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Association between Adjuvant Posterior Repair and Success of Native Tissue Apical Suspension

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Abstract

Background—Posterior repairs and perineorrhaphies are often performed in prolapse surgery to reduce the size of the genital hiatus. The benefit of an adjuvant posterior repair at the time of sacrospinous ligament fixation or uterosacral ligament suspension is unknown.

Objective—We aimed to determine if an adjuvant posterior repair at transvaginal apical suspension is associated with improved surgical success.

Study Design—This secondary analysis of Operations and Pelvic Muscle Training in the Management of Apical Support Loss [OPTIMAL] trial compared 24-month outcomes in 190 participants who had a posterior repair (posterior repair group) and 184 who did not (No posterior

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Conflicts of interest:

All other authors report no conflict of interest

The OPTIMAL trial is registered at clinicaltrials.gov under Registration #

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repair) at the time of SSLF or USLS. Concomitant posterior repair was performed at surgeon's discretion. Primary composite outcome of 'surgical success' was defined as no prolapse beyond the hymen, point C $\leq$ 2/3TVL, no bothersome bulge symptoms, and no retreatment at 24 months. The individual components were secondary outcomes. Propensity score methods were employed to build models that balanced posterior repair and No posterior repair groups for ethnographic factors and preoperative Pelvic Organ Prolapse Quantification (POPQ) values. Adjusted ORs were calculated to predict surgical success based on the performance of a posterior repair. Groups were also compared with unadjusted Chi Square analyses. An unadjusted probability curve was created for surgical success as predicted by preoperative genital hiatus (GH).

Results—Women in the posterior repair group were less likely to be Hispanic or Latino, were more likely to have had a prior hysterectomy and be on estrogen therapy. The groups did not differ with respect to pre-operative POPQ stage; however, subjects in the posterior repair group had significantly greater preoperative posterior wall prolapse. There were no group differences in surgical success using PS methods (66.7% posterior repair vs 62.0% no posterior repair, aOR 1.07 (0.56, 2.07), p : 0.83) or unadjusted test (66.2% posterior repair vs. 61.7% No posterior repair, p : 0.47). Individual outcome measures of prolapse recurrence (bothersome bulge symptoms, prolapse beyond the hymen or retreatment for prolapse) also did not differ by group. Similarly, there were no differences between groups in anatomic outcomes of any individual compartment (anterior, apical, or posterior) at 24 months. There was high variation in performance of posterior repair by surgeon [IQR 15%–79%]. The unadjusted probability of overall success at 24 months, regardless of posterior repair, decreased with increasing GH such that a GH of 4.5 cm was associated with 65.8% success (95% CI: 60.1%, 71.1%).

Conclusion—Concomitant posterior repair at sacrospinous ligament fixation or uterosacral ligament suspension was not associated with surgical success after adjusting for baseline covariates using propensity scores or unadjusted comparison. Posterior repair may not compensate for the pathophysiology that lead to enlarged pre-operative GH which remains prognostic of prolapse recurrence.

Condensation:

Adjuvant posterior repair was not associated with surgical success in women undergoing uterosacral or sacrospinous ligament suspension for prolapse.

Keywords

apical suspension; colpopexy; perineorrhaphy; posterior colporrhaphy; posterior repair; prolapse; propensity score analysis; sacrospinous ligament fixation; transvaginal surgery; uterosacral ligament suspension; variation in practice; vault prolapse

INTRODUCTION

Pelvic organ prolapse (POP) is a burdensome condition. The life-time risk of surgery for POP is estimated between 11 and 19%, and up to 30% of these women will undergo additional surgical procedure for recurrent prolapse.^{1–4} Women with POP often have multi-compartment vaginal wall defects, with apical support now commonly understood as the key to achieving a successful prolapse repair.^{5–7} The benefit of an adjuvant posterior repair after

the apex has been adequately supported remains unknown; this intraoperative decision is typically made at the surgeon's discretion. The Pelvic Floor Disorders Network has previously shown that with sacrocolpopexy, a concurrent posterior repair was not associated with rectocele-associated symptoms or posterior anatomic outcomes.^{8,9} There is a paucity of comparable information regarding the impact of concurrent posterior repair on overall surgical outcomes after transvaginal native tissue apical suspensions.

Existing data suggest an association between increased genital hiatus size and loss of apical vaginal support, which may lead to the development of prolapse.^{10–12} Posterior repair along with apical suspension has been proposed not only to restore the complete vaginal axis but also potentially to reduce the stress on the apical suspension sutures to prevent prolapse recurrence.¹³ However, there is a paucity of data on the impact of concurrent posterior repair at the time of transvaginal apical suspension procedures on overall surgical outcomes. Our group has previously reported that an adjuvant Anterior Repair at the time of transvaginal native tissue apical suspension was not associated with anterior anatomic success.¹⁴

The Operations and Pelvic Muscle Training in the Management of Apical Support Loss (OPTIMAL) trial¹⁵ provides a well-characterized cohort of patients that underwent a standardized transvaginal apical suspension with which to examine the impact of adjuvant posterior repair. The primary aim of this secondary analysis was to examine the association between an adjuvant posterior repair on overall surgical success at 24 months after transvaginal, native tissue, apical suspension in women enrolled in the OPTIMAL trial.

MATERIALS AND METHODS

This was a secondary analysis of data from 374 women with Stage 2 uterine or vaginal prolapse and stress urinary incontinence enrolled in the OPTIMAL Trial, a 2 × 2 factorial randomized trial conducted at 9 sites of the Pelvic Floor Disorders Network. The trial design, methods and results have been previously published.^{15,16} Briefly, each subject underwent two distinct randomizations: first, perioperative behavioral therapy with pelvic floor muscle training (BPMT) or usual care; and second, uterosacral ligament suspension (USLS) or sacrospinous ligament fixation (SSLF). All women received a midurethral sling. In the absence of accepted standard, the protocol did not proscribe a posterior repair technique or suture material. As such, posterior repair may or may not have included a perineorrhaphy and/or levator myorrhaphy. Anatomic and patient-reported outcomes were ascertained by study personnel masked to both perioperative BPMT and surgical assignment. The primary aims of the OPTIMAL Trial were: (1) to compare surgical outcomes for the two apical suspension surgeries at 24 months; and (2) to evaluate the impact of BPMT on urinary symptoms at 6 months as assessed by the Pelvic Floor Distress Inventory (PFDI) and on anatomic outcomes and prolapse symptoms at 24 months. A composite surgical outcome was analyzed using an intention to treat approach. Surgical “success” was defined as the absence of all of the following: (1) descent of the vaginal apex more than one-third into the vaginal canal; (2) anterior or posterior vaginal wall descent beyond the hymen; (3) bothersome vaginal bulge symptoms; (4) re-treatment for prolapse by either surgery or pessary.

The primary aim of this secondary analysis was to determine if an adjuvant posterior repair with the assigned transvaginal apical suspension was associated with improved surgical success, using the composite outcome of the OPTIMAL Trial. The secondary aims included determining if adjuvant posterior repair was associated with the individual components of the composite outcome, if preoperative posterior vaginal prolapse was associated with surgical failure regardless of posterior repair, and if there was variance amongst surgeons in the performance of posterior repair.

Participants were grouped into those who underwent adjuvant posterior repair and those who did not. In OPTIMAL there was a 64% overall surgical success rate in the 304 women with non-missing outcomes at 2 years. Conservatively estimating success rates among participants without posterior repair to be 50% – 64%, we estimated that 304 participants would provide 80% power to detect a difference of 16% in surgical success rates between women with and without adjuvant PRs with an alpha level of 0.05.

The percent of participants who underwent posterior repair was calculated for each surgeon. Preoperative characteristics of participants with and without posterior repair were compared using Wilcoxon rank-sum tests, exact Mantel-Haenszel tests using modified ridit scores, or Fisher's exact tests. Unadjusted comparisons of outcomes between posterior repair groups were performed using Fisher's exact tests.

We explored clinically plausible patient variables that might impact a surgeon's choice for performing a posterior repair. Propensity score methods were used to adjust for nonrandom treatment selection between those with and without posterior repair in a two-step process. First, a logistic regression model was constructed to estimate the propensity for posterior repair based on preoperative characteristics that were clinically relevant to the outcome measures and differed between posterior repair and no posterior repair groups at an alpha level of < 0.2 in bivariate analyses. Surgeon was not included in this propensity score model, as a surgeon's predisposition toward posterior repair is not a characteristic of the individual patient, and its inclusion would have increased the variance of the predicted probabilities substantially. Second, outcomes were analyzed using generalized linear models, with a logit link, that adjusted for the propensity for posterior repair via stabilized inverse probability weighting; within-surgeon correlation was modeled as a random effect with a compound-symmetry covariance structure. A p-value of less than 0.05 was considered statistically significant.

Unadjusted logistic regression models were created to estimate the probability of surgical success based on either preoperative Bp or preoperative GH. Receiver operating characteristic (ROC) curves and predicted probability graphs were generated from the models. All statistical analyses were conducted using SAS Version 9.4 (SAS Institute, Cary, NC) software. All sites obtained local institutional review board approval and participants provided written research informed consent.

RESULTS

A total of 374 women were included in the original OPTIMAL study, and in this study. Posterior repair was performed in 190 subjects (50.8%), while 184 subjects (49.2%) did not receive posterior repair. Table 1 displays baseline demographics, clinical characteristics and Pelvic Organ Prolapse Quantification (POPQ) variables for all subjects. The median age was 56 [IQR 49–66] years. The majority were white, overweight, post-menopausal and vaginally parous. Overall, few reported prior prolapse or stress urinary incontinence surgery (7% and 3.5% respectively). Women in the posterior repair group were less likely to be Hispanic or Latino than those not receiving posterior repair (10.5% vs. 29.9%, $p < .0001$). Those in the posterior repair group were more likely to be on estrogen therapy, whether topical or systemic, (43.7% vs 18.5%, $p < .0001$) and to have had a prior hysterectomy (35.3% vs 17.9%, $p = 0.0002$). The groups in this secondary analysis did not differ with respect to pre-operative POPQ stage ($p = 0.1102$). However, subjects in the posterior repair group had significantly greater preoperative posterior wall prolapse (as measured by points Ap, Bp, and GH) (Table 1).

The propensity score (PS) model predicted PR based on ethnicity, education (≥ 4 years of college), estrogen replacement therapy, prior hysterectomy, preoperative POPQ values Ap and Bp, preoperative POPQ values of genital hiatus (GH) and perineal body (PB), and preoperative total vaginal length (TVL). Table 2 displays the primary outcome of our study. In the subsequent outcome model that accounted for the likelihood of receiving PR based on the PS model, there was no difference in composite surgical success between the posterior repair and no posterior repair groups (66.7% vs 62.0%, aOR 1.07 (0.56, 2.07), $p = 0.83$). Furthermore, no group differences were seen in the individual components of the composite definition of recurrence (i.e., patient-reported bothersome vaginal bulge, any prolapse beyond the hymen, descent of the vaginal apex more than one-third into the vaginal canal or retreatment for prolapse). Similarly, there were no differences between groups in anatomic outcomes of any individual compartment (anterior, apical, or posterior) at 24 months.

To further evaluate these findings, we conducted unadjusted analyses without propensity scoring. When the unadjusted effect of adjuvant posterior repair was compared at 24 months, again, no differences in composite success were seen between groups (66.2% posterior repair vs. 61.7% no posterior repair, $p = 0.47$). Furthermore, there were no intergroup differences in the individual components of the composite surgical outcome.

Figure 1 displays a scatter plot, with each dot representing a surgeon, of the number of posterior repairs performed by each surgeon and the proportion of their surgeries that included a posterior repair. In total, thirty-one surgeons performed the 374 native tissue apical surgeries at 9 clinical sites (range 3–5 surgeons per site). There was wide variation in performance of posterior repair by surgeon [Mean 51% of surgeries, Interquartile range 15%–79% of surgeries], with a minimum of 0 and maximum of 100%. Among the sixteen surgeons who contributed at least 10 cases to the OPTIMAL trial, their proportion of cases with posterior repair ranged from 0–94.4%. One surgeon performed 27.9% of all posterior repair surgeries in the study, with 93.0% of their cases including posterior repair. Five surgeons performed no adjuvant posterior repairs.

The unadjusted probability of composite success decreased with increasing baseline GH; a baseline GH of 4.5 cm was associated with a predicted 65.8% composite success rate at 24 months (95% CI: 60.1%, 71.1%); (Figure 2). Similarly, success decreased with increasing baseline GH + PB; 8.0 cm was associated with a predicted 65.8% success rate. (Figure not shown) However, these associations were not strong; the area under the ROC curve for both GH and GH + PB was 0.6, which is considered poor association. We found no correlation between baseline POPQ Bp score and surgical success at 24 months; (Figure 3) the area under the ROC curve was 0.51, indicative of only a chance association.

COMMENT

Principal Findings: Posterior Repair

This study found that performing an adjuvant posterior repair at the time of vaginal apical native tissue prolapse repair was not associated with surgical success. These findings were similar in an unadjusted comparison and by using propensity score methods to control for clinically relevant baseline differences between those with and without adjuvant posterior repair. The findings were also consistent when recurrent prolapse was defined using separate subjective, objective and retreatment outcomes.

Other Results: Genital Hiatus

We found that that surgeons in our study were more likely to perform a posterior repair in women with a larger GH, larger GH+PB, or more posterior POP beyond the hymen. However, controlling for the likelihood of receiving a posterior repair based on these and other preoperative characteristics, we found that having a posterior repair was not associated with surgical success.

The relationship between preoperative size of the genital hiatus and postoperative success is unclear. A recent study by Vaughn et al. retrospectively compared success rates in 3 groups: women with persistently wide genital hiatus after surgical repair, women with improved genital hiatus after surgery and women with stably normal genital hiatus preoperatively and post-operatively. Women in that study with persistently enlarged genital hiatus had increased risk of anatomic failure compared to those with either improved or normal postoperative genital hiatus size.¹⁸ Carter-Brooks et al. found that women with a larger preoperative GH were more likely to receive a posterior repair and therefore experienced a larger reduction in GH. Both the posterior repair and no posterior repair groups in that study had similar postoperative GH measurements.¹⁹ That study further demonstrated that a smaller preoperative genital hiatus length was associated with surgical success regardless of the performance of a posterior repair. This finding was similar to our results, although the predictive ability of our model was poor.

We found that the relationship between GH and composite surgical success was similar to the relationship between the sum GH + PB and composite surgical success. A GH of 4.5 cm and a GH + PB of 8.0 cm were both associated with a 66% chance of success, and this rate decreased as these perineal measurements increased. DeLancey et al found that on average, patients with two or more recurrences of prolapse after surgery had a larger urogenital

hiatus, as measured from the pubic symphysis to the perineal body.¹² It is possible that damage to the surrounding levator muscles, including interruption of the nerve supply of the levator ani muscles, results in a genital hiatus less amenable to a successful surgical repair.

Clinical Implications

Our principle findings suggest that contrary to prevailing thought, an adjuvant posterior repair does not impact overall surgical success after vaginal apical prolapse surgery. Additionally, performance of a posterior repair may predispose to adverse events such as dyspareunia or vaginal scarring.¹⁷ These findings may aid in the appropriate surgical counseling of patients. Additionally, surgeons should utilize caution when considering preoperative genital hiatus size in counseling patients about surgical success.

Strengths and Limitations

The main strengths of this study include the large number of participating surgeons and surgical sites. The multisite nature allowed the study to include different surgical approaches for performing adjuvant posterior repair using different techniques. Our use of propensity score analysis allowed us to control for participant characteristics associated with the performance of a posterior repair in the absence of randomization. Propensity score analysis is a statistical technique that attempts to estimate the effect of an intervention while accounting for an individual's likelihood of receiving the treatment. The purpose is to reduce the effect of treatment bias when some people are more likely to receive the treatment than others. It is a method that is particularly useful in retrospective, observational studies to balance two cohorts. Additionally, we used a primary outcome that included both anatomic and subjective components and secondary outcomes included each component separately.

This study has several limitations. Since posterior repair was not the primary intervention in this study, there was significant variation in performance of adjuvant posterior repair across sites and surgeons. This reflects the lack of guidelines and conflicting data about the utility of performing a posterior repair at the time of vaginal apical prolapse surgery. We did not assess obstructed defecation as a preoperative symptom, which might have influenced the surgeon's decision to perform a posterior repair. However, in a prior survey of surgeons attending a national gynecology surgery meeting, Kanter et al. found that the most common reasons for performing a posterior repair were large genital hiatus size and adjuvant prolapse procedure.²⁰ This underscores the need for more research clarifying the need for adjuvant posterior repair at the time of apical prolapse surgery. The OPTIMAL trial did not standardize how the adjuvant posterior repair was performed. Additionally, Bp may not be ideal at reflecting the integrity of the rectovaginal septum. Bp is a measure of default, never better than -3 cm and equal to C when C is greater than -3 cm. As noted by Kanter et al., there is a wide heterogeneity on how gynecological surgeons perform posterior repairs, and this may have contributed to the lack of association with surgical success.²⁰ However, in the absence of a standardized technique deemed optimal for performing a posterior repair, the diversity of methods reflects the current practice pattern of surgeons. Although propensity score methods are useful for reducing the impact of treatment bias in retrospective observational analyses, they do not eliminate such bias, and this should be considered in the interpretation of results. Finally, we did not analyze subgroups, such as those that received a

SSLF or a USLS, to see if they benefited from a posterior repair, as we did not have sufficient power.

Conclusions and Research Implications

In conclusion, our analyses found that performing an adjuvant posterior repair at the time of vaginal apical native tissue surgery was not associated with surgical success. There continues to be a need for a well-designed prospective randomized trial to provide quality evidence for adjuvant posterior repair at the time of native tissue apical suspensions.

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AJOG at a Glance:**A. Why was this study conducted?**

- To determine if adjuvant posterior repair was associated with surgical success of native tissue vaginal apical suspension.

B. What are the key findings?

- Adjuvant posterior repair was not associated with the following surgical success composite outcome or individual outcomes: no prolapse beyond the hymen, the apex not descending more than one-third of total vaginal length, no bothersome vaginal bulge, and no retreatment at 24 months.
- The probability of surgical success decreased as the size of the preoperative genital hiatus increased
- There was high variation in performance of posterior repair by surgeon

C. What does this study add to what is already known?

- Posterior repair performed with sacrospinous ligament fixation or uterosacral ligament suspension in this study was not associated with surgical success

Figure 1. Posterior Repair Performed by Surgeon

Each circle represents an individual surgeon. The y-axis shows the number of surgeries performed by that surgeon and the x-axis is the percent of those surgeries that included a Posterior Repair.

Figure 2. Predicted Probability of Surgical Success at 24 Months Plotted Against Baseline POPQ Strain GH

The predicted probabilities and the Wald 95% confidence limits (shaded area) are obtained from a logistic regression model predicting surgical success at 24 months based on preoperative POPQ strain GH.

Figure 3. Predicted Probability of Surgical Success at 24 Months Plotted Against Baseline POPQ Point Bp

The predicted probabilities and the Wald 95% confidence limits (shaded area) are obtained from a logistic regression model predicting surgical success at 24 months based on preoperative POPQ point Bp.

Table 1.

Baseline Demographic and Clinical Characteristics in Study Population with and without Adjuvant Posterior Repair

Baseline Characteristic	Posterior repair	N	No posterior repair	N	Total	N	P-value ^a
Race, n (%)							0.6348
White	160 (84.2)	190	155 (84.2)	184	315 (84.2)	374	
African American	13 (6.8)	190	9 (4.9)	184	22 (5.9)	374	
Other	17 (8.9)	190	20 (10.9)	184	37 (9.9)	374	
Hispanic or Latino ^b , n (%)	20 (10.5)	190	55 (29.9)	184	75 (20.1)	374	<.0001
Education ^c , n (%)							0.0136
Less than high school	17 (9.5)	179	33 (19.5)	169	50 (14.4)	348	
Completed high school or equivalent	46 (25.7)	179	45 (26.6)	169	91 (26.1)	348	
Some college or greater	116 (64.8)	179	91 (53.8)	169	207 (59.5)	348	
Age, Median (IQR)	57 (50, 68)	190	56 (49, 64)	184	56 (49, 66)	374	0.2928
Body Mass Index (kg/m ²), Median (IQR)	28 (25, 32)	190	28 (25, 32)	183	28 (25, 32)	373	0.5592
Current Smoker, n (%)	19 (10.0)	190	14 (7.6)	184	33 (8.8)	374	0.4684
Diabetes Mellitus, n (%)	20 (10.8)	186	24 (13.3)	180	44 (12.0)	366	0.5210
Post-Menopausal, n (%)	125 (65.8)	190	121 (65.8)	184	246 (65.8)	374	1.0000
Currently using Estrogen Therapy ^d , n (%)	83 (43.7)	190	34 (18.5)	184	117 (31.3)	374	<.0001
Vaginal Deliveries, Median (P25, P75)	3 (2, 3)	190	3 (2, 4)	184	3 (2, 4)	374	0.2493
Cesarean Deliveries, Median (P25, P75)	0 (0, 0)	190	0 (0, 0)	184	0 (0, 0)	374	0.6853
Prior Hysterectomy ^e , n (%)	67 (35.3)	190	33 (17.9)	184	100 (26.7)	374	0.0002
Prior Prolapse Surgery, n (%)	15 (7.9)	190	11 (6.0)	184	26 (7.0)	374	0.5441
Prior Stress Urinary Incontinence Surgery, n (%)	8 (4.2)	190	5 (2.7)	184	13 (3.5)	374	0.5749
Baseline POPQ Values							
POPQ Stages ^f , n (%)							0.1102
Stage 2	76 (40.0)	190	68 (37.0)	184	144 (38.5)	374	
Stage 3	101 (53.2)	190	111 (60.3)	184	212 (56.7)	374	
Stage 4	13 (6.8)	190	5 (2.7)	184	18 (4.8)	374	
POPQ Values ^g							
Aa, Median (P25, P75)	1 (0, 3)	190	1 (0, 2)	184	1 (0, 2)	374	0.9922
Ba, Median (P25, P75)	2 (0, 4)	190	2 (0, 3)	184	2 (0, 3)	374	0.8014
C, Median (P25, P75)	-2 (-4, 2)	189	-2 (-3, 1)	184	-2 (-4, 1)	373	0.3793
Ap, Median (P25, P75)	-1 (-2, 0)	190	-2 (-2, -1)	184	-1 (-2, 0)	374	<.0001
Bp, Median (P25, P75)	-1 (-2, 1)	190	-2 (-2, -1)	184	-1 (-2, 0)	374	<.0001
GH, Median (P25, P75)	5 (4, 6)	189	4 (4, 5)	184	5 (4, 5)	373	<.0001
PB, Median (P25, P75)	3 (3, 4)	189	3 (3, 4)	184	3 (3, 4)	373	0.1953
GH + PB, Median (P25, P75)	9 (7, 10)	189	8 (7, 9)	184	8 (7, 9)	373	<.0001

Baseline Characteristic	Posterior repair	N	No posterior repair	N	Total	N	P-value ^a
TVL, Median (P25, P75)	10 (9, 10)	190	9 (8, 10)	184	10 (9, 10)	374	<.0001
Prolapse beyond the hymen, n (%)							
Anterior	132 (69.5)	190	137 (74.5)	184	269 (71.9)	374	0.3018
Posterior	48 (25.3)	190	25 (13.6)	184	73 (19.5)	374	0.0059
Apical	57 (30.2)	189	56 (30.4)	184	113 (30.3)	373	1.0000
Sexually Active ^h , n (%)	95 (53.7)	177	89 (53.0)	168	184 (53.3)	345	0.9144

^aP-values were obtained using Wilcoxon Rank-Sum test for continuous measures, Exact Mantel-Haenszel test using modified ridit scores for ordinal categorical measures, and Fisher's Exact Test for categorical nominal measures. All tests were conducted at a significance level of 0.20 as inclusion criteria for including in the propensity score model as fixed effects to estimate the probability of each participant receiving concomitant posterior repair.

^bAfter stratifying for posterior repair, there is an association between the sites and the proportion of Hispanic and Latina participants at each of the sites ($p < .0001$ chi-square test conducted at a significance level of 0.05). Thus, the association between ethnicity and posterior repair may be due to regional variation.

^cAfter stratifying for posterior repair, there is an association between the sites and the proportion of lower educated (< 4 years of college) participants at each of the sites ($p < .0001$ chi-square test conducted at a significance level of 0.05). Thus, the association between education and posterior repair may be due to regional variation.

^dEstrogen therapy includes any prescribed estrogen ingested orally, topically via vaginal cream (tablets or cream), or topically via skin patch. After stratifying for posterior repair, there is an association between the sites and the proportion of participants on estrogen therapy at each of the sites ($p < .0001$ chi-square test conducted at a significance level of 0.05). Thus, the association between estrogen replacement and posterior repair may be due to regional variation.

^eAfter stratifying for posterior repair, there is an association between the sites and the proportion of participants with prior hysterectomy at each of the sites ($p < .0001$ chi-square test conducted at a significance level of 0.05). Thus, the association between prior hysterectomy and posterior repair may be due to regional variation.

^fPelvic Organ Prolapse Quantification (POPQ) Stages: Stage 2-The vagina is prolapsed between 1 cm above the hymen and 1 cm below the hymen; Stage 3-The vagina is prolapsed more than 1 cm beyond the hymen but is less than totally everted; Stage 4-The vagina is everted to within 2 cm of its length.

^gIn the POPQ system, the positions of C, Ba and Bp are measured at the most dependent location (the point of greatest prolapse) of the apex, anterior vaginal wall and posterior vaginal wall respectively during a straining. Values are measured in cm and are negative if above the hymen, and positive if below the hymen. TVL (total vaginal length), GH (genital hiatus) and PB (perineal body) are measured as positive values.

^hSexually active is defined as a positive response to question A1 in the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire "In the past 3 months, have you engaged in sexual activities with a partner?".

Table 2.

Composite and Individual Components of Surgical Success 24 Months After Native Tissue Apical Suspension With and Without Adjuvant Posterior Repair

Outcomes at 24 Months	PR (N=181)	N	No PR (N=172)	N	Adjusted Odds Ratio (95% CI) ^a	Adjusted P-value ^a
Surgical Success	100 (66.7)	150	86 (62.0)	138	1.07 (0.56, 2.07)	0.8329
Bothersome Vaginal Bulge	28 (18.5)	150	29 (21.4)	134	1.12 (0.46, 2.69)	0.8032
Apical descent 1/3 of total vaginal length (TVL)	14 (9.1)	155	18 (12.5)	142	1.11 (0.54, 2.28)	0.7738
Any prolapse beyond hymen						
Posterior Prolapse (POPQ Bp > 0) ^b	3 (1.8)	156	2 (1.6)	142		
Anterior Prolapse (POPQ Ba > 0)	23 (14.9)	156	18 (12.4)	142	0.63 (0.23, 1.73)	0.3712
Apical Prolapse (POPQ C > 0) ^b	3 (1.6)	155	1 (0.5)	142		
Retreatment for prolapse ^b	4 (2.5)	160	9 (6.0)	145		

^aAdjusted odds ratios and p-values for the effect of posterior repair on 24 month outcomes were obtained by fitting a generalized linear model controlling for surgeon correlation (as a random effect) and adjusting for the propensity score for posterior repair via stabilized inverse probability weighting.

^bModel results are not presented due to small numbers of participants with the outcomes.