Published in final edited form as:

Female Pelvic Med Reconstr Surg. 2019 ; 25(1): 22–28. doi:10.1097/SPV.0000000000000526.

Concomitant Anterior Repair, Preoperative Prolapse Severity, and Anatomic Prolapse Outcomes after Vaginal Apical Procedures

Charles W. Nager, MD¹, Cara L. Grimes, MD², Tracy L. Nolen, DrPh³, Clifford Y. Wai, MD⁴, Linda Brubaker, MD¹, Peter C. Jeppson, MD⁵, Tracey S. Wilson, MD⁶, Anthony G. Visco, MD⁷, Matthew D. Barber, MD⁷, Gary Sutkin, MD⁸, Peggy Norton, MD⁹, Charles R. Rardin, MD¹⁰, Lily Arya, MD¹¹, Dennis Wallace, PhD³, Susan F. Meikle, MD¹², and for the Pelvic Floor Disorders Network

¹Department of Reproductive Medicine, UC San Diego Health Care System, San Diego, CA

²Department of Obstetrics and Gynecology, Westchester Medical Center, New York, NY

³Research Triangle International, Research Triangle Park, NC

⁴Department of Obstetrics and Gynecology, UT Southwestern Medical Center, Dallas, TX

⁵Department of Obstetrics and Gynecology, University of New Mexico Medical Center, Albuquerque, NM

⁶Department of Urology, University of Alabama at Birmingham, Birmingham, AL

⁷Department of Obstetrics and Gynecology, Duke University Medical Center, Durham, NC

⁸Department of Obstetrics and Gynecology, University of Missouri, Kansas City, Missouri

⁹Department of Obstetrics and Gynecology, University of Utah Medical Center, Salt Lake City, UT

¹⁰Department of Obstetrics and Gynecology, Warren Alpert Medical School of Brown University, Women's & Infants Hospital, Providence, RI

¹¹Department of Obstetrics and Gynecology, Hospital of University of Pennsylvania, Philadelphia, PA

¹²Gynecologic Health and Disease Branch, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD

Abstract

Objective—To compare anterior and overall prolapse prevalence at one year in surgical participants with or without concomitant anterior repair at the time of sacrospinous ligament fixation(SSLF) or uterosacral ligament suspension(ULS).

Methods—This is a secondary analysis of two surgical trials; concomitant anterior repair was performed at surgeon's discretion. Anterior anatomic success was defined as POPQ point Ba = 0 and overall success was defined as POPQ points Ba, Bp, and C = 0 at 12 months.

Results—63% (441/701) of the participants underwent concomitant anterior repair and were older, more often post-menopausal, had prior hysterectomy, and had higher stage anterior, but not apical prolapse. Anterior anatomic success was marginally but statistically better in the combined group (SSLF and ULS) with concomitant anterior repair (82% vs. 80%, $p=0.03$). In sub analyses, the improvement in anatomic support with anterior repair was observed only in the SSLF subgroup (81% vs 73%, $p=0.02$) and mostly in the SSLF subgroup with higher preoperative stage (74% vs. 57%, $p=0.02$). Anterior repair did not improve success rates in participants with lower stage prolapse or undergoing ULS. Overall success rates were similar to anterior anatomic success rates. Participants with higher stage preoperative anterior prolapse had significantly lower success rates.

Conclusion—In the absence of clinical trial data, this analysis suggests an anterior repair should be considered for women with higher stage prolapse undergoing a SSLF. Preoperative prolapse severity is a strong predictor of poor anatomic outcomes with native tissue vaginal apical surgeries.

Introduction

A recent study reports that the lifetime risk of any primary surgery for pelvic organ prolapse (POP) is 12.6%¹ and up to 17%² of women will undergo re-operation. The anterior compartment is the most common site of recurrence following support of the apical compartment.^{3–5} Data in the literature to guide a surgeon's decision on whether to perform a concomitant anterior repair (AR) at the time of vaginal apical correction of prolapse are sparse. Currently, this decision could be based on the extent of pre-operative prolapse and/or the position of the anterior compartment after the apical correction intraoperatively, or the surgeon's personal belief that the additional procedure is warranted. An informal survey of surgeons in the Pelvic Floor Disorder Network (PFDN) suggested wide variation in the practice of adding a concomitant anterior repair at the time of a vaginal apical suspension procedure, suggesting that this is a practice needing preliminary outcome data.

The NIH-sponsored PFDN has conducted surgical trials that have generated evidence regarding vaginal apical suspension operations. In two of these studies, concomitant anterior repair at the time of vaginal apical suspension was performed at the surgeon's discretion. With an enrollment total of more than 700 well-characterized participants, these studies provide a unique opportunity to compare prolapse outcomes in women undergoing native tissue vaginal apical suspension procedures with or without a concomitant anterior repair.

The primary aim of this analysis was to compare the prevalence of anterior compartment prolapse one year after native tissue vaginal apical suspension in participants of surgical trials who underwent concurrent anterior repair versus those who did not. Secondary aims included: 1) to compare the prevalence of overall prolapse one year after native tissue vaginal apical suspension in participants of surgical trials who underwent concurrent anterior repair versus those who did not, 2) to measure the progression of the anterior compartment

prolapse from baseline to one year postoperatively in each group, and 3) to determine if preoperative anterior prolapse severity was a predictor of anatomic prolapse outcomes. We hypothesized that concomitant anterior repair would be associated with a decreased prevalence of anterior vaginal prolapse at 1 year.

Methods

This study is a secondary analysis of the OPUS (Outcomes following vaginal Prolapse repair and mid Urethral Sling)⁶ and OPTIMAL⁷ (The Operations and Pelvic Muscle Training in the Management of Apical Support Loss) trials. Details of the trial designs and methods for OPUS⁸ and OPTIMAL⁹ and have been previously described and their primary outcomes⁶⁷. All sites obtained local institutional review board approval and participants provided written research informed consent.

OPUS participants had stage 2–4 POP, did not have stress urinary incontinence, and were randomized to a TVT or sham incisions at the time of vaginal prolapse surgery. To study the effects of anterior repair during native tissue vaginal apical suspension, only participants in the OPUS trial with a Sacrospinous Ligament Fixation (SSLF) or Uterosacral Ligament Suspension (ULS) and either an anterior repair or no procedure in the anterior compartment were included in this study. (i.e. patients with an anterior repair only or a vaginal prolapse mesh procedure were not included) OPTIMAL participants had Stage 2–4 POP with apical prolapse and stress urinary incontinence and were randomized to one of two native tissue vaginal apical suspensions (SSLF or ULS). All OPTIMAL participants had stress urinary incontinence symptoms and TVT was routinely performed as part of the study surgery.

This anterior compartment analysis was planned to include data from both trials before outcomes were available for either study. In both studies, surgeons reported preoperatively whether they planned to do an anterior repair at the time of the apical suspension and then reported at the time of surgery whether they actually performed an anterior repair. The decision to perform an anterior repair was left entirely to the discretion of the surgeon. Surgery was not concluded until the immediate surgical outcome was an anatomic success in all compartments. Postoperative POPQ measures were obtained by non-surgeon study personnel.

Demographics, anthropomorphic measures, clinical characteristics, use of estrogen replacement therapy, prior UI or POP treatment, and quantification of pelvic organ prolapse (POP-Q)¹⁰ were recorded at baseline. We report the individual surgeon rates of concomitant anterior repair for all surgeons who participated in these surgeries. We compared the proportion of participants in each of the OPUS randomization groups (TVT vs. no TVT) who underwent concomitant anterior repair. Pre- and post-operative POP-Q point Ba and the change in point Ba between baseline and 12 months after surgery were compared between groups who underwent SSLF or ULS with and without anterior repair. Participants were considered an anterior anatomic success if: a) POPQ point Ba was less than or equal to 0 cm, and b) the participant did not undergo subsequent surgery for anterior vaginal compartment prolapse, and c) the participant did not use a pessary for prolapse at any point during the 1-year follow-up period. Participants were considered an overall anatomic success

if: a) POPQ points Ba, Bp, and C were less than or equal to 0 cm, and b) the participant did not undergo subsequent surgery for prolapse, and c) the participant did not use a pessary for prolapse at any point during the 1-year follow-up period. Results were assessed for each specific vaginal vault procedure (SSLF or ULS) and for the total group combined (Combined group). Data were also analyzed based on preoperative anterior compartment prolapse severity with a cut-point that was selected *a priori*; dichotomizing point Ba +1 for “lower stage” prolapse (Stage 2 or less) and point Ba >+1 for “higher stage” prolapse (Stage 3 or 4). The “All Stages” group included both lower stage and higher stage prolapse groups. Intraoperative complication rates were compared between the groups with and without concomitant anterior repair.

Demographic and baseline characteristics were compared between participants with and without a concurrent anterior repair within each vaginal vault procedure group using t-tests for continuous measures, Kruskal-Wallis tests for scale measures, mean score tests with modified ridit scores for ordinal categorical measures, and chi-square tests for categorical measures. Change from baseline in Ba was analyzed within and across vaginal vault procedure groups using analysis of covariance (ANCOVA) models. For subgroup analyses based on preoperative POP-Q stage of the anterior vaginal compartment, the models included a corresponding categorical baseline stage variable and its interaction with concurrent anterior repair status. Analyses of the success outcome were conducted in a similar fashion except using logistic models in place of ANCOVA models. Analyses of outcome data were adjusted for baseline POP-Q points Ba and C as well as age and prior hysterectomy. Logistic regression models were also used to evaluate probability of success as a function of baseline POP-Q point Ba. Data were analyzed with SAS version 9.4 (SAS Institute, Cary, NC) software.

Results

701 women [ULS 476 (68%), SSLF 225 (32%)] met inclusion criteria for this study from the previously described PFDN surgical trials.⁶⁷ Overall, concomitant anterior repair was performed in 63% (441/701) of the participants; 59% (133/225) of SSLF procedures and 65% (308/476) of ULS procedures (N.S). Changes to the preoperative plan occurred infrequently: anterior repair planned but not performed in 9% (61/701) and performed although not planned in 1% (10/701).

In the OPTIMAL trial, all participants except 2 received a TVT. In the randomized population of OPUS in which ½ of the participants received a TVT, a similar proportion in the TVT group (66%) and in the sham (no TVT) group (57%) underwent concomitant anterior repair.

Table 1 displays baseline demographics and clinical characteristics of the study participants. Women who underwent concomitant anterior repair were older, more often post-menopausal, on estrogen, not Hispanic/Latina, had previously undergone hysterectomy and had more advanced anterior prolapse. The women with concomitant anterior repair had on average 0.7cm greater POPQ Point Ba (i.e. greater anterior prolapse) in the SSLF group (p=0.05) and 0.9 cm more in the ULS group (p<0.001) than women who did not undergo

anterior repair. However, women who underwent an anterior repair did not have significantly more overall (POPQ Stage) or apical (POPQ Point C) prolapse at baseline.

Figure 1 displays a scatterplot of individual surgeon characteristics demonstrating how many surgeries each surgeon performed and what percent of those surgeries included a concomitant anterior repair. Thirty-six surgeons at 10 clinical sites (range of 1–5 surgeons per site) performed the 701 surgeries. Thirty-five of the 36 surgeons are board certified in the Female Pelvic Medicine and Reconstructive Surgery subspecialty. The mean number of surgeries per surgeon in these trials was 20 (median = 15) and ranged from 1 to 103; the surgeon-specific proportion of surgeries with concomitant anterior repair ranged from 0 to 100%: 6 (17%) of the surgeons performed anterior repair less than 15% of the time and 12 (33%) performed an anterior repair more than 85% of the time. There was no apparent relationship between the number of surgeries done and rate of concomitant anterior repair. No significant differences in rates of intraoperative complications were observed between the groups with and without anterior repair.

The primary outcome of our study is found in Table 2. Overall, anterior anatomic outcomes were marginally better with a concomitant anterior repair (82% vs. 80%, $p=0.03$). This difference was largely the result of improvements in anterior success observed in the higher stage prolapse subgroup (76% vs. 69%, $p=0.03$) and from the SSLF group (81% vs 73%, $p=0.02$). The largest percentage group difference in anatomic success rates (17%) was observed among patients with higher stage prolapse (preoperative Ba $>+1$) undergoing a SSLF; (74% vs. 57%, $p=0.02$). Concomitant anterior repair did not significantly improve anterior success rates for women undergoing ULS regardless of the pre-operative stage of anterior prolapse. Similarly, there was no evidence that anterior success rates improved with an anterior repair with either surgical procedure in any lower stage prolapse group.

Overall anatomic success rates (which required success for points C and Bp, in addition to Ba) trended closely behind anterior anatomic success rates (Table 3) confirming the well-known observation that the anterior wall is the most common site for anatomic failures after apical vaginal native tissue surgeries. For the entire study group, overall anatomic outcomes were better with a concomitant anterior repair (76% vs. 72%, $p=0.002$).

Most study participants 62/701 (89%) contributed 12-month outcome data. In participants that underwent concomitant anterior repair, Ba improved on average -1.8 ± 1.3 cm in the (Ba $\leq +1$) lower stage prolapse group and -4.4 ± 2.2 cm in the (Ba $>+1$) higher stage prolapse group. (Table 3). Similarly In the participants not undergoing anterior repair, Ba improved -1.4 ± 1.4 cm in the (Ba $\leq +1$) group and -3.8 ± 2.1 cm in the (Ba $>+1$) group. Overall, improvements in point Ba from baseline to 12 months were observed in both vaginal vault procedure groups and there was no significant difference in improvement in point Ba between women who underwent concomitant anterior repair and those who did not ($p=0.27$)

Overall, the anterior anatomic success rate was 81% (508/627) and the overall anatomic success was 75% (469/627) at 12 months (Table 4). Participants with lower stage anterior vaginal compartment prolapse at baseline demonstrated a higher successful anterior prolapse

outcome than those with higher stage baseline anterior prolapse (93% vs. 74%, $p < 0.001$) and had a significantly higher overall anatomic success rate (88% vs 61%, $p < 0.001$).

To determine if there is a possible POPQ inflection point that is predictive of overall anatomic success rates we plotted the predicted probability of overall anatomic success against baseline anterior vaginal compartment prolapse as measured by preop Ba (Figure 2a). The associated receiver operator curve (ROC) is also shown (Figure 2b). A point Ba of + 2.5 had predicted probability of success of 0.76 with a sensitivity of 0.64 and a specificity of 0.62. Overall anatomic success rates were predicted at less than 50% if baseline Ba was greater than +6 cm. We also plotted the predicted probability of overall anatomic success rates for maximum preoperative prolapse from either Ba, C, or Bp (instead of just Ba) and the results and ROC curve were very similar (results not shown). Subgroup analysis for the SSLS and the USLS groups were similar to the overall group (data not shown).

Discussion

The clinical question we wanted to address in this study is whether a concomitant anterior repair should be performed at the time of native tissue vaginal apical surgery. We could not find high-quality evidence in the literature to guide this decision and indeed the variability related to surgeon bias on this topic was confirmed in our study. Without a randomized trial, our study provides some information from a large, well characterized dataset. Our hypothesis was confirmed, and our study population showed a modest general benefit of concomitant anterior repair completed at the time of native tissue vaginal apical suspension for one-year anterior anatomic outcomes. Although the difference in the overall group for both procedures was small, this difference was significant when controlling for pre-op baseline prolapse severity. There may be a larger benefit for those women with higher stage baseline anterior prolapse and for women undergoing SSLF as we found a large difference favoring anterior repair in women with higher stage baseline anterior prolapse undergoing SSLF. These results and conclusions did not change when the outcome included postoperative prolapse in any compartment. We did not find any difference in intraoperative complications related to the anterior repair and we think it is unlikely that there are long term complications related to the procedure. Our results suggest that the current practice of surgeon discretion on whether to perform an anterior repair or not in women with lower stage prolapse or in women undergoing ULS remains viable. Also, there is evidence in our analysis that an anterior repair should be considered for women with higher stage prolapse undergoing a SSLF.

Several investigators have reported that anterior compartment support defects are largely secondary to apical support loss.¹¹¹² Our study supports that assertion, given that many women with anterior support loss had favorable surgical outcomes although they did not undergo specific anterior repair. It is likely that the post-operative axis of the vagina is directed more posteriorly with the SSLF than the ULS, increasing the mechanical stress on the vulnerable anterior compartment.

Given the standardized inclusion criteria for these 2 clinical trials, these results suggest that the individual surgeon's practice pattern on whether concomitant anterior repair should be

performed with vaginal apical surgery was a major factor determining whether an anterior repair was performed or not; the performance of a concomitant anterior repair was very surgeon dependent with 17% of the surgeons performing an anterior repair less than 15% of the time and 33% of surgeons performing an anterior repair more than 85% of the time. Overall however, our concomitant anterior repair rate of 63% in this study is consistent with a 58% rate in results from a large single site doing ULS.¹³ Therefore, the findings of this study appear to be generalizable, given the participation of multiple centers and surgeons. The anterior wall is the most common site of recurrence after a vaginal apical surgery, consistent with our findings. The 81% anatomic success rate for the anterior compartment decreased to 75% when apical and posterior measures were added.

A secondary finding of this study is that it provides evidence for the common clinical belief that participants with higher stage prolapse are more likely to have worse anatomic outcomes following native tissue vaginal apical repairs. In this study, those participants with higher stage baseline anterior prolapse had significantly lower anterior and overall anatomic success rates than those with lower stage prolapse. In fact, the predicted probability for anatomic success after a native tissue vaginal suspension decreases markedly for preop prolapse > 2.5 cm and is less than 50 % if Point Ba is >6 cm.. This data provides some evidence for doing other (e.g. non- native tissue vaginal suspensions) for patients with high degree prolapse. This information is likely to be helpful in counselling patients considering specific prolapse surgeries or in designing future clinical trials for varying degrees of prolapse.

The strengths of our study are the large number of participants (>700), the 10 sites, and the 35 surgeons that make our study generalizable. Our observations are certainly limited by the lack of randomization for concomitant anterior repair; however, evaluation of the study results in light of those potential biases support our conclusions. We hypothesized that concomitant anterior repair would be associated with a decreased risk of anterior vaginal prolapse at 1 year. In fact, the study showed a modest overall benefit in the unadjusted comparisons (82% success with anterior repair to 80% without anterior repair) but after adjusting for the observed confounding between anterior repair and prolapse severity, the benefit was significant (p=0.03). Furthermore the benefit was clearly demonstrated among the most severe prolapse patients, allowing us to be fairly confident of these conclusions about the benefit of anterior repair.

As with all studies, we recognize some limitations, including the point that our outcomes were only anatomic. We accepted this limitation as we wanted to address whether anatomy correcting surgery produced an anatomic result and we wanted a clean, easily understood anatomic outcome. Ideally, primary outcomes for most prolapse trials should also have subjective and symptomatic outcomes and these composite outcomes probably better reflect patient desired outcomes.

Additional surgery that is not associated with clinically relevant improvements in surgical outcome increase health care cost, surgical time and potential surgical morbidity although we found no evidence of surgical morbidity. We hope that surgeons will find this information useful for surgical planning and counseling. Future surgical investigations

evaluating anatomic outcomes may benefit from our treatment and effect size estimates in order to plan appropriately powered randomized surgical trials to eliminate surgeon bias as a possible confounder. Such studies are needed to provide the high-quality evidence that patients, colleagues and payors deserve. For these native tissue vaginal apical surgeries there is a strong relationship between preoperative prolapse severity and worse postoperative anatomic outcomes; this is important for patient counselling and possibly important for surgical procedure selection.

Acknowledgments

Supported by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development grants HD054214, HD054241, HD069031, HD054215, HD041250, HD069025, HD041261, HD041267, HD054215, HD069006, HD054136, HD069013, HD069010, and the National Institutes of Health Office of Research on Women's Health.

References

1. Wu JM, Matthews CA, Conover MM, et al. Lifetime risk of stress urinary incontinence or pelvic organ prolapse surgery. *Obstet Gynecol*. 2014; 123(6):1201–6. DOI: 10.1097/AOG.0000000000000286 [PubMed: 24807341]
2. Denman MA, Gregory WT, Boyles SH, et al. Reoperation 10 years after surgically managed pelvic organ prolapse and urinary incontinence. *Am J Obstet Gynecol*. 2008; 198(5):555 e1–5. DOI: 10.1016/j.ajog.2008.01.051 [PubMed: 18355779]
3. Holley RL, Varner RE, Gleason BP, et al. Recurrent pelvic support defects after sacrospinous ligament fixation for vaginal vault prolapse. *Journal of the American College of Surgeons*. 1995; 180(4):444–8. [PubMed: 7719548]
4. Fialkow MF, Newton KM, Weiss NS. Incidence of recurrent pelvic organ prolapse 10 years following primary surgical management: a retrospective cohort study. *International urogynecology journal and pelvic floor dysfunction*. 2008; 19(11):1483–7. DOI: 10.1007/s00192-008-0678-8 [PubMed: 18682876]
5. Morgan DM, Rogers MA, Huebner M, et al. Heterogeneity in anatomic outcome of sacrospinous ligament fixation for prolapse: a systematic review. *Obstet Gynecol*. 2007; 109(6):1424–33. DOI: 10.1097/01.AOG.0000264066.89094.21 [PubMed: 17540817]
6. Wei JT, Nygaard I, Richter HE, et al. A midurethral sling to reduce incontinence after vaginal prolapse repair. *N Engl J Med*. 2012; 366(25):2358–67. DOI: 10.1056/NEJMoa1111967 [PubMed: 22716974]
7. Barber MD, Brubaker L, Burgio KL, et al. Comparison of 2 transvaginal surgical approaches and perioperative behavioral therapy for apical vaginal prolapse: the OPTIMAL randomized trial. *JAMA : the journal of the American Medical Association*. 2014; 311(10):1023–34. DOI: 10.1001/jama.2014.1719 [PubMed: 24618964]
8. Wei J, Nygaard I, Richter H, et al. Outcomes following vaginal prolapse repair and mid urethral sling (OPUS) trial—design and methods. *Clin Trials*. 2009; 6(2):162–71. [PubMed: 19342469]
9. Barber MD, Brubaker L, Menefee S, et al. Operations and pelvic muscle training in the management of apical support loss (OPTIMAL) trial: design and methods. *Contemp Clin Trials*. 2009; 30(2): 178–89. [PubMed: 19130903]
10. Bump RC, Mattiasson A, Bo K, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol*. 1996; 175(1):10–7. [PubMed: 8694033]
11. Rooney K, Kenton K, Mueller ER, et al. Advanced anterior vaginal wall prolapse is highly correlated with apical prolapse. *Am J Obstet Gynecol*. 2006; 195(6):1837–40. DOI: 10.1016/j.ajog.2006.06.065 [PubMed: 17132485]

12. Crosby EC, Sharp KM, Gasperut A, et al. Apical descent in the office and the operating room: the effect of prolapse size. *Female pelvic medicine & reconstructive surgery*. 2013; 19(5):278–81. DOI: 10.1097/SPV.0b013e31829c6365 [PubMed: 23982576]
13. Silva WA, Pauls RN, Segal JL, et al. Uterosacral ligament vault suspension: five-year outcomes. *Obstet Gynecol*. 2006; 108(2):255–63. DOI: 10.1097/01.AOG.0000224610.83158.23 [PubMed: 16880293]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.

Surgeon characteristics. Each diamond 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 an anterior repair.

Figure 2.

Predicted Probability of Overall Anatomic Success plotted against baseline POPQ Point Ba. The shaded area represents the 95% Confidence Intervals.

Figure 3.
Receiver Operator Curve for Overall Anatomic Success and Preoperative POPQ Point Ba.

Table 1

Baseline demographics and characteristics of study participants

Characteristic	Statistic/Category	Group					Uls
		SSLF			w/o Ant. Repair		
		w/Ant. Repair (N=133)	w/o Ant. Repair (N=93)	P-value [I]	w/Ant. Repair (N=308)	w/o Ant. Repair (N=168)	P-value [I]
Age at surgery (years)	N	133	92		308	168	
	Mean (SD)	60.0 (10.3)	57.1 (11.0)	0.05	61.3 (9.9)	57.2 (10.5)	<.0001
	Median	59	58		61	58	
	Range	35, 85	32, 75		31, 82	29, 81	
Primary race	Black/African American	6 (5%)	4 (4%)	0.99	22 (7%)	8 (5%)	0.34
	White	117 (88%)	81 (87%)		266 (86%)	145 (86%)	
	Other	10 (8%)	7 (8%)		19 (6%)	15 (9%)	
	Unknown		1 (1%)		1 (0%)		
Ethnicity	Hispanic/Latina	15 (11%)	22 (24%)	0.01	40 (13%)	48 (29%)	<.0001
	Not Hispanic/Latina	118 (89%)	71 (76%)		268 (87%)	120 (71%)	
Education	Less than high school	14 (11%)	16 (17%)	0.18	31 (10%)	31 (18%)	0.02
	Completed high school or equivalent	28 (21%)	25 (27%)		77 (25%)	33 (20%)	
	Some college or higher	83 (62%)	49 (53%)		180 (58%)	92 (55%)	
	Unknown	8 (6%)	3 (3%)		20 (6%)	12 (7%)	
Marriage	Married or living as married	91 (68%)	56 (60%)	0.18	214 (69%)	108 (64%)	0.28
	Other	35 (26%)	32 (34%)		75 (24%)	48 (29%)	
Unknown		7 (5%)	5 (5%)		19 (6%)	12 (7%)	
	N	133	93		307	168	
BMI	Mean (SD)	28.0 (4.9)	29.6 (6.6)	0.04	28.1 (4.9)	28.4 (6.0)	0.52
	Median	27	30		27	28	
Range		20, 46	20, 50		19, 46	19, 59	
	N	133	93		305	166	
Vaginal deliveries	Mean (SD)	2.6 (1.7)	3.1 (2.2)	0.07	3.0 (1.9)	3.2 (1.7)	0.08
	Median	2	3		3	3	
Range		0, 12	0, 15		0, 12	0, 9	
	Yes	102 (77%)	60 (65%)	0.05	248 (81%)	119 (71%)	0.02

Characteristic	Statistic/Category	Group				SSLF		ULS	
		w/Ant. Repair (N=133)	w/o Ant. Repair (N=93)	P-value [1]	w/Ant. Repair (N=308)	w/o Ant. Repair (N=168)	P-value [1]	P-value [1]	
Currently using estrogen replacement therapy	No	31 (23%)	33 (35%)		58 (19%)	47 (28%)			
	Unknown				2 (1%)	2 (1%)			
	Yes	63 (47%)	16 (17%)	<.0001	116 (38%)	36 (21%)	0.0003		
Prior Hysterectomy	No	70 (53%)	77 (83%)		190 (62%)	130 (77%)			
	Unknown				2 (1%)	2 (1%)			
	Yes	69 (52%)	24 (26%)	<.0001	86 (28%)	15 (9%)	<.0001		
Prior UI surgery	No	64 (48%)	69 (74%)		220 (71%)	151 (90%)			
	Unknown				2 (1%)	2 (1%)			
	Yes	5 (4%)	3 (3%)	0.83	11 (4%)	4 (2%)	0.48		
Prior POP surgery	No	128 (96%)	90 (97%)		295 (96%)	162 (96%)			
	Unknown				2 (1%)	2 (1%)			
	Yes	20 (15%)	7 (8%)	0.09	25 (8%)	6 (4%)	0.057		
POPQ stage	No	113 (85%)	86 (92%)		281 (91%)	160 (95%)			
	Unknown				2 (1%)	2 (1%)			
	2	55 (41%)	28 (30%)	0.17	88 (29%)	57 (34%)	0.05		
POPQ Point Aa	3	66 (50%)	59 (63%)		199 (65%)	109 (65%)			
	4	11 (8%)	6 (6%)		21 (7%)	2 (1%)			
	Unknown	1 (1%)							
POPQ Point Ba	N	133	93		308	168			
	Mean (SD)	1.1 (1.6)	0.8 (1.5)	0.15	1.5 (1.4)	1.0 (1.4)	<.0001		
	Median	1	1		2	1			
POPQ Point C	Range	-2, 4	-3, 3		-3, 3	-3, 3			
	N	133	93		308	168			
	Mean (SD)	2.3 (2.6)	1.6 (2.2)	0.05	2.6 (2.3)	1.7 (1.7)	<.0001		
POPQ Point C	Median	2	2		2	2			
	Range	-2, 10	-3, 8		-3, 11	-2, 6			
	N	131	93		308	168			
POPQ Point C	Mean (SD)	-0.8 (4.1)	-0.7 (3.5)	0.27	-0.6 (3.8)	-0.4 (3.2)	0.27		
	Median	-3	-2		-2	0	0.27		

Characteristic	Statistic/Category	Group				P-value [1]	U/S
		w/Ant. Repair (N=133)	w/o Ant. Repair (N=93)	w/Ant. Repair (N=308)	w/o Ant. Repair (N=168)		
	Range	-6, 10	-7, 8	-6, 11	-7, 8		

Table 2
Anterior and Overall Anatomic Success Rates for All Stage, Lower Stage and Higher Stage prolapse groups.

Through 12 Months	SSLF		ULS		Combined	
	w/Ant. Repair	w/o Ant. Repair	w/Ant. Repair	w/o Ant. Repair	w/Ant. Repair	w/o Ant. Repair
All Stage (N)	118	84	271	154	389	238
Anterior Anatomic Success	96 (81%)	61 (73%)	222 (82%)	129 (84%)	318 (82%)	190 (80%)
Adjusted p-value	0.02		0.42		0.03	
Overall Anatomic Success	95 (81%)	57 (68%)	202(75%)	115 (75%)	297 (76%)	172 (72%)
Adjusted p-value	0.002		0.11		0.002	
Lower Stage (N)	49	40	74	71	123	111
Anterior Anatomic Success	45 (92%)	36 (90%)	70 (95%)	66 (93%)	115 (93%)	102 (92%)
Adjusted p-value	0.74		0.76		0.68	
Overall Anatomic Success	45 (92%)	34 (85%)	67 (91%)	60 (85%)	112 (91%)	94 (85%)
Adjusted p-value	0.20		0.33		0.12	
Higher Stage (N)	69	44	197	83	266	127
Anterior Anatomic Success	51 (74%)	25 (57%)	152 (77%)	63 (76%)	203 (76%)	88 (69%)
Adjusted p-value	0.02		0.48		0.03	
Overall Anatomic Success	50 (72%)	23 (52%)	135 (69%)	55 (66%)	185 (70%)	78 (61%)
Adjusted p-value	0.004		0.20		0.009	

Lower stage prolapse is defined as preoperative POPQ point Ba +1. Higher stage prolapse is defined as preoperative POPQ point Ba>+1. P-values based on comparing anatomic success between participants w/ and w/o a repair within and across SSLF and ULS groups adjusting for baseline POPQ Point Ba and Point C as well as age and prior hysterectomy. For subgroup analyses by baseline Point Ba severity, p-values obtained from a model also including categorical baseline severity measure defined by POPQ Point Ba and its interaction with repair group

Table 3

Point Ba Baseline, 12 month and Change values in for All Stage, Lower Stage and Higher Stage prolapse groups. Point Ba values are presented as mean (SD).

Measure	SSLF			ULS			Combined		
	w/Ant. Repair	w/o Ant. Repair	p-value	w/Ant. Repair	w/o Ant. Repair	p-value	w/Ant. Repair	w/o Ant. Repair	p-value
N									
All Stage	117	84		273	153		390	237	
Lower Stage	49	40		76	71		125	111	
Higher Stage	68	44		197	82		265	126	
Baseline									
All Stage	2.3 (2.6)	1.6 (2.2)		2.6 (2.3)	1.7 (1.7)		2.5 (2.4)	1.6 (1.9)	
Lower Stage	0.1 (0.8)	-0.1 (1.0)		0.3 (0.8)	0.2 (0.8)		0.2 (0.8)	0.1 (0.9)	
Higher Stage	4.1 (2.0)	3.3 (1.8)		3.7 (1.9)	2.9 (1.1)		3.8 (1.9)	3.1 (1.4)	
12 month									
All Stage	-1.0 (1.5)	-0.6 (1.8)		-0.9 (1.6)	-1.2 (1.5)		-0.9 (1.6)	-1.0 (1.7)	
Lower Stage	-1.5 (1.0)	-1.0 (1.2)		-1.6 (1.0)	-1.5 (1.2)		-1.6 (1.0)	-1.3 (1.2)	
Higher Stage	-0.6 (1.7)	-0.2 (2.1)		-0.6 (1.7)	-1.0 (1.7)		-0.6 (1.7)	-0.7 (1.9)	
Change									
All Stage	-3.4 (2.4)	-2.3 (2.5)	0.04	-3.7 (2.2)	-2.9 (1.9)	0.65	-3.6 (2.3)	-2.7 (2.2)	0.27
Lower Stage	-1.6 (1.2)	-0.9 (1.5)	0.13	-1.9 (1.3)	-1.7 (1.3)	0.70	-1.8 (1.3)	-1.4 (1.4)	0.22
Higher Stage	-4.7 (2.2)	-3.6 (2.5)	0.10	-4.4 (2.1)	-3.9 (1.8)	0.31	-4.4 (2.2)	-3.8 (2.1)	0.80

Lower stage prolapse is defined as preoperative POPQ point Ba +1. Higher stage prolapse is defined as preoperative POPQ point Ba≥+1. P-values based on comparing change from baseline between participants w/ and w/o a repair within and across SSLF and ULS groups adjusting for baseline POPQ Point Ba and Point C as well as age and prior hysterectomy. For subgroup analyses by baseline Point Ba severity, p-values obtained from a model also including categorical baseline severity measure defined by POPQ Point Ba and its interaction with repair group

Table 4

Anatomic Success Rates through 12 months based on preoperative Point Ba prolapse stage for both procedures with and without anterior repair

	Anterior Anatomic Success Rate	P value	Overall Anatomic Success Rate	P value
All Stage	81% (508/627)		75% (469/627)	
Lower Stage	93% (217/234)		88% (206/234)	
		<0.001		<0.0001
Higher Stage	74% (291/393)		61% (240/393)	

Lower stage prolapse is defined as preoperative POPQ point Ba +1. Higher stage prolapse is defined as preoperative POPQ point Ba>+1. P -values obtained from a model of anatomic success as a function of anterior repair adjusting for POPq Point C as well as age and prior hysterectomy and including categorical baseline severity measure defined by POPq Point BA and its interaction with repair group