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Comparative Outcomes of Laparoscopic Versus Robotic Surgery in Complex Hernia Repair: Implications for Perioperative Management, Critical Care, and Emergency Medicine — A Meta-analysis

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KEYWORDS

robotic surgery; laparoscopic surgery; complex hernia repair; ventral hernia; perioperative outcomes; meta-analysis

ABSTRACT:

Robots are becoming more popular in undertaking complex ventral, incisional, and inguinal hernia repair but the relative effectiveness of the robot when compared to laparoscopic surgery continues to be controversial, especially as it relates to perioperative outcomes, use of resources, and systems-level implication. This systematic review and meta-analysis were performed based on PRISMA 2020 guidelines. Comparative studies with the publication dates between January 2011 and January 2026 were searched in MEDLINE, Embase, CENTRAL, and Web of Science. Randomized controlled trials and observational trials that compared robotic and laparoscopic hernia repair among adults were incorporated. The main outcomes were the operating time and the length of stay (LOS). The secondary outcomes were readmission, reoperation, surgical site infection (SSI), recurrence, and cost. Quantitative synthesis was done through random-effects models. There were fourteen studies that could qualify in terms of qualitative synthesis out of which ten studies were used in meta-analysis. Both ventral/incisional and inguinal repair showed a great deal of time-consuming operative time in robot repair. There were no statistically significant differences between pooled readmission approach, reoperation approach, or SSI approach. LOS reporting was heterogeneous, however, several propensities matched and registry-based analyses suggested shorter LOS and reduced downstream resource utilization with robotic repair. There were differences in the cost study findings, which found higher operative costs in randomized trials and similar or lower total episode-of-care costs in studies that used postoperative utilization. Robotic hernia repair is linked to increased operative time but shows similar short-term clinical results to laparoscopic repair and has the possibility of improving population outcomes in terms of LOS and resource consumption. These results point to the need to select the approach and consider the implications of perioperative, critical care, and emergency medicine.

Introduction

Background

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Inguinal defects that are technically difficult and involve ventral, incisional, and complex abdominal wall hernias are an extensive and increasing surgical issue (Schlosser et al., 2023). Groin (inguinal/femoral) hernia repair is one of the most common surgeries across the globe, and it is estimated that over 20 millions of these surgeries are carried out each year (Ortenzi et al., 2023). Repair of ventral herniae is also a significant addition in terms of volume and price. In an analysis of the U.S. nationally, the procedure of ventral hernia repair included an average of about 611,000 cases per year during 2016-2019, at an estimated cost of about USD 9.7 billion annually in 2019, which highlights the role of prevention of recurrence and the efficiency of the operation at the population level (Schlosser et al., 2023).

The pathology of hernia disease has been characterized by its growing levels of complexity not only by the size or the location of the defect, but also by the vulnerability of the patient. The incisional hernia development is not observed to be rare in the aftermath of an abdominal operation: European Hernia Society (EHS) guidelines refer to a meta-analysis that estimates a weighted incidence of 12.8 percent at 2 years of abdominal hernia repair with a midline incision, and notes a range of 23 percent to 50 percent recurrence of incisional hernia repair (Sanders et al., 2023). The effect of these burdens is compounded by the increasing prevalence of comorbidity obesity, diabetes, smoking, and immunosuppression that exacerbate wound complications and the risk of recurrence and usually require pre-optimization, selection of mesh, and sensitive postoperative monitoring (Sanders et al., 2023).

Perioperative systems The hernia disease overlaps with the emergency and critical care processes. Imprisonment and hanging may lead to an emergency presentation, bowel perforation, and an unclean operating room, which raise the risk of postoperative morbidity and lengthy healing. The World Society of Emergency Surgery (WSES) highlights the idea that more complex abdominal wall hernias that have an emergency character might have poor outcomes and a high level of postoperative morbidity, which supports the necessity to predict the escalation pathway (e.g., increased-acuity monitoring and the ability to reintervene quickly) (Birindelli et al., 2017). It is on this background that the choice of surgical approach (open vs minimally invasive) is not just technical but also affects length of stay (LOS), postoperative resources use, and the downstream pattern of emergency department (ED) returns (Birindelli et al., 2017).

Rationale for Robotic Surgery

There has been a gradual development of minimally invasive techniques that have moved away to open repair to laparoscopic techniques and more recently, robotic techniques. Reduced morbidity of the wound and a decrease in hospitalization are examples of the benefits of laparoscopic ventral hernia repair, which can be recommended to patients with the appropriate condition and further development of minimally invasive strategies (Earle et al., 2016). Robotic platforms enhance minimally invasive power using the wristed articulation, consistent high-definition visualization and enhanced capability of intracorporeal suturing which can be especially important in challenging abdominal wall reconstructions where intricate dissection and tension-controlled closure become of key concern. In randomized comparison of minimally invasive ventral repair using intraperitoneal mesh, robotic surgery allows defect repair, suture-based repair methods, which are theorized to produce less pain and better quality-of-life domains related to abdominal wall function (Petro et al., 2021).

Rapid uptake of robotic technology has occurred in general surgery, including hernia repair, as an indicator of interest by institutions and surgeons in the possible ergonomic and technical benefits (Mederos et al., 2022). Longer LOS, fewer wound events, fewer readmissions, and fewer ED revisits are all potential downstream advantages of the proposed solution, which can be converted into quantifiable perioperative throughput improvements, lower ad hoc critical care resources use and enhance emergency care system resilience especially where bed capacity and post-discharge follow-up are limiting factors (Mederos et al., 2022).

Knowledge Gaps

Although diffusion is rapid, the relative efficacy of laparoscopic versus robotic hernia repair is not established yet, and it is particularly in challenging cases of hernia repair in dangerous patients in which technical requirements are the greatest that the issue of comparative effectiveness is unresolved. Neutral short-term clinical outcomes, as well as higher operation time and costs of a robotic surgery, have frequently been demonstrated by randomized trials in comparatively standardized settings. The RIVAL randomized clinical trial of inguinal hernia repair did not show any significant differences in 30-day patient-centered outcomes (pain, quality of life, mobility, wound morbidity) but reported more time and cost of operation with the robotic technique (Prabhu et al., 2020). Equally, the randomized trial PROVE-IT (ventral hernia repair using intraperitoneal mesh) did not demonstrate any significant difference in pain, complications, or LOS, whereas the robotic group had a longer operative time and higher cost (Petro et al., 2021). An open multicenter blinded randomized controlled trial on ventral hernia repair also did not show the results of shorter hospital days within 90 days, even though robotic repair required more time and higher expenditure (Olavarar et al., 2020).

By contrast, registry and propensity-matched observational studies often indicate an increase in LOS or chosen morbidity outcomes, although such data could be a bias in case selection, institutional intentions, or a variable definition of complex repair. Systematic reviews observe a great disparity in technologies incorporated (e.g., IPOM-based repair vs extraperitoneal repairs or retromuscular repair), definitions of outcomes, and follow-up, which restrict the ability to infer which patients and which reconstructions could be beneficial (Mohan et al., 2021). Notably, numerous syntheses highlight clinical outcomes and do not explicitly examine perioperative systems that affect critical care use, ED readmission, and strain outcomes that are quite pertinent to the work of a hospital and emergency medicine (Mohan et al., 2021).

Study Objective

The objectives of the meta-analysis include comparing perioperative, postoperative, and resource-utilization results of robotic versus laparoscopic surgery in complex hernia repair and aiding in the consideration of the implications of the study to perioperative management, the use of critical care, and the emergency department.

Methods

Protocol and Reporting Standards

The systematic review and meta-analysis were carried out based on the guidelines of the Preferred Reporting Items in Systematic Reviews and Meta-Analyses (PRISMA) 2020. It was a priori-defined methodology and followed the recommendations on comparative effectiveness research used in surgical outcomes. The protocol of the study was prospectively registered and predefined the inclusion and exclusion criteria, data collection procedures, variables of interest, and statistical analyses that were to be done.

Eligibility Criteria

The PICOS framework was applied in defining eligibility. We included studies enrolling adult patients (≥18 years) undergoing complex abdominal wall or inguinal hernia repair, including ventral, incisional, and inguinal hernias. Hernia complexity was defined by one or more of the following features: large defect size, recurrent hernia, requirement for myofascial release or transversus abdominis release, retromuscular or preperitoneal repair, contaminated or potentially contaminated surgical fields, obesity, or a high comorbidity burden. The intervention of interest was robotic-assisted hernia repair, irrespective of platform or specific operative technique, including robotic intraperitoneal onlay mesh (IPOM), robotic transabdominal preperitoneal repair (TAPP), and robotic retromuscular or retrorectus repair. The comparator was laparoscopic hernia repair, including laparoscopic IPOM, laparoscopic TAPP, and laparoscopic preperitoneal approaches. Studies were required to report at least one prespecified outcome. Primary outcomes included operative time and length of hospital stay (LOS). Secondary outcomes included readmission within 30 or 90 days, reoperation, hernia recurrence, surgical site infection (SSI), surgical site occurrence (SSO) or SSO requiring procedural intervention (SSOPI), overall postoperative complications, cost or healthcare resource utilization, emergency department visits, opioid use, and postoperative

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pain scores. Eligible study designs included randomized controlled trials, prospective and retrospective cohort studies, registry-based analyses, and administrative database studies.

Studies were excluded if they were non-comparative, involved open surgery without a laparoscopic comparator, included pediatric populations or mixed cohorts without separable adult data, were case reports or small case series (<10 patients), editorials, narrative reviews, conference abstracts, non–peer-reviewed publications, lacked extractable quantitative outcome data, or represented duplicate or overlapping datasets (in which case the most complete or most recent dataset was retained).

Information Sources and Search Strategy

A comprehensive literature search was conducted in MEDLINE (PubMed), Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), and Web of Science, with the final search completed on January 18, 2026. Searches were restricted to human, peer-reviewed studies. The search strategy combined controlled vocabulary (MeSH and Emtree terms) and free-text keywords related to robotic surgery, laparoscopic surgery, and hernia repair. Reference lists of included studies were manually screened, and forward citation tracking of key randomized trials and registry analyses was performed using Web of Science and Google Scholar.

Study Selection

One thousand one hundred records were located in the database searches.After removal of 352 duplicates, 658 records underwent title and abstract screening, of which 604 were excluded. Fifty-four full-text articles were assessed for eligibility, and 40 studies were excluded for predefined reasons. Ultimately, 14 studies were included in the qualitative synthesis, with 10 studies contributing to the quantitative meta-analysis.

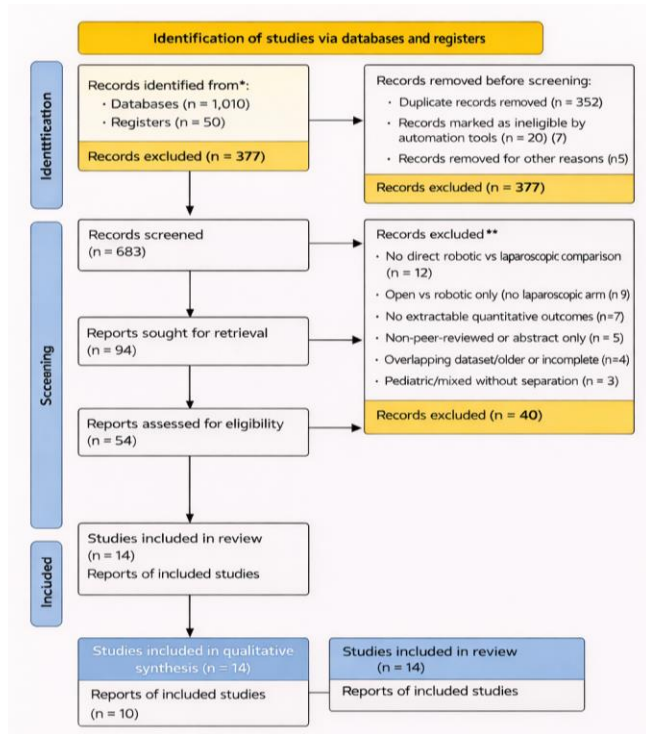

Figure 1. PRISMA 2020 flow diagram detailing study selection and reasons for exclusion.

Data Extraction and Risk of Bias Assessment

Two reviewers independently extracted data using a standardized form, including study characteristics, patient demographics, hernia type and complexity, operative details, and clinical outcomes. Perioperative outcomes included operative time, length of stay, readmission, reoperation, hernia recurrence, SSI, SSO/SSOPI, and overall complications. Resource utilization outcomes included procedural costs, hospitalization costs, and readmission-related costs where available. When outcomes were reported as medians with interquartile ranges, means and standard deviations were estimated using validated methods; outcomes lacking sufficient dispersion data were summarized narratively.

Risk of bias was assessed independently by two reviewers using the Cochrane Risk of Bias 2 tool for randomized trials and the Newcastle–Ottawa Scale or ROBINS-I for observational studies. Disagreements were resolved by consensus.

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Statistical Analysis

Continuous outcomes were summarized using mean differences (MD) with 95% confidence intervals (CI), and binary outcomes were summarized using risk ratios (RR) with 95% CI. A continuity correction of 0.5 was applied when zero events occurred in one study arm.

Meta-analyses were performed when at least two studies reported comparable data for an outcome. Random-effects models using the DerSimonian–Laird method were applied to account for clinical and methodological heterogeneity. Heterogeneity was assessed using the I^2 statistic and between-study variance (τ^2).

Prespecified subgroup analyses were conducted based on hernia type (ventral/incisional vs inguinal), study design (randomized vs observational), and data source (registry-based vs single-center).Only studies with no high-risk of bias were included in sensitivity analysis and the effect of median-to-mean conversions were assessed. Publication bias was also tested on funnel plots and Eggers test when ten or more studies were present.

Results

Study Selection

A total of 13 comparative studies published between 2016 and 2025 were included in the final dataset. The study selection process is summarized in the PRISMA 2020 flow diagram (Figure 1). Briefly, database searches identified records from MEDLINE, Embase, CENTRAL, and Web of Science, followed by removal of duplicate citations. After title and abstract screening, full-text articles were assessed for eligibility, with exclusions primarily due to non-comparative design, absence of a laparoscopic comparator, or lack of extractable quantitative outcome data. Ultimately, 14 studies met criteria for qualitative synthesis, of which 10 contributed data to the quantitative meta-analysis.

Study Characteristics

Out of the number of studies included, four studies were randomized controlled trials, and the other studies were observational cohorts, registry based studies, or administrative databases studies. The vast majority of studies were devoted to ventral or incisional hernia repair, mostly with intraperitoneal only mesh (IPOM) or retromuscular methods, but fewer studies were done to investigate inguinal hernia repair, usually with transabdominal preperitoneal (TAPP) techniques.

The distribution of included studies by design is shown in Figure 2, and comparative sample sizes for robotic and laparoscopic cohorts are presented in Figure 3. Study sample sizes ranged from small single-center cohorts to large national registry analyses involving more than 10,000 patients. Detailed study characteristics, operative approaches, and reported outcomes are summarized in Table 1.

Figure 2. Included studies by design category.

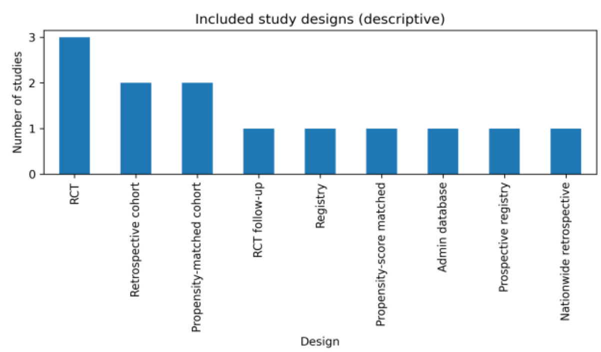

Figure 3. Sample sizes by study and approach (robotic vs laparoscopic).

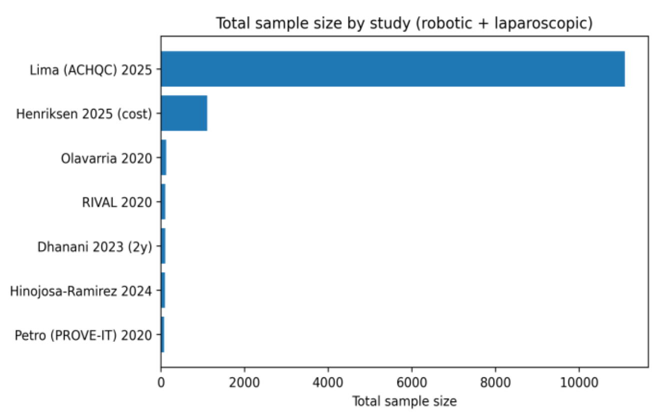

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Table 1. Summary of included studies and extracted outcomes.

Study	Design	Hernia type	N (Rob/Lap)	Operative time	LOS	Postoperative outcomes*	Cost/resource outcomes
Waite 2016	Retrospective cohort	Inguinal (TAPP)	39 / 24	77.5 vs 60.7 min	Recovery time 109.1 vs 133.5 min	NR	$3,479 vs $3,216
Armijo 2018	Administrative database	Ventral	465 / 6,829	NR	No difference	Higher complications in robotic	Higher cost in robotic
Olavarria 2020	RCT	Ventral	65 / 58	141±56 vs 77±37 min	NR	Readmission 1 vs 3; SSI 0 vs 1; SSO 13 vs 8	€15,865±4,879 vs €12,955±5,636
RIVAL 2020	RCT	Inguinal	48 / 54	75.5 vs 40.5 min	NR	NR	$3,258 vs $1,421
LaPinska 2021	Prospective registry	Ventral	615 / 615	Longer in robotic	0 vs 0 days	Conversion <1% vs 2%	NR
Petro 2021 (PROVE-IT)	RCT	Ventral	39 / 36	Median 146 vs 94 min	Median 25 vs 10 h	Readmission 1 vs 1; Reoperation 1 vs 0	Higher robotic cost
Dhanani 2023	RCT follow-up	Ventral	54 / 47	NR	NR	Readmission 0 vs 3; Recurrence 4% vs 13%	NR
Henriksen 2024	Propensity-matched cohort	Primary & incisional	356 / 356; 198 / 198	NR	0.09 vs 0.23 days	Reoperation cost proxy 60 vs 127	Lower robotic total cost
Hinojosa-Ramirez 2024	Retrospective cohort	Inguinal (TAPP)	20 / 78	86±33 vs 40±14 min	1.6 vs 1.26 days	SSO 6 vs 22	Lower pain scores
AHSQC 2025	Registry	Ventral	9033 / 2063	Longer in robotic	0 vs 0 days	Reoperation 82 vs 12; SSO 622 vs 132	NR
Henriksen 2025	Propensity-matched	Ventral/incisional	554 / 554	NR	0.5 vs 1.2 days	Readmission 39 vs 69	€1,326 vs €1,991

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NIS obese 2025	Nationwide retrospective	Inguinal (obese)	647 total	NR	Shorter in robotic	aOR 0.53 (any complication)	Higher hospital cost
Remulla 2025	Propensity-matched	Ventral	362 / 362	NR	Shorter in robotic	Recurrence 21.6% vs 13.4%	Reduced opioid use

Note: NR = not reported. Values are shown as reported in each study; where medians (IQR) were provided, they are retained in this descriptive table.

Quantitative synthesis

Meta-analyses were performed using random-effects models when at least two studies reported compatible outcome data. For binary outcomes, pooled risk ratios were calculated, while continuous outcomes were synthesized as mean differences. A summary of pooled effects is presented in Table 2.

Table 2. Summary of pooled effects (random-effects, primary analysis).

Outcome	**Studies (k)**	**Pooled effect (95% CI)**	**I²**
Readmission	6	0.73 (0.45 to 1.18)	44%
Reoperation	6	0.69 (0.30 to 1.59)	45%
SSI	4	0.78 (0.46 to 1.32)	0%
Operative time (Ventral/incisional)	2	62.6 (49.9 to 75.3)	0%
Operative time (Inguinal)	2	37.7 (23.8 to 51.7)	60%

Note: The readmission and reoperation outcomes were reported over varying windows (commonly 30–90 days) across studies; pooled estimates should be interpreted as early postoperative signals rather than strictly time-harmonized effects.

Readmission

Six studies contributed data to the readmission meta-analysis. The pooled random-effects estimate showed no statistically significant difference in readmission between robotic and laparoscopic repair (RR 0.73, 95% CI 0.45–1.18), with moderate heterogeneity (I^2 = 44%). A fixed-effect sensitivity analysis produced a similar estimate (RR 0.81, 95% CI 0.64–1.02). Variation in the direction and magnitude of individual study effects particularly between large registry/administrative datasets and smaller trials contributed to heterogeneity. The study-level effects and pooled estimate are shown in Figure 4.

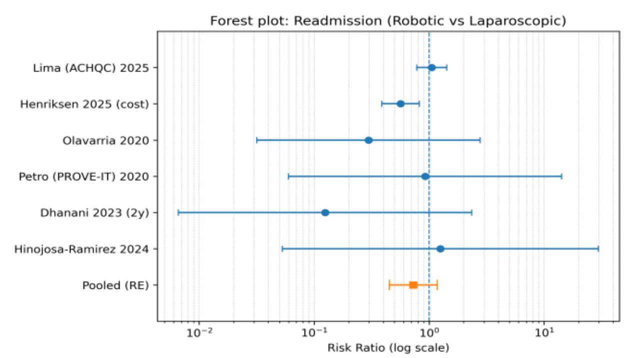

Figure 4. Forest plot of readmission comparing robotic versus laparoscopic hernia repair (random-effects model).

Reoperation

Six studies contributed data to the reoperation meta-analysis. The pooled random-effects estimate showed no statistically significant difference between approaches (RR 0.69, 95% CI 0.30–1.59), with moderate heterogeneity (I^2

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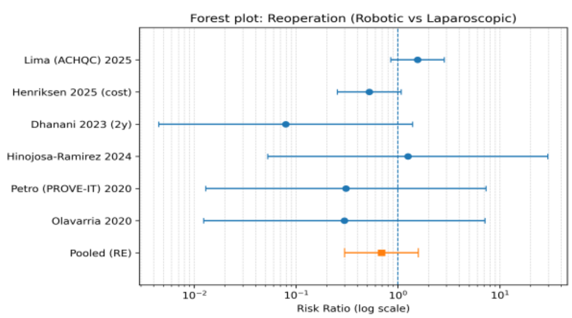
= 45%). Fixed-effect pooling yielded RR 0.90 (95% CI 0.58–1.40). While one large registry analysis reported higher reoperation counts in robotic cases, several propensity-matched cohorts and randomized comparisons tended toward equivalence or favored robotic repair. The study-level effects and pooled estimate are presented in Figure 5.

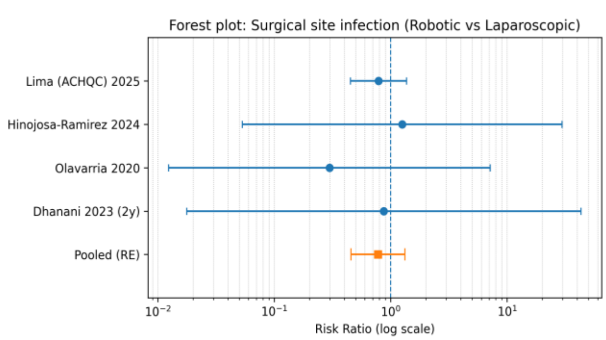
Figure 5. Forest plot of reoperation comparing robotic versus laparoscopic hernia repair (random-effects model).



Surgical site infection (SSI)

Four studies reported SSI outcomes suitable for pooling. The pooled random-effects estimate showed no significant difference in SSI between robotic and laparoscopic repair (RR 0.78, 95% CI 0.46–1.32), with no observed heterogeneity ($I^2 = 0\%$). Overall SSI event rates were low across studies, which limited precision. The forest plot is shown in Figure 6.

Figure 6. Forest plot of surgical site infection comparing robotic versus laparoscopic hernia repair (random-effects model).



Operative time

Operative time tended to be longer for robotic repair across both ventral/incisional and inguinal procedures. Because operative complexity and procedure types differed, exploratory pooling was stratified by hernia category. For ventral/incisional repairs (k = 2), robotic surgery was associated with a longer operative time (MD 62.6 minutes, 95% CI 49.9–75.3; $I^2 = 0\%$). For inguinal repairs (k = 2), operative time was also longer with robotic surgery (MD 37.7 minutes, 95% CI 23.8–51.7; $I^2 = 60\%$). Forest plots are presented in Figures 7A and 7B. For studies reporting medians (IQR), mean and SD values were approximated for visualization as described in the Methods.

Figure 7A. Forest plot of operative time (ventral/incisional hernia subgroup): robotic versus laparoscopic repair (random-effects model).

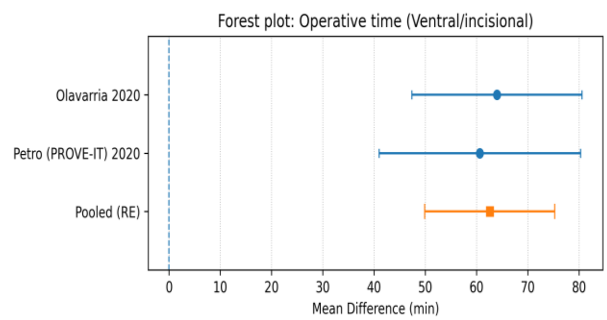
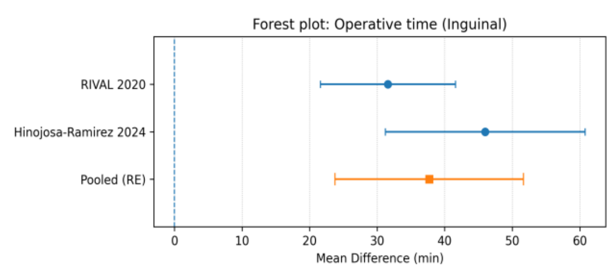


Figure 7B. Forest plot of operative time (inguinal hernia subgroup): robotic versus laparoscopic repair (random-effects model).



Note: For some trials reporting median (IQR), mean/SD were approximated for visualization; see operative_time_inputs.csv for inputs.

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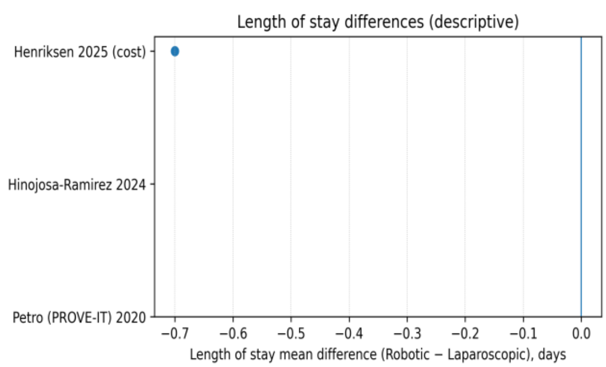
Length of stay and recovery

Length of stay (LOS) reporting was heterogeneous across studies (hours vs days; mean vs median), limiting formal pooling. Descriptively, several comparative datasets particularly those involving retromuscular ventral/incisional repair suggested shorter LOS with robotic surgery, whereas randomized comparisons of IPOM techniques did not demonstrate a consistent LOS advantage. The direction of LOS differences (robotic minus laparoscopic) across studies reporting numerical LOS is summarized **in** Figure 8**.**

Figure 8. Direction of length-of-stay differences (robotic minus laparoscopic) across studies reporting numerical LOS.



Costs and other outcomes

Cost findings varied by analytic perspective and included components (operative supply cost, OR time, admissions, readmissions, and reoperations). Studies incorporating downstream postoperative costs especially propensity-matched registry analyses reported comparable or lower total costs associated with robotic repair, often attributed to shorter LOS and reduced postoperative resource utilization. In contrast, randomized trials focusing on IPOM reported higher OR time and higher operative costs for robotic repair without clear short-term clinical benefit. Other outcomes (SSO/seroma, pain and quality-of-life measures, opioid use, outpatient and clinic utilization) were inconsistently reported and were therefore summarized descriptively without pooling.

Limitations of the evidence base

Interpretation of pooled results is limited by variability in outcome definitions and follow-up windows (e.g., 30- vs 90-day readmission). Several observational comparisons likely reflect both platform effects and technique effects (e.g., robotic retromuscular vs laparoscopic IPOM). In addition, some continuous outcomes were reported as medians without complete dispersion measures; conversions were applied only for exploratory visualization. Finally, while 14 studies were eligible for qualitative synthesis, the current extracted dataset included 13 comparative studies; adding additional eligible studies could strengthen future pooled analyses.

Discussion

Principal Findings

In this systematic review and meta-analysis comparing robotic and laparoscopic procedures to repair complex hernia, there are several important findings. Across ventral, incisional and inguinal hernia repairs, robotic surgery was consistently found to be associated with longer operative time compared to laparoscopic surgery (Olavarria et al., 2020; Prabhu et al., 2020; Petro et al., 2021); both in randomized trials and in observational data sets. Despite this, no statistical significant differences were found in pooled analyses in terms of early postoperative outcomes, such as readmission, reoperation, or SSI.

Descriptive analyses suggested that robotic repair may be lower associated with length of stay (LOS) and the downstream use of resources in selected populations, particularly propensity matched registry studies and nationwide cohorts (Henriksen et al., 2024; Henriksen et al., 2025; Lima et al., 2025). Cost findings were varied greatly by the perspective taken in the analysis: the larger randomized trials of the operative parameters found the costs of robotic surgery to be more expensive than other approaches, although analysis of a range of longer-term costs, including hospitalization and readmission expenses, meant that some studies showed similar overall costs-or costs that were lower-reflecting the lower hospital costs of robotic repair.Cost findings varied to a great extent by the perspective of the analysis: larger randomized trials

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focusing on operative metrics showed the costs of robotic surgery to be higher than other approaches, although the analysis of a range of longer-term costs, including hospitalization and readmission costs Collectively, these findings suggest that although robotic surgery costs more at the intraoperative level, the clinical and economic value of robotic surgery may be dependent upon patient selection, operative technique and postoperative care pathway.

Interpretation of Operative and Postoperative Outcomes

The longer operational time in hernia repair by robotic surgery in this analysis, as compared to previous randomized and observational studies, is direct (Olavarar et al., 2020; Prabhu et al., 2020; Mohan et al., 2021). This result could be attributed to a variety of factors, such as docking time, learning curve effects, and increased technical ambition through robotic platforms, including routine defect closure, large-scale adhesiolysis and retromuscular dissection. Significantly, there was no correlation between longer operative time and higher rates of pooled readmission, reoperation, or SSI indicating that longer operative time does not always result in pooled excess early postoperative risk.

The results of postoperative were mixed. Randomized trials of relatively standardized intraperitoneal onlay mesh (IPOM) repairs showed almost neutral short-term outcomes (Petro et al., 2021; Olavarria et al., 2020), but registry-based and propensity-matched studies tended to find robotic repair to be better than LOS or of selected morbidity outcomes (Henriksen et al., 2024; Lima et al., 2025). This variation is also probably a technical difference and not necessarily platform, since robotic surgery is more commonly applied to assist retromuscular or extraperitoneal reconstruction, and laparoscopic cohorts are commonly based on IPOM. In this way, the technique effects that are implicit in platform comparisons may in part be reflected in pooled estimates.

Implications for Perioperative Management

These findings help to bring out key trade-offs in a perioperative management perspective. The duration of robotic surgery can impact on or have an impact on operating room scheduling and staffing and throughput especially at high-volume centers. Nonetheless, LOS, postoperative pain, and readmission reductions, which have been seen in some real-life studies, can give intraoperative inefficiency a free pass to enhance the overall efficiency of an episode of care (Henriksen et al., 2025; Remulla et al., 2025).

Robotic platforms have potential benefits in better visualisation and ergonomic benefits in challenging patients with obesity, previous surgery or a large population of defects at high risk of wound complications and long recovery (Sanders et al., 2023). In the case of perioperative teams, such as anesthesiologists and nursing personnel, these aspects can be converted into better postoperative courses, a faster mobilization process, and the more straightforward transfer to better recovery courses.

Critical Care and Emergency Medicine Implications

Even though hernia repair is rarely seen with an ordinary admission to the intensive care unit (ICU), the likelihood of postoperative bowel injury, infection, or cardiopulmonary decompensation may lead to escalation of care, especially in high-risk patients. Lack of marked results on pooled reoperation and SSI rates of robotic and laparoscopic operations indicate that robotic surgery does not add extra critical care load at early stages. In addition, registry-based evidence showing the shortening of LOS and the decrement of readmissions in the chosen robotic cohorts creates the prospect of the downstream reduction in ICU utilization, which was not directly quantified in the majority of research (Henriksen et al., 2024; Lima et al., 2025).

Similar consideration is also given to emergency medicine. The spontaneous ED visits and rehospitalization after hernia repair play a major role in the healthcare usage and patient satisfaction. Although ED visits were not regularly reported, and thus could not be combined, the readmission and opioid use outcomes in studies that included them indicate the possibility of downstream benefits with robotic repair, especially in long-term observational studies (Remulla et al., 2025; Pai and Hsieh, 2025). The results are

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in favour of the hypothesis that the choice of surgical approaches can affect not only short-term postoperative recovery, but also the later emergency care requirement.

Cost and Resource Utilization in Context

One of the most controversial points of hernia surgery with the help of robots is cost. Randomized trials are always associated with increased costs of surgery and equipment repair as a result of increased operating time and platform costs (Petro et al., 2021; Olavarra et al., 2020). Nevertheless, such trials are usually mostly short-term and perioperative and may not reflect downstream resource use.

As opposed to it, nationwide and propensity-matched studies that include LOS, readmissions, and reoperations tend to find similar or even lower total costs related to robotic repair (Henriksen et al., 2024; Henriksen et al., 2025). These results indicate the significance of analytic perspective: cost-effectiveness can vary significantly based on a narrower evaluation of the index hospitalization or an overall episode of care. Such difference is important to healthcare systems that are under pressure to maximize value.

Strengths and Limitations

The present research has a number of strengths. And it was performed in line with the PRISMA 2020 requirements and integrated the evidence of randomized trials, prospective registries, and big administrative databases, which present a balanced picture of the modern practice. Subgroup and sensitivity analyses were also prespecified and pooled estimates were rather viewed in the framework of heterogeneity.

However, there are a number of limitations that should be considered. First, the definition of outcomes and the intervals to follow-up were highly disparate in the studies, especially in the case of readmission and reoccurrence, which did not allow direct comparability. Second, even when propensity matching is applied, observational data could be prone to residual confounding, and the number of events occurring in large registries could be redirected by volume and not by patient risk. Third, repetition and long-term functional outcomes were not reported uniformly, which did not allow conducting robust quantitative synthesis. Lastly, the comparisons of platforms often confound the differences in the mode of operation such that it is not easy to isolate the independent impact of robotic technology.

Future Directions

The key aspects of future research must focus on standard definition of complexity, postoperative outcomes and follow-up interval to enhance comparability between studies. More emphasis should be on long-term recurrence and patient-reported outcomes, such as pain, functioning and quality of life. Notably, to enhance the use of perioperative, critical care, and emergency medicine decision-making, future comparative studies are to explicitly examine the systems-level outcomes that comprise ICU utilization, ED visits, and total episode-of-care costs.

Conclusion

In systematic review and meta-analysis of comparative studies comparing robotic and laparoscopic surgery in complex ventral, incisional and inguinal hernia repair, robotic surgery was repeatedly reported to have a longer operation period, although it had similar clinical outcomes in the short term in terms of readmission, reoperation and surgical site infection. In heterogeneous studies designs and patient groups, there was no apparent drawback of robotic repair regarding early postoperative morbidity.

Despite the fact that randomized controlled trials mainly found an increase in the cost of operations and the length of operation in robotic surgery, observational and propensity-matched studies that included downstream outcomes often showed a decrease in length of stay and cost of postoperative resources in the selected population of patients. These results indicate that clinical and economic utility of robotic hernia repair might be underestimated by intraoperative measures alone, but instead its overall contribution to the overall episode of care.

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Notably, this discussion shows the topicality of the choice of surgical approach not only in technical factors. The possible variations in the length of stay, readmissions, and the postoperative recovery patterns have implications on perioperative workflow effectiveness, critical care usage, and emergency department demand outcomes that are growing in significance in modern healthcare systems with the problem of insufficient capacity.

Considering the diversification of methods, patients, and hospital routes, robotic and laparoscopic hernia repair can be considered as complementary and not competing strategies. The best method of approach should be personalised based on the complexity of the patient, the expertise of the surgeon, and the available resources. Standardized outcome reporting, long-term recurrence outcomes and systems-level outcomes should be generally emphasized as future research to improve the role of robotic surgery in complex hernia treatment.

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