$stage 2
Stanford et al, 2013[42] and 2015[43]	Pros nRCs	C	65.3 (39–85.7)	25.8 (17.9–51.3)	Vag MHP vs. TVH/VMS (both with Elevate)	80 (51 PRES)	12 mo; 24 mo (2013 and 2015 publications, respectively)	POP-Q $\geq$stage 2

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(continued)

TABLE 3
Studies investigating transvaginal mesh uterine suspension or hysteropexy procedures against other transvaginal mesh surgeries involving hysterectomy *(continued)*

Study	Study design	Study quality	Mean age, y, of subjects ±SD (range)	Mean BMI, kg/m^2, of subjects ±SD (range)	Surgeries compared	Women, n	Length of follow-up (actual or mean/median)	Definition of POP recurrence
de Landsheere et al, 2012[70]	Retr nRCs	B	64 ± 10.1	ND	Vag MHP vs TVH/VMS (both with Prolift)	308 (286 PRES)	2 mo	Uterine prolapse recurrence not clearly defined
Huang et al, 2011[71]	Retr nRCs	C	61.2 ± 11.4 (33–85)	24.8 ± 3.6	Vag MHP vs TVH/VMS (both with Prolift)	65 (50 included as 15 prior HYST; PRES, 11)	12 mo	POP-Q ≥stage 2
Chu et al, 2012[72]	Pros nRCs	B	65.5 ± 8.0	24.9 ± 3.4	Vag MHP vs TVH/VMS (both with Apogee/ Perigee)	91 (PRES, 52)	12 mo (mean 8.9 mo)	Not measured (measured leading POP-Q edge stage)
Vu et al, 2012[73]	Retr nRCs	B	62.8 (36–85)	26.6 (16.6–38.1)	Vag MHP vs TVH/VMS (both with Uphold)	110 (87 included as 23 prior HYST; PRES, 53)	11.8 mo, PRES; 10.8 mo, HYST	POP-Q point C >−1 or point C beyond hymen (measured both)

abd, abdominal; *BMI*, body mass index; *hyst*, hysterectomy; *HYST*, prolapse surgery with hysterectomy; *MHP*, mesh hysteropexy; *nRC*, nonrandomized comparative study; *PIVS*, posterior intravaginal slingplasty; *POP*, pelvic organ prolapse; *POPDI*, pelvic organ prolapse distress inventory; *POP-Q*, pelvic organ prolapse quantification; *PRES*, prolapse surgery with uterine preservation; *pros*, prospective; *RCT*, randomized controlled trial; *retr*, retrospective; *SS*, sacrospinous; *SSLF*, sacrospinous ligament fixation; *TVH*, total vaginal hysterectomy; *USLS*, uterosacral ligament suspension; *vag*, vaginal/transvaginal; *VMS*, vaginal mesh suspension.

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to +1.07 cm)[43,63,72,73] was also slightly but significantly longer with uterine preservation.

EBL (difference, −93.5 mL, 95% CI, −78.8 to −108.3 mL),[43,63,66,67,69,72,73] drop in hemoglobin in 1 study (−1.3 vs −2.6 g/dL, $P = .06$)[66] and hematoma formation in 1 study (0% vs 10%, OR, 0.4)[63] were also significantly less with uterine preservation. Hospital time was similar (difference, −0.50 days, 95% CI, +0.18 to −1.17 days),[62,63,66,69,72] but operating room time was significantly less in uterine preservation (difference, −35.7 minutes, 95% CI, −44.6 to 26.7).[63,67,69,72,73] Both mesh exposure (Figure 3, 17 of 337 [5%] PRES vs 29 of 192 [15%] HYST, OR, 0.34, 95% CI, 0.18−0.67][43,62,63,67,69,72,73] and reoperation for mesh exposure (5 of 378 [1.3%] PRES vs 12 of 154 [7.3%] HYST, OR, 0.16, 95% CI, 0.05−0.46)[63,67,70] were less with uterine preservation in the setting of transvaginal mesh procedures.

De novo stress incontinence was more prevalent with uterine preservation in mesh repairs, but this difference was not statistically significant (OR, 2.24, 95% CI, 0.43−14.34, $P = .32$).[63,65] Similarly, postoperative overactive bladder symptoms such as urinary frequency and urgency (RR, 0.99, 95% CI, 0.47−2.07, $P = .98$)[62,63,67] were also similar in these procedures. Prolapse recurrence in transvaginal mesh surgeries was slightly more prevalent with hysterectomy, although this was not statistically significant (RR, 1.66, 95% CI, 0.95−2.92).[61-63,68-70,73] Repeat prolapse surgery in this setting was also not significantly different between preservation and hysterectomy (RR, 2.45, 95% CI, 0.42−15.28).[63,65-67]

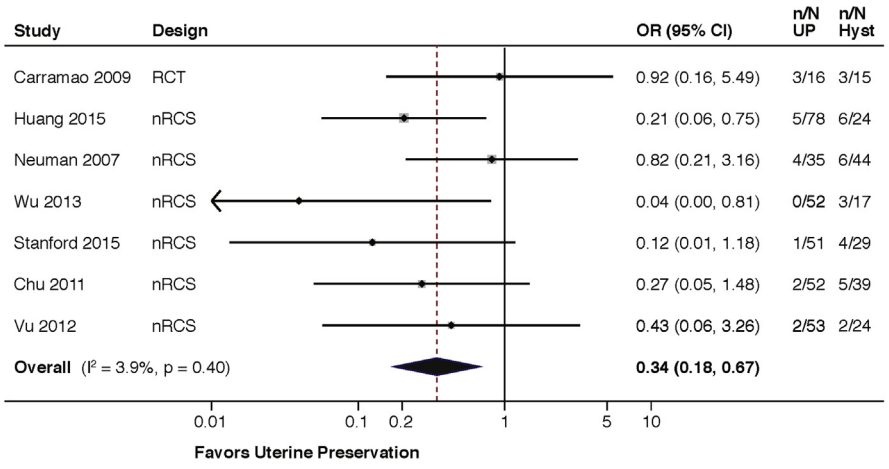
Transvaginal native tissue hysteropexy vs vaginal hysterectomy with native tissue suspension

There were 13 studies (4 RCTs[74-77] and 9 nRCs[9,78-85]) that investigated the comparison between transvaginal native tissue hysteropexy with a vaginal hysterectomy and transvaginal native tissue suspension (Table 4). Eleven of these studies compared sacrospinous hysteropexy with other transvaginal suspension[74-79,81-85]: 2 compared

sacrospinous hysteropexy with total vaginal hysterectomy with uterosacral suspension,[74,75] 2 compared sacrospinous hysteropexy with vaginal hysterectomy,[76,77] and 7 compared sacrospinous suspension with and without hysterectomy.[78,79,81-85] One study compared uterosacral suspension with and without transvaginal hysterectomy,[80] and 1 was a mix of various surgical approaches to uterine preservation.[9]

EBL (difference, −89.9 mL, 95% CI, −14.9 to −165.0 mL)[74,81,83] and operating room time (difference, −17.5 min, 95% CI, −6.0 to −29.2 minutes)[74,79,81,83] favored uterine preservation, and there was no significant difference in hospital stay (difference, −0.01 days, 95% CI, −0.28 to +0.25 days). There were also no significant differences in prolapse outcomes, including apical prolapse recurrence (RR, 2.22, 95% CI, 0.80−6.17),[74,75,80,82,83] anterior prolapse recurrence (RR, 0.86, 95% CI, 0.48−1.55),[74,75,80,83,84] and posterior prolapse recurrence (RR, 0.79, 95% CI, 0.39−2.03)[74,75,80,83] and no significant difference in surgery satisfaction (RR, 1.07, 95% CI, 0.38−2.99).[9,78,83]

FIGURE 3
Mesh exposure in transvaginal hysteropexy vs vaginal hysterectomy with suspension



Mesh exposure in transvaginal mesh hysteropexy (uterine preservation) vs vaginal hysterectomy with mesh vaginal suspension, with outcomes favoring uterine preservation (transvaginal mesh hysteropexy) to the left.

CI, confidence interval, *Hyst*, groups with pelvic organ prolapse procedures involving hysterectomy, *n/N*, number of mesh exposures/number analyzed, *nRC*, nonrandomized comparative study, *OR*, odds ratio, *UP*, groups with pelvic organ prolapse procedures with uterine preservation.

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Manchester procedure vs total vaginal hysterectomy with native tissue repair

There were 6 studies that compared the Manchester procedure with a vaginal hysterectomy with or without a transvaginal native tissue repair (Table 5).[86-91] Both EBL (difference, 103.6 mL, 95% CI, 63.8−143.3 mL)[87,88,90,91] and the risk of transfusion (RR, 0.41, 95% CI, 0.19−0.90)[87,91] favored the Manchester, as did operating room time (difference, −33.7 minutes, 95% CI, −27.9 to −39.5 minutes).[87,88,90,91] There was no significant difference in hospital stay (difference, 0 days, 95% CI, −0.56 to +0.56 days).[87,88,90,91]

One study found a longer time to recurrence of prolapse with the Manchester procedure (72.0 PRES vs 64.4 months HYST, $P = .03$).[88] Another study investigated POP-Q points, in which the genital hiatus was significantly smaller in Manchester (3.6 cm vs 4.0 cm, $P < .01$), and the perineal body significantly larger (3.9 cm vs 3.6 cm, $P < .01$), with no differences in other POP-Q points.[89] In the 2 studies investigating repeat surgery for prolapse, no difference was seen (RR, 0.42, 95% CI, 0.15−1.15, $P = .09$).[88,90]

LeFort colpocleisis vs vaginal hysterectomy and colphorrhaphy

There was 1 nRC that compared the LeFort colpocleisis obliterative procedure (uterine preservation) with a vaginal hysterectomy with a reconstructive procedure (anterior-posterior colpoperineoplasty) for prolapse (Table 1).[92] There was a shorter operating room time with the LeFort procedure (75 vs 90 minutes, $P < .01$) but no significant difference in resolution of prolapse symptoms or adverse events.

Reporting on uterine pathology after uterine preservation

Of the studies included in this review, only 2 reported on a need for interventions or hysterectomy needed at a later date after uterine preservation because of uterine pathology. Cvach et al[46] reported that 1 of 18 patients (5.5%) needed subsequent surgery because of uterine pathology (hysteroscopy and curettage with benign findings), and 4 of 18 (22%) needed some type of workup because of abnormal bleeding, with all having benign findings on workup.

Rahmanou et al[54,56] reported that 1 of their 50 patients randomized to vaginal hysterectomy (2%) had an incidental uterine malignancy found, and they had no subsequent findings of uterine malignancy in patients randomized to uterine preservation. Overall, there was insufficient data to make any clinical practice guidelines about the risks of subsequent malignancy or preoperative workup of asymptomatic women prior to uterine-preservation POP surgery.

Clinical practice guidelines

Clinical practice guidelines based on our findings are listed in Table 6.

Comment

Main findings

The results of this review confirm that many uterine preservation surgeries have benefits over POP surgeries with

TABLE 4
Studies investigating transvaginal native tissue (sacrospinous or uterosacral) uterine suspension or hysteropexy procedures against other prolapse surgeries involving hysterectomy

Study	Study design	Study quality	Mean age of subjects, y, ±SD or (range)	Mean BMI, kg/m^2, of subjects ±SD or (range)	Surgeries compared	Women, n	Length of follow-up (actual or mean/median)	Definition of POP recurrence
Detollenaere et al, 2011[74]	RCT	A	Median 62.7 (45–85)	26.0 ± 3.3	Vag SS HP vs TVH/vag USLS	208 (103 PRES)	60 mo	POP-Q ≥stage 2; repeat treatment
Jeng et al, 2005[77]	RCT	B	39.3 ± 6.2	ND	Vag SS HP vs TVH	158 (80 PRES)	18 mo	Not measured (sexual function outcomes only)
Dietz et al, 2010[75]	RCT	A	61.5 ± 9.6	26.3 ± 3.2	Vag SS HP vs TVH/vag USLS	66 (35 PRES)	12 mo	POP-Q ≥stage 2
Dietz et al, 2006[76]	RCT	C	ND	ND	Vag SS HP vs TVH	30 (18 PRES)	6 wk	Not measured (pain outcomes only)
van Brummen et al, 2003[78]	Retr nRCs	B	65.1 ± 11.4	25.2 ± 3.2	Vag SS HP vs TVH/SSLF	138 (86 PRES)	15.4 mo	Not measured (surgical satisfaction and urinary outcomes)
Marschalek et al, 2014[79]	Retr nRCs	C	Median 47 (IQR 38.3–68.9)	Median 26.5 (IQR 22.5–27.7)	Vag SS HP vs TVH/SSLF or USLS	96 (21 PRES)	6 mo	Not clearly defined (measured symptoms recurrence)
Romanzi and Tyagi, 2012[80]	Retr nRCs	B	52.3 ± 10.66	ND	Vag US HP vs TVH/USLS	200 (100 PRES)	12 mo	Baden-Walker grade ≥grade 2; apex greater than halfway down the TVL
Hefni et al, 2003[81]	Pros nRCs	B	70.1 ± 6	28.1 (23–35)	Vag SS HP vs TVH/SSLF	109 (61 PRES)	33 mo, PRES; 34 mo, HYST	Absence of symptoms and apex >6 cm above hymen with Valsalva and 2 fingers in vagina without discomfort
Hefni and El-Toukhy, 2006[82]	Pros nRCs	B	59.9 ± 10.4	28.1 ± 4.1	Vag SS HP vs. TVH/SSLF	182 (65 PRES)	57 mo	Apex > 6 cm above hymen with Valsalva
Maher et al, 2001[83]	Retr nRCs	B	65 ± 18 (23–87)	28 ± 9 (19–60)	Vag SS HP vs TVH/SSLF	56 (27 PRES)	26 mo	Apex greater than halfway down the TVL
Carey and Slack, 1994[84]	Retr nRCs	B	76.7 (63–93)	ND	Vag SS HP vs TVH/SSLF	24 (11 PRES)	4 mo	Recurrence not clearly defined
Lo et al, 2015[85]	Retr nRCs	B	58.1 ± 12.7	25.1 ± 3.4	Vag SS HP vs TVH/SSLF	146 (26 PRES)	86.0 ± 21.5 mo	POP-Q ≥stage 2
Farthmann et al, 2015[9]	Retr nRCs	B	62.47 ± 11.08	ND	Vag SS HP with or without mesh vs various HYST approaches	196 (74 PRES)	67.25 mo	Not measured; surgery satisfaction only

abd, abdominal; *HP*, hysteropexy; *hyst*, hysterectomy; *HYST*, prolapse surgery with hysterectomy; *IQR*, interquartile range; *nRC*, nonrandomized comparative study; *POP*, pelvic organ prolapse; *POP-Q*, pelvic organ prolapse quantification; *PRES*, prolapse surgery with uterine preservation; *pros*, prospective; *RCT*, randomized controlled trial; *retr*, retrospective; *SS*, sacrospinous; *SSLF*, sacrospinous ligament fixation; *TVH*, total vaginal hysterectomy; *TVL*, total vaginal length; *US*, uterosacral; *USLS*, uterosacral ligament suspension; *vag*, vaginal/transvaginal.

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hysterectomy and should be considered in patients without contraindications. For these women, uterine preservation decreases mesh exposure, operating time, and bleeding, when compared with prolapse repairs with hysterectomy. The majority of comparative trials on the topic do not show substantive differences in prolapse outcomes or recurrence. However, this is limited by shorter-term follow-up (1–3 years) seen in most studies.

Comparison with existing literature

The clinical practice guidelines underscore that preservation of the uterus, provided that the surgical approach is the same, helps to save time and reduce blood loss in many cases. However, when hysterectomy is considered, the vaginal route is still considered the least morbid, generally resulting in the least blood loss and shortest operative time.[93-96] Thus, in those studies comparing a uterine preservation POP surgery of an abdominal route against a hysterectomy of a vaginal route, it is unsurprising that vaginal hysterectomy was advantageous. It appears that the safety of the vaginal route outweighs the advantages of uterine preservation in those hysteropexy procedures involving a more morbid abdominal route.

Past studies indicate that the risk of mesh exposure in sacrocolpopexy is lowered to one fifth that of hysterectomy with the use of uterine or cervical preservation, and multiple studies have upheld that a vaginal apical incision is a risk factor for vaginal mesh exposure.[29,37,97] This review further underscores that, whether by a transvaginal or abdominal route, the placement of mesh concurrent with a hysterectomy is associated with an increased risk of mesh exposure and, importantly, reoperation for mesh exposure complications.

In some individual studies, specifically those involving transvaginal and laparoscopic mesh hysteropexy, the postoperative prevalence of urinary symptoms was somewhat higher, although not statistically significant in this review. While a past cohort study found hysterectomy was associated with a higher risk of urinary

TABLE 5
Studies investigating transvaginal Manchester procedures against other surgeries involving hysterectomy

Study	Study design	Study quality	Mean age of subjects, y, ± SD or (range)	Mean BMI of subjects, kg/m^2, ±SD or (range)	Surgeries compared	Women, n	Length of follow-up (actual or mean/median)	Definition of POP recurrence
Ünlübilgin et al, 2013[86]	RCT	B	50.0 ± 10.0	27 ± 4.2	Manchester vs TVH (did not specify if reconstructive procedure)	94 (45 PRES)	61 mo	C point on POP-Q
Kalogirou Andonova 1996[87]	Retr nRCs	B	59	ND	Manchester vs TVH with APR	421 (190 PRES)	18 days	No prolapse outcomes
Iliev and Andonova, 2014[90]	Retr nRCs	C	ND	ND	Manchester vs TVH (did not specify if reconstructive procedure)	66 (33 PRES)	12 mo	Prolapse recurrence (not further defined), measured repeat surgery for prolapse
Thys et al, 2011[88]	Retr nRCs	B	62 ± 13	25 ± 3	Manchester vs TVH with USLS	196 (98 PRES)	At least 72 mo PRES; 64.4 mo in HYST (states only 6 wks but data imply longer follow-up)	Objective recurrence by examination (but no further definition)
Thomas et al, 1995[91]	Retr nRCs	C	Median 66 (26–85)	ND	Manchester vs TVH (did not specify if reconstructive procedure)	193 (88 PRES)	2.5 y	Prolapse to second or third degree by Beecham,[107] 1980, criteria
de Boer et al, 2009[89]	Retr nRCs	C	Median 58 (34–83)	Median 24 (19–41)	Manchester vs TVH with USLS	156 (85 PRES)	12 mo	POP-Q points

abd, abdominal; *APR*, anterior and posterior vaginal repair; *hyst*, hysterectomy; *HYST*, prolapse surgery with hysterectomy; *ND*, no data; *nRC*, nonrandomized comparative study; *POP*, pelvic organ prolapse; *POP-Q*, pelvic organ prolapse quantification; *PRES*, prolapse surgery with uterine preservation; *pros*, prospective; *RCT*, randomized controlled trial; retr, retrospective; *TVH*, total vaginal hysterectomy; *TVL*, total vaginal length; *USLS*, uterosacral ligament suspension; *vag*, vaginal/transvaginal.

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TABLE 6
Clinical practice guidelines regarding the use of uterine preservation in contrast to hysterectomy in the setting of surgical, apical repair of pelvic organ prolapse

Relevant surgical comparison	Contributing studies	GRADE recommendation	Choice recommended
Abd (open or LS) mesh sacrohysteropexy (PRES) vs abd (open or LS) hysterectomy with mesh sacrocolpopexy (HYST)	9 nRCs (5 pros)	2B We suggest:	Uterine preservation to reduce mesh exposure OR time, EBL, and surgical cost.
Laparoscopic mesh sacrohysteropexy (PRES) vs vaginal hysterectomy with native tissue reconstruction (HYST)	1 RCT	2B We suggest:	Laparoscopic sacrohysteropexy to improve TVL (nearly 2 cm) and C (1−2 cm) points on the POP-Q, EBL, postoperative pain and functioning, and hospital stay, although it may elongate operative time
Open mesh sacrohysteropexy (PRES) vs vaginal hysterectomy with native tissue reconstruction (HYST)	1 RCT	2B We suggest:	Vaginal hysterectomy with native tissue reconstruction to decrease bothersome urinary symptoms, improve QOL, and improve postoperative pain and mobility
LS native tissue prolapse hysteropexy (such as USLS) (PRES) vs LS hyst with native tissue prolapse surgery (HYST)	2 nRCs (1 pros)	2C We suggest:	Uterine preservation to reduce OR time, EBL, and pain medication use, although this may result in a slight increase in risk of prolapse recurrence (stage $\geq$2) within 2−3 years.
LS USLS hysteropexy (PRES) vs TVH with USLS (HYST)	1 retr nRC	2C We suggest:	TVH with USLS as opposed to a LS USLS hysteropexy, to improve point C (nearly 2 cm), despite no significant difference in reoperation for prolapse and increased TVL ($<$1 cm) with uterine preservation
Vag mesh hysteropexy (PRES) vs TVH with vag mesh colpopexy (HYST)	4 RCT; 9 nRCs (4 pros nRCs)	2A We suggest:	Uterine preservation to decrease mesh exposure, reoperation for mesh exposure OR time, postoperative hematoma formation, and EBL as well as improve posterior POP-Q points and TVL
Vag native tissue hysteropexy such as USLS hysteropexy (PRES) vs TVH with native tissue colpopexy (HYST)	4 RCT; 9 nRCs (2 pros nRCs)	2A We suggest:	Uterine preservation because it does not worsen any outcomes and improves OR time and EBL
Manchester procedure (PRES) vs TVH with or without USLS and/or APR (HYST)	1 RCT; 5 nRCS (0 pros nRCs)	2B We suggest:	That when the surgeon offers Manchester procedures as part of their practice, the Manchester procedure should be chosen over vaginal hysterectomy with native tissue suspension to elongate time to reoperation as well as decrease transfusion OR time and EBL

All clinical practice guidelines are intended to begin with the clause, "For women who desire and have no contraindications to uterine preservation, … ."

abd, abdominal; *EBL* estimated blood loss; *HYST*, prolapse surgery with hysterectomy; *LS*, laparoscopic; *LSSCH*, laparoscopic supracervical hysterectomy; *nRC*, nonrandomized comparative study; *OAB* overactive bladder; *OR* operating room; *POP*, pelvic organ prolapse; *POP-Q*, pelvic organ prolapse quantification; *PRES*, prolapse surgery with uterine preservation; *pros*, prospective; *QOL* quality of life; *RCT*, randomized controlled trial; *retr*, retrospective; *SCerP*, sacrocervicopexy; *TLH*, total laparoscopic hysterectomy; *TVH*, total vaginal hysterectomy; *TVL* total vaginal length; *USLS*, uterosacral ligament suspension; *vag*, vaginal/transvaginal.

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incontinence and more incontinence episodes,[98] a systematic review on the topic found that urinary incontinence was reduced after hysterectomy,[99] and large Swedish trials have found that the response of urinary symptoms to hysterectomy is highly variable.[100,101] Overall, the role of the uterus in urinary symptoms is very unclear, and this review does not provide any evidence that uterine preservation worsens urinary outcomes.

Our review includes only studies with patients who had no contraindications to uterine preservation, and uterine preservation POP surgery is clearly not appropriate for all women. Not all surgeons may have the appropriate skill to perform advanced uterine preservation surgeries such as minimally invasive sacrohysteropexy, the Manchester

procedure, or transvaginal mesh hysteropexy. Furthermore, uterine preservation is contraindicated in women with uterine abnormalities such as enlarged fibroids or adenomyosis, abnormal menstrual bleeding, postmenopausal bleeding, current or recent history of cervical dysplasia, familial cancer syndromes that may affect endometrial or ovarian cancer risk, tamoxifen therapy, and in those unable to continue routine gynecological surveillance.[13]

In this review, the literature was shown to be severely lacking in any information on the prevalence of future hysterectomy after uterine preservation. Only 3 studies reported on this,[46,54,56,102] one of which was not included in this manuscript because it did not compare uterine preservation with hysterectomy.[102] Because of this dearth of information in the literature, we are unable to make evidence-based recommendations on how to counsel patients regarding the risk of a need for later hysterectomy or the utility of screening tools for uterine abnormalities in asymptomatic women without contraindications to uterine preservation.

The discussion of uterine preservation as a surgical modality in prolapse repair should be a key step in patient-centered counseling. As noted in the previous text, greater than a third of women expressed a preference for uterine preservation during prolapse surgery if outcomes were equal,[5] but this preference may be influenced by geographical area and socioeconomic status. Although 1 study found that most women do not believe the uterus is important for health or sexual function,[103] women have expressed that the uterus is "important to their sense of self."[5]

Despite this fact, surgeons may not routinely offer uterine preserving POP surgeries because of practice patterns, skill, reimbursement, or concerns about prolapse recurrence. The authors recognize that the introduction of uterine preservation to patient counseling prior to POP surgery adds a layer of complexity in the already time-consuming and complicated informed consent process,[104,105] but this review underscores the utility of screening patients for eligibility for uterine preservation and desire to preserve the uterus upon initial assessment. The decision to preserve the uterus during POP surgery should depend on patient preference, uterine pathology, and surgeon skills and should be an individualized decision for each patient.

Strengths and limitations

The strengths of this review are its comprehensive methodology and review by female pelvic surgeons. The overall quality of the literature included was moderate, and this manuscript includes more randomized trials than previously recognized in other reviews of uterine preservation.[7,13] This could be due to the fact that past reviews have focused only on English-language literature or only journal publication forms.

This review also included diverse types of uterine-preservation procedures, including obliterative techniques, which we believed worthy of inclusion, given the high patient satisfaction rates with colpocleisis surgeries.[14,106] Overall, this was a comprehensive review of all reported modalities of uterine preservation and included all surgical comparators that clinicians may find applicable to this population.

Limitations of this review include the heterogeneity of the studies and, for some comparisons, the relative lack of evidence (eg, between LeFort colpocleisis and hysterectomy with colpocleisis) or a very low quality of evidence (eg, between Manchester procedure and vaginal hysterectomy). In the case of some studies, such as those comparing sacrospinous hysteropexy with vaginal hysterectomy,[76,77] the study manuscript does not clarify whether or not an apical suspension was performed and the manner of the apical suspension, limiting our ability to apply data from these comparisons. Moreover, the surgical techniques and definitions of prolapse outcomes vary significantly.

The authors also acknowledge that not all statistically significant findings in the analysis, such as small differences in TVL or point C, can be said to be clinically significant. Regarding the transvaginal mesh surgeries reviewed, it is notable that many studies investigated mesh products that are no longer in use, and current mesh products may not have similar outcomes.

Lastly, we cannot make recommendations about the long-term risk of recurrent prolapse or malignancy in uteri retained or regarding pregnancy outcomes after uterus-preserving prolapse surgery because the limits of the trials contained insufficient data on these outcomes.

Conclusions and implications

Overall, we find that appropriate candidates for uterine preservation prolapse surgery can be offered this approach, and this review indicates that women should be counseled about the reduced operating room time and morbidity (such as lower mesh exposure risk) associated with this choice. However, women should also be informed that the long-term influence of the uterus on prolapse outcomes many years after surgery is still largely unknown.

Implications and contributions

This study was conducted to investigate the effect of uterine preservation on outcomes in the surgical repair of apical pelvic organ prolapse.

What are the key findings?

- Uterine preservation decreases operative time and morbidities such as mesh erosion without significant worsening of prolapse outcomes.
- There is a significant lack of literature on long-term prolapse outcomes after uterine preservation, the role of uterine preservation in obliterative prolapse procedures, and the risk of uterine pathology in the longer term.

What does this study add to what is already known?

- Condenses the available data on uterine preservation in prolapse surgery.
- Allows surgeons to appropriately counsel patients who desire uterine preservation in this setting.

- Highlights gaps in the literature on this topic. ■

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The study was registered with PROSPERO (CRD42017067899), and full protocol can be found at https://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42017067899.

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Supplemental Material

Literature search strategy

Among the MeSH items searched were uterine prolapse, pelvic organ prolapse, prolapse, descensus, vaginal prolapse, pelvic floor, rectocele, cystocele, sacrocolpopexy, sacropexy, colpopexy, hysteropexy, uterine preservation, Manchester, colpocleisis, Fothergill, LeFort, randomized trial, longitudinal studies, clinical trial, controlled clinical trial, comparative study, prospective study, retrospective study, meta-analysis, and systematic review. Included studies could be in any published format (eg, journal article, abstract, poster) as long as the data were able to be extracted from the form in which it was published. We did not attempt to identify unpublished articles or abstracts, and we did not contact study authors. The search was limited to human subjects and included any language. Studies in languages that were not fluently read by one of our group members were interpreted with the assistance of a fluent speaker in the medical field or with professional translational software to extract relevant findings. Reference lists of selected articles and review papers were screened for additional eligible references.

SUPPLEMENT TABLE

Study outcomes investigated

Prolapse outcomes

Objective outcomes
- Compound success (subjective and objective criteria)
- Repeat surgery for prolapse
- Anatomic success
  - Overall
  - Apical
  - Anterior
  - Posterior
- POP-Q points (Aa, Ba, TVL, C, Ap, Bp, GH, PB)
- Postoperative prolapse stage (POP-Q)
- Objective prolapse recurrence (anatomic criteria)
  - Overall
  - Apical
  - Anterior
  - Posterior

Subjective outcomes
- Subjective prolapse recurrence
  - Symptom recurrence
  - Persistence or non-resolution of symptoms
- Surgery satisfaction
- Resolution or cure of prolapse symptoms
- Improvement in prolapse symptoms
- POP-DI 6 score
- PGI-I
- PGI-C

Other pelvic floor outcomes

Urinary symptoms
- Resolution of symptoms
  - Incontinence
  - Voiding dysfunction
- Urinary frequency/urgency/OAB
  - Any postoperative
  - New (de novo)
- Urinary incontinence (any type)
  - Any postoperative
  - New (de novo)
- Urinary incontinence (stress)
  - Any postoperative
  - New (de novo)
- Urinary incontinence (urgency)
  - Any postoperative
  - New (de novo)
- Recurrent UTI
- Voiding dysfunction
  - Objective (measured)
  - Subjective
  - Need for catheterization
- UDI-6 score
- IIQ score

Fecal symptoms
- Resolution of symptoms
  - Defecatory dysfunction
  - Incontinence
- Fecal/anal incontinence
  - Any postoperative
  - New (de novo)
- Constipation
  - Any postoperative
  - New (de novo)
- Fecal urgency
  - Any postoperative
  - New (de novo)
- CRADI-8 score
- FIQOL

Sexual symptoms
- Sexual activity
  - Any postoperative
  - New (de novo)
- PISQ-12 or PISQ-IR
- FSFI score
- Sexual function (another questionnaire)

Other pelvic floor questionnaires
- PFDI-20
- PFIQ-7

Perioperative outcomes

Bleeding
- EBL
- Hemoglobin/hematocrit

OR time

Hospital stay

Postoperative pain
- VAS scale
- Medication use

Quality of life

Return to function
- ADLs
- Return to work
- Validated questionnaires
- QALYs

Postoperative voiding
- Catheter use length
- Home with catheter

Surgical cost
- Overall
- Surgery alone

Intraoperative conversion
- Change of route
- Abandonment of procedure

Adverse events

Severe events
- Death
- Return to OR
- Intubation
- ICU admission
- Cardiac events

Hematological events
- Transfusion
- Postoperative bleeding
  - Requiring intervention
  - Any noted
  - Hematoma formation
- Large EBL
- VTEs (DVT or PE)

Other organ injury
- Bladder injury
- Bowel injury
- Ureteral injury
- Nerve injury or postoperative neuropathy

GI complications
- SBO
- Ileus
- Postoperative constipation requiring intervention

Infectious/wound complications
- Postoperative fever
- UTI
- Pneumonia
- Wound infection
  - Vaginal cuff
  - Cellulitis
  - Abscess
  - Skin or laparoscopic site
- Wound separation
  - Skin
  - Vaginal cuff

Long-term pain
- Chronic pelvic pain
- Dyspareunia

Mesh complications
- Erosion
- Requiring excision

Complications of uterine preservation
- Postoperative bleeding
- Uterine/cervical malignancy
- Uterine/cervical pathology (nonmalignant)
  - Requiring workup
  - Requiring medical intervention
  - Requiring surgery
- Required later hysterectomy

ADL, activities of daily living; *CRADI*, colorectal-anal distress inventory; *DVT*, deep venous thrombosis; *EBL*, estimated blood loss; *FIQOL*, fecal incontinence quality-of-life scale; *FSFI*, female sexual function index; *GI*, gastrointestinal; *ICU*, intensive care unit; *IIQ*, Incontinence Impact Questionnaire; *OAB*, overactive bladder; *OR*, operating room; *PE*, pulmonary embolism; *PFDI*, Pelvic Floor Distress Inventory; *PFIQ*, Pelvic Floor Impact Questionnaire; *PGI-C*, patient global impression of change; *PGI-I*, patient global impression of improvement; *PISQ (IR)*, Pelvic Organ Prolapse/Incontinence Sexual Questionnaire (International Urogynecologic Association revision); *POPDI*, Pelvic Organ Prolapse Distress Inventory; *POP-Q*, pelvic organ prolapse quantification system; *QALY*, quality life-years; *SBO*, small bowel obstruction; *UDI*, Urogenital Distress Inventory; *UTI*, urinary tract infection; *VAS*, visual analog scale; *VTE*, venous thrombotic events.

Meriwether. Uterine preservation in pelvic organ prolapse surgery: a systematic review. Am J Obstet Gynecol 2018.