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Systematic Review

"Less is More, is R-LESS More?"—The Use of Robotic Laparoendoscopic Single-Site Surgery in Gynaecology: A Scoping Review

Liliana Mereu[1], Giorgia Gaia[2], Margarita Afonina[2], Stefano Terzoni[2,*], Saverio Tateo[3], Arsenio Spinillo[4]

[1]San Paolo bachelor school of Nursing, ASST Santi Paolo e Carlo, 20142 Milan, Italy
[2]Department of Obstetrics and Gynecology, San Paolo Hospital Medical School, ASST Santi Paolo e Carlo, 20142 Milan, Italy
[3]Laboratory of Probiogenomics, Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, 43124 Parma, Italy
[4]Department of Obstetrics and Gynecology, IRCCS Fondazione Policlinico San Matteo, University of Pavia, 27100 Pavia, Italy
*Correspondence: stefano.terzoni@unimi.it (Stefano Terzoni)

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Abstract

Background: Since the Da Vinci system was introduced in the gynaecological profession, for benign and most malignant procedures, it appeared that using 5 incisions for trocar insertion could jeopardize the system's mini-invasiveness. To protect this important characteristic, robotic laparoendoscopic single-site surgery was developed and authorized for gynaecological use in 2013. Using a single small incision for the entire treatment appears to be a promising attempt to improve cosmetic results while lowering wound infections, postoperative pain, and recovery time. After nearly ten years of use, several limitations of this technique became apparent, such as a limited set of non-articulating instruments and electrical possibilities compared to multiport surgery, smoke evacuation and visual impairment. By examining the most relevant research, the goal of this review was to emphasize the indications, risks, and benefits of R-LESS in gynaecological surgery. **Methods**: A scoping review was conducted on Pubmed, Scopus, Web of Science, and Embase. Publications in English or Italian in the previous 10 years on the use of single-site robotic surgery in gynaecology for benign disorders were included. **Results**: This review includes 37 of the 297 papers that were retrieved. Myomectomy, hysterectomy, pelvic floor surgery, and endometriosis were the most common indications for single-site surgery. Several studies have reported R-LESS usage in cancer patients. According to the data analysis, the R-LESS approach is comparable to robotic multi-port surgery as regards feasibility and safety, with faster operative and postoperative durations, reduced pain, and a superior cosmetic outcome. **Conclusions**: The single-port robotic technique is gaining popularity. Our findings provide preliminary evidence of the global experience of surgical teams. Standardizing operative durations and conducting comparative research on the R-LESS learning curve represent one of the most significant future difficulties, as do surgical outcomes, costs, and patient satisfaction in the long run.

Keywords: single-site surgery; robotic surgery; review

1. Introduction

Since the approval of robotic-assisted laparoscopic surgery for the gynaecological field in the early 2000s, the use of the "Da Vinci System" in this discipline has grown. Despite increased surgical accuracy, faster recovery, and a considerable reduction in wound-related complications (infections, hematomas, and dehiscence) [1,2], most gynaecological operations, including muscle-splitting, need three to five trocar incisions. As a result, a new method of maintaining the mini-invasivity is required. Wheeless *et al*. [3] described the first single-incision tubal ligation in 1969, which was the first laparoendoscopic single-site surgery (LESS) treatment. The Food and Drug Administration (FDA) authorized the Da Vinci Single-Site platform for gynaecological treatments by single umbilical access in 2013. The LESS umbilical incision, on the other hand, is larger than a standard laparoscopic or robotic port site [3–5]. As a result, LESS may be more useful whenever surgery requires a safe extraction outlet (i.e., adnexal masses, rcholecystectomy, nephrectomy, or splenectomy) reducing the need for a muscle-splitting incision [6–10].

The introduction of the Single-site Da Vinci platform enhanced the cosmetic benefits of minimally invasive surgery by utilizing only one small incision for the entire procedure, thereby reducing the potential morbidity associated with multiple incisions (port-related complications, pain, esthetic, and recovery time [11–14]. Extensive research has been conducted since this minimally invasive approach became popular. In this section, we will summarize the indications, pros and cons of this procedure in the gynaecological field.

2. Methods

2.1 Study Design

We conducted a scoping review, which allows a broad search while performing a systematic search, even though it does not require methodological appraisal or grading of the evidence [15]. This work was conducted following the indications of the Joanna Briggs Institute [16] and the PRISMA statement (PRISMA-ScR) [17]. The protocol was registered in the Open Science Framework platform.

2.2 Searches and Information Sources

2.2.1 Systematic Database Search

The research question was: "What are the indications, the risks and the benefits of single-site surgery for gynaecological benign conditions?". We searched Pubmed, Scopus, Web of Science, Embase for studies published in English or Italian.

2.2.2 Eligibility Criteria

We included trials, case studies or series, and other descriptive studies regarding the abovementioned research question. Literature reviews and guidelines published by scientific societies were also considered.

2.2.3 Exclusion Criteria

We excluded position papers because of the lack of references, but we did use such sources to snowball additional references, similarly to other authors [18]. The same we did with scientific textbooks with references from indexed papers, which were manually consulted to retrieve additional evidence.

2.2.4 Study Selection

The papers were retrieved by two authors independently; Mendeley was used to store the articles and delete duplicates. The two researchers screened all record titles and abstracts by using the Rayyan Platform for systematic reviews; those with insufficient information were screened in full text. Disagreement between the reviewers was solved by discussion after reading the full text. The literature search was stopped on 30 June 2022. The PRISMA-SR criteria were used to report the results of this review [17].

3. Results

297 papers were retrieved, 37 of which were included in this qualitative synthesis, as shown in Fig. 1. Myomectomy, hysterectomy, pelvic floor surgery, and endometriosis were the principal subjects of study in benign gynaecology for which single-site surgery was advised. The important findings published in the literature in these areas are discussed and summarized in the following sections.

Six of the seven excluded papers were not retrieved because, although they had been included by one of the two researchers in charge of the literature search, after a discussion the two authors agreed that the articles were not relevant for a review on R-LESS, i.e., they contained information on multiple port access. One of the seven articles was not covered by the academic subscriptions in our possession; its abstract contained no additional information beyond the data we were able to extract from the included articles. Table 1 (Ref. [19–24]) shows the citations of the excluded articles.

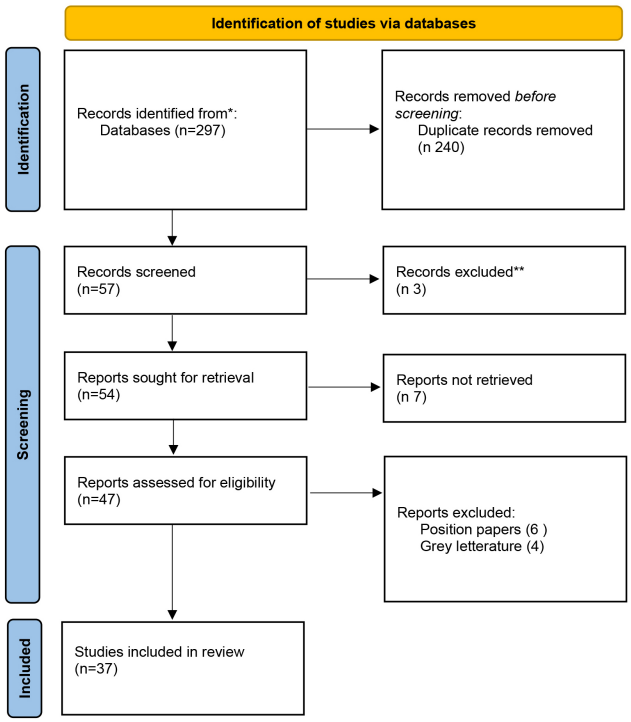

Fig. 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only. *Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). **If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

Table 1. Reasons for not retrieving the seven papers cited in Fig. 1.

Paper	Reason for exclusion
Lallemant *et al.* (2022) [19]	Not relevant
Mach *et al.* (2022) [20]	Not relevant
Noor *et al.* (2022) [21]	Not relevant
Kilic GS *et al.* (2020) [22]	Not relevant
van Zanten *et al.* (2019) [23]	Not relevant
Matanes *et al.* (2018) [24]	Not covered by our academic subscriptions

In terms of general concerns about the safety and usability of single-site surgery, Scheib *et al*. [25] pondered in 2015 if R-LESS done by experienced surgeons was possible and safe. They identified many drawbacks of the single-site system, such as limited extracorporeal triangulation and when compared to conventional multiport robotic surgery. Because of the limited smoke evacuation and hindered visibility, one case necessitated the insertion of an additional port. Because of the limited flexibility of the instruments and the inability to articulate, suturing the vaginal cuff was the most difficult technical hurdle when conducting hysterectomy. Nonetheless, the authors concluded that, in skilled hands, R-LESS looked safe and usable for hysterectomy and adnexal surgery, also in overweight patients (median Body Mass Index [BMI] of 28.2 kg/m^2).

3.1 Myomectomy

A systematic review published in 2015 indicated no significant differences between robotic aided and laparoscopic myomectomy [26]. Regarding blood loss, the mean difference observed in studies comparing robotis-assisted and open myomectomy groups was 92.78 mL (95% confidence interval [CI] [47.26–138.29], p = 0.05), whilst the mean difference between robotic and laparoscopic approach was not significant (42.10 mL; 95% CI [1.28–85.48], p = 0.05). The need for blood transfusion during open myomectomy was statistically significant as compared to the robotic aided group (981 patients (odds ratio [OR] = 0.20, 95% CI [0.09–0.43], $p < 0.05$)). Hospital length of stay was considerably reduced in robotis-assisted myomectomy compared to conventional, open myomectomy, with a mean difference of 1.84 days per patient (95% CI [1.40–2.29], $p < 0.05$). Furthermore, the investigators only looked at three studies presenting data on length of stay after myomectomy, finding a statistically significant difference (0.04 days/patient, 95% CI [0.09–0.18], $p < 0.05$). The mean difference in operative time between robotic and open approach was 84.85 minutes (95% CI [60.41–109.29], $p < 0.05$). In contrast, no statistically significant difference was observed between the robotis-assisted and the laparoscopic myomectomy groups.

The first study comparing traditional (C-LESS), robotic, and hand-assisted laparoendoscopic surgery (HA-LESS) was published in 2020. The authors specifically stated that the size of the uterus can help determining the surgical technique and that HA-LESS can be paired with C-LESS myomectomy in case of large or multi-fibroid uterus, without compromising operating time or postoperative recovery [27]. The mean number (HA-LESS: 6.9; C-LESS: 3.7; Robot-assisted laparoendoscopic surgery (RA-LESS): 2.9, p = 0.001), diameter (HA-LESS: 11.3 cm; C-LESS: 9.3 cm; RA-LESS: 7.1 cm, p = 0.003), and weight (HA: 850.1 g; C: 320.7 g; RA: 181.1 g, p = 0.003) of the estimated uterine size, as well as the total weight of myomas removed, showed a positivecorrelation (r = 0.647, p = 0.001).

Blood loss was greater in the HA-LESS group (HA-LESS: 567.5 mL; C-LESS: 207.2 mL; RA-LESS: 96.3 mL; p = 0.001) while the mean surgical time and postoperative stay were not statistically different between groups (HA-LESS: 194.6 min; C-LESS: 184.9 min; RA-LESS: 206.4 min, p = 0.680 and HA: 0.3 days; C: 0.2 days; RA: 0.3 days, p = 0.686, respectively). Estimated uterine size and intraoperative blood loss were positively correlated (r = 0.571, p = 0.001).

Several single studies on the use of single port for myomectomies have been reported [28–30], and in 2021 a systematic review [31] highlighted the safety of single-site robotic myomectomy, considering it equivalent to the multiport technique on the most common outcomes. However, only four of the 697 listed studies to be reviewed were included at the end. As a result, the writers were unable to reach any definite findings. Two papers compared the outcomes of robotic single-site myomectomy against a multiport/multisitesite technique [32,33]. 185 patients in total underwent single-site myomectomy, whereas 345 underwent multiport/site myomectomy. Both papers found a relevant difference in the size of the largest myoma (6.3 $\pm$ 1.7 *vs*. 7.7 $\pm$ 2.5 and 5.9 $\pm$ 2.02 *vs*. 8.3 $\pm$ 3.85, p = 0.001), and in the mean number (2.6 $\pm$ 2.3 *vs*. 4.6 $\pm$ 4.1 and 2.4 $\pm$ 2.05 *vs*. 4.7 $\pm$ 4.11, p = 0.001) and weight tumours (114.9 $\pm$ 83.9 *vs*. 250.8 $\pm$ 208.1). Both investigations found no difference in mean total operative time (145.9 *vs*. 147.3 and 83.3 *vs*. 109.2, respectively) or blood loss (210.1 *vs*. 213.9 and 162.4 *vs*. 162.4, respectively) after adjusting for patient characteristics. Nonetheless, docking time was significantly greater in the single-site sample (5.1 $\pm$ 3.6 *vs*. 3.8 $\pm$ 2.9, $p < 0.05$). Some authors [32,33] found that patients who received a single-site strategy had considerably longer hospital stays than those who received a multi-site approach. Despite the absence of statistical significance, Moawad *et al*. [32] found a tendency of increased risk of overnight admission in the single-site group (OR = 1.53, 95% CI [0.230–10.130], p = 0.662). Choi *et al*. [33] found no complications in the single-site group, while Moawad *et al*. [32] found comparable results in terms of risk of complications between the two groups. More research is needed to determine the best minimally invasive procedure for myomectomy.

3.2 Hysterectomy

Nine studies considered the use of single-site robotic surgery for hysterectomy. Pelosi *et al*. [34] performed the first procedure of this type using a single laparoscopic trocar method in 1991. In 2009, a case of averting hysterectomy in a BRCA-positive patient was reported using robot-assisted single port laparoscopy to improve esthetic benefits of minimally invasive surgery [35]. The authors discovered that the combination of a uterine manipulator and the range of motion of the robotic system allows for adequate tissue dissection. They concluded that single-port laparoscopic (SPL) is viable in certain circumstances as a safe alterna-

tive to traditional laparoscopy. The use of robotics during single-port laparoscopy may improve surgical capabilities.

The first and only systematic review on this topic was published in 2013 and focused on robotic single-site surgery [36]. Only six studies with 16 women matched the inclusion criteria and were summarized in that review. There were no postoperative problems among the patients included, such as urinary tract infection, wound infection, ileus, or hernia. Due to extensive pelvic adhesions, one out of all the sixteen patients required conversion to three-port robotic surgery, although no blood transfusion was required. The length of the postoperative hospital stay ranged from one to six days. In any of the included tests, there was no information on postoperative follow-up or scar's cosmesis.

A comprehensive review and meta-analysis [37] comparing single-site and traditional laparoscopic surgery was published in 2016, based on 18 papers (six RCTs, twelve retrospective studies). SPLH (single-port laparoscopic hysterectomy) had a greater failure rate than CLH (conventional laparoscopic hysterectomy) (OR = 6.37, 95% CI [3.34–12.14], p = 0.001). The incidence of perioperative problems was comparable (OR = 0.89, 95% CI [0.45–1.74], p = 0.73).

Gungor *et al*. [38] analyzed the feasibility and safety of robotic single port hysterectomy and laparoscopic single port hysterectomy, comparing the perioperative parameters of the two systems. The median operative time in the robotic group was 90 minutes (range 70–165) and 90 minutes (range 60–200) in the laparoscopic group (p = 0.74). In the robotic and laparoscopic groups, the median hysterectomy time was 57.5 (40–120) min *vs*. 60 (45–160) min (p = 0.17). The median blood loss in the robotic group was 40 mL (20–200) and 50 mL (20–250) in the laparoscopic group (p = 0.77). There were no operational or postoperative problems in any group. For both procedures, patients were discharged after a median of one day (p = 0.17). Without an established superiority of robotic single-site surgery, the procedures appeared equivalent.

An update by Iavazzo *et al*. [39] comprised 26 research and discovered that this approach was employed in elderly individuals (range 21 to 88 years for case series and 37 to 60 years for case reports). The included patients' BMI ranged from 15.9 to 55 kg/m^2 in case series and from 20 to 29.3 kg/m^2 in case reports. There was a 4.9% complication rate, which included bleeding, vaginal hematoma, laceration and dehiscence, umbilical hernia, and visceral injuries, and a 2.8% conversion rate, even though patients could be converted to a multi-port robotic/laparoscopic or open/vaginal approach. However, due to the considerable heterogeneity, clear conclusions about postoperative pain and cosmetic outcomes could not be derived from this study. Finally, Gupta *et al*. [40] compared the surgical outcomes of SingleSite Robotic (SS-Rob), Multiport Robotic (MP-Rob), and conventional laparoscopic (LSC) hysterectomy for benign conditions.

The median age differed between (39.5 years) SS-Rob (41 years) and MP-Rob (46 years) (p = 0.009). The median BMI also raised (SS-Robm 26.8 kg/m^2, LSC 27 kg/m^2, MP-Rob 33.7 kg/m^2). Age differences between LSC (Me = 39.5 years) and MP-Rob (Me = 46 years) were statistically significant (p = 0.009), but not between LSC and SS-Rob (Me = 41 years) or SS-Rob and MP-Rob. BMI differed between LSC (Me = 27 kg/m^2) and MP-Rob (Me = 33.7 kg/m^2) (p = 0.001), as well as between SS-Rob (Me = 26.8 kg/m^2) and MP-Rob (p = 0.001).

Uterus weight differed significantly between LSC (Me = 102 g) and MP-Rob (Me = 144 g, p = 0.008) and SS-Rob (Me = 105 g) and MP-Rob (p = 0.012) whilst it was comparable between LSC and SS-Rob. LSC (Me = 192 min) and SS-Rob (Me = 150 min) had different operational times (p = 0.007) differently from LSC/MP-Rob (Me = 163 min) and SS-Rob/MP-Rob.

The distributions of hospital stay and blood loss were similar across all groups; however, median length of stay (LOS) rose from LSC (16.4 h) to SS-Rob (17.1 h) to MP-Rob (20.6 h), albeit not statistically significantly (p = 0.288). The median blood loss in all three surgery groups was the same (50 mL, p = 0.260).

The authors found that traditional LSC or the robotic single-site tools can be beneficial for young, non-obese women with endometriosis. A multiport Da Vinci aided technique can benefit older women with higher BMI, as well as those with abnormal uterine bleeding or suspected fibroid uterus and produce satisfactory clinical outcomes.

3.3 Pelvic Organ Prolapse

Sacrocolpopexy is the accepted standard for this condition. Although laparoscopic sacrocolpopexy requires at most four ports with a diameter of 5mm each, robotic-assisted sacrocolpopexy needs five ports with three 8-mm, ten-mm, and twelve-mm incisions. A higher number of ports (as well as larger incisions) raise the risk of infections and pain, require longer recovery, and reduce patient satisfaction with esthetic outcomes [41,42].

The first video article on single port sacrocolpopexy (SPS) for pelvic organ prolapse (POP) [43] was published in 2016, demonstrating that robotic sacrocolpopexy through a single port was feasible and warranted good esthetic results. Because there are fewer incisions, this procedure minimizes morcellation by removing the anatomical portion through the umbilical incision. It also reduces the danger of infection. Following the publication of this first report, several further trials were published, establishing the feasibility of the single-site surgery and pointing out its low complication rates, reduced blood loss and pain, quick recovery, short length of stay, and low number of scars [44,45].

Matanes *et al*. [45] described 25 women undergoing SPS for uterovaginal or vaginal apical prolapse. Median operative time and console time were both significantly reduced (Me = 226 minutes, range [142–308] to

156 [114–180], p = 0.0001 and Me = 170 [85–261] to Me = 115 [90–270], p = 0.008) respectively. SPS took longer times than in the multi-port robotic approach; the authors concluded that the anatomic repair was equivalent in both methods. There were no statistically significant differences between the groups in terms of anticipated blood loss, intra-operative problems, or the requirement for analgesics throughout the hospital stay. Pelvic organ prolapse quantitative assessments, such as the Pelvic Floor Distress Inventory and POP/Urinary Incontinence, were also used to assess quality-of-life characteristics. Prior to surgery, 6 weeks, and 6 months later, sexual questionnaires were administered. At 6 weeks and 6 months following surgery, the Patient Scar Assessment Questionnaire (PSAQ) and Activity Assessment Scale were performed. The possible scores range from 28 (the best) to 112 (the worst). R-LESS and MPR values were comparable at baseline, 6-week, or 6-month follow-up for any of the investigated parameters. At 6-week and 6-month follow-up, the R-LESS group had lower median scar evaluation scores than the MPR group (33 *vs.* 43, $p < 0.05$ and 28 *vs.* 31, $p < 0.05$, respectively) [45]. The learning curve is without a doubt one of the most crucial components of this technique [46,47]. As with robotic multiport surgery, single port robotic surgery is simple to execute and replicate, as demonstrated by some authors [47]. Indeed, when comparing the MP-RSC and SP-RSC techniques, the practicality, immediate outcomes, and learning curve are comparable. The mean operational periods for the MP-RSC and SP-RSC procedures were statistically different: 206.5 $\pm$ 39.4 and 187.8 $\pm$ 46.2 respectively, p = 0.028. Furthermore, the docking times were statistically different between the two groups (the mean MP-RSC was 3 min longer, p = 0.001). Duration of surgery for both MP-RSC and SP-RSC decreased from 224.2 $\pm$ 43.2 to 198.4 $\pm$ 36.3 min and stayed stable during the subsequent 22 surgeries (199.9 $\pm$ 36.3, p = 0.12 and from 222.4 $\pm$ 53.1 to 161.3 $\pm$ 28.2 min increasing to 182.3 $\pm$ 37.2, p = 0.0001 and 0.014, respectively).

The continual decrease in console time is primarily responsible for the reduction in surgery time. Console time in the MP-RSC group was reduced in the first 15 procedures (from 163.8 $\pm$ 35.5 to 125.5 $\pm$ 23.9 min) then rose to 143.7 $\pm$ 28.3 min in the next 22, p = 0.01. In the SP-RSC group, console time dropped from 173.9 $\pm$ 59.9 to 115.2 $\pm$ 19.3 min in the first 15 procedures and climbed to 140.7 $\pm$ 31.9 min in the following 22 surgeries, p = 0.001 and 0.053, respectively.

Despite the need for multiple intra-corporeal suturing and deep tissue dissection, the demand for minimally invasive sacrocolpopexy has grown to the point where Lee Sa Ra *et al.* [48] compared single-site surgery using the da Vinci Xi or Si system and single port surgery using the da Vinci SP system alone, concluding that both are viable options for symptomatic apical POP, while guaranteeing good aesthetic results.

3.4 Endometriosis

Although endometriosis surgery appears hard and requires specialist centres with sufficient surgical volumes for excellent results, the use of robotic single port surgery is quickly growing in this sector. Initially, laparoendoscopic single-port surgery appeared to provide the possibility of scarless and minimally invasive surgery; nevertheless, technical, and surgical challenges due to limited space and movement, resulting in tool conflict, were documented. With superior visualization and field depth perception, the da Vinci Single-Site robotic surgical system (RSS, robotic single-site surgery) eliminated the problem of instrument conflict. Surgeons can now remove endometriosis with RSS surgical procedure more easily than with SPL (single-port laparoscopy). RSS surgery, as revealed by Moon HS *et al.* [49] in their retrospective research of 120 patients, can be used to treat advanced-stage endometriosis, particularly in complex situations. Furthermore, Guang *et al.* [50] proposed that indocyanine green and Firefly technology (that is, integrated fluorescence capability) could aid in the identification of endometriosis in single-site robotic surgery [51].

Overall, this method resulted in a successful single-site laparoscopic resection of advanced endometriosis nodules overlaying the ureter and rectum, with complete relief of pelvic pain symptoms and outstanding cosmetic outcomes. Finally, R-LESS appears to be suitable for cystectomy: as demonstrated by Paek J. *et al.* [14] RSS for adnexal tumours does not need additional ports and is not prone to high rates of complications, although it requires longer operative times; indeed, surgery with the RSS technique took longer thanks to the LESS (91.1 $\pm$ 31.4 *vs.* 68.7 $\pm$ 34.0 min; $p < 0.05$). Even after correcting for age, BMI, previous surgery history, presence of pelvic adhesions, procedure, and tumour size, no relevant difference was detected in docking time or tumour removal.

Although we elected to exclude malignant situations from our study, various oncology aspects were found in the publications reported in this work; so, we have provided a brief synopsis of the significant findings [52–57]. A retrospective research comparing standard laparoscopy, laparoendoscopic single-site, and robotic surgery was published in 2012. There were no significant differences between the three groups in terms of median operating time or estimated blood loss. The robotic group (17.0, range [8–36]) and SPL group (16.0 [11–21]) acquired substantially more pelvic lymph nodes than the laparoscopic group (13.0 [3–18]), p = 0.04. The median number of para-aortic nodes acquired by the three groups, however, did not differ significantly. LOS, comorbidities, incidence of complications and operative times were comparable in the two groups. This study demonstrated the viability of SPL surgery for endometrial carcinoma over laparoscopy and robotic surgery, with comparable operating times, hospital length of stay, complication rates, and predicted blood loss. Fagotti *et*

Table 2. Comparison between R-LESS and the other surgical techniques in the literature.

Operation	Comparison	Outcome	Advantage with R-LESS
Myomectomy	Laparoscopy	Blood transfusion	YES
		Length of stay	YES
		Operative times	YES
Hysterectomy	Laparoscopy	Failure rate	NO
		Perioperative problems	NO
		Operative times	NO
		Blood loss	NO
		Length of stay	NO
Pelvic organ prolapse	Traditional sacrocolpopexy	Blood loss	NO
		Intraoperative problems	NO
		Pain	NO
		Scar appearance and symptoms	YES
		Console	YES
Endometriosis	Laparoscopy	Docking time	NO
		No. of lymph nodes	YES
		Blood loss	NO

al. [58] published a retrospective analysis on 57 individuals with early endometrial cancer a year later. RSS-H was performed on 19 women, and LESS-H was performed on 38 patients with early endometrial carcinoma. Pre-surgical procedures (port installation and docking) took an average of 8 minutes in the RSS-H group and 2 minutes in the LESS-H group ($p = 0.0001$). The intervention group had a median estimated blood loss of 75 mL versus 30 mL in the control group ($p = 0.005$). The median operating time the start of intraperitoneal procedures to skin suture, was 90 minutes *vs*. 107 minutes ($p > 0.05$). For both methods, the median time to discharge was 48 hours. Very few differences emerged, none of which were clinically significant; the authors concluded that the two techniques were statistically equivalent. Sun H *et al*. [59] demonstrated in 2021 that robotic single-site surgery (RSSS) for early-stage endometrial cancer was feasible and safe. It also reduced significantly operating time, blood loss, and hospital stay compared to LESS [59]. The RSSS group had considerably longer pre-surgical time (8 min *vs*. 2 min, $p < 0.05$), lower blood loss (Me = 50 mL *vs*. 85 mL, $p < 0.05$), and much shorter vaginal cuff closure time (21 min *vs*. 30 min, $p < 0.05$) than the LESS group. There were no intraoperative problems in either the RSSS or the LESS groups.

Median LOS in the RSSS group was considerably shorter (2 days *vs*. 3 days, $p < 0.05$) while the incidence of early and late problems did not differ significantly ($p > 0.05$). In addition, a video piece published in The Journal of Minimally Invasive Surgery demonstrates the viability of a pelvic lymphadenectomy for endometrial cancer [60].

Table 2 summarizes the outcomes of this review.

4. Discussion

Since the Da Vinci Single-Site method was approved, RSSS has gained popularity as a practical, safe, and easily reproducible approach in gynaecology. The first and only systematic review on this topic (based on 36 papers) was released in 2018 [61]. Since this first attempt to review the extant literature was four years ago, we wanted to make a point regarding subsequent R-LESS developments. In most gynaecological conditions (whether benign ora malignant), the R-LESS approach was non-inferior to robot-assisted multi-port surgery as regarded ease of use and safety, with shorter times, less pain, and better aesthetic outcomes when compared to laparoscopic single-site surgery.

Because of semi-rigid instruments, curved stiff cannulas, 3D imaging, a steady camera, precision of movement, and tremor control, the robot restores instrument triangulation and has the advantage of greater ergonomics compared to conventional LESS. Endowristed robotic devices provide seven degrees of freedom, enabling for difficult surgical treatments, particularly in the event of severe endometriosis, which necessitates rectum dissection, ureter individualization, deep adhesiolysis, or vaginal vault suturing. Furthermore, single port technology lowers the number of accessory ports that penetrate the abdominal wall, reducing the risk of trocar insertion issues such as epigastric vascular damage, surgical wound infections, and hematoma development. As a result, postoperative discomfort is minimized, and return to everyday activities is quicker, with shorter hospital stays and lower costs.

This review has significant limitations: the data on R-LESS in gynaecology is mostly retrospective, as only a few prospective investigations have been completed, and no randomized trials are currently available. This is most likely due to the technique's recent launch, which has lim-

ited the number of hospitals where these devices are available.

It should be emphasized that there are currently no clear criteria or guidelines for regulating the learning curve of these procedures [62]. As a result, it appears difficult to standardize the operative times of this approach and perform comparative studies on the subject. However, the double console introduced in 2009 allowed the trainee and supervisor to control the primary and secondary consoles concurrently. This modality allows the surgeon to switch one or more controls with the student, allowing for easier surgical takeovers and communication while also offering real-time education [63,64]. Indeed, Leon *et al*. [65] demonstrated in 2022 that the double console allows trainees to gain with more "hands-on" experience in terms of surgical steps performed (OR = 3.37, 95% CI [1.36–8.37], p = 0.009), more surgical takeovers between by the attending surgeon (OR = 3.53, 95% CI [2.43–5.14], p = 0.001) and a higher console time/docking time ratio (p = 0.001). These objective measurements improve competency-based training while reducing times and the incidence of problems.

Finally, enhancing quality of life, esthetics, and postoperative recovery time are all key goals of minimally invasive surgery. The single-port technique, which involves operating through only one umbilical incision, improves cosmetic results, and the hidden incision makes it a "scarless surgery" notwithstanding the larger umbilical wound compared to multi-port surgery (20–30 mm *vs*. 5–12), which may increase the risk of hernia. Long-term surgical results, costs, and patient satisfaction are all essential issues that should be investigated through prospective studies.

5. Conclusions

Notwithstanding the diffusion of the single-port approach, there is still the need for standardization of this surgical technique; the results of this review report the initial learning curve of surgical teams worldwide, with the expectation of reduced complication rates as their experience increases.

Author Contributions

STer and MA performed the initial literature search and drafted the manuscript; GG helped with the literature screening; STat and AS finalized the manuscript; LM proved important methodological insights.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest. GG is serving as one of the Guest editors of this journal. LM is serving as one of the Editorial Board members/Guest editors of this journal. We declare that GG and LM had no involvements 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 JO and MHD.

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