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Review

Robotic versus Vaginal Surgery for Treatment of Pelvic Organ Prolapse: A Comprehensive Review

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Abstract

Objectives: The aim of this study was to compare robotic-assisted surgery (RS) and vaginal surgery (VS) for pelvic organ prolapse (POP) through an updated review. **Mechanism**: We performed a comprehensive review from March 1, 2022 up to April 1, 2022. All comparative studies that compared RS and VS for the management of POP were included. **Findings in Brief**: A total of 10 non-randomized studies including 1424 participants were included in the review. The results revealed that robotic surgery (RS) was associated with longer operative time, less estimated blood loss, and fewer postoperative complications. There were no differences between the length of hospital stays, intraoperative complications and effectiveness between the two groups. **Conclusions**: RS and VS have comparable efficacy, although RS was associated with less blood loss and postoperative complications. The choice of surgical procedure depends on the surgeon's discretion and the patient's preference.

Keywords: pelvic organ prolapse (POP); sacrocolpopexy (SC); robotic surgery (RS); robotic-assisted sacrocolpopexy (RASC); vaginal surgery (VS)

1. Introduction

Pelvic organ prolapse (POP) consists of the fall of the anterior vaginal wall (also known as cystocele) or posterior vaginal wall (or rectocele), uterus, or the apex of the vagina if a hysterectomy has been previously performed [1]. POP is common in 40%–60% of parous women; the most common sites for repair are the anterior compartment, followed by the posterior compartment [2].

The risk of surgery for POP by age 80 is estimated to be around 12.2% [3,4]. Therapies for symptomatic POP consist of surgical and conservative options. Non-surgical options for POP include pelvic floor physical therapy (including Kegel exercises) and pessary placement [5]. According to a Cochrane review, there is no rigorous evidence from randomized controlled trials on the use of conservative options in the management of POP [6].

Surgical interventions for pelvic organ prolapse include apical abdominal reconstructive repairs (mainly sacrocolpopexy) through open, laparoscopic, or robotic approaches; apical vaginal reconstructive repairs (sacrospinous hysteropexy, uterosacral hysteropexy, iliococcygeal hysteropexy, hysteropexy); and vaginal obliterative procedures [7].

Most patients with symptomatic POP can be managed properly with the vaginal approach, while correction of apical descent or multicompartmental prolapse is usually treated abdominally [8].

In sacrocolpopexy (SC), the surgeon fixes the vaginal vault and/or cervix by grafting into the sacrum. Sacrocolpopexy with laparotomic access achieves a 90% success rate. However, this procedure involves longer operation time, higher morbidity and higher hospital costs. These downsides can be avoided by performing SC with a less invasive, laparoscopic access (LASC) or its robotic equivalent (RASC) [9,10].

The da Vinci Surgical System® (Intuitive Surgical Inc., Sunnyvale, CA, USA) is a surgical robot that increases magnification, enables 3-dimensional vision, eliminates physiological tremor, and has 7 degrees of freedom in order to simplify complex laparoscopic tasks such as suturing and knot tying, key techniques in SC [9].

Two randomized control trial (RCT) studies compared RASC with LASC without finding any difference in functional outcomes between the robotic and laparoscopic approaches at 1 year. In the RASC group, however, there were significantly longer operative times, greater pain reported by patients up to 5 weeks after surgery, and higher surgical costs [10,11]. After these studies, three reviews state that it seems reasonable to conclude that SCs of any type RASC or LASC are equally effective [12–14]. Therefore, the choice of surgical method should be determined by evaluating complication rates, postoperative recovery, surgeon preference, and surgical factors such as uterine size or adnexal pathology [15].

Vaginal approach to the peritoneal cavity may decrease the rate of intraoperative complications by avoiding bowel manipulation and extreme Trendelenburg positioning, as well as by shortening the need for general anesthesia. However, this approach can implicate higher mesh exposure rates and poorer functional outcomes [12,16,17].

The aim of this study was to review the literature about vaginal and robotic surgical approaches in POP.

2. Materials and Methods

We conducted a comprehensive literature review, focusing on a particular research area or topic, in order to provide an opportunity to identify key concepts, research gaps, when the topic has not been extensively examined or is complex or heterogeneous in nature. The steps to perform this review were: identifying the research question, identifying relevant studies, making a selection of studies, tracking data, collecting, summarizing, and reporting results [18–20]. The sixth step (stakeholder consultation) was not performed in this review because it is optional [18–21].

We follow the Preferred Reporting Items for Systematic reviews and Meta-Analyzes extension for Scoping Reviews (PRISMA-ScR) Checklist [22].

2.1 Identifying the Research Question

The PICO question (Patients/intervention/comparison/outcome) was the following: P = female patients with pelvic organ prolapse (any grade/type), I = robotic surgery, C = vaginal surgery, O = any outcome studied by the authors (e.g., intraoperative bleeding, surgical timing, postoperative pain) [23].

The population studied includes high-income countries with the availability of robotic surgery, without geographic differences.

2.2 Identifying Relevant Studies

PubMed, Scopus, ISI Web of Science, and Cochrane Library were searched for relevant literature from 01 March, 2022 up to 01 April, 2022. A combination of keywords such as "vaginal surgery", "robotic surgery", and "pelvic organ prolapse" was used (**Supplementary Table 1**).

2.3 Study Selection

Titles and abstracts of the records reported through the database review were independently screened by two reviewers. Only papers published after 1998 (any language) were considered. Additional manual search was performed to allow retrieval of other potentially relevant articles, using the reference lists of key papers. Full texts of records recommended by at least one reviewer were screened independently by the same two reviewers and assessed for inclusion in the review [24]. In case of disagreement between the reviewers, this was resolved with consensus.

2.4 Data Charting and Sorting

Arksey and O'Malley [18] recommend charting and sorting the data according to key themes and questions to organize the data. Our table includes authors, year of publication, research design, study sample, type of intervention, population age, patient characteristics, degree of prolapse, and hospital variables (Table 1, Ref. [17,25–33]).

2.5 Collating, Summarizing and Reporting the Results

To collect, summarize, and report the approaches of the articles a data charting module was used, with the same structure as Table 1.

3. Results

Electronic database search yielded a total of 577 results. After exclusion of duplicates, 243 citations remained. Of these, 233 were not relevant for review based on title and abstract screening. 10 studies were considered for full-text evaluation. No articles were added by searching the reference lists. Therefore, 10 studies met the inclusion criteria and were added to the review [17,25–33]. All included studies were prospective and retrospective studies published from 2013 to 2021 and described a total of 1424 patients. A total of 547 women underwent robotic surgery and 877 underwent vaginal surgery. The main characteristics of these studies are listed in Table 1.

3.1 Baseline Characteristics of the Women

Overall, the literature considered women with many different baseline characteristics, thus preventing a quantitative synthesis of results. In particular, most papers reported statistically significant differences at baseline in the characteristics of patients undergoing robotic and vaginal surgery; in 9 papers [17,25–27,29–33] it was unclear whether the statistical analysis accounted for these differences, thus eliminating potential bias.

Regarding previous surgeries, in the study by Anand *et al.* [25] a higher percentage of patients in the robotic group had previous sling placement for stress urinary incontinence (24.8%) than patients in the vaginal group (8.6%) (p <0.001). The robotic-assisted surgery (RS) group had less need for splinting for defecation or a feeling of incomplete bowel evacuation (6.9%) than the vaginal surgery (VS) group (23.0%; $p < 0.001$) [25]. Patients in the robotic group had less anal incontinence at baseline (5.9%) than the VS group (14.9%; $p = 0.03$) [25]. In Jambusaria *et al.* [17] it was found that the RS group also had a significantly higher rate of previous hysterectomies ($p = 0.02$), previous POP surgery ($p = 0.02$) and concomitant hysterectomies ($p = 0.01$). Also in the case of Jaresova [28], no patient in the vaginal group had undergone previous surgery for POP or stress urinary incontinence, compared with 10% in the robotic group.

Regarding the grade of prolapse, a higher percentage of advanced (grade 3 or 4) anterior vaginal compartment prolapse was found in Anand *et al.* [25] VS than in both RS ($p = 0.004$). In Jambusaria *et al.* [17] the preoperative functional and quality-of-life scores of the PFDI-20 (Pelvic Floor Distress Inventory, validated and recommended by

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Table 1. Characteristics of the studies.

Study	Year	Design	Sample	Type of surgery	Age	Patient characteristics	Prolapse Grade	Hospital Variables
Anand [25]	2016	retrospective cohort study	RS 100 VS 252	VS: Mayo-McCall culdoplasty (MMC) RS: robotically assisted laparoscopic sacrocolpopexy (RSC)	63.2 ± 10.9 y VS 68.9 ± 10.4 RS 59.9 ± 9.3 y ($p < 0.001$)	-BMI RS 28 VS 27.4 ($p = 0.55$) -Vaginal Deliveries RS 3.0 (1.7) VS 2.6 (1.0) ($p = 0.41$) -Prior prolapse surgeries RS 61.4% VS 35.6% ($p < 0.001$) -ASA 3+ RS 8.9% VS 25.2% ($p < 0.001$) -Need to splint to defecate or a sensation of incomplete bowel evacuation RS 5.9% VS 14.9% ($p = 0.03$) -Chronic pain of any kind RS 11.9% VS 3.4% ($p = 0.006$)	VS advanced (grade 3 or 4) anterior vaginal compartment prolapse than either RS ($p = 0.004$)	None
Anand [26]	2017	retrospective cohort study	see previous article	VS: Mayo-McCall culdoplasty (MMC) RS: robotically assisted laparoscopic sacrocolpopexy (RSC)	see previous article	see previous article		-Operative time RS 228 min (185, 285) ($p < 0.001$) VS 101 min (82, 123) -Estimated blood loss mL RS 100 (88, 200) VS 200 (150, 300) ($p < 0.001$) -Any intraop complication RS 23.8% (24/101) VS 4.6% (5/109) ($p < 0.001$) -Urinary tract infection RS 7.4% (7/94) VS 26.9% (28/104) ($p < 0.001$) -Any grade wound complication RS 20.2% (19 e/94) VS 49.0% (51 f/104) ($p < 0.001$) -Length of hospitalization, RS d 1 (1, 2) VS 2 (2, 3) ($p < 0.001$) -Total cost of hospitalization (in 2013 dollars) RS $12,859 ($11,997, $14,575) VS $8879 ($7967, $10,124) ($p < 0.001$)
Anand [27]	2017	retrospective cohort study	see previous article	VS: Mayo-McCall culdoplasty RS: robotically assisted laparoscopic sacrocolpopexy (RSC)	see previous article	see previous article		-Intraoperative complications was highest in the RS ($p < 0.01$) -Postoperative complications (including urinary tract infection) was significantly greater in the VS group than the RS group (37.0% vs 23.4%; $p = 0.04$)

Table 1. Continued.

Study	Year	Design	Sample	Type of surgery	Age	Patient characteristics	Prolapse Grade	Hospital Variables
Jambusaria [17]	2015	retrospective cohort study	VS 38 RS 38	VS: transvaginal mesh repairs RS: robotic-assisted laparoscopic sacrocolpopexy (RALSC)	VS (60.4 ± 6.2) RS (54.8 ± 10.4) (p = 0.01)	-BMI RS 26.6 (5.9) VS 27.5 (3.9) (p = 0.48) -Vaginal Deliveries RS 3.0 (1.7) VEC 2.6 (1.0) (p = 0.26) -Prior prolapse surgeries RS 11/38 VS 3/38 (p = 0.002)		-Operative time min RS 274.5 (45.9) VS 178.1 (50.6) ($p < 0.001$) -Estimated blood loss mL RS 106 VS 131 (p = 0.3) -Length of hospitalization day RS 1.4 (1) VS 1.2 (0.4) (0.12)
Jaresova [28]	2021	prospective study	VS 20 RS 20	VS: vaginal high uterosacral ligament suspension RS: robotic sacrocolpopexy	VS 69 (66−74) RS 65 (59−68)	-BMI RS 27 (24−31) VS 25 (22−29) -Vaginal Deliveries RS 2 (2−3) VS 3 (2−3) -Prior prolapse surgeries RS 5 (25) VS 0		-Operative time min RS 181 (165−201) VS 162 (128−186) p = 0.008) -Estimated blood loss mL RS 43 mL (28−63) VS 75 mL (75−100)
Nguyen [29]	2020	retrospective cohort study	VS 87 RS 103	VS: Transvaginal uterosacral ligament suspension RS: robotic sacrocolpopexy	VS 62 (8) RS 58 (11) (p = 0.005)	-BMI RS 28 (4) VS 30 (5) (p = 0.06) -Vaginal Deliveries RS 3 (2, 4) VS 3 (2, 4) (p = 0.44) -Prior prolapse surgeries RS 7 (8%) VS 10 (10%) (p = 0.69)	RS: severe POP including POP-Q stage III or IV apical prolapse	-VS: higher NVP score (4.2 ± 2.4 vs 2.6 ± 1.8, $p < 0.0001$), maximum NVP score (6.9 ± 2.7 vs 5.8 ± 1.9, p = 0.01) compared to RS -Prolonged urethral catheterization RS 0 versus VG 6, 6%; p = 0.03 -Operative time min RS 175 (34) VS 157 (52) ($p < 0.0001$) -Estimated blood loss mL RS 99 (70) VS 194 (131) ($p < 0.0001$)
Robinson [30]	2013	retrospective cohort study	VS 66 RS 70	VS: sacrospinous ligament suspension, uterosacral ligament suspension, colpocleisis, and vaginal mesh placement RS: sacrocolpopexy or sacrocervicopexy performed with a macroporous polypropylene mesh and permanent suture	VS 74.5 (65–92) RS 69.0 (65–81) ($p < 0.0001$)	-BMI RS 26.6 (18.0–42.9) VS 26.0 (18.0–37.0) (p = 0.059) -Vaginal Deliveries RS 2 VS 3 (p = 0.162)		-Intraoperative complications was similar (RS, 11.5% vs VS, 4.5%; p = 0.194) -VS: more postoperative complications (43.3% vs 20.9%; p = 0.005) More urinary tract infections (18.2% vs 6.0%; p = 0.030) -Operative time min RS 201 ± 70 (87–417) VS 139 ± 60 (36–243) ($p < 0.0001$) -Estimated blood loss mL RS 91 ± 97 (5–500) VS 172 ± 140 (5–700) ($p < 0.0001$) -Length of hospitalization day RS 2.0 ± 0.5 (0–4) VS 2.3 ± 0.5 (2–4) (0.013)

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Table 1. Continued.

Study	Year	Design	Sample	Type of surgery	Age	Patient characteristics	Prolapse Grade	Hospital Variables
Vallabh-Patel [31]	2016	retrospective cohort study	VS 42 RS 26	VS: vaginal high uterosacral ligament suspension RS: robotic high uterosacral ligament suspension after a total hysterectomy	VS 65.2 (11.0) RS 54.12 (10.86) ($p < 0.0001$)	-BMI RS 28.246 (4.465) VS 27.3 (6.3) ($p = 0.589$) -Vaginal Deliveries RS 2.462 (1.334) VS 2.5 (1.4) ($p = 0.7632$)		-No intraoperative complications -Operative time min RS 153.35 (37.59) VS 143 (29) ($p = 0.1894$) -Estimated blood loss mL RS 106 (121.4) VS 133 (106.9) ($p = 0.0762$) -Length of hospitalization day RS 1 VS 1.07 ($p = 1.000$)
Westermann [32]	2017	prospective study	VS 39 RS 39	VS: vaginal hysterectomy with vaginal reconstructive surgery RS: vaginal hysterectomy with robotic sacrocolpopexy	VS 61.9 (12.2) RS 56.3 (8.6) ($p = 0.02$)	-BMI RS 25.8 (6.2) VS 27.8 (9.6) ($p = 0.11$) -Vaginal Deliveries RS 2 (1.0) VS3 (2.0) ($p = 0.18$) -Prior prolapse surgeries RS 2 (5.1) VS 2 (5.1) ($p > 0.999$)		-RS had lower recorded NVP scores in the first 24 hours ($p = 0.04$) -Operative time min RS 230.0 (33.0) VS 172.0 (33.0) ($p < 0.0001$) -Estimated blood loss mL RS 100.0 (75.0) VS 150.0 (100.0) ($p = 0.01$) -Length of hospitalization day RS 1 VS 1 ($p = 0.4$)
Yune [33]	2018	retrospective cohort study	VS 333 RS 151	VS: transvaginal high uterosacral ligament suspension RS: robotic-assisted sacrocolpopexy	VS 64.2 (12.6) RS 57.9 (11.4) ($p < 0.001$)	-BMI RS28.0 (4.85) VS 27.7 (5.65) ($p = 0.367$) -Vaginal Deliveries RS 2.70 (1.35) VS 3.21 (1.75) ($p = 0.006$)	Grades of anterior (VS 2.58 vs RS 2.81; $p = 0.025$) and posterior POP (VS 1.96 vs RS 2.26; $p = 0.001$)	-Postoperative retention RS 15 (9.9%) VS 113 (33.9%) <0.001 -Length of hospitalization day RS 1.4 (0.8) VS 1.4 (0.8) ($p = 0.654$)

RS, Robotic surgery; VS, vaginal surgery; ASA, American Society of Anesthesiologists; NVP, nurse verbal pain.

the International Consultation on Incontinence as grade A for the assessment of pelvic floor dysfunction) [34], the PFIQ (Pelvic Floor Impact Questionnaire, a supplementary health-related quality-of-life questionnaire specifically for women with pelvic floor disorders) [35] and the PISQ (Pelvic Organ Prolapse/Incontinence Sexual Questionnaire) [36] were similar in both groups, as was the objective measurement of the anterior edge of prolapse from the POP-Q (Pelvic Organ Prolapse Quantification System, which is based on specific measurements of defined points in the midline of the vaginal wall) [37] measurements. Nguyen describes that women in the robotic group had more severe POP, including a higher percentage of stage III or IV POP-Q apical prolapse than those in the VS group [29]. In Robinson *et al*. [30] the stage of apical prolapse was more advanced in the RS group than in the VS group. In Yune [33], VS patients also had lower grades of anterior POP (VS 2.58 *vs* RS 2.81; $p = 0.025$) and posterior POP (VS 1.96 *vs* RS 2.26; $p = 0.001$).

We noted a variety of vaginal surgical techniques. The main vaginal surgical technique used was uterosacral ligament suspension [28–31,33], followed by Mayo-McCall culdoplasty [25–27] and vaginal mesh placement [17]. Almost all robotic surgeries were sacrocolpopexy.

Women in the vaginal group were significantly older in all studies, while there were no differences in body mass index (BMI) and number of vaginal deliveries between the groups. Some studies analyzed previous surgery for POP in the patients' medical history, finding them more frequent in the robotic surgery group in Anand *et al*. [25–27], Jambusaria *et al*. [17], Jaresova *et al*. [28] while in N'Guyen *et al*. [29] previous surgery for POP was more common in the vaginal group. In Westermann *et al*. [32], there were no differences between the groups.

3.2 Clinical Outcomes

Most studies analyzed operative duration, intraoperative bleeding, postoperative pain, and incidence of urinary tract infections (UTI) and LUTS (Lower Urinary Tract Symptoms).

The operative time was significantly longer in the RS in all studies, although the estimated blood loss was greater in the VS in each study (Table 1).

Overall, VS produced higher rates of urinary tract complications, regardless of the reason for surgery. Robinson *et al*. [30] and Anand *et al*. [25–27] reported a higher incidence of UTI among women undergoing Mayo-McCall culdoplasty compared to robotic laparoscopic sacrocolpopexy (18.2% *vs* 6.0%; $p = 0.030$, and 37.0% *vs* 23.4%; $p = 0.04$, respectively). Postoperative urinary retention rates were higher in the Yune *et al*. [33] cohorts of women operated vaginally for transvaginal suspension of the high uterosacral ligament (RS 15, 9.9%, VS 113, 33.9%, $p < 0.001$), and prolonged urethral catheterization (>12 hours) occurred more frequently in the Nguyen cohort of women undergoing transvaginal suspension of the uterosacral ligament (RS 0 versus VG 6, 6%; $p = 0.03$). Robotic surgery had lower NVP (nurse verbal pain) scores in the first 24 hours [29,33]. We found no differences in terms of hospitalization days (Table 1).

The follow-up of Anand *et al*. [25–27] was analyzed using a written questionnaire. Quality of life between the two groups did not differ with regard to long-term symptoms post-treatment of POP in women who completed the questionnaire. In the comparison between VS and RS, survival without retreatment did not differ significantly in the first 5 years after surgery (hazard ratio (HR), 1.14; 95% confidence interval (CI), 0.24–5.38; $p = 0.86$) [26]. Significant improvement was also found in Jambusaria [17] in both groups' anatomical POP-Q measures of posterior, anterior, and apical support defects ($p = 0.001$), as well as among functional measures of PFDI, PFIQ, or PISQ scores. In Vallabh [31], researchers contacted all patients by telephone and completed the PFDI-20 questionnaire. The mean follow-up times in the vaginal and robotic groups were 22 (standard deviation (sd) = 7) and 29 (sd = 10) months, respectively ($p = 0.05$). No difference was observed in postoperative PDFI-20 total scores between the RS and VS groups, 5.5 (9.2) and 3.0 (7.3) ($p = 0.33$). There was significant improvement between preoperative and postoperative PFDI-20 scores, as expected (preoperative RS 96.4 (59.3%) *vs* postoperative RS 5.5 (9.17); $p < 0.001$. Preoperative VS 94.6 (66.3%) *vs* postoperative VS 2.98 (7.29%); $p < 0.001$) [31]. Regarding the Westermann [32] follow-up, no significant differences in percentage change were found for either PCS or MCS (Physical and mental health composite scores are generated using 12 questions. The scores range from 0, indicating the lowest level of health, to 100, indicating the highest level of health) by surgical group [32]. Significant improvement was found between preoperative and postoperative scores for each surgical technique using the SF-12 (Short Form 12-item Survey) which provides information on mental and physical health status (Windsor, 2006) (preoperative RS 51.70 (18%) *vs* postoperative RS 2 weeks 33.84 (8.79%); $p < 0.001$. Preoperative VS 42.82 (17.00) vs postoperative VS 33.06 (12.21); $p = 0.006$).

In Jaresova [28], follow-up was not described because the purpose of the study was to verify and compare the angles and time spent in the Trendelenburg position in three procedures commonly performed to correct POP: vaginal approach, laparoscopic SC, and robotic SC. It was found that the maximum median Trendelenburg angle was significantly greater for the laparoscopic approach than for the vaginal and robotic approaches, with the vaginal approach requiring the least tilt. In Nguyen [29] and Robinson [30], the purpose of the studies was to analyze perioperative adverse event rates (NVP score, postoperative pain scores, surgical and hospitalization times, and perioperative adverse event rates), described above, so we do not have follow-up. There is also no follow-up in Yune [33], because the purpose of the study was to compare urinary retention rates between the transvaginal and transabdominal robotic approaches.

4. Discussion

There is a variety of methods performed by surgeons for POP repair, each technique has its own success and complication rates, and surgeons should arrange individualized plans for each patient, considering risks and benefits. McCall Culdoplasty is the surgical correction of enterocele during vaginal hysterectomy [38]. In a larger retrospective study (n = 693), the McCall Culdoplasty technique demonstrated 82% patient satisfaction and a reintervention rate of 5.2% [39]. No recent RCTs evaluating McCall culdoplasty have been performed. A 2011 prospective study evaluating this technique at the time of vaginal hysterectomy found that the only risk factor for failure at 2 years, defined as Pelvic Organ Prolapse Quantification (POPQ) ≥stage 3, was a history of fetal macrosomia (44.4 *vs* 6.9%, p = 0.000) [40]. The satisfaction rate of uterosacral ligament suspension was estimated to be around 89%, with only 5.5% requiring reoperation [41]. A meta-analysis of 32 studies reported 81.2%, 98.3%, and 87.4% success for the anterior, apical, and posterior compartments, but with a high ureteral injury rate of 1–11% [42]. Minimally invasive surgery for abdominal sacrocolpopexy is designed to promote rapid postoperative recovery, reducing 30-day complication rates, blood transfusion, long hospital stay, and hospital readmission compared with abdominal sacrocolpopexy [43,44]. In 2014, a retrospective study compared abdominal sacrocolpopexy (ASC) (n = 58) with a minimally invasive abdominal surgical approach, including robotic-assisted sacrocolpopexy (RS) n = 262 and laparoscopic-assisted sacrocolpopexy (LS) n = 273. No differences in anatomical failures were observed, but complications such as postoperative ileus or small bowel obstruction were greater in the ASC group (20 *vs* 12.7%, p = 0.001). Women undergoing the robotic procedure had similar surgical success rates compared to the vaginal route or laparoscopic approach. Once the feasibility of undergoing minimally invasive surgery is established, robotic surgery could be considered an alternative to classic laparoscopic surgery, with equal efficacy [45–48]. Robotic sacrocolpopexy has longer operative times, while vaginal procedures have been associated with higher estimated blood loss [45,49].

The literature has considered many heterogeneous procedures, often enrolling women with significant differences in baseline characteristics [50]. In Vanspauwen *et al.* [51], it is clear that vaginal vault prolapse repair post hysterectomy is preferred in older patients. Jha and Moran [52] report that 11% of physicians surveyed in the United Kingdom would change the procedure of choice for posthysterectomy vaginal vault prolapse if the patient was not sexually active [25]. When asked what factors influence the choice of type of surgery for primary or recurrent correction of a pelvic organ prolapse, Montoya *et al.* [50] found that for primary correction the vaginal route was preferred, while in case of prolapse recurrence the abdominal route was preferred. In the study, factors considered by surgeons for primary or recurrent POP were age, desire to maintain vaginal function, comorbid conditions, and stage of POP. In choosing the type of laparoscopic technique (laparoscopic SC or robotic SC), the relevant decision factors were the degree of prolapse and the surgeon's experience [50]. POP is a public health problem and affects the lives of millions of adult women. Surgery can offer effective treatment. The problem of pelvic prolapse will become larger and larger, requiring more and more surgeries each year [53–55]. It is estimated that the demand for pelvic prolapse treatment will increase by 35% from 2010 to 2030, and surgical intervention rates for pelvic organ prolapse will increase by 42.7% by 2050 [4,56,57]. Therefore, it will be increasingly necessary to provide subspecialty medical care.

5. Conclusions

To date, this appears to be the first paper to examine the state of the art of robotic and vaginal surgery for pelvic organ prolapse. Surprisingly, very few papers met the inclusion criteria, although we tried to include any study design, type of surgery, and clinical outcome. Despite these limitations, the general conclusion can be drawn that RS and VS have comparable efficacy in terms of prolapse correction. The choice of robotic or vaginal approach is based on the patient's characteristics and preferences. This review suggests that robotic apical suspension may be associated with less pain and narcotic use than vaginal suspension and that robotic surgery has lower rates of postoperative urinary complications, such as urinary tract infections, urinary retention, and prolonged urethral catheterization. For repeated surgical prolapse procedures, the most commonly reported route is the robotic approach. When possible, choosing the robotic approach appears to provide more favorable functional outcomes and lower infection rates.

Author Contributions

NA conceived the topic; NA, GG and ST retrieved the literature; NA, ST and MA wrote the paper; AMM provided relevant methodological support and supervision. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest. Giorgia Gaia is serving as one of the Guest editors of this journal. Anna Maria Marconi is serving as one of the Editorial Board members and Guest editors of this journal.We declare that Giorgia Gaia and Anna Maria Marconi had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Christos Iavazzo.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/j.ceog4912266.

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