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Symptom Relief and Retreatment After Vaginal, Open, or Robotic Surgery for Apical Vaginal Prolapse

Mallika Anand, MD, Amy L. Weaver, Kristin M. Fruth, Emanuel C. Trabuco, MD, and John B. Gebhart, MD

Division of Gynecologic Surgery (Drs Anand, Trabuco, and Gebhart), and Division of Biomedical Statistics and Informatics (Mss Weaver and Fruth), Mayo Clinic, Rochester, Minnesota

Abstract

Objectives—To determine the degree of symptom relief and survival free of retreatment after Mayo-McCall culdoplasty (MMC), open abdominal sacrocolpopexy (ASC), and robotic sacrocolpopexy (RSC) for posthysterectomy vaginal vault prolapse.

Methods—We retrospectively studied patients who had undergone surgery for posthysterectomy apical vaginal prolapse from January 1, 2000, through June 30, 2012, at our institution. Baseline characteristics and perioperative outcomes were abstracted from electronic health records. Cross-sectional data for current pelvic floor symptoms were collected by using validated questionnaires. Survival free of retreatment was estimated with the Kaplan-Meier method. To account for selection bias, adjusted analyses using inverse probability weighting (IPW) were performed to compare outcomes for MMC vs ASC, MMC vs RSC, and ASC vs RSC.

Results—Of 512 patients, 337 completed at least a validated or abbreviated questionnaire. Among MMC, ASC, and RSC groups, overall PFDI-20, PFIQ-7, and PISQ-12 summary scores were not statistically significant. There was no significant difference in 5-year survival free of retreatment for MMC (94.0%) vs RSC (95.5%) and ASC (94.8%) vs RSC (92.1%). However, patients who had MMC were more likely to have retreatment than patients who had ASC during the first 10 years (10-year survival free of retreatment: 81.1% vs 95.4%; hazard ratio, 3.68 [95% CI, 1.51–8.98]); the 10-year data were not available for RSC comparisons, given the later initiation of RSC.

Conclusions—Symptom relief was comparable after MMC, ASC, and RSC. Among all groups, most patients were free of retreatment for prolapse at 5 years. Between MMC and ASC groups, survival free of retreatment (%) within 10 years was still favorable, but ASC had greater durability, particularly after accounting for selection bias.

Keywords

apical prolapse; Mayo-McCall culdoplasty; posthysterectomy vaginal prolapse; sacrocolpopexy

Reprints: John B. Gebhart, MD, Division of Gynecologic Surgery, Mayo Clinic, 200 First St SW, Rochester, MN 55905 (gebhart.john@mayo.edu) Telephone: (507) 284-2511 Fax: (507) 266-9300.

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Introduction

Prolapse of the vaginal apex after hysterectomy (vaginal vault prolapse), occurs at an incidence of 3.6 per 1,000 women-years (1). Among patients undergoing hysterectomy, the proportion of posthysterectomy apical vaginal prolapse ranges from 1.8% (after a hysterectomy for nonprolapse indication) to 11.6% (after a hysterectomy for preexisting prolapse indication) (2). The vaginal bulge can cause bladder, bowel, and sexual dysfunction, affecting a patient's quality of life (3). Patients can be observed or treated with pessary or surgery (4). Various transvaginal or transabdominal operations exist (5), and operations are generally considered successful if a patient's symptoms improve (6).

Determining which route and type of surgery to recommend is made more difficult by a paucity of level-1 evidence, including that for robotic sacrocolpopexy (RSC). Compared with many transvaginal approaches, open abdominal sacrocolpopexy (ASC) has been associated with lower rates of prolapse recurrence and dyspareunia (7). However, a recent study has shown the long-term durability of ASC for relieving symptoms to be less than previously thought (71%–76% at 7 years) (8).

Three operations for vaginal vault prolapse are routinely performed at our institution: Mayo-McCall Culdoplasty (MMC), ASC, and RSC. Our objective was to assess long-term symptom relief and survival free of retreatment for prolapse after these 3 procedures. We hypothesized that rates of symptom relief and survival free of retreatment would be higher in the ASC group than in the MMC and RSC groups.

Materials and Methods

This was a questionnaire-based, retrospective cohort study of patients undergoing MMC, ASC, or RSC at a single institution. The Mayo Clinic Institutional Review Board approved the protocol, which was part of a precedent examination of the cohort. The demographic and selection factors of the cohort have been previously described (9), as have the perioperative complications and hospital costs to the patients (10). Patients were identified by using the Surgical Operative Note Explorer (Mayo Clinic, Rochester, Minnesota). Patients were included in the study if they had apical prolapse and underwent posthysterectomy vaginal vault prolapse repair via MMC, ASC, or RSC at Mayo Clinic, Rochester, Minnesota, from January 1, 2000, through June 30, 2012. Patients who did not authorize use of their health record information for research purposes were excluded. Patients were also excluded if they had prior or concomitant vaginal mesh excision, upper vaginectomy, a nonhealing vaginal wound, prior radical hysterectomy, oncologic surgery, systemic chemotherapy, pelvic radiation therapy, current malignancy, connective tissue disease, nonpermanent mesh, concomitant trachelectomy or hysterectomy, concomitant major nongynecologic surgery (rectopexy, colectomy), suspension of neovagina, fistula repair, pouch of Douglas hernia, sacrocolpoperineopexy with extension of mesh bilaterally to the pelvic sidewalls, or no apical prolapse. Patients were also excluded if their procedure was done by a nongynecologic surgeon or was otherwise misclassified.

All patients underwent 1 of 3 procedures for posthysterectomy apical vaginal prolapse: 1) Mayo-McCall culdoplasty, a modification of uterosacral ligament suspension, 2) abdominal sacrocolpopexy, or 3) robotic sacrocolpopexy, which have previously been described (10). The procedures were done in the same manner by all surgeons. Three absorbable sutures were used Vicryl #1 (Ethicon) for the MMC, permanent suture at the sacrum and permanent or absorbable suture at the vagina for ASC, and absorbable suture at both the sacrum and vagina for RSC. Only permanent mesh was used for the sacrocolpopexies; the specific type of permanent mesh for sacrocolpopexy was selected by the surgeon (10).

Baseline, intraoperative, and postoperative data were abstracted from the electronic health records between August 17, 2013, and April 7, 2014. Baseline characteristics abstracted included age, ethnicity, body mass index, smoking status, vaginal parity, comorbidities, American Society of Anesthesiologists (ASA) physical classification status, number and type of prior pelvic organ prolapse surgeries, number and type of prior incontinence surgeries, pelvic floor symptomatology (including bladder dysfunction, bowel dysfunction, dyspareunia) based on the history of present illness, chronic pain of any kind, and preoperative prolapse grade of each vaginal compartment. A Charlson Comorbidity Index score was assigned on the basis of baseline comorbidities (11). Intraoperative variables abstracted consisted of surgeon, anesthesia type, primary and concomitant operations performed, operative time, estimated blood loss, intraoperative complications, and preoperative and postoperative hemoglobin and serum creatinine values. Postoperative variables abstracted consisted of length of hospitalization, follow-up (date and type, eg, phone or office), and complications. Complications were tracked for up to 63 days after surgery and included more than 40 distinct complications relating to the following categories: wound, infectious, gastrointestinal, electrolyte, cardiopulmonary, neurologic, psychiatric, and endocrine. Specific symptoms of pelvic floor dysfunction were also abstracted from the subjective portion of notes documented during subsequent follow-up visits or patient-initiated phone calls.

To determine symptom relief and survival free of retreatment, we administered a mailed, written questionnaire to all patients in the study cohort who were alive on June 27, 2013, with a second mailing to nonrespondents on July 31, 2013, and phone reminders on September 14, 2013. Our written questionnaire was a composite of a sequence of 3 validated questionnaires, in addition to our own questions regarding information on retreatment and barriers to sexual activity. We used the following validated written questionnaires, with permission obtained from the publishers: the Pelvic Floor Distress Inventory 20 (PFDI-20), which consists of 3 subscales for prolapse, bowel, and urinary dysfunction; the Pelvic Floor Impact Questionnaire Short Form 7 (PFIQ-7), which consists of 3 subscales quantifying the impact of prolapse, bowel, and urinary dysfunction on activities, relationships, and feelings (12); and the Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire 12 (PISQ-12), which is a single scale measuring sexual function (13). For the PFDI-20, which is a validated, abridged version of the original PFDI, individual questions are scored from 0 to 4, with 0 conveying *no bother* and 4 conveying *quite bothersome*. The mean score from the questions in each subscale is multiplied by 25 to obtain the subscale score; scores from the 3 subscales are then added to obtain a summary score out of a possible 300 points. For the PFIQ-7, questions are scored from 0 to 3, with 0 conveying *no bother*. The mean score

from the questions in each subscale is then multiplied by 100 and divided by 3 to obtain a subscale score; scores from the 3 subscales are added to obtain the summary score out of a possible 300 points. The PISQ-12 scores each individual question on a scale of 0 to 4; the highest possible score is 48, with higher scores reflecting better sexual function.

Barber et al (6) reported that 2 questions from the original, unabridged PFDI (14) consistently related to the presence or absence of prolapse: “Do you usually have a bulge or something falling out that you can see or feel in the vaginal area?” and “Do you usually have a sensation of bulging or protrusion from the vaginal area?” Only the first question is part of the PFDI-20; therefore, we added the second question from the original PFDI to our questionnaire.

In addition to the PISQ-12, we asked 2 additional questions regarding sexual function: “Which, if any of the following, are barriers to sexual activity? Mark all that apply.” A few examples of the 12 possible barriers to sexual function were “low desire,” “pain in vagina,” “vaginal dryness,” and “vagina too short.” Answer options also included “other,” “choose not to answer,” and “no barriers.” The second additional question was: “For the barriers you marked above, which of the barriers to sexual activity is the single most bothersome? (Mark only one.)” A brief phone survey was developed for nonrespondents to the written questionnaire and administered between September 26, 2013, and November 16, 2013, with at most 5 attempted contacts per patient. This phone survey contained the 2 key prolapse-related questions mentioned above, in addition to select questions from the bowel, bladder, and sexual function domains in the written questionnaires.

To determine time to retreatment, we asked the following questions at the beginning of both the written and phone surveys: “Since your surgery to treat pelvic floor condition on [the date listed at the top of this page], have you required repeat treatment with pessary (a device placed in the vagina to support the uterus) or surgery? If yes, when did you first have the repeat treatment? Was that retreatment initially with pessary or surgery? What was the reason for repeat treatment?” If a patient responded “yes” to the question regarding retreatment, we checked the patient’s record to verify that the retreatment was for prolapse. Charts of all nonrespondents were cross-checked from date of index surgery through the survey mailing period to identify any retreatment for prolapse (date and type) or date of last relevant clinical follow-up if no retreatment was documented. Cross-check was not performed for patients who indicated no retreatment.

Statistical Analyses

Patient characteristics were compared at the time of the index surgery between survey respondents and nonrespondents and between the survey respondents in the 3 procedure groups by using the χ^2 test for categorical variables and the 2-sample *t* test or Wilcoxon rank sum test, as appropriate, for continuous and ordinal variables.

Three separate comparisons of outcomes were conducted: MMC vs ASC, which included all patients who had surgery from January 1, 2000, through June 30, 2012; and MMC vs RSC and ASC vs RSC, both of which included all patients who had surgery from February 1, 2007, through June 30, 2012, when the RSC procedure was performed. The PFDI-20 total

score and subscale scores were each compared between 2 procedure groups based on fitting separate general linear regression models after first transforming the individual scores ($[\text{value}+1]$) to obtain a less skewed distribution. The PISQ-12 total score was also compared between 2 procedure groups using general linear regression. The PFIQ-7 overall score and subscale scores were each compared between 2 procedure groups based on fitting ordinal logistic regression models after categorizing the skewed distribution of scores into 3 ordinal categories. The remaining nominal outcome measures from additional questionnaire items were compared between the 2 procedure groups by fitting logistic regression models for each comparison. Survival free of retreatment was compared between the 2 procedure groups based on fitting a Cox proportional hazards model. Both unadjusted and adjusted results were reported for all afore-mentioned outcomes. Comparisons of outcomes between the 3 procedure groups were adjusted by using stabilized inverse probability weights derived from propensity scores. Propensity score methodology was used to obtain less biased comparisons of the outcomes between the procedure groups, given the potential for patient selection bias between the 3 procedures.

Separate propensity scores (and weights) were derived for each comparison (MMC vs ASC, MMC vs RSC, ASC vs RSC) and for each of 4 subsets of patients within each comparison (all patients, patients who completed the mailed questionnaire or brief phone survey, patients who completed the PFDI-20 and PFIQ-7 in the mailed questionnaire, and patients who completed the PISQ-12 in the mailed questionnaire). Separate propensity score derivations were performed for each subset in order to ensure balance of baseline covariates within each subset of patients, given that not all patients completed each validated instrument within the questionnaire. In each analysis, the propensity score (PS) for each patient was defined as the estimated conditional probability of having procedure A (vs procedure B), given a patient's baseline covariates and was estimated from a multivariable logistic regression model with the binary endpoint of procedure A (vs procedure B). The baseline covariates included in the multivariable model were age, Charlson Comorbidity Index score (0, 1, 2+), ASA score (1 or 2 vs 3 or 4), number of prior prolapse surgeries (0, 1, or 2+), chronic pain (yes vs no), apical prolapse grade (1 or 2 vs 3 or 4), anterior prolapse grade (1 or 2 vs 3 or 4), and posterior prolapse grade (1 or 2 vs 3 or 4). Inverse probability weights were derived as $1/\text{PS}$ for patients with procedure A, and $1/(1-\text{PS})$ for patients with procedure B, using each patient's specific PS value. Large weights were trimmed at the 95th percentile, and the weights were then stabilized according to the proportion of patients in the 2 procedure groups so that the sum of the weights equaled the sample size of the 2 procedure groups within each analysis. Before fitting the weighted models to compare the outcomes between 2 procedure groups, the covariate imbalance between the procedure groups was assessed by calculating standardized differences for each of the covariates included in the aforementioned model, separately for the original unadjusted cohort and the IPW-adjusted cohort.

Statistical analyses were performed by using SAS version 9.3 software (SAS Institute, Inc). All calculated P values were 2-sided, and P values less than .05 were considered statistically significant. An adjustment or correction for the multiple comparisons between the 3 procedures or for the number of outcomes compared was not made. However, if one chooses

to interpret the findings after applying a Bonferroni correction to account for the 3 pairwise procedure comparisons, then P values could be interpreted against a criterion of .0167.

Results

A total of 711 records were identified and assessed for eligibility (MMC, 252; ASC, 349; and RSC, 110) (Figure 1). Thirty patients were excluded because they did not provide research authorization. An additional 169 patients met the exclusion criteria (MMC, 65; ASC, 100; and RSC, 4). After inclusion and exclusion criteria were applied, 512 patients remained in the cohort: MMC, 174; ASC, 237; and RSC, 101. The baseline characteristics of the original cohort of 512 patients have been previously described (9).

Of the 512 patients mailed the written questionnaire, 21 had died by the time of the mailing. Of the remaining 491 patients, 337 (68.6%) completed the survey (208, the complete written survey; 129, the abbreviated phone survey), 82 (16.7%) responded that they were unwilling to complete the survey, and 72 (14.7%) did not respond. Generally, baseline characteristics of the survey respondents ($n=337$) were similar to those of the nonrespondents ($n=154$); however, respondents had slightly more prior transabdominal surgeries ($P=.05$) and a lesser degree of posterior prolapse ($P=.02$) at baseline compared with nonrespondents (data not shown). The median duration of follow-up from the date of the surgery to the date of questionnaire response for the 337 respondents was 4.5 years (interquartile range [IQR], 2.4–8.2 years) for the MMC group, 5.2 years (IQR, 3.1–7.9 years) for the ASC group, and 2.9 years (IQR, 1.9–4.3 years) for the RSC group.

The baseline characteristics of the survey respondents from the 3 procedure groups are shown in Table 1. At baseline, patients in the MMC group were older and had more prior prolapse surgeries (although fewer prior vaginal surgeries for prolapse) than patients in the ASC and RSC groups. A greater proportion of patients in the ASC group had grade 3 or 4 apical prolapse (51.0%) than did patients in the MMC (26.8%) or RSC (22.1%) groups, and preoperative chronic pain was significantly more common in the ASC group compared with the MMC group. A smaller proportion of patients in the RSC group had grade 3 or 4 posterior vaginal prolapse (14.3%) preoperatively than did those in the ASC (32.1%) or RSC (34.3%) groups, and prior sling placement was more common in the RSC group compared with the other 2 groups. Preoperative defecatory dysfunction and the need to splint to defecate were also less common in the RSC group.

Figure 2 depicts the standardized differences for the baseline covariates included in the derivation of the propensity scores. After the IPW adjustment, the patients in the MMC vs ASC, ASC vs RSC, and MMC vs RSC comparisons were better matched on these covariates, with lower standardized differences in each of the IPW-adjusted cohorts compared with the unadjusted cohorts. However, there was still some residual imbalance present for some of the measured covariates in the IPW-adjusted cohorts, particularly for the MMC vs RSC comparison that had covariates with standardized differences above the 0.25 threshold.

On the basis of the IPW-adjusted analyses, summary overall scores from the PFDI-20, PFIQ-7, and PISQ-12 did not differ regarding long-term posttreatment symptoms and quality of life among the 3 groups of women (MMC, ASC, RSC) who completed the written questionnaire (Tables 2, 3, and 4). There were, however, a few discernible differences among validated survey subscales and pelvic floor symptom domains. Symptom domains reflect symptom categories from the validated written questionnaires or a positive response to a symptom from the abbreviated phone questionnaires. In the IPW-adjusted cohort, patients responding to the written questionnaire who had undergone MMC had a greater median score (more distress) on the Urogenital Distress Inventory 6 (UDI-6) subscale of the PFDI-20 than patients who had undergone ASC (20.8 vs 8.3, $P=.02$) (Table 2).

In the IPW-adjusted analysis of MMC vs RSC, patients undergoing MMC had a higher median Colorectal-Anal Distress Inventory-8 (CRADI-8) score (18.8 vs 12.5, $P=.04$); otherwise, we were unable to identify any significant differences in the long-term posttreatment symptoms and quality of life between these 2 procedures (Table 3). In the IPW-adjusted analysis of ASC vs RSC, a greater proportion of patients after RSC reported symptoms of defecatory dysfunction overall (66.3% vs 50.3%, $P=.04$). None of the specific symptoms of defecation differed significantly, however, and there was no significant difference among CRADI-8 or CRAIQ-7 scores (Table 4).

Overall, 289 of the 337 survey respondents chose to answer the questions about the most frequently reported barriers to sexual function. At least 1 barrier was endorsed by 201 patients (mean [SD] age at the time of the questionnaire, 61.3 [9.6] years), with the most common barriers being vaginal dryness (44.3%), low desire (42.3%), partner problems (42.3%), and vaginal pain (30.4%).

Regarding survival free of retreatment, 23 of 512 patients reported retreatment (18, surgery; 5, pessary) in the first 5 years after their operations. The 23 patients who were retreated included 12/174 in the MMC group (9, surgery; 3, pessary), 7/237 in the ASC group (6, surgery; 1, pessary), and 4/101 in the RSC group (3, surgery; 1, pessary). Two additional patients (1, MMC and 1, ASC) reported retreatment at 8.5 years and 10.2 years, respectively. Among the remaining 487 patients without documented treatment, the median duration of follow-up from the date of the surgery to the date of last relevant clinical follow-up or questionnaire response was 3.0 years (IQR, 0.4–6.1 years) for the MMC group, 3.3 years (IQR, 1.0–5.9 years) for the ASC group, and 2.4 years (IQR, 1.2–3.8 years) for the RSC group. Tables 2, 3, and 4 list the unadjusted and IPW-adjusted comparisons of MMC vs ASC (over a 10-year follow-up period), MMC vs RSC, and ASC vs RSC (each over a 5-year period because RSC was initiated in 2007). Figures 3A, 3B, and 3C depict the IPW-adjusted survival free of retreatment. In the IPW-adjusted analysis, patients who underwent MMC were 3.68 times more likely to have retreatment within 10 years after surgery than patients who underwent ASC (95% CI, 1.51–8.98; $P=.004$). In the IPW-adjusted comparison of MMC vs RSC, survival free of retreatment did not significantly differ within the first 5 years after surgery (hazard ratio [HR], 1.14; 95% CI, 0.24–5.38; $P=.86$). In the IPW-adjusted comparison of ASC vs RSC, the survival free of retreatment also did not differ significantly (HR, 0.64; 95% CI, 0.17–2.35; $P=.50$).

Discussion

In our study, we examined symptom relief and time to retreatment for MMC, ASC, and RSC. Scant data exist regarding the use of validated symptom questionnaires, for outcomes of patients undergoing MMC for posthysterectomy vaginal vault prolapse. We found that symptom relief, as measured by validated questionnaires and phone surveys, did not differ overall among patients undergoing MMC, ASC, or RSC for posthysterectomy vaginal prolapse. However, our PFDI-20 and PFIQ-7 summary scores for the RSC group were higher than outcomes of other studies of RSC (15,16). It is unclear whether this difference is an effect of the time elapsed since surgery (other studies reported symptom relief at 12–36 months) or the mix of primary uterovaginal and posthysterectomy vaginal vault prolapse in the other studies.

Sexual function outcomes after vaginal surgery were reported in 2 previous studies from our institution, which used the PISQ-12 questionnaire (14,17). The PISQ-12 scores among the subset of sexually active patients postoperatively were largely unchanged across the 2 studies: preoperative, 33.4; postoperative at 5–8 weeks, 34.7; and at 18–36 months, 32.9. The lower PISQ-12 scores of our study might be attributed to our cohort's consisting solely of patients with posthysterectomy vaginal vault prolapse, a longer follow-up, older age at follow-up, or a combination of these factors. On the basis of our inclusion of additional, specific questions regarding sexual function, we found that 3 of the top 4 most bothersome barriers to sexual function were partner problems, low desire, and vaginal dryness, which could largely be presumed to be *nonsurgical* barriers in patients after hysterectomy; these results may be useful for patient counseling. That being said, vaginal pain was cited by more than 25% of patients who reported a barrier and therefore merits long-term follow-up. We did not have a measure of preoperative, baseline pelvic pain.

We found a significant difference regarding survival free of retreatment between the MMC and ASC groups over a 10-year period. Webb et al (18) described a large series of patients who underwent MMC; in their study, the success rate (defined as lack of symptoms from bulge) was estimated to be 84% up to 8.8 years postoperatively, with 67% to 95% of patients requiring retreatment, computed on the basis of a sensitivity analysis. Our findings were somewhat similar to those of Webb et al (18), in that bulge was noted among 23.9% of respondents in the MMC group. Interestingly, 22.7% of respondents in our ASC group and 18.6% in the RSC group answered affirmatively to at least 1 of the 2 validated questions of symptomatic bulge, and these proportions of symptomatic bulge were not noted to be significantly different. The findings of symptomatic prolapse over time with ASC are less consistent, with the more recently published results of the CARE trial, in which 24% to 29% of patients who had undergone ASC had symptomatic prolapse at 7 years (8). A randomized, controlled trial of ASC versus transvaginal high uterosacral vault suspension (HUVS), which included patients undergoing concomitant hysterectomy, demonstrated greater objective success for ASC (100%) versus the vaginal approach (82.5%) at 1 year but comparable subjective success (PFDI-20 scores: ASC, 20.3; HUVS, 31.0) between the 2 approaches (19).

Other studies have commented upon the overall high objective and/or subjective success of uterosacral ligament suspension and/or McCall or modified McCall culdoplasty (20) and/or other restorative native tissue repairs, such as sacrospinous ligament suspension (21). In a systematic review of uterosacral ligament suspension, Margulies et al (22) described a pooled success rate (based on a definition of anatomic prolapse stage or grade <2 of 81.2% to 94.4% in all compartments, similar to our success rate at 5 years but with a different median follow-up length of 25 months. In a retrospective study, Unger et al (23) found a 3.4% retreatment (pessary or surgery) at 5 years, following different variations of uterosacral ligament suspension in a case series of procedures for both uterovaginal as well as posthysterectomy vaginal vault prolapse. Among patients undergoing the Michigan four-wall sacrospinous ligament fixation, those with advanced preoperative prolapse were more likely to have a high postoperative satisfaction compared with those who had preoperative grade 0–2 prolapse (21). Our low rate of prolapse retreatment after both abdominal and robotic sacrocolpopexies was similar to that found by Siddiqui et al (24), who reported on 1-year outcomes after ASC and RSC with and without concomitant hysterectomy.

Our study had strengths and limitations. The study's greatest strengths included its large sample size and use of IPW-adjusted analyses to attempt to mitigate selection bias. Additional strengths were the use of validated questionnaires, additional clinically relevant questions, and the reasonable response rate. Our definition of success for the survey was based on absence of retreatment rather than on a strict anatomic definition. In addition, we had a large proportion of patients with prior prolapse surgeries, which increased generalizability. Our surgeons were trained at the same institution, strengthening internal validity, particularly for the general surgical techniques of Mayo-McCall culdoplasty and sacrocolpopexy. However, the heterogeneity with regard to mesh and suture selection for sacrocolpopexy is a limitation. The study was also limited by its retrospective design. We were unable to compare Mayo-McCall culdoplasty to other native tissue transvaginal procedures, such as sacrospinous ligament fixation, which is not performed at Mayo Clinic in Rochester. Questionnaire-based studies are subject to response bias; however, we supplemented the mailing with phone surveys to increase the response rate. We did not have preoperative, baseline questionnaires with which to compare our results. We were unable to determine objective, long-term anatomic outcomes for the patients. We may have been underpowered to detect a difference in time to retreatment for the MMC vs RSC and ASC vs RSC comparisons. Also, despite using PS methodology to balance the procedure groups on measured baseline covariates, residual imbalance was still present in the comparison of the MMC and RSC groups. We could not ascertain for which specific compartment(s) retreatment for prolapse was performed. Finally, we did not inquire regarding all long-term reoperations that might have occurred, such as mesh excisions or surgery for other complications related to any of the operations.

To summarize, MMC, ASC, and RSC all gave patients good symptom relief and were durable. There is a need for longer-term follow-up and randomized studies (for example, under the auspices of the American Urogynecologic Society's Pelvic Floor Disorders Registry) that would further help compare outcomes of one approach with the others.

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Abbreviations

ASA	American Society of Anesthesiologists
ASC	open abdominal sacrocolpopexy
CRADI-8	Colorectal-Anal Distress Inventory-8
HR	hazard ratio
HUVS	high uterosacral vault suspension
IPW	inverse probability weighted
IQR	interquartile range
MMC	Mayo-McCall culdoplasty
PFDI-20	Pelvic Floor Distress Inventory 20
PFIQ-7	Pelvic Floor Impact Questionnaire Short Form 7
PISQ-12	Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire 12
PS	propensity score
RSC	transabdominal robotic sacrocolpopexy
UDI-6	Urogenital Distress Inventory 6

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Summary

Overall symptom relief scores did not differ among patients undergoing Mayo-McCall culdoplasty (MCC), open abdominal sacrocolpopexy (ASC), and transabdominal robotic sacrocolpopexy (RSC); however, at 10 years and after accounting for selection bias, survival free of retreatment for prolapse was greater among patients who underwent ASC compared with patients who had MMC.

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Figure 1.

Study Flowchart. MMC indicates Mayo-McCall culdoplasty; ASC, open abdominal sacrocolpopexy; RSC, transabdominal robotic sacrocolpopexy.

Figure 2.

Summary of the standardized differences (absolute value) for each covariate within the unadjusted cohort and the IPW-adjusted cohort, shown separately for each of the 3 comparisons (MMC vs ASC, MMC vs RSC, and ASC vs RSC) and for each of the 4 subsets of patients within each comparison: all patients; subset A, patients who completed the PFDI-20 and PFIQ-7 in the mailed questionnaire; subset B, patients who completed the PISQ-12; and subset C, patients who completed the mailed questionnaire or brief phone survey. ASA indicates American Society of Anesthesiologists; IPW, inverse probability weighted; MMC, Mayo-McCall culdoplasty; ASC, open abdominal sacrocolpopexy; RSC, transabdominal robotic sacrocolpopexy.

Figure 3.

Inverse probability weight-adjusted survival free of retreatment: A, Mayo-McCall culdoplasty (MMC) vs open abdominal sacrocolpopexy (ASC); B, MMC vs transabdominal robotic sacrocolpopexy (RSC); C, ASC vs RSC.

Table 1

Summary of Baseline Characteristics Among the 337 Survey Respondents

Characteristic	Procedure Group ^a			P Value ^b		
	MMC (n=117)	ASC (n=150)	RSC (n=70)	Overall	MMC vs ASC	MMC vs RSC
Age at surgery, y	67.5 (9.8)	60.2 (8.9)	61.2 (8.7)	<.001	<.001	<.001
Race, white	109 (100)	144 (98.6) (n=146)	69 (100) (n=69)	.29		
BMI, kg/m ²	28.4 (4.5)	28.2 (4.7)	27.3 (3.6)	.23		
Ever smoker	44 (37.9) (n=116)	43 (29.3) (n=147)	23 (32.9) (n=70)	.33		
Nulliparous	2 (1.7) (n=170)	5 (3.4) (n=149)	3 (4.3) (n=70)	.57		
No. of vaginal deliveries	3 (2–4)	3 (2–4)	3 (2–4)	.51		
Charlson comorbidity index				.12		
0	64 (54.7)	97 (64.7)	48 (68.6)			
1	38 (32.5)	40 (26.7)	15 (21.4)			
2+	15 (12.8)	13 (8.7)	7 (10.0)			
ASA classification	(n=115)	(n=147)	(n=70)	.05		
1	5 (4.3)	7 (4.8)	2 (2.9)			
2	85 (73.9)	124 (84.4)	62 (88.6)			
3+	25 (21.7)	16 (10.9)	6 (8.6)			
No. of prior prolapse operations				<.001	<.001	.48
0	65 (55.6)	47 (31.3)	28 (40.0)			
1	44 (37.6)	77 (51.3)	28 (40.0)			
2	7 (6.0)	23 (15.3)	13 (18.6)			
3+	1 (0.9)	3 (2.0)	1 (1.4)			
Prior vaginal operations for prolapse	45 (38.5)	92 (61.3)	38 (54.3)	<.001	<.001	.32
Prior abdominal operations for prolapse	6 (5.1)	16 (10.7)	5 (7.1)	.24	.03	
Prior hysterectomy for indication of prolapse	6 (5.1)	13 (8.7)	4 (5.7)	.48		
No. of prior incontinence				.16		

Characteristic	Procedure Group ^a			P Value ^b		
	MMC (n=117)	ASC (n=150)	RSC (n=70)	Overall	MMC vs ASC	MMC vs RSC
						ASC vs RSC
operations						
0	90 (76.9)	117 (78.0)	46 (65.7)			
1	24 (20.5)	26 (17.3)	22 (31.4)			
2	3 (2.6)	5 (3.3)	2 (2.9)			
3+	0 (0.0)	2 (1.3)	0 (0.0)			
Prior MMK	4 (3.4)	7 (4.7)	3 (4.3)	.88		
Prior Burch procedure	3 (2.6)	10 (6.7)	3 (4.3)	.29		
Prior sling placement	12 (10.3)	11 (7.3)	16 (22.9)	.003	.40	.001
No. of prior transabdominal operations				.28		
0	21 (17.9)	28 (18.7)	9 (12.9)			
1	33 (28.2)	57 (38.0)	30 (42.9)			
2	34 (29.1)	39 (26.0)	22 (31.4)			
3+	29 (24.8)	26 (17.3)	9 (12.9)			
Urinary dysfunction (any)	98 (83.8)	117 (78.0)	60 (85.7)	.29		
Presence of urinary incontinence	76 (65.0)	91 (60.7)	45 (64.3)	.74		
Urinary incontinence						
Stress	15 (12.8)	19 (12.7)	17 (24.3)	.06		
Urge	19 (16.2)	18 (12.0)	6 (8.6)	.29		
Mixed	34 (29.1)	47 (31.3)	19 (27.1)	.80		
Occult	8 (6.8)	10 (6.7)	2 (2.9)	.47		
Urinary urgency ± frequency				.60		
No urinary urgency ± frequency	106 (90.6)	142 (94.7)	64 (91.4)			
Urinary urgency alone	6 (5.1)	6 (4.0)	3 (4.3)			
Urinary urgency and frequency	5 (4.3)	2 (1.3)	3 (4.3)			
Urinary retention or sensation of incomplete bladder emptying	32 (27.4)	47 (31.3)	17 (24.3)	.53		
Recurrent UTIs	6 (5.1)	10 (6.7)	2 (2.9)	.50		
Defecatory dysfunction (any)	69 (59.0)	73 (48.7)	27 (38.6)	.02	.09	.007
						.16

Characteristic	Procedure Group ^a			P Value ^b		
	MMC (n=117)	ASC (n=150)	RSC (n=70)	Overall	MMC vs ASC	MMC vs RSC
Chronic constipation	29 (24.8)	28 (18.7)	12 (17.1)	.35		
Need to splint to defecate or sensation of incomplete evacuation	26 (22.2)	23 (15.3)	4 (5.7)	.01	.15	.003
Anal incontinence	17 (14.5)	13 (8.7)	4 (5.7)	.11		
Dyspareunia	14 (12.0)	20 (13.3)	9 (12.9)	.95		
Chronic pain	4 (3.4)	25 (16.7)	7 (10.0)	.002	<.001	.06
Apical grade	(n=112)	(n=140)	(n=68)	.002	.005	.59
1	16 (14.3)	19 (13.6)	10 (14.7)			
2	66 (58.9)	51 (36.4)	43 (63.2)			
3	23 (20.5)	60 (42.9)	11 (16.2)			
4	7 (6.3)	10 (7.1)	4 (5.9)			
Apical grade 3 or 4	30 (26.8)	70 (50.0)	15 (22.1)	<.001	<.001	.48
Anterior prolapse grade	(n=112)	(n=123)	(n=66)	.15		
0	4 (3.6)	12 (9.8)	4 (6.1)			
1	18 (16.1)	17 (13.8)	10 (15.2)			
2	29 (25.9)	40 (32.5)	25 (37.9)			
3	49 (43.8)	45 (36.6)	24 (36.4)			
4	12 (10.7)	9 (7.3)	3 (4.5)			
Anterior prolapse grade 3 or 4	61 (54.5)	54 (43.9)	27 (40.9)	.14		
Posterior prolapse grade	(n=112)	(n=127)	(n=63)	.19		
0	7 (6.3)	17 (13.4)	7 (11.1)			
1	25 (22.3)	27 (21.3)	13 (20.6)			
2	44 (39.3)	39 (30.7)	34 (54.0)			
3	31 (27.7)	37 (29.1)	8 (12.7)			
4	5 (4.5)	7 (5.5)	1 (1.6)			
Posterior prolapse grade 3 or 4	36 (32.1)	44 (34.6)	9 (14.3)	.01	.68	.01
						.003

Abbreviations: ±, with or without; ASA, American Society of Anesthesiologists; ASC, open abdominal sacrocolpopexy; BMI, body mass index; MMK, Marshall-Marchetti-Krantz operation; MMC, Mayo-McCall culdoplasty; RSC, transabdominal robotic sacrocolpopexy; UTI, urinary tract infection.

^aValues are mean (SD), No. of patients (%), or median (interquartile range).

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Comparisons among the 3 procedures were evaluated using the χ^2 test for categorical (nonordered) variables, the F-test from a 1-way analysis of variance model for age and BMI, and the Kruskal-Wallis test for all other ordinal variables. If the P value was $<.05$ for the overall test, then pairwise comparisons were evaluated using the χ^2 test, 2-sample t test, or Wilcoxon rank sum test, as appropriate.

Comparison of Symptom Relief and Quality of Life Measures Between Patients Undergoing MMC vs ASC (January 1, 2000, to June 30, 2012)

Table 2

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b		
	MMC	ASC	p ^c	MMC	ASC	p ^d
PFDI-20 ^e						
No.	73	83		73	83	
PFDI-20 overall score	53.1 (27.1–96.9)	37.5 (9.4–80.2)	.09	53.1 (16.7–108.3)	37.5 (8.3–80.2)	.06
POPDI-6	8.3 (0.0–20.8)	12.5 (0.0–29.2)	.98	8.3 (0.0–25.0)	12.5 (0.0–29.2)	.50
CRADI-8	18.8 (6.3–34.4)	12.5 (0.0–25.0)	.05	18.8 (6.3–34.4)	12.5 (0.0–25.0)	.22
UDI-6	25.0 (8.3–45.8)	12.5 (0.0–33.3)	.08	20.8 (8.3–45.8)	8.3 (0.0–33.3)	.02
PFIQ-7 ^e						
No.	72	82		72	82	
PFIQ-7 overall score			.93			.82
0	32 (44.4%)	38 (46.3%)		40.5%	45.9%	
<150	39 (54.2%)	39 (47.6%)		58.6%	47.4%	
150–300	1 (1.4%)	5 (6.1%)		0.9%	6.7%	
UIQ-7			.88			.41
0	38 (52.8%)	44 (53.7%)		49.3%	56.2%	
<50	29 (40.3%)	33 (40.2%)		43.2%	37.0%	
50–100	5 (6.9%)	5 (6.1%)		7.5%	6.7%	
CRAIQ-7			.97			.48
0	48 (66.7%)	55 (67.1%)		67.6%	63.1%	
<50	21 (29.2%)	22 (26.8%)		29.4%	30.2%	
50–100	3 (4.2%)	5 (6.1%)		3.0%	6.7%	
POPIQ-7			.43			.90
0	57 (79.2%)	61 (74.4%)		73.7%	75.9%	
<50	14 (19.4%)	17 (20.7%)		25.2%	18.1%	
50–100	1 (1.4%)	4 (4.9%)		1.1%	6.0%	
PISQ-12 ^e						
No.	36	57		36	57	

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>p</i> ^d
	MMC	ASC	<i>p</i> ^c	MMC	ASC		
PISQ-12 overall score	13.0 (10.5–18.5)	13.0 (10.0–19.0)	.99	14.0 (11.0–19.0)	14.0 (9.0–20.0)		.94
Symptom domain ^f							
No.	117	150		117	150		
Bulge	28 (23.9%)	34 (22.7%)	.81	27.1%	19.5%		.15
Stress urinary incontinence	46 (39.3%)	55 (36.7%)	.66	38.6%	34.2%		.46
Urge urinary incontinence	63 (53.8%)	62 (41.3%)	.04	50.8%	39.3%		.06
Defecatory dysfunction	81 (69.2%)	93 (62.0%)	.22	65.9%	57.1%		.14
Specific disorders of defecation ^f							
No.	117	150		117	150		
Need to splint	33 (28.2%)	57 (38.0%)	.09	28.3%	33.3%		.38
Need to strain	47 (40.2%)	60 (40.0%)	.98	39.8%	37.2%		.67
Anal incontinence	53 (45.3%)	46 (30.7%)	.01	44.4%	29.3%		.01
Painful defecation	14 (12.0%)	23 (15.3%)	.43	13.1%	12.0%		.80
Sexual dysfunction barriers ^f							
No.	117	150		117	150		
Chose not to answer	15 (12.8%)	26 (17.3%)	.31	10.3%	21.1%		.02
Partner problems	34 (29.1%)	34 (22.7%)	.23	29.7%	21.9%		.15
Low desire	30 (25.6%)	30 (20.0%)	.27	26.8%	18.0%		.08
Pain in vagina	15 (12.8%)	29 (19.3%)	.16	13.2%	14.8%		.71
Pain in abdomen	4 (3.4%)	12 (8.0%)	.13	5.2%	6.4%		.66
Vaginal dryness	22 (18.8%)	43 (28.7%)	.06	20.6%	23.3%		.61
Vaginal bulge or prolapse	7 (6.0%)	4 (2.7%)	.19	5.2%	2.2%		.19
Leakage of urine during intercourse	10 (8.5%)	13 (8.7%)	.97	8.3%	7.1%		.72
Anal incontinence during intercourse	8 (6.8%)	8 (5.3%)	.61	9.1%	3.6%		.07
Vaginal looseness	3 (2.6%)	7 (4.7%)	.38	4.9%	3.3%		.50
Vaginal tightness	14 (12.0%)	11 (7.3%)	.20	11.7%	5.9%		.10
Vagina too short	16 (13.7%)	17 (11.3%)	.56	15.2%	8.4%		.09
Other problem(s)	17 (14.5%)	20 (13.3%)	.78	15.7%	11.3%		.29

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>p</i> ^d
	MMC	ASC	<i>p</i> ^c	MMC	ASC	<i>p</i> ^c	
No problems	10 (8.5%)	22 (14.7%)	.13	9.7%	15.2%		.19
Survival free of retreatment within 10 y after surgery ^g							
No.	174	237		174	237		
No. of events: surgery, pessary	10, 3	6, 1					
Kaplan-Meier estimate at 5 y, % (95% CI)	88.7 (82.6–95.2)	95.5 (92.3–98.8)		85.6 (78.1–93.8)	95.4 (91.7–99.3)		
Kaplan-Meier estimate at 10 years, % (95% CI)	85.1 (76.5–94.7)	95.5 (92.3–98.8)		81.1 (70.7–93.0)	95.4 (91.7–99.3)		
Hazard ratio for MMC vs ASC (95% CI)	2.79 (1.11–7.00)	1.0	.03	3.68 (1.51–8.98)	1.0		.004

Abbreviations: ASC, open abdominal sacrocolpopexy; CI, confidence interval; CRAIQ-7, Colorectal-Anal Impact Questionnaire Short Form 7; IPW, inverse probability weighted; MMC, Mayo-McCall culdoplasty; PFDI-20, Pelvic Floor Distress Inventory 20; PFIQ-7, Pelvic Floor Impact Questionnaire Short Form 7; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire 12; POPDI-6, Pelvic Organ Prolapse Distress Inventory 6; POPIQ-7, Pelvic Organ Prolapse Impact Questionnaire Short Form 7; UDI-6, Urinary Distress Inventory 6; UIQ-7, Urinary Impact Questionnaire Short Form 7.

^aValues are median (25th and 75th percentiles) for continuous variables and percentage (No. with variable/No. available) for categorical variables.

^bValues are weighted median (weighted 25th and 75th percentiles) for continuous variables and weighted percentage for categorical variables.

^cThe PFDI-20 total score and subscale scores were each compared between the 2 procedure groups based on fitting separate general linear regression models after first transforming the individual scores ([value+1]). The PISQ-12 total score was also compared between 2 procedure groups using general linear regression. The PFIQ-7 overall score and subscale scores were each compared between the 2 procedure groups based on fitting separate ordinal logistic regression models. Each nominal outcome measure was compared between the 2 procedure groups based on fitting a separate logistic regression model. Survival free of retreatment was compared between the 2 procedure groups based on fitting a Cox proportional hazards model.

^dWithin the IPW cohort, corresponding weighted regression models were fit incorporating the inverse probability weights.

^eThe 3 validated instruments, PFDI-20, PFIQ-7, and PISQ-12, were only completed by the patients who responded to the mailed questionnaire.

^fItems pertaining to symptom domains, specific disorders of defecation, and sexual dysfunction barriers were answered by the patients who responded to the mailed questionnaire or the phone questionnaire.

^gSurvival free of retreatment was estimated using the Kaplan-Meier method, considering all patients regardless of whether or not they responded to the questionnaires. For those patients who were not retreated, their duration of follow-up was censored at the date of their last relevant, clinical follow-up or questionnaire response.

Comparison of Symptom Relief and Quality of Life Measures Between Patients Undergoing MMC vs RSC (February 1, 2007, to June 30, 2012)

Table 3

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>P</i> ^d
	MMC	RSC	<i>P</i> ^c	MMC	RSC		
PFDI-20 ^e							
No.	50	42		50	42		
PFDI-20 overall score	56.3 (29.2–107.3)	39.1 (15.5–69.8)	.11	59.4 (27.1–108.3)	41.7 (16.7–69.8)		.15
POPDI-6	8.3 (0–20.8)	6.3 (0–12.5)	.06	8.3 (0–20.8)	8.3 (0–12.5)		.09
CRADI-8	18.8 (6.3–37.5)	12.5 (0–25.0)	.03	18.8 (6.3–37.5)	12.5 (0–25.0)		.04
UDI-6	25.0 (8.3–50.0)	16.7 (0–37.5)	.19	25.0 (8.3–58.3)	16.7 (4.2–37.5)		.29
PFIQ-7 ^e							
No.	50	43		50	43		
PFIQ-7 overall score			.72				.75
0	21 (42.0%)	21 (48.8%)		37.7%	44.9%		
<150	28 (56.0%)	19 (44.2%)		60.8%	47.5%		
150–300	1 (2.0%)	3 (7.0%)		1.5%	7.6%		
UIQ-7			.69				.70
0	27 (54.0%)	25 (58.1%)		52.5%	57.0%		
<50	19 (38.0%)	15 (34.9%)		39.9%	35.2%		
50–100	4 (8.0%)	3 (7.0%)		7.6%	7.8%		
CRAIQ-7			.25				.22
0	31 (62.0%)	32 (74.4%)		59.1%	73.0%		
<50	16 (32.0%)	8 (18.6%)		35.4%	19.4%		
50–100	3 (6.0%)	3 (7.0%)		5.5%	7.6%		
POPIQ-7			.99				.79
0	38 (76.0%)	33 (76.7%)		71.8%	74.9%		
<50	11 (22.0%)	8 (18.6%)		26.3%	20.9%		
50–100	1 (2.0%)	2 (4.7%)		1.9%	4.2%		
PISQ-12 ^e							
No.	22	29		22	29		

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>p</i> ^d
	MMC	RSC	<i>p</i> ^c	MMC	RSC	<i>p</i> ^c	
PLSQ-12 overall score	14.5 (10.0–20.0)	13.0 (10.0–19.0)	.40	17.0 (11.0–22.0)	14.0 (10.0–19.0)		.31
Symptom domain ^f							
No.	76	70		76	70		
Bulge	17 (22.4%)	13 (18.6%)	.57	21.1%	15.9%		.42
Stress urinary incontinence	31 (40.8%)	26 (37.1%)	.65	37.3%	43.7%		.43
Urge urinary incontinence	41 (54.0%)	30 (42.9%)	.18	50.8%	44.8%		.47
Defecatory dysfunction	55 (72.4%)	45 (64.3%)	.29	71.0%	66.4%		.55
Specific disorders of defecation ^f							
No.	76	70		76	70		
Need to splint	20 (26.3%)	17 (24.3%)	.78	29.9%	22.3%		.29
Need to strain	30 (39.5%)	22 (31.4%)	.31	42.4%	26.9%		.05
Anal incontinence	40 (52.6%)	30 (42.9%)	.24	52.2%	47.5%		.57
Painful defecation	9 (11.8%)	10 (14.3%)	.66	15.5%	15.3%		.97
Sexual dysfunction barriers ^f							
No.	76	70		76	70		
Chose not to answer	9 (11.8%)	7 (10.0%)	.72	11.5%	13.8%		.68
Partner problems	21 (27.6%)	17 (24.3%)	.65	26.7%	22.1%		.52
Low desire	17 (22.4%)	25 (35.7%)	.08	25.6%	29.8%		.57
Pain in vagina	9 (11.8%)	17 (24.3%)	.05	15.2%	19.3%		.51
Pain in abdomen	2 (2.6%)	7 (10.0%)	.08	4.4%	6.8%		.53
Vaginal dryness	11 (14.5%)	24 (34.3%)	.006	17.1%	30.7%		.06
Vaginal bulge or prolapse	4 (5.3%)	3 (4.3%)	.78	4.4%	3.1%		.69
Leakage of urine during intercourse	8 (10.5%)	5 (7.1%)	.48	10.3%	5.6%		.30
Anal incontinence during intercourse	3 (4.0%)	5 (7.1%)	.40	5.3%	5.5%		.95
Vaginal looseness	1 (1.3%)	2 (2.9%)	.52	2.8%	1.9%		.72
Vaginal tightness	6 (7.9%)	4 (5.7%)	.60	8.6%	4.2%		.28
Vagina too short	9 (11.8%)	5 (7.1%)	.34	15.3%	6.8%		.11
Other problem(s)	11 (14.5%)	9 (12.9%)	.78	19.3%	11.7%		.21

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>p</i> ^d
	MMC	RSC	<i>p</i> ^c	MMC	RSC		
No problems	5 (6.6%)	10 (14.3%)	.13	5.9%	16.8%		.045
Survival free of retreatment within 5 y after surgery ^e							
No.	109	101		109	101		
No. of events: surgery, pessary	3, 1	3, 1					
Kaplan-Meier estimate at 5 y, % (95% CI)	93.4 (86.8–100.0)	93.4 (87.0–100.0)		94.0 (86.4–100.0)	95.5 (89.6–100.0)		
Hazard ratio for MMC vs RSC (95% CI)	0.97 (0.24–3.87)	1.0	.96	1.14 (0.24–5.38)	1.0		.86

Abbreviations: CI, confidence interval; CRAIQ-7, Colorectal-Anal Impact 39 Questionnaire Short Form 7; IPW, inverse probability weighted; MMC, Mayo-McCall culdoplasty; PFDI-20, Pelvic Floor Distress Inventory 20; PFIQ-7, Pelvic Floor Impact Questionnaire Short Form 7; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire 12; POPDI-6, Pelvic Organ Prolapse Distress Inventory 6; POPIQ-7, Pelvic Organ Prolapse Impact Questionnaire Short Form 7; RSC, robotic-assisted sacrocolpopexy; UDI-6, Urinary Distress Inventory 6; UIQ-7, Urinary Impact Questionnaire Short Form 7.

^aValues are median (25th and 75th percentiles) for continuous variables and percentage (No. with variable/No. available) for categorical variables.

^bValues are weighted median (weighted 25th and 75th percentiles) for continuous variables and weighted percentage for categorical variables.

^cThe PFDI-20 total score and subscale scores were each compared between the 2 procedure groups based on fitting separate general linear regression models after first transforming the individual scores (value+1). The PISQ-12 total score was also compared between 2 procedure groups using general linear regression. The PFIQ-7 overall score and subscale scores were each compared between the 2 procedure groups based on fitting separate ordinal logistic regression models. Each nominal outcome measure was compared between the 2 procedure groups based on fitting a separate logistic regression model. Survival free of retreatment was compared between the 2 procedure groups based on fitting a Cox proportional hazards model.

^dWithin the IPW cohort, corresponding weighted regression models were fit incorporating the inverse probability weights.

^eThe 3 validated instruments, PFDI-20, PFIQ-7, and PISQ-12, were only completed by the patients who responded to the mailed questionnaire.

^fItems pertaining to symptom domains, specific disorders of defecation, and sexual dysfunction barriers were answered by the patients who responded to the mailed questionnaire or the phone questionnaire.

^gSurvival free of retreatment was estimated using the Kaplan-Meier method considering all patients regardless of whether or not they responded to the questionnaires. For those patients without retreatment, their duration of follow-up was censored at the date of their last relevant clinical follow-up or questionnaire response.

Comparison of Symptom Relief and Quality of Life Measures Between Patients Undergoing ASC vs RSC (February 1, 2007, to June 30, 2012)

Table 4

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>P</i> ^d
	ASC	RSC	<i>P</i> ^c	ASC	RSC		
PFDI-20 ^e							
No.	58	42		58	42		
PFDI-20 overall score	37.5 (7.3–75.8)	39.1 (15.5–69.8)	.67	37.5 (8.3–75.8)	37.5 (14.6–69.8)		.82
POPDI-6	8.3 (0–29.2)	6.3 (0–12.5)	.14	8.3 (0–25.0)	4.2 (0–12.5)		.22
CRADI-8	10.0 (0–28.1)	12.5 (0–25.0)	.88	12.5 (0–25.0)	9.4 (0–25.0)		.71
UDI-6	10.0 (0–33.3)	16.7 (0–37.5)	.50	10.0 (0–33.3)	16.7 (4.2–37.5)		.51
PFIQ-7 ^e							
No.	58	43		58	43		
PFIQ-7 overall score			.91				.84
0	29 (50.0%)	21 (48.8%)		47.1%	50.5%		
<150	25 (43.1%)	19 (44.2%)		46.9%	41.4%		
150–300	4 (6.9%)	3 (7.0%)		6.0%	8.1%		
UIQ-7			.79				.93
0	32 (55.2%)	25 (58.1%)		55.6%	56.7%		
<50	22 (37.9%)	15 (34.9%)		38.4%	37.1%		
50–100	4 (6.9%)	3 (7.0%)		6.0%	6.2%		
CRAIQ-7			.38				.26
0	38 (65.5%)	32 (74.4%)		62.5%	74.7%		
<50	16 (27.6%)	8 (18.6%)		31.5%	17.2%		
50–100	4 (6.9%)	3 (7.0%)		6.0%	8.1%		
POPIQ-7			.82				.79
0	46 (79.3%)	33 (76.7%)		79.2%	76.7%		
<50	8 (13.8%)	8 (18.6%)		13.7%	16.8%		
50–100	4 (6.9%)	2 (4.7%)		7.1%	6.5%		
PISQ-12 ^e							
No.	41	29		41	29		

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			<i>I²</i>
	ASC	RSC	<i>p^c</i>	ASC	RSC	<i>p^d</i>	
PISQ-12 overall score	12.0 (9.0–19.0)	13.0 (10.0–19.0)	.76	14.0 (9.0–19.0)	13.0 (12.0–19.0)	.90	
Symptom domain ^f							
No.	99	70		99	70		
Bulge, No.	17 (17.2%)	13 (18.6%)	.81	17.1%	20.4%	.59	
Stress urinary incontinence	32 (32.3%)	26 (37.1%)	.52	30.4%	40.2%	.19	
Urge urinary incontinence	33 (33.3%)	30 (42.9%)	.21	33.4%	45.9%	.10	
Defecatory dysfunction	50 (50.5%)	45 (64.3%)	.08	50.3%	66.3%	.04	
Specific disorders of defecation ^f							
No.	99	70		99	70		
Need to splint	32 (32.3%)	17 (24.3%)	.26	30.7%	27.2%	.62	
Need to strain	29 (29.3%)	22 (31.4%)	.77	28.9%	32.1%	.66	
Anal incontinence	28 (28.3%)	30 (42.9%)	.05	28.1%	41.8%	.07	
Painful defecation	8 (8.1%)	10 (14.3%)	.20	8.5%	15.6%	.16	
Sexual dysfunction barriers ^f							
No.	99	70		99	70		
Chose not to answer	10 (10.1%)	7 (10.0%)	.98	10.7%	11.6%	.85	
Partner problems	22 (22.2%)	17 (24.3%)	.75	20.8%	24.1%	.61	
Low desire	21 (21.2%)	25 (35.7%)	.04	23.0%	35.4%	.08	
Pain in vagina	17 (17.2%)	17 (24.3%)	.26	15.2%	25.3%	.10	
Pain in abdomen	8 (8.1%)	7 (10.0%)	.67	8.2%	11.1%	.52	
Vaginal dryness	29 (29.3%)	24 (34.3%)	.49	27.9%	33.7%	.42	
Vaginal bulge or prolapse	3 (3.0%)	3 (4.3%)	.67	3.0%	5.4%	.46	
Leakage of urine during intercourse	7 (7.1%)	5 (7.1%)	.99	6.4%	6.6%	.96	
Anal incontinence during intercourse	4 (4.0%)	5 (7.1%)	.38	3.8%	7.8%	.27	
Vaginal looseness	2 (2.0%)	2 (2.9%)	.73	2.1%	3.7%	.54	
Vaginal tightness	7 (7.1%)	4 (5.7%)	.73	6.1%	5.6%	.90	
Vagina too short	11 (11.1%)	5 (7.1%)	.39	9.6%	9.0%	.89	
Other problem(s)	12 (12.1%)	9 (12.9%)	.89	11.7%	12.7%	.84	

Variable	Original Unadjusted Cohort ^a			IPW-Adjusted Cohort ^b			I ^d
	ASC	RSC	P ^c	ASC	RSC	P ^c	
No problems	19 (19.2%)	10 (14.3%)	.41	20.2%	14.9%		.38
Survival-free of retreatment within 5 y after surgery ^e							
No.	153	101		153	101		
No. of events: surgery, pessary	3, 1	3, 1					
Kaplan-Meier estimate at 5 y, % (95% CI)	95.6 (91.4–100.0)	93.4 (87.0–100.0)		94.8 (90.2–99.7)	92.1 (84.8–100.0)		
Hazard ratio for ASC vs RSC (95% CI)	0.61 (0.15–2.43)	1.0	.48	0.64 (0.17–2.35)	1.0	.50	

Abbreviations: ASC, open abdominal sacrocolpopexy; CI, confidence interval; CRAIQ-7, Colorectal-Anal Impact Questionnaire Short Form 7; IPW, inverse probability weighted; PFDI-20, Pelvic Floor Distress Inventory 20; PFIQ-7, Pelvic Floor Impact Questionnaire Short Form 7; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire 12; POPDI-6, Pelvic Organ Prolapse Distress Inventory 6; POPIQ-7, Pelvic Organ Prolapse Impact Questionnaire Short Form 7; RSC, robotic-assisted sacrocolpopexy; UDI-6, Urinary Distress Inventory 6; UIQ-7, Urinary Impact Questionnaire Short Form 7.

^aValues are median (25th and 75th percentiles) for continuous variables and percentage (No. with variable/No. available) for categorical variables.

^bValues are weighted median (weighted 25th and 75th percentiles) for continuous variables and weighted percentage for categorical variables.

^cThe PFDI-20 total score and subscale scores were each compared between the 2 procedure groups based on fitting separate general linear regression models after first transforming the individual scores (value+1). The PISQ-12 total score was also compared between 2 procedure groups using general linear regression. The PFIQ-7 overall score and subscale scores were each compared between the 2 procedure groups based on fitting separate ordinal logistic regression models. Each nominal outcome measure was compared between the 2 procedure groups based on fitting a separate logistic regression model. Survival free of retreatment was compared between the 2 procedure groups based on fitting a Cox proportional hazards model.

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