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Readmission and Prolapse Recurrence After Abdominal and Vaginal Apical Suspensions in Older Women

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Abstract

Objective—Our objective was to evaluate 30-day readmission, 12-month prolapse recurrence, and complications after apical surgeries in older women.

Methods—A retrospective cohort study was conducted using 2002–2011 Medicare data in women ≥65 years who underwent abdominal sacrocolpopexy with synthetic mesh, or vaginal uterosacral, or sacrospinous colpopexy with 12-months follow-up. Vaginal mesh procedures were excluded. The primary outcome was 30-day inpatient readmission. Secondary outcomes were complications and prolapse recurrence, defined as either reoperation or pessary insertion. We used Pearson Chi-square, Fisher's tests and ANOVAs to examine difference between surgical treatment groups. Odds Ratio (OR) utilizing Charlson Comorbidity Index, age, race, and procedure type were calculated to assess the differences in the outcomes probability.

Results—Out of 3015 women, 863 underwent abdominal sacrocolpopexy, 510 – uterosacral, and 1642 – sacrospinous ligament suspensions. The 30-day readmission was 7.4% (95% Confidence Interval (CI) 5.7–9.2%), OR= 2.4 (95% CI 1.7–3.5, $p<0.01$) after abdominal sacrocolpopexy, 4.5% (95% CI 2.7–6.3%), OR=1.3 (95% CI 0.8–2.1, $p=0.3$) after uterosacral compared to 3.5% (95% CI 2.6–4.4% $p<0.01$) after sacrospinous ligament suspensions. Prolapse recurrence did not differ between the groups 8.2% (95% CI 6.4–10.1%), 10.6% (95% CI 7.9–13.3%), and 9.9%, (95% CI 8.4–11.3%, $p=0.3$), respectively. Women had 30-day gastrointestinal complications 6.1% (95% CI 4.5–7.7%), 1.2% (95% CI 0.2–2.1%), and 1.1% (95% CI 0.6–1.6%, $p<0.01$); surgical site infections 5.9% (95% CI 4.3–7.5%), 3.1% (95% CI 1.6–4.7%) and 3.7% (95% CI 2.8–4.6%, $p=0.01$); genitourinary complications 10.9% (95% CI 8.8–13%), 17.7% (95% CI 14.3–21%), and 13.6% (95% CI 12–15.3%, $p<0.01$); and medical complications 7.4% (95% CI 5.7–9.2%), 7.8% (95% CI 5.5–10.2%), and 4.4% (95% CI 3.4–5.4%, $p<0.01$); (all after abdominal sacrocolpopexy, uterosacral, and sacrospinous ligament suspensions, respectively).

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Conclusions—Vaginal apical suspensions compared to abdominal sacrocolpopexy with synthetic mesh are associated with lower rates of postoperative 30-day readmissions without increase in prolapse recurrence among older women.

Précis

Vaginal apical prolapse suspensions compared to abdominal sacrocolpopexy are associated with lower rates of postoperative 30-day readmissions without 12-month prolapse recurrence increase among older women.

Introduction

Randomized controlled trials (RCTs) and systematic reviews have investigated optimal surgical approaches for pelvic organ prolapse, but the safest and most durable apical suspension is yet to be definitely identified^{1–6}. Estimates of prolapse recurrence vary widely due to differences in study design and length of follow-up ranging from 2.3%^{5,7} to 29.2%⁸. Moreover, differential findings from three RCTs resulted in discordant conclusions with respect to the best apical surgery^{2–4}. Systematic reviews suggest that abdominal sacrocolpopexy with synthetic mesh provides more durable repair than vaginal apical suspensions but is associated with higher rates of gastrointestinal, mesh/suture, and thromboembolism complications^{1,6}. Recent research indicates that older women experience greater morbidity and higher mortality after surgical prolapse treatment^{9,10}. Therefore, the benefits of better anatomic outcomes after abdominal sacrocolpopexy with synthetic mesh may not outweigh the risks of surgical complications in this population.

Pubmed search “older women and apical prolapse” revealed only one retrospective study specifically designed to examine postoperative outcomes among older women¹¹. The underrepresentation of this group in clinical trials¹² further limits our ability to assess this important clinical area. The rich array of longitudinal inpatient, outpatient, and emergency room data from Medicare files is well suited to study outcomes after prolapse surgeries in women ≥65 years in the United States. Therefore, our objective was to evaluate 1) 30-day readmission, 2) 12-month prolapse recurrence, and 3) complications after commonly performed apical procedures in older women. We tested the hypothesis that abdominal sacrocolpopexy will have higher readmission as compared to vaginal apical suspensions.

Materials and Methods

This retrospective cohort study was conducted as part of the Urologic Diseases in America Project at University of California, Los Angeles using the 2002–2011 administrative Medicare claims data files sponsored by the Centers for Medicare and Medicaid Services. This research was exempt from the Institutional Review Board approval because only de-identified data were analyzed. The design, validity, and reliability of the Medicare datasets has been studied extensively^{13,14}. Medicare claims data consist of three component files: Medicare Provider Analysis and Review file containing records from hospital inpatient services; the carrier file, previously referred to as the Physician (Part B) claims file; and the outpatient claims file that contains data from hospital outpatient and Emergency Room visits, as well as laboratory, radiology, rehabilitation, and various other facility charges¹³. A

5% random sample was drawn from each of the three Medicare files, since previous research has demonstrated that a simple 5% random sample is sufficient to detect statistically significant differences¹³. Linked claims data on inpatient, ambulatory surgery center, hospital outpatient, physician office, and emergency room utilization services were used to evaluate the surgical outcomes using methodologic approaches previously described¹³.

We identified the study sample from carrier (physician) file using Current Procedural Terminology, 4th edition (CPT) codes: CPT 57280 – colpopexy, abdominal; 57282 – colpopexy, vaginal extraperitoneal (sacrospinous ligament suspension); 57283 – colpopexy, vaginal intraperitoneal (uterosacral ligament suspension,). The 57283 CPT code was introduced in 2005, and there were no procedures associated with this code available for identification in 2003 and 2004. Eligible participants included women 1) aged 65 years who underwent abdominal or vaginal colpopexy according to respective CPT codes during 2002–2011; 2) who had no evidence of prolapse repair within 12-months prior to the apical procedure; and 3) at least 12-months of follow-up. Subjects were excluded if there was evidence of any prolapse repair within 12 months preceding the apical procedure in order to avoid cases with recent recurrent prolapse. Thus, all subjects were 66 years and had their surgeries during 2003–2010. Participants who underwent vaginal mesh placement identified by CPT code 57267 were also excluded. Procedural codes between the inpatient, outpatient, and carrier files were matched with either inpatient stay (+/– 5 days) or outpatient service (+/– 3 days). There were 5 cases where surgeries were in both inpatient and outpatient files; each of these surgeries were then assigned to an inpatient surgery and counted only once (Study flow chart Figure 1).

The primary outcome was 30-day inpatient readmission rate among the three treatment groups, which was defined as an inpatient stay within 30 days of the discharge date after the original surgery. All other secondary outcomes included prolapse recurrence and complications, defined utilizing International Classification of Diseases, 9th Edition (ICD-9) diagnosis, ICD-9 Clinical Modification (ICD-9-CM), and CPT procedure codes. We defined prolapse recurrence as either prolapse reoperation or pessary insertion based on CPT or ICD-9-CM procedure codes during 12-month follow-up after surgery (Appendix 1, available online at <http://links.lww.com/xxx>). Prolapse reoperation in the year following surgery was categorized by the type of the procedure or compartment. All post-surgical complications were identified if at least one corresponding code was present during the study follow-up (Appendix 2, available online at <http://links.lww.com/xxx>). All complications were divided into short-term (30 days) and long-term (12 months) outcomes based on clinical judgment of when such complication most likely occurs. Our study team manually reviewed all diagnoses and procedure codes frequencies in all analytic files to avoid missed significant complications.

Factors selected a priori as potential confounders were patient demographics and clinical characteristics. Demographics included age, race, and geographic region. Clinical variables were Charlson Comorbidity Index, individual chronic conditions, and provider surgical volume. Race categories were Caucasian, African-American, and other. Geographic region was defined using U.S. Census Bureau categories: Northeast, South, Midwestern, and West. The Charlson Comorbidity Index is a composite score calculated from selected

comorbidities, with higher score indicating a greater burden of co-morbidity¹⁵. The ICD-9 codes were used to identify individual chronic conditions that may contribute to the readmission or complication risks because they increase inpatient prolapse surgical costs and length of hospitalization¹⁶. These comorbid conditions included diabetes, congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease, coagulopathy, and hypercoagulable state. Claims records were searched 12 months prior to the procedure index date to identify these conditions. When using outpatient claims, two diagnoses separated by more than one month were required to identify a comorbidity in a patient. Surgeon's volume was evaluated by linking physician ID (either Unique Physician Identification Number or National Provider Identifier) to prolapse procedure codes in all three analytic files.

Frequencies and percentages were calculated for categorical variables and Chi-square or Fisher's tests were used to examine differences between the surgical groups. Means and standard deviations were estimated for continuous variables and evaluated with ANOVA tests. Logistic regression models utilizing Charlson Comorbidity Index, age, race, procedure type, and surgeon's volume were performed to assess the differences in the probability of 30-day readmission, prolapse reoperation or recurrence, and complications between the different surgeries. Due to small numbers of surgeries for each surgeon, our analyses did not reveal correlation between surgeon's volume and readmission rates, and thus, surgeon's volume was not included into the final logistic regression models. Odds ratio point estimates with 95% Wald confidence intervals (CI) are reported. Statistical significance was set an alpha level of 0.05 for all study outcomes. Analyses were performed using the statistical package SAS (SAS version 9.4; SAS Institute). All data are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations¹⁷.

Results

We identified 3015 women ≥ 65 years with no history of prolapse surgery within 12 months before the principal procedure who underwent apical prolapse procedures between 2003 and 2010 and had a median 12-month follow-up. The sample included 863 women who underwent abdominal sacrocolpopexy, 510 – vaginal uterosacral, and 1642 – vaginal sacrospinous ligament suspensions (Table 1). Subjects' mean age was 72.9±5.2 years in abdominal sacrocolpopexy, 73.5±5.7 years in uterosacral, and 73.9±5.7 years, $p<0.01$ in the sacrospinous groups. Table 1 demonstrates that Caucasians underwent 94.1% of all procedures. The majority of subjects in all three groups had a Charlson Comorbidity Index score of 0 with no difference in prevalence of diabetes, congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease, or hypercoagulable state across surgical groups. Participants in the abdominal sacrocolpopexy group had lower rates of coagulopathy disorder than women in the uterosacral and sacrospinous ligament suspensions. The number and the type of surgery also differed by region: the South had the highest rates of surgeries, with abdominal sacrocolpopexy comprising 52.0% of all procedures. The sacrospinous and uterosacral groups had higher rates of concomitant procedures than abdominal sacrocolpopexy (87.3%, 82.9%, and 47.4%, $p<0.01$, respectively). The mean length of stay was longest for abdominal sacrocolpopexy as

compared to sacrospinous and uterosacral suspensions (3.4 ± 2.1 , 2.2 ± 1.6 , and 2.0 ± 1.1 days, $p < 0.01$, respectively).

The 30-day readmission rate was 7.4% (95% CI 5.7–9.2%) after abdominal sacrocolpopexy, 4.5% (95% CI 2.7–6.3%) after uterosacral, and 3.5% (95% CI 2.6–4.4%) $p < 0.01$ after sacrospinous ligament suspensions. Table 2 shows the readmission rates with majority of causes related to gastrointestinal complications, surgical infection, and cardiovascular diagnoses.

Tables 3 and 4 demonstrate main outcomes with crude and adjusted OR of outcomes probabilities as well as details on short and long-term complications. The adjusted OR for re-admission was 2.4 (95% CI 1.7–3.5, $p < 0.01$) after abdominal sacrocolpopexy and 1.3 (95% CI 0.8–2.1, $p = 0.3$) after uterosacral compared to sacrospinous suspensions indicating a two-fold greater risk for subsequent hospitalization post-sacrocolpopexy. There were no differences in 12-month reoperation rates after abdominal sacrocolpopexy (7.3%), vaginal uterosacral ligament (9.0%), and sacrospinous (7.8%, $p = 0.5$) suspensions. Despite more common use of pessary after sacrospinous (2.7%) and uterosacral (2.6%) suspensions as compared to abdominal sacrocolpopexy (1.0%, $p = 0.02$), the prolapse recurrence (pessary insertion and reoperation) was similar 8.2% (95% CI 6.4–10.1%) after open sacrocolpopexy, 10.6% (95% CI 7.9–13.3%) after vaginal uterosacral, and 9.9% (95% CI 8.4–11.3%, $p = 0.3$) after sacrospinous suspensions. Prolapse recurrence rates by the reoperation, type of the procedure during reoperation, and pessary insertion are shown in Table 5. Adjusted OR indicated that women undergoing abdominal sacrocolpopexy were more likely to experience 30-day gastro-intestinal complications such as ileus, bowel obstruction, or and bowel injury (OR=5.9, 95% CI 3.4–10.2, $p < 0.01$), and surgical site infections (OR=1.7, 95% CI 1.2–2.6, $p < 0.01$) compared to sacrospinous suspensions. Women had 30-day gastrointestinal complications 6.1% (95% CI 4.5–7.7%), 1.2% (95% CI 0.2–2.1%), and 1.1% (95% CI 0.6–1.6%, $p < 0.01$) as well as as surgical site infections 5.9% (95% CI 4.3–7.5%), 3.1% (95% CI 1.6–4.7%) and 3.7% (95% CI 2.8–4.6%, $p = 0.01$) after abdominal sacrocolpopexy, uterosacral, and sacrospinous ligament suspensions, respectively. The uterosacral group had a higher rates of genitourinary complications 17.7% (95% CI 14.3–21%) compared to abdominal sacrocolpopexy 10.9% (95% CI 8.8–13%), and sacrospinous 13.6% (95% CI 12–15.3%, $p < 0.01$) suspensions. Sacrospinous suspensions had the lowest rates of medical complications 4.4% (95% CI 3.4–5.4%), compared to abdominal sacrocolpopexy 7.4% (95% CI 5.7–9.2%), and vaginal uterosacral procedures 7.8% (95% CI 5.5–10.2%, $p < 0.01$). There were no differences in bleeding, vascular injuries, thromboembolism, mesh/suture complications, fistula, and pain between the three procedures. Participants with higher Charlson Comorbidity Index (2 or higher) had increased likelihood of any complication OR=2.0 (95% CI 1.4–2.8, $p < 0.01$) or readmission OR=2.7 (95% CI 1.5–4.8, $p < 0.01$) regardless of vaginal or abdominal approach. Even after controlling for higher comorbidity index, age was still associated with slightly increased risk for any complication OR=1.02 (95% CI 1.01–1.04, $p < 0.01$) and readmission OR=1.05 (95% CI 1.02–1.08, $p < 0.01$).

Discussion

Our findings suggest that the likelihood of 30-day readmission is lower after vaginal apical suspensions compared to abdominal sacrocolpopexies without increase in prolapse recurrence at 12-month follow-up among older women. Abdominal sacrocolpopexies have higher rates of gastrointestinal complications and surgical site infections. Uterosacral suspensions have higher rates of genitourinary complications. Sacrospinous suspensions had the lowest rates of complications without increase in prolapse recurrence at 12-month follow-up.

Hospital readmission after prolapse procedures has been previously described. A retrospective cohort study (N=76; median age=66.2 years) estimated 30-day readmission rate of 2.6% after vaginal hysterectomy for prolapse¹⁸. The readmission after vaginal colpocleisis was 4.2% in a retrospective cohort of 4776 women, of which 43% were >80 years old¹⁹. Thus, reported 30-day readmission rates after vaginal procedures are consistent with our findings and similar after different vaginal procedures in older women. Hoyte et al. reported 3.3% for 30-day readmission after abdominal sacrocolpopexy in women almost 10 years younger than population in our study²⁰. Therefore, our data suggests that abdominal sacrocolpopexy and age are associated with higher readmissions.

Unplanned 30-day readmission is used as a quality metric for general surgeons in the 2016 Physician Quality Reporting System (PQRS)²¹. The American Urogynecologic Society has recently developed six PQRS measures in Female Pelvic Medicine and Reconstructive Surgery (FPMRS) (Appendix 3, available online at <http://links.lww.com/xxx>)²¹. Our study provides more scientific evidence to develop 30-day unplanned readmission as a physician and hospital quality measure in FPMRS.

The reoperation and complications rates in our cohort are consistent with reports in recent systematic and comprehensive reviews. Previous research estimated reoperation rates of 3.9% (95% CI 3.5–4.4%) for vaginal and 2.3% (95% CI 1.9–2.7%) for abdominal colpopexies,⁵ while other evidence indicated reoperation rates for prolapse range from 0–12.9% for sacrospinous and 0–11.9% for uterosacral ligament suspensions²². The median reoperation rate after abdominal sacrocolpopexy is estimated at 4.4%²³. In contrast to previous Cochrane review¹, our study suggests that women ≥65 years have similar prolapse recurrence after abdominal sacrocolpopexies and vaginal apical suspensions during 12-month follow-up. The increased risks of gastrointestinal complications after abdominal sacrocolpopexy in older women are comparable to reported increased risks of gastrointestinal complications in a systematic review (OR 9.5, 95% CI 3.4–26.4)⁶.

There are several limitations in this study. Our study has limited racial diversity. We are not able to adjust for surgeon's selection bias. The abdominal and vaginal groups could differ in severity of prolapse and indications for surgery. We used the CPT codes as primary method to identify the apical procedures to minimize the ambiguity of ICD-9-CM codes. Outcomes, based on ICD-9, CPT, and ICD-9-CM codes, lack patient-reported outcomes and are less sensitive and specific than clinical data. Nonetheless, 30-day readmission and 12-month reoperation are well captured within Medicare data on all beneficiaries. Additionally, linked

Medicare data represents a real-world readmission and reoperation rates as opposed to other study designs (e.g., RCT) where participants drop out or receive care from other providers. The CPT code for vaginal uterosacral suspension (57283) was not introduced until 2005 with no uterosacral procedures in 2003 and 2004. Without access to operative notes, we excluded CPT code 57425, which is used in claims for both laparoscopic sacrocolpopexy with synthetic mesh and uterosacral ligament suspension without mesh. The majority of women in our study underwent vaginal (64.6%) and abdominal (26%) apical suspensions, and only 9.4% of women had minimally invasive procedures. Thus, vaginal and open abdominal apical suspensions remain most common procedures in older women. Our study suggests that age is associated with slightly increased risks for readmission and complications in older women. We are not able to point out the “cut off” age for worse outcomes. Functional status worsens in women with prolapse age ≥ 75 years²⁴. Therefore, our hypothesis that age ≥ 75 years is a risk factor for readmission and complications in older women warrants further testing. The limitations of this study are mitigated by various strengths. We used and manually searched a comprehensive linked outpatient, inpatient, and physician Medicare data that contained health records on 3,015 women.

Clinical implications of our study include 1) vaginal apical procedures can be offered as first-line surgical treatment for prolapse in older women to decrease 30-day readmissions, gastrointestinal and surgical wound complications in older women with prolapse, 2) vaginal uterosacral ligament suspensions have higher genitourinary complications; 3) sacrospinous ligament suspensions have the most favorable complications profile without increase in prolapse recurrence in older women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Maher CM, Feiner B, Baessler K, Glazener CM. Surgical management of pelvic organ prolapse in women: the updated summary version Cochrane review. *Int Urogynecol J.* 2011; 22(11):1445–1457. [PubMed: 21927941]
2. Maher CF, Qatawneh AM, Dwyer PL, Carey MP, Cornish A, Schluter PJ. Abdominal sacral colpopexy or vaginal sacrospinous colpopexy for vaginal vault prolapse: a prospective randomized study. *Am J Obstet Gynecol.* 2004; 190(1):20–26. [PubMed: 14749629]
3. Benson JT, Lucente V, McClellan E. Vaginal versus abdominal reconstructive surgery for the treatment of pelvic support defects: a prospective randomized study with long-term outcome evaluation. *Am J Obstet Gynecol.* 1996; 175(6):1418–1421. [PubMed: 8987919]
4. Roovers JP, van der Vaart CH, van der Bom JG, van Leeuwen JH, Scholten PC, Heintz AP. A randomised controlled trial comparing abdominal and vaginal prolapse surgery: effects on urogenital function. *BJOG.* 2004; 111(1):50–56. [PubMed: 14687052]

5. Diwadkar GB, Barber MD, Feiner B, Maher C, Jelovsek JE. Complication and reoperation rates after apical vaginal prolapse surgical repair: a systematic review. *Obstet Gynecol.* 2009; 113:367–373. [PubMed: 19155908]
6. Siddiqui NY, Grimes CL, Casiano ER, Abed HT, Jeppson PC, Olivera CK, et al. Mesh sacrocolpopexy compared with native tissue vaginal repair: a systematic review and meta-analysis. *Obstet Gynecol.* 2015; 125(1):44–55. [PubMed: 25560102]
7. Gotthart PT, Aigmueller T, Lang PF, Ralph G, Bjelic-Radusic V, Tamussino K. Reoperation for pelvic organ prolapse within 10 years of primary surgery for prolapse. *Int Urogynecol J.* 2012; 23(9):1221–1224. [PubMed: 22538553]
8. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol.* 1997; 89(4):501–506. [PubMed: 9083302]
9. Sung VW, Weitzen S, Sokol ER, Rardin CR, Myers DL. Effect of patient age on increasing morbidity and mortality following urogynecologic surgery. *Am J Obstet Gynecol.* 2006; 194(5): 1411–1417. [PubMed: 16647926]
10. Bretschneider CE, Robinson B, Geller EJ, Wu JM. The Effect of Age on Postoperative Morbidity in Women Undergoing Urogynecologic Surgery. *Female Pelvic Med Reconstr Surg.* 2015; 21(4): 236–240. [PubMed: 25521471]
11. Robinson BL, Parnell BA, Sandbulte JT, Geller EJ, Connolly A, Matthews CA. Robotic versus vaginal urogynecologic surgery: a retrospective cohort study of perioperative complications in elderly women. *Female Pelvic Med Reconstr Surg.* 2013 Jul-Aug;19(4):230–237. [PubMed: 23797528]
12. Morse AN, Labin LC, Young SB, Aronson MP, Gurwitz JH. Exclusion of elderly women from published randomized trials of stress incontinence surgery. *Obstet Gynecol.* 2004; 104(3):498–503. [PubMed: 15339759]
13. Saigal, C.; Liu, H.; Hanley, JM.; Madison, RA.; Smith, AC.; Lai, JC., et al. US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2012. Chapter 15: Methods. *Urologic Diseases in America*; p. 497–522. NIH Publication No. 12–7865
14. Baron JA, Lu-Yao G, Barrett J, McLerran D, Fisher ES. Internal validation of Medicare claims data. *Epidemiology.* 1994; 5(5):541–544. [PubMed: 7986870]
15. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J. Chronic Dis.* 1987; 40:373–383. [PubMed: 3558716]
16. Sanes TV, Schiltz NK, Richter HE, Koroukian SM. Trends and Factors Influencing Inpatient Prolapse Surgical Costs and Length of Stay in the United States. *Female Pelvic Med Reconstr Surg.* 2016; 22(2):103–110. [PubMed: 26571432]
17. Vandenbroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. *Int J Surg.* 2014; 12(12):1500–1524. [PubMed: 25046751]
18. Kalogera E, Barrum-Gamez JN, Jankowski CJ, Trabuco E, Lovely JK, Dhanorker S, et al. Enhanced recovery in gynecologic surgery. *Obstet Gynecol.* 2013; 122:319–328. [PubMed: 23969801]
19. Mueller MG, Ellimootil C, Abernethy MG, Mueller ER, Hohmann S, Kenton K. Colpocleisis: a safe, minimally invasive option for pelvic organ prolapse. *Female Pelvic Med Reconstr Surg.* 2015; 21(1):30–33. [PubMed: 25185616]
20. Hoyte L, Rabbanifard R, Mezzich J, Bassaly R, Downes K. Cost analysis of open versus robotic-assisted sacrocolpopexy. *Female Pelvic Med Reconstr Surg.* 2012; 18(6):335–339. [PubMed: 23143426]
21. Centers for Medicare & Medicaid Services. [Retrieved June 13, 2016] Measure Codes. Available at <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/PQRS/MeasuresCodes.html>
22. Barber MD, Maher C. Apical prolapse. *Int Urogynecol J.* 2013; 24(11):1815–1833. [PubMed: 24142057]

23. Nygaard IE, McCreery R, Brubaker L, Connolly A, Cundiff G, Weber AM, et al. Abdominal sacrocolpopexy: a comprehensive review. *Obstet Gynecol.* 2004; 104(4):805–823. [PubMed: 15458906]
24. Sanses TV, Schiltz NK, Couri BM, Mahajan ST, Richter HE, Warner DF, et al. Functional status in older women diagnosed with pelvic organ prolapse. *Am J Obstet Gynecol.* 2016; 214(5):613.e1–613.e7. [PubMed: 26704893]

Figure 1.

Abdominal and vaginal apical procedures study flow. ASC (57280) – Abdominal Sacrocolpopexy; SSLS (57282) – Vaginal Sacrospinous Ligament Suspension; USLS (57283) – Vaginal Uterosacral Ligament Suspension; VMP (57267) – Vaginal Mesh Placement.

Table 1

Study Population Characteristics

Procedures (N, %)									
Variables	Total	%	ASC ^{*‡} 57280		SSLS [†] 57282		USLS [‡] 57283		p-value [§]
			N	%	N	%	N	%	
Participants	3015	100	863	100	1642	100	510	100	
Age, years									
66–70	1069	35.5	332	38.5	552	33.6	185	36.3	<0.01
71–75	921	30.5	279	32.3	497	30.3	145	28.4	
76–80	657	21.8	163	18.9	370	22.5	124	24.3	
81–85	281	9.3	80	9.3	165	10.1	36	7.1	
86	87	2.9	9	1.0	58	3.5	20	3.9	
Race									
Caucasian	2837	94.1	800	92.7	1563	95.2	474	92.9	<0.01
African-American	73	2.4	33	3.8	26	1.6	14	2.8	
Hispanic									
Other	105	3.5	30	3.5	53	3.2	22	4.3	
Charlson Comorbidity Index									
0	2376	78.8	699	81.0	1295	78.9	382	74.9	0.15
1	497	16.5	128	14.8	269	16.4	100	19.6	
2	110	3.6	29	3.4	57	3.4	24	4.7	
3	32	1.1	7	0.8	21	1.3	4	0.8	
Comorbidities //									
Diabetes	739	24.5	216	25.0	387	23.6	136	26.7	0.33
CHF¶	151	5.0	41	4.8	87	5.3	23	4.5	0.71
CAD [#]	513	17.0	139	16.1	300	18.3	74	14.5	0.10
COPD ^{**}	358	11.9	89	10.3	198	12.1	71	13.9	0.13
Coagulopathy	103	3.4	18	2.1	67	4.1	18	3.5	0.03
Hypercoagulable State	11	0.4	3	0.4	6	0.4	2	0.4	0.99
Region									
South	1258	41.7	449	52.0	609	37.1	200	39.2	<0.01
Midwest	864	28.7	213	24.7	497	30.2	154	30.2	
Northeast	388	12.9	78	9.0	236	14.4	74	14.5	
West	496	16.4	122	14.1	292	17.8	82	16.1	

Procedures (N, %)									
Variables	Total	%	ASC [*] 57280		SSLS [†] 57282		USLS [‡] 57283		p-value [§]
			N	%	N	%	N	%	
Other	9	0.3	1	0.1	8	5	0	0	

^{*} Abdominal Sacrocolpopexy;

[†] Sacrospinous Ligament Suspension;

[‡] Uterosacral Ligament Suspension;

[§] Pearson Chi-square test or Fisher's test, when sample in numerator was less than 5;

// Based on International Classification of Diseases, 9th Edition Diagnosis (ICD-9) codes;

[¶] Congestive Heart Failure;

[#] Coronary Artery Disease;

^{***} Chronic Obstructive Pulmonary Disease

Table 2

Readmissions in women 65 years and older after abdominal and vaginal prolapse suspensions.

Diagnoses	Admissions, N	Percent (%)	Readmission Rate*, (%; 95% CI†)
Gastrointestinal	42	29.0	1.4 (1.0–1.8)
Surgical infection	23	15.8	0.8 (0.5–1.1)
Cardiovascular	19	13.1	0.6 (0.3–0.9)
Other	14	9.6	0.5 (0.2–0.7)
UTI	10	6.9	0.3 (0.1–0.5)
Pulmonary	9	6.2	0.3 (0.1–0.5)
Bleeding	8	5.5	0.3 (0.1–0.4)
Genitourinary	8	5.5	0.3 (0.1–0.4)
Pain	4	2.8	0.1 (0–0.3)
Thromboembolism	3	2.1	0.1 (0–0.2)
Renal	2	1.4	0.1 (0–0.2)
Neuro	2	1.4	0.1 (0–0.2)
Fistula	1	0.7	0.1 (0–0.1)
Total	145	100	4.8 (4.0–5.6)

* Readmission Rate = Admissions N/3015×100%;

† Confidence Interval

Readmission, prolapse reoperation and recurrence, complications, crude and adjusted* odds ratio after abdominal and vaginal suspensions in women 65 years and older

Table 3

	N	%	Crude OR [†]	95% CI [‡]	p-value	Adjusted OR	95% CI	p-value
30-day Readmission								
SSLs [§]	58/1642	3.5	REF	REF	REF	REF	REF	REF
USLS	23/510	4.5	1.3	0.8–2.1	0.3	1.3 [¶]	0.8–2.1	0.3
ASC [#]	64/863	7.4	2.2	1.6–3.2	<0.01	2.4	1.7–3.5	<0.01
12 month Prolapse Recurrence (Reoperation or Pessary Insertion)								
SSLs	162/1642	9.9	REF	REF	REF	REF	REF	REF
USLS	54/510	10.6	1.1	0.8–1.5	0.6	1.1	0.8–1.5	0.7
ASC	71/863	8.2	0.8	0.6–1.1	0.2	0.8	0.6–1.1	0.1
12-month Reoperation								
SSLs	128/1642	7.8	REF	REF	REF	REF	REF	REF
USLS	46/510	9.0	1.2	0.8–1.7	0.4	1.2	0.8–1.6	0.4
ASC	63/863	7.3	0.9	0.7–1.3	0.7	0.9	0.6–1.2	0.4
12-month Pessary Insertion								
SSLs	45/1642	2.7	REF	REF	REF	REF	REF	REF
USLS	13/510	2.6	0.9	0.5–1.7	0.8	0.9 [¶]	0.5–1.8	0.9
ASC	9/863	1.0	0.4	0.2–0.8	<0.01	0.4 [¶]	0.2–0.8	0.01
30-day complications								
Gastrointestinal complications (Ileus, Bowel Obstruction, Bowel Injury)								
SSLs	18/1642	1.1	REF	REF	REF	REF	REF	REF
USLS	6/510	1.2	1.1	0.4–2.7	0.9	1.0 [¶]	0.4–2.7	0.9
ASC	53/863	6.1	5.9	3.4–10.1	<0.01	5.9	3.4–10.2	<0.01

	N	%	Crude OR [†]	95% CI [‡]	p-value	Adjusted OR	95% CI	p-value
Genitourinary complications (Bladder Injury, Ureter Injury, Urinary Dysfunction)								
SSLs	224/1642	13.6	REF	REF	REF	REF	REF	REF
USLS	90/510	17.7	1.4	1.0–1.8	0.03	1.4	1.1–1.8	0.02
ASC	94/863	10.9	0.8	0.6–1.0	0.05	0.8	0.6–1.0	0.07
Medical Complications (Pulmonary, Cardiovascular, Renal)								
SSLs	72/1642	4.4	REF	REF	REF	REF	REF	REF
USLS	40/510	7.8	1.9	1.2–2.8	<0.01	1.9	1.3–2.9	<0.01
ASC	64/863	7.4	1.7	1.2–2.5	<0.01	2.1	1.5–3.0	<0.01
UTI								
SSLs	242/1640**	14.8	REF	REF	REF	REF	REF	REF
USLS	91/507	18.0	1.3	0.97–1.6	0.08	1.3	0.97–1.7	0.08
ASC	114/858	13.3	0.9	0.7–1.2	0.3	0.9	0.7–1.2	0.5
Surgical Site Infection								
SSLs	61/1642	3.7	REF	REF	REF	REF	REF	REF
USLS	16/510	3.1	0.8	0.5–1.5	0.5	0.9¶	0.5–1.5	0.6
ASC	51/863	5.9	1.6	1.1–2.4	0.01	1.7	1.2–2.6	<0.01
Thromboembolism								
SSLs	15/1642	0.9	REF	REF	REF	REF	REF	REF
USLS	5/510	1.0	1.1	0.4–2.9	0.9	1.1¶	0.4–2.9	0.9
ASC	14/863	1.6	1.8	0.9–3.7	0.1	2.1¶	0.97–4.3	0.06
Pain								
SSLs	123/1642	7.5	REF	REF	REF	REF	REF	REF
USLS	38/510	7.5	1.0	0.7–1.5	1.0	1.0	0.7–1.4	0.9
ASC	56/863	6.5	0.9	0.6–1.2	0.4	0.8	0.6–1.1	0.1

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* Adjusted for Charlson Comorbidities Index, age, race, region, procedure type;
† Odds Ratio;
‡ Confidence Interval;
§ Sacrospinous Ligament Suspension;
|| Uterosacral Ligament Suspension;
¶ Samples insufficient to allow reliable estimate of adjusted ORs;
Abdominal Sacrocolpopexy;
** Data is missing data on some participants.

Table 4

Short and long-term complications after abdominal and vaginal suspensions in women 65 years and older.

Outcomes	Total	%	Procedures (N, %)								P-value [§]
			ASC* 57280		SSLS [†] 57282		USLS [‡] 57283				
30-day complications			N	%	N	%	N	%	N	%	
Bleeding //	17/3005	0.6	7/858	0.8	8/1640	0.5	2/507	0.4		0.48	
Gastrointestinal complications											
Ileus, Bowel Obstruction //	74/3005	2.5	52/858	6.1	16/1640	1.0	6/507	1.2		<0.01	
Bowel injury	31/3015	1.0	23/863	2.7	6/1642	0.4	2/510	0.4		<0.01	
Genitourinary complications											
Bladder injury [#]	98/3015	3.3	21/863	2.4	52/1642	3.2	25/510	4.9		0.04	
Ureter injury	56/3015	1.9	10/863	1.2	27/1642	1.6	19/510	3.7		<0.01	
Urinary Dysfunction	320/3015	10.6	78/863	9.0	172/1642	10.5	70/510	13.7		0.02	
Vascular injury	2/3015	0.01	0/863	0	2/1642	0.1	0/510	0		0.43	
Thromboembolism	34/3015	1.1	14/863	1.6	15/1642	0.9	5/510	1.0		0.26	
Post-operative infection											
UTI	447/3005	14.9	114/858	13.3	242/1640	14.8	91/507	18.0		0.06	
Respiratory Infection	114/3015	3.8	36/863	4.2	52/1642	3.2	26/510	5.1		0.11	
Surgical site Infection ^{**}	128/3015	4.2	51/863	5.9	61/1642	3.7	16/510	3.1		0.01	
Medical Complications											
Pulmonary	34/3015	1.1	12/863	1.4	12/1642	0.7	10/510	2.0		0.049	
Cardiovascular	151/3015	5.0	53/863	6.1	63/1642	3.8	35/510	6.8		<0.01	
Renal	15/3015	0.5	8/863	0.9	3/1642	0.2	4/510	0.8		0.025	

Procedures (N, %)									
Outcomes	Total	%	ASC* 57280	N	%	SSL [†] 57282	N	%	USLS [‡] 57283
P-value [§]									
30-day complications									
12-month complications									
Mesh/Suture complications	39/3005	1.3	12/858	1.4	22/1640	1.3	5/507	1.0	0.79
Fistula	24/3015	0.8	7/863	0.8	15/1642	0.9	2/510	0.4	0.51
Pain	217/3015	7.2	56/863	6.5	123/1642	7.5	38/510	7.5	0.64

* Abdominal Sacrocolpopexy;

[†] Sacrospinous Ligament Suspension;

[‡] Uterosacral Ligament Suspension;

[§] Pearson Chi-square or Fisher's test;

// With or without transfusion;

[¶] Bowel obstruction with or without surgical intervention;

[#] Urinary complications and hematuria;

^{**} Wound complication

Table 5

Summary of 12-month reoperation and prolapse recurrence in abdominal and vaginal suspensions in women 65 years and older.

Procedures (N, %)											
Outcomes	Total	%	ASC* 57280	SSL† 57282	USLS‡ 57283	p-value§					
			N	%	N	%	N	%	N	%	
Participants	3015	100	863	100	1642	100	510	100			
Re-operation¶											
Total	237¶	7.9	63	7.3	128	7.8	46	9.0			0.5
Type of Surgery											
Anterior	72	2.4	18	2.1	39	2.4	15	2.9			0.60
Posterior	56	1.9	18	2.1	27	1.6	11	2.2			0.64
Anterior-Posterior	65	2.2	8	0.9	44	2.7	13	2.6			0.01
Apical	188	6.2	47	5.5	106	6.5	35	6.9			0.50
Colpocleisis	8	0.3	0	0	5	0.2	3	0.1			0.11
Insertion of mesh	43	1.4	9	1.0	27	1.6	7	1.4			0.48
Pessary treatment¶	67	2.2	9	1.0	45	2.7	13	2.6			0.02
Prolapse Recurrence#	287**	9.5	71	8.2	162	9.9	54	10.6			0.28

^{*} Abdominal Sacrocolpopexy;

[†] Sacrospinous Ligament Suspension;

[‡] Uterosacral Ligament Suspension;

[§] Pearson Chi-square or Fisher's test;

[¶] Based on International Classification of Diseases, 9th Edition Clinical Modification (ICD-9-CM) and Current Procedural Terminology (CPT) codes;

[¶] Some participants had more than one type of surgery during re-operation;

[#] Reoperation and pessary treatment within 12 months after surgery;

Some participants had both re-operation and pessary treatment

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