



Robotic vs. laparoscopic ventral mesh rectopexy for external rectal prolapse and rectal intussusception: a systematic review

S. Albayati^{1,2,5} · P. Chen¹ · M. J. Morgan^{1,2} · J. W. T. Toh^{3,4}

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Abstract

Background Laparoscopic ventral mesh rectopexy (LVR) is a treatment with promising results in external rectal prolapse, rectal intussusception, and rectocele. Because of the emergence of robotic-assisted surgery and the technical advantage it provides, we examined the potential role and place of robotic surgery in ventral rectopexy.

Methods MEDLINE, PubMed, and other databases were searched, by two independent reviewers, to identify studies comparing robotic to laparoscopic ventral mesh rectopexy. The primary outcome was the rate of unplanned conversion to open. The secondary outcomes were morbidity, length of hospital stay and recurrence rate.

Results Five studies (4% male, $n = 259$) met the inclusion criteria. All 5 studies reported on conversion rate and showed no significant difference between the conversion rate of robotic and laparoscopic groups [OR 0.58 (95% CI 0.09–3.77)]. Robotic surgery was also similar to laparoscopic surgery for both morbidity [OR 0.71 (95% CI 0.34–1.48)] and recurrence rate [OR 0.56 (95% CI 0.18–1.75)]. Operative time was longer in the robotic group with a MWD of 22.88 minutes (CI 5.73–40.04, $p < 0.0007$). There was a statistically significant reduction in length of stay with robotic surgery [mean difference -0.36 days (95% CI -0.66 to -0.07)].

Conclusions This systematic review shows that robotic-assisted ventral rectopexy requires longer operative time with no significant added benefit over laparoscopic ventral rectopexy. The conversion rate was low in both groups and the trends to benefit did not reach statistical significance. More studies are required to clarify whether the potential technical advantage of robotic surgery in ventral rectopexy translates to an improvement in clinical outcome.

Keywords Rectal prolapse · Ventral mesh rectopexy · Robotic surgery · Laparoscopic surgery

Introduction

Minimally invasive surgery has become a common practice in colorectal surgery, with robotic-assisted surgery being increasingly adopted due to the technical advantage it provides in narrow confined spaces. Current literature suggests

that robotic-assisted surgery is associated with fewer conversions to open compared to laparoscopic surgery with similar oncological outcomes. However, the recent ROLARR study showed no advantage of robotic surgery in rectal cancer surgery [1].

With ventral mesh rectopexy, the idea of robotic surgery appears to make sense; the surgeon is tasked with dissecting out the anterior plane of the rectum from the vagina or prostate and then suturing mesh onto the rectum deep within the narrow confines of the pelvis before fixing it onto the sacral promontory.

To date, there have been several small comparative studies comparing robotic versus laparoscopic ventral rectopexy, with a recent systematic review reporting on their outcomes [2]. This study did not show a reduction in conversion rate. The inpatient length of stay, morbidity, recurrence rates and functional outcomes were similar between laparoscopic and robotic surgery. However, this systematic review included 5

✉ S. Albayati

¹ Department of Surgery, Bankstown-Lidcombe Hospital, Sydney, NSW, Australia

² South Western Sydney Clinical School, University of New South Wales, Sydney, NSW, Australia

³ Department of Surgery, Westmead Hospital, Sydney, NSW, Australia

⁴ Discipline of Surgery, Sydney Medical School, University of Sydney, Sydney, NSW, Australia

⁵ Moorebank, Australia

studies ($n=244$) of which 2 studies included patients having posterior Well's rectopexy in approximately a third of the cohort [3, 4].

Since the systematic review by Ramage et al. [2], there have been two additional studies [5, 6] comparing robotic vs. laparoscopic ventral rectopexies which have been included in this review.

As the major advantage of robotic surgery is technical with improved ergonomics, three-dimensional (3D) vision and improved instrumentation, we believe this may result in fewer unplanned conversions to open and less morbidity which could lead to better functional outcomes. The primary outcome measure selected for this study was unplanned conversion to open. The secondary outcomes were postoperative outcomes including morbidity, length of hospital stay, recurrence rate and functional outcomes. This systematic review and meta-analysis synthesises the current evidence on the use of robotic surgery in ventral rectopexy and provides an insight into whether the technical advantage of robotic surgery translates into improved clinical outcomes.

Materials and methods

Literature search strategy

The following databases were searched to identify the studies: MEDLINE, EMBASE, Scopus, CENTRAL, PubMed, ISI Web of Science and MEDLINE InProcess. The terms used for the search were ventral rectopex.tw, (ventral adj3 rectopex\$.tw, (anterior adj3 rectopex\$.tw, (ventral adj3 colprorectopex\$.tw, rectovaginopexy.tw using the Boolean operator OR. Those were combined with MeSH terms robotics, and laparoscopy using the Boolean operator AND. There were no language restrictions and the search period was between 2004 when the procedure was first described to October 2017. Titles and abstracts that resulted from the research were screened by two reviewers (SA and PC) following PRISMA guidelines [7].

Inclusion criteria

Inclusion criteria for study selection were randomised and non-randomised studies comparing laparoscopic ventral mesh rectopexy (LVR) to robotic ventral mesh rectopexy (RVR), studies that clearly reported ventral rectopexy as described by D'Hoore, and reported at least one outcome of interest. Outcomes of interest were conversion rate, operative time, intraoperative and postoperative complications, length of hospital stay, recurrence rate, and functional outcomes.

Exclusion criteria

Exclusion criteria were studies that reported posterior mobilisation of the rectum, studies that reported concomitant sacrocolpopexy, or if there was no comparison of the robotic and laparoscopic approaches. Studies from the same units with overlapping data were also excluded.

Methodology assessment or data extraction

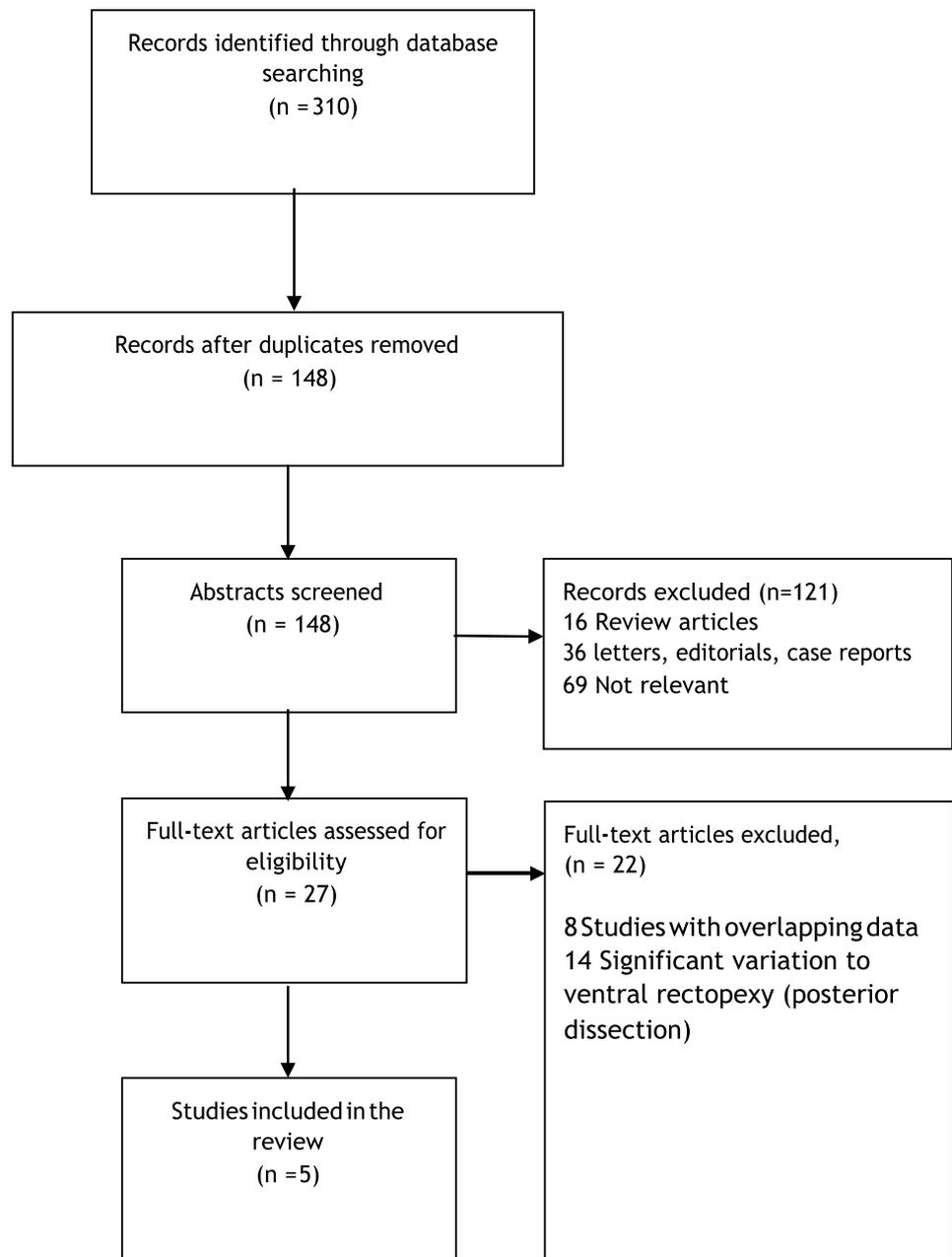
Two reviewers (SA and PC) independently reviewed and appraised studies using a standard form and extracted data on patient demographics, methods and outcome measures. Discrepancy between the two authors was resolved by consensus with a third reviewer (MM). The quality of the included studies was assessed using the Newcastle–Ottawa scale [8]. The Newcastle–Ottawa scale assesses the quality of non-randomised studies by judging selection, comparability and ascertainment of the exposure or outcome of interest between the groups in the cohort and rating it on a star system (highest score—9 stars).

Statistical analysis

Statistical analysis was performed using Review Manager 5.3. Odds ratio was the effect measure used for dichotomous outcomes, whereas the mean weighted difference (WMD) was used for continuous data. Mean and standard deviation were used. When data was presented in median and range [5, 9], the mean and standard deviation were estimated using formulae reported by Hozo et al. [10]. Heterogeneity was examined using I^2 . Random effects model rather than fixed model was used when heterogeneity was moderate or high ($I^2 \geq 50$). Where heterogeneity was low, a fixed effect model was used. Risk of publication bias was assessed using funnel plots.

Results

A total of 310 studies were identified through 7 electronic database searches and from reviewing reference lists (Fig. 1). Following the exclusion of duplicates and the application of inclusion and exclusion criteria, 5 studies (1 randomised, and 4 non-randomised) were included in the review [5, 6, 9, 11, 12]. Table 1 shows the summary of included studies. In total, there were 259 patients (152 laparoscopic, 107 robotic). All studies had a Newcastle–Ottawa rating of 5–8 (out of 9) stars. Ninety-six percent of patients were female.

Fig. 1 PRISMA flow chart of selection of studies for review

Technique of ventral rectopexy

The technique of ventral rectopexy was assessed in the five studies included in this review. All of the studies included reported using the technique as described by D’Hoore and Penninckx [13] with minor modifications. Dissection was limited to the anterior of the rectum down to the pelvic floor with no lateral or posterior dissection. Mantoo et al. performed an additional dissection in the vesicovaginal plane in the case of concurrent cystocele and an extra mesh was secured to the anterior wall of the vagina and the pelvic floor below the level of the trigone. The proximal end of the mesh was fixed to the right of the sacral promontory in all

papers, but there were several variations in fixing the distal end of the mesh. Mehmood et al. fixed the mesh to the anterior wall of the rectum [9]. Makela-Kaikkonen et al. added additional fixation of the distal mesh to the pelvic floor [6, 11]. Mantoo et al. fixed the distal end of the mesh to pelvic floor muscles on either side of the rectum with no fixation to the rectum [12]. Faucheron et al. used two meshes that were attached distally to the right and left anterior aspects of the rectal wall and attached proximally to the sacral promontory [5]. The type of mesh used was also variable in the reported studies. Polyester mesh was used in three studies [5, 6, 12], polypropylene mesh was used one study [11], and one study reported on outcomes using a biological mesh [9].

Table 1 Summary of included studies

Study	No. of patients (F:M)	Study design	Age in years mean (\pm SD) or median (min–max)	Operative time in minutes (SD)	Conversions	Morbidity, <i>n</i> (%)	Recurrence, <i>n</i> (%)	Length of hospital stay in days mean (\pm SD) or median (min–max)	Follow-up in months mean (\pm SD)	NOS
Makela-Kaikkonen et al. [6]	Total 30									
	RVR 16 (16:0)	RCT	60.8 (11.5)	202 (46)	0	5 (31)		2.2 (1.5)	3	
	LVR 14 (14:0)		66.0 (10.1)	195 (21)	0	1 (7)		2.5 (0.9)	3	8
Mehmood et al. [9]	Total 51									
	RVR 17 (17:0)	PC	61 (25–89)	138 (33)	0	0	0	2 (1–4)		
	LVR 34 (31:3)		58 (30–87)	115 (36)	1 (3%)	6 (17)	0	2 (1–6)	12	5
Makela-Kaikkonen et al. [11]	Total 40									
	RVR 20 (17:3)		60.7 (\pm 17.4)	231 (39)	0	2 (10)	1 (5)	3.1 (2.0)	3	
	LVR 20 (17:3)	PC	60.4 (\pm 17)	234 (41)	0	1 (5)	1 (5)	3.3 (1.3)	3	7
Mantoo et al. [12]	Total 118									
	RVR 44 (44:0)		61 (\pm 12)	191 (26)	1 (2%)	5 (11)	3 (7)	4 (1)		
	LVR 74 (74:0)	PC	62 (\pm 12)	163 (39)	3 (4%)	15 (20)	6 (8)	5 (2)	16 (\pm 7)	8
Faucheron et al. [5]	Total 20									
	RVR 10 (10:0)		57 (20–73)	94 (78–150)	0	0	0	11 (8.15–32.2)	1	
	LVR 10 (9:1)	PC	35.5 (15–68)	52.5 (38–103)	0	1 (10)	0	11 (7.75–79.5)	1	7

F:M female; male ration, RVR robotic ventral rectopexy, LVR laparoscopic ventral rectopexy, SD standard deviation, NOS NewCastle–Ottawa scale, PC prospective cohort, RC retrospective cohort, RCT randomized controlled trial

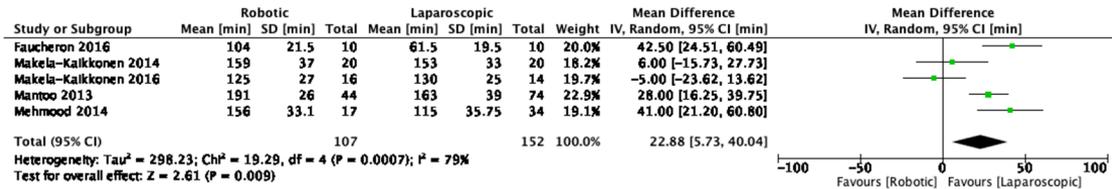
Primary outcome measures: unplanned conversion to open

Figure 2 shows the Forest plots of robotic versus laparoscopic ventral mesh rectopexy. Unplanned conversions to open were reported in all five studies [5, 6, 9, 11, 12]. There were fewer conversions to open associated with RVR (1/107)

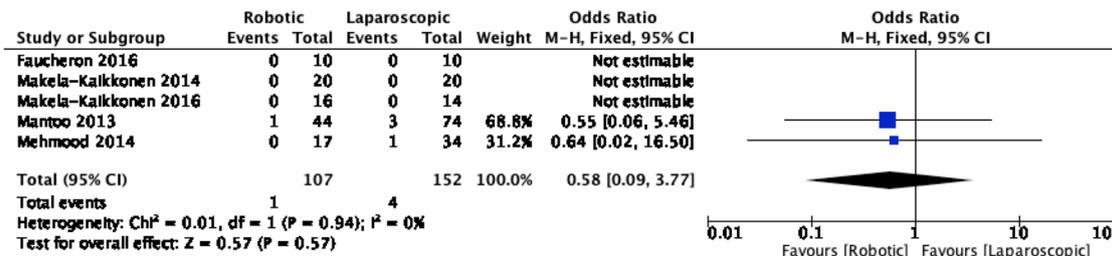
compared to LVR (4/152) but this did not meet statistical significance (OR 0.58, CI 0.09–3.77, $p = 0.57$).

Secondary outcome measures

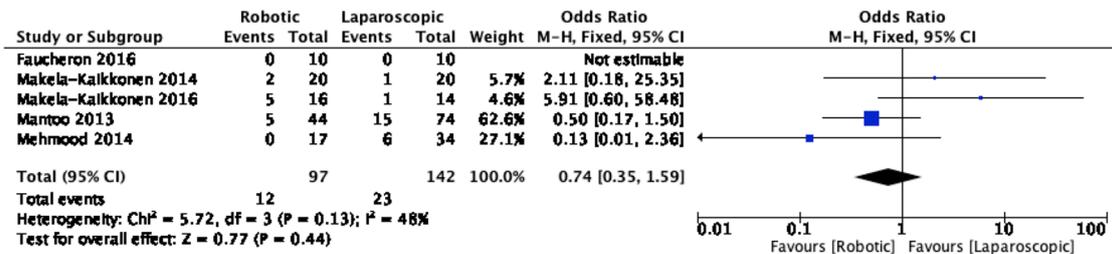
Morbidity was reported in all five studies [5, 6, 9, 11, 12]. While Faucheron et al reported no postoperative



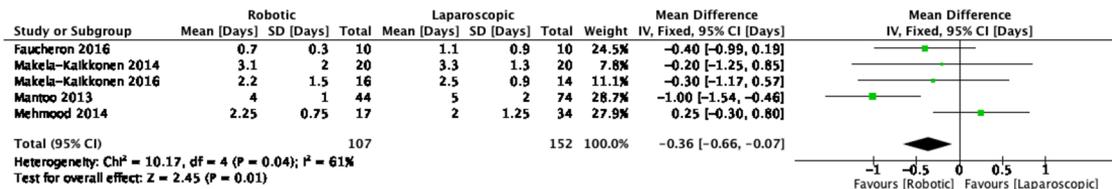
Operative time



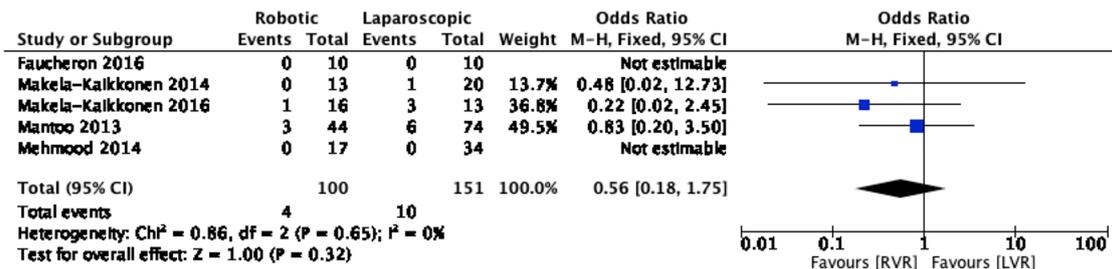
Conversion rate



Morbidity



Length of hospital stay



Recurrence rate

Fig. 2 Forest plots of robotic ventral mesh rectopexy (RVR) vs. laparoscopic ventral mesh rectopexy (LVR)

complications in either the RVR or the LVR groups [5], the pooled complication rate reported in the other studies was 12.4% (12/97) in the RVR group versus 16.2% (23/142) in the LVR group. Although there was a trend towards lower complication rate associated with RVR, this did not reach statistical significance (OR 0.74, CI 0.35–1.59, $p=0.44$).

Operative time was reported in all five studies [5, 6, 9, 11, 12]. Mean operative time for RVR was 147 min (range 104–191 min). This was significantly longer than the operative time for LVR (mean 124.5 min, range 61.5–163 min) with a MWD 22.88 (CI 5.73–40.04, $p<0.0007$).

The mean length of hospital stay was also reported in all studies [5, 6, 9, 11, 12]. In the robotic group, the mean length of stay was 2.45 days (range 0.7–4 days) compared to 2.78 days (range 1.1–5 days) in the LVR group with a MWD of -0.36 (CI -0.66 to 0.07 , $p=0.01$). There was a statistically significant reduction in length of stay, but the difference was less than 1 day.

Recurrence rate was reported in four studies [5, 9, 11, 12]. The recurrence rate following RVR was 4% (4/100) versus 6.6% (10/151) following LVR. However, this trend towards lower recurrences with RVR failed to reach statistical significance (OR 0.56, CI 0.18–1.75, $p=0.32$).

Functional outcomes were reported in two studies [9, 12]. Mehmood et al. [9] assessed faecal incontinence in patients with external rectal prolapse using FISI and Wexner scores, which were both, reduced postoperatively in both LVR and RVR groups. There was no statistically significant difference in postoperative FISI score between the two groups, and although postoperative median Wexner score was lower in the LVR group, preoperative median Wexner score was also lower in the RVR group, which confounds true difference between the groups.

Mantoo et al. [12] assessed faecal incontinence and obstructed defecation using Wexner and obstructed defecation syndrome (ODS) scores, respectively. There was a marginal improvement in mean Wexner scores postoperatively in both groups but this failed to reach statistical significance. The ODS score improved postoperatively in both groups, and the reduction in ODS was superior in the RVR group ($p=0.004$).

Discussion

This review reported a statistically significant increase in operating time for robotic surgery, a finding similar to that reported by Ramage et al. [2]. It is likely that the learning curve effect has influenced this result as the cohorts in each of the studies evaluated in both the study by Ramage et al. [2] and the present study were small; the largest study, by Mantoo et al. had 118 patients [12] and the smallest study, by Faucheron et al. had 20 patients [5]. With experience, the

robot provides a technical advantage particularly in suturing deep in the narrow pelvis. Duration of surgery should decrease with increased caseload.

The reduction of conversion rate (OR 0.58, 95% CI 0.09–3.77) associated with RVR did not reach statistical significance. This may be due to the small size of pooled data. LVR is likely performed by experienced laparoscopic surgeons, with few conversions to open, that make it difficult to detect a significant difference with small size groups. The lack of a significant advantage in lowering the conversion rate was also reported in a previous review of all types of rectopexy procedures [14] but there is emerging evidence that robotic-assisted rectal surgery is associated with fewer conversions to open [15, 16]. This may also explain the lack of a clear benefit in reducing morbidity (OR 0.71 95% CI 0.34–1.48). A previous review that examined all types of rectopexy procedures showed a significant reduction in post-operative complications [14]. There was also a statistically significant reduction in length of stay albeit less than 1 day.

Four studies reported recurrence rates showing no significant difference between RVR and LVR (OR 0.56, 95% CI 0.18–1.75). The small size of pooled data and the short duration of follow-up reported in those studies (between 1 and 16 months) make it difficult to derive any conclusion from the available data. The same can be said about the reported functional outcomes that were reported in only two studies and were not different following RVR or LVR. It is also feasible that when LVR is performed by an experienced laparoscopic surgeon, recurrence and functional outcome are not significantly improved by the additional technical advantages from robotic-assisted surgery.

Strengths and limitations

This study is the largest meta-analysis to date comparing robotic vs. laparoscopic ventral mesh rectopexy. All the studies included were considered higher quality studies by the Newcastle–Ottawa scale. There was a standardised technique of surgery with minor modifications for all studies. We excluded studies which included posterior rectopexies. However, there are several limitations to this study. First, the small size of the study ($n=259$, 104 robotic) as well as lack of data in several of the outcome measures could have affected our findings. For example, only the studies by Mehmood et al. [9] and Mantoo et al. [12] reported on conversion rate and similarly only two studies reported on functional outcomes. Second, studies did not differentiate between external rectal prolapse and rectal intussusception or rectocele when assessing recurrence rate. Third, there was no clear definition of recurrence for rectal intussusception or rectocele. Fourth, the studies also had a relatively short duration of follow-up, which makes it difficult to assess for recurrence rates and functional outcomes and longer-term data

would be beneficial to determine if robotic surgery has not only a short-term benefit, but also makes a longer-term difference. Fifth, there were various types of mesh used in the studies, which would have affected the outcomes. Although there are no studies comparing synthetic mesh to biological mesh in ventral rectopexy, there is a belief that biological mesh is associated with a higher recurrence rate as a trade off for a lower complication rate compared to synthetic mesh [17].

Finally, on evaluation of the analysis performed, the majority of outcome measures had significant heterogeneity reported (operative time I^2 79%; length of stay 61%; morbidity 33%) suggesting that confounding factors may be significant in the results reported, consistent with the wide confidence intervals and lack of statistical significance for most of the reported outcome measures.

Conclusions

Although there is a trend towards fewer conversions to open and fewer complications with RVR, this systematic review shows that RVR requires longer operative time with no added benefit over LVR. Further studies may be required if any short- or long-term benefit following RVR are to be found.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by the authors.

Informed consent For this type of study formal consent is not required.

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