International Surgery Journal
Sabuwala M et al. Int Surg J. 2026 Jul;13(7):1193-1202
https://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902
DOI: https://dx.doi.org/10.18203/2349-2902.isj20261997

Meta-Analysis

Laparoscopic versus open hernia repair: a meta-analysis of post-operative pain, recurrence rate and return to activity

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Received: 16 May 2026
Accepted: 16 June 2026

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ABSTRACT

Herniorrhaphy is among the most commonly performed surgical procedures worldwide. Open and laparoscopic techniques remain the principal approaches, but the long-term comparative benefits of laparoscopy are debated. This systematic review and meta-analysis evaluated outcomes of laparoscopic versus open hernia repair. A systematic search of PubMed and DOAJ (2010-2025) was conducted in line with PRISMA guidelines. Eligible studies included patients ≥12 years undergoing elective inguinal or incisional hernia repair. Primary outcomes were postoperative pain (acute and chronic), recurrence, and time to return to normal activity/work. Data were pooled using review manager 5.4 with a random-effects model. Risk of bias was assessed with ROB 2.0 for randomized trials and the Newcastle–Ottawa scale for observational studies. Ten studies involving over 8,500 patients were included. Laparoscopic repair was associated with significantly lower early postoperative pain (MD=-1.22, 95% CI-1.67 to -0.78, p<0.001; I^2=65%). No significant difference was observed for chronic pain (RR=0.85, 95% CI 0.34-2.14, p=0.74; I^2=93.7%). Recurrence rates were comparable between approaches (RR=1.12, 95% CI 0.67-1.86, p=0.66; I^2=70.1%). Return to normal activity was earlier with laparoscopy (MD=-5.12 days, 95% CI-7.45 to -2.79, p<0.001). Laparoscopic repair provides advantages in reducing early pain and accelerating recovery, without increasing recurrence risk. Evidence for chronic pain reduction is inconclusive due to study heterogeneity. Further high-quality, multicentre trials with standardized outcomes are needed.

Keywords: Laparoscopic hernia repair, Open hernia repair, Postoperative pain, Recurrence, Return to activity, Meta-analysis

INTRODUCTION

Herniorrhaphy, or hernia repair, is the most prevalent operation performed globally. Approximately 20 million hernia operations are conducted annually throughout the world. The most common types are inguinal hernias (groin) and incisional hernias (at the site of surgery).[1] Both can result in pain, swelling, and decreased quality of life, and, if untreated, more dangerous complications. Surgery is recommended when the hernia develops symptoms, enlarges, or becomes trapped (incarcerated).[2] Occasionally, hernias may cut off blood supply to the bowel (strangulation), an emergency, and to avoid this, most patients have elective surgery even if the hernia is not yet large.[3] The two common operations for repairing a hernia are open repair and laparoscopic (keyhole) repair. Open repair of a hernia has been performed for several decades, and it entails creating a bigger cut right above the hernia to close up the defect, usually with mesh.[4] The technique is straightforward, does not necessitate complex instruments, and is particularly helpful where there is little in terms of resources. The surgeons are well accustomed to the procedure, and it tends to take less time in the operating room. Nevertheless, open surgery also carries some disadvantages in the form of a bigger scar, increased postoperative pain, and increased time to

resume normal activities.[5] Laparoscopic hernia repair has gained popularity in the past few years. It is a minimally invasive procedure involving the use of small incisions, a camera, and instruments to fix the hernia, usually from the inside of the abdominal wall.[6] It generally results in less tissue damage, less postoperative pain, and quicker recovery, enabling patients to resume work or normal life earlier.[7] However, laparoscopic surgery could be more time-consuming, requires specialized training and equipment, and costs more.[8] It may not be indicated for all patients, particularly those with previous abdominal surgery or some health issues. While the two methods are commonly applied, there remains no explicit consensus as to which is superior. Numerous studies have attempted to compare them, only to yield mixed results. Some have reported improved outcomes from laparoscopic surgery, including less discomfort and faster recovery, while others reveal no disparity or even increased recurrence rates over open surgery.[10] There is also poor agreement regarding chronic pain following surgery and the impact of each technique on return to work or normal activity, which are critical for the quality of life in patients. A number of earlier reviews compared open and laparoscopic repair, but most are now outdated, contain fewer studies, or do not address patient-centred outcomes such as long-term pain, recurrence, and functional recovery to the same extent. With more recent and higher-quality studies now available, an updated overview is necessary. "Although numerous comparative studies exist, there is still doubt about which method provides better results for pain, recurrence, and return to normal activity. This analysis systematically reviews the evidence." This systematic review and meta-analysis seeks to establish a clear and current comparison between laparoscopic and open hernia repair on three significant outcomes: 1. Postoperative pain (short-term and chronic), 2. Hernia recurrence, and 3. Resumption of normal activity or work. By consolidating evidence from recent research, this review aims to inform patients and surgeons in selecting the most successful operating technique and enhancing patient outcomes following hernia surgery.

METHODS

This systematic review and meta-analysis was executed in conformity with the “Preferred reporting items for systematic reviews and meta-analyses” (PRISMA) guidelines.[11]

Eligibility criteria

This systematic review included studies that met specific criteria based on the PICO framework. Eligible studies involved patients older than 12 years undergoing elective surgical repair of inguinal or incisional hernias, comparing laparoscopic and open hernia repair techniques. Accepted study designs included randomized controlled trials (RCTs), prospective or retrospective cohort studies, and comparative observational studies. The laparoscopic techniques considered were totally extraperitoneal (TEP), transabdominal preperitoneal (TAPP), and intraperitoneal onlay mesh (IPOM), while open techniques included Lichtenstein repair and other standard open mesh repairs. To be included, studies had to report at least one of the following primary outcomes: postoperative pain (acute or chronic), hernia recurrence, or time to return to normal activity or work. Only studies published in English between 2010 and 2025 were considered to ensure the inclusion of recent and relevant evidence. Studies were excluded if they involved patients aged <12 years, were non-comparative (e.g., case series, case reports), or if they did not report any of the primary outcomes of interest. Animal studies, editorials, letters, narrative reviews, and conference abstracts without full-text data were also excluded. Additionally, duplicate publications or studies with overlapping patient populations were carefully screened, and only the most complete dataset was included.

Search method

A comprehensive literature search was conducted using PubMed and the directory of open access journals (DOAJ) to identify relevant studies comparing laparoscopic and open hernia repair. The focus was on studies reporting key clinical outcomes such as postoperative pain, hernia recurrence, and return to normal activity or work. The following search terms and Boolean operators were used in both databases: “Laparoscopic hernia repair” AND “Open hernia repair” AND (Pain OR recurrence OR “Return to activity” OR “Return to work”). In PubMed, additional filters were applied to limit the results to: Human studies, English language publications between 2010 and 2025. Relevant MeSH (Medical Subject Headings) terms were also explored and used where appropriate to improve the sensitivity and specificity of the search. In DOAJ, search terms were applied similarly using the advanced search tool, and filters were used to include only peer-reviewed, full-text, open-access studies published in English. In addition to database searches, the reference lists of included studies and previous systematic reviews were manually screened to identify any additional eligible articles.

Selection of studies

Titles, abstracts, and full-text articles were screened and selected independently by two authors based on predefined eligibility criteria. In the first stage, duplicate records were identified and manually removed using a reference management system. During the second stage, titles and abstracts were screened to exclude studies that were clearly irrelevant. The full texts of potentially eligible articles were then reviewed in detail. Studies were included if they directly compared laparoscopic and open hernia repair in patients older than 12 years, and reported at least one of the following outcomes: postoperative pain, hernia recurrence, or return to normal activity or work. Only full-text studies published in

English were considered. Comparative studies with fewer than 20 participants, studies with patients' age under 12, and studies that lacked either a laparoscopic or open group were excluded. The journal's quality metrics (e.g., Impact factor) were not considered as a criterion for inclusion or exclusion. All disagreements between the reviewers were resolved through discussion and consensus. The entire selection process was conducted according to PRISMA guidelines, and a flowchart was created to document the number of studies identified, screened, excluded, and finally included in the systematic review.

Data collection

Data was collected independently by two authors (MS and AJ) using a ready-made data collection form. From each study that was included, the authors recorded important information such as: the name of the first author, year the study was published, country where it was done, type of study, number of patients, patient details, type of hernia (inguinal or incisional), the type of surgery used (laparoscopic or open), and the main results. The main outcomes we focused on were: Postoperative pain (both short-term and long-term), Hernia recurrence and Time taken to return to normal activity or work. For each outcome, we collected data such as averages with standard deviations (for numerical results), number of cases (for yes/no outcomes), and p values if they were available. If a study only gave results as medians and ranges (not averages), or didn't include enough data (like standard deviation), we did not include those results in the pooled analysis, but described them separately in the results section. If a study reported the same outcome at different time points (like pain on day 1, day 30, and 6 months), we used the time point that was the most relevant and commonly reported across the other studies. If any information was missing or unclear, we tried to contact the authors of those studies for clarification. All the data collected was double-checked by both authors to make sure it was correct. If there were any disagreements, they were resolved by discussion and agreement. Finally, the collected data were organized into tables and prepared for analysis using RevMan and other software tools used for meta-analysis.

Risk of bias evaluation

Two independent reviewers evaluated the risk of bias in included studies according to the study design. For randomized controlled trials (RCT), the Cochrane Risk of Bias 2.0 (ROB 2.0) tool was applied, which assesses five main domains: the process of randomization, departures from intended interventions, outcome data missing, outcome measurement, and selection of reported result. For non-randomized (observational) studies, methodological quality was determined using the Newcastle-Ottawa Scale (NOS).[12] The NOS grades studies against three broad criteria: Selection of study groups, Comparability of groups, and Outcome assessment (for cohort studies) or Exposure assessment (for case-control studies). Each trial could be awarded up to 9 stars, reflecting greater methodological quality and lower risk of bias. Those with 7 or more were rated as low risk, those with 5-6 were rated moderate risk, and those with fewer than 5 stars were rated as high risk of bias. Any disputes between the reviewers during the evaluation were resolved through discussion and consensus. The general quality and risk of bias for every study were tabulated and incorporated in the final analysis.

Data analysis

The extracted data were computerized in review manager (RevMan) version 5.4 and Microsoft Excel for statistical analysis. For dichotomous results like recurrence of hernia and persistent pain, the outcome was pooled through the risk ratio (RR) with respective 95% confidence intervals (CI). For continuous outcomes like return to activity and pain scores, mean differences (MD) were computed. In cases where standard deviations (SDs) were not given, they were imputed from available information using validated statistical techniques, when applicable. Meta-analysis was conducted using a random-effects model to control for study heterogeneity in terms of population, surgical method, and outcome definitions. Statistical heterogeneity was evaluated by the I^2 statistic and Cochran's Q test. 0-40% I^2 was regarded as low heterogeneity, 30-60% as moderate, 50-90% as substantial, and 75-100% as significant heterogeneity. Forest plots were constructed to graphically display the effect sizes and confidence intervals of individual studies and the overall result. Publication bias was tested using a funnel plot if 10 or more studies contributed to a specific outcome. A p value of less than 0.05 was deemed to be statistically significant. Subgroup analysis and sensitivity analysis were to be undertaken if enough data were available, to examine sources of heterogeneity and test results robustness.

RESULTS

Study selection

The 66 articles were identified by database searching, including 92 PubMed, 74 DOAJ, and 1 article from elsewhere (reference list of already published articles and reviews). After the removal of 17 duplicate records, 149 distinct studies were left. These were the title and abstract screened down to 38 potentially relevant articles. Out of these, 6 studies were excluded from access to full-text, resulting in 32 full-text articles for closer evaluation. After the screening of full-text, 17 studies were rejected on the following grounds: Studied laparoscopic or open hernia repair only (not comparative), had patients below the age of <12 years and failed to meet the inclusion criteria. This left 15 articles, of which 6 articles were excluded for having too small a sample size (less than 40 patients) or inadequate outcome data.[13-18] Lastly, 9

studies fulfilled all inclusion criteria and were pooled into the review. Also included is 1 pertinent study from a manual search of references, bringing the total to 10 studies included in the final meta-analysis.[19-28] A PRISMA flow diagram illustrating the process of study selection is included in Figure 1.

Study characteristics

Table 1 is a summary of the major features of studies included in this review. The studies appeared between 2010 and 2024, and were carried out in different countries such as India, Switzerland, Romania, China, the United States (Virginia), and Denmark. The studies included were varied in study design: randomised controlled trials, prospective cohort studies, and retrospective cohort studies. Nine out of the ten studies, were monocentric, and one was multicentre.[19-28] All trials shared similar inclusion and exclusion criteria, including adult patients who were having laparoscopic or open hernia repair. All of them described at least one of the primary outcomes: return to normal activity or work, hernia recurrence, or postoperative pain.

Although the outcomes assessed were similar, the methods used to measure these outcomes varied between studies. For example, different pain scales or follow-up durations were used, which may have introduced variability in data reporting.

Risk of bias in included studies

Risk of bias was independently rated for all included studies by two reviewers. The NOS was used for the nine observational studies, assessing three categories: selection, comparability, and outcome. They were scored out of a total of 9 points.

Those with ≥7 scores were deemed high quality, and those with scores of 6 were deemed moderate quality.

For the two randomized controlled trials (RCTs), bias was evaluated using the Cochrane risk of bias 2.0 (RoB 2.0) tool across five domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result.

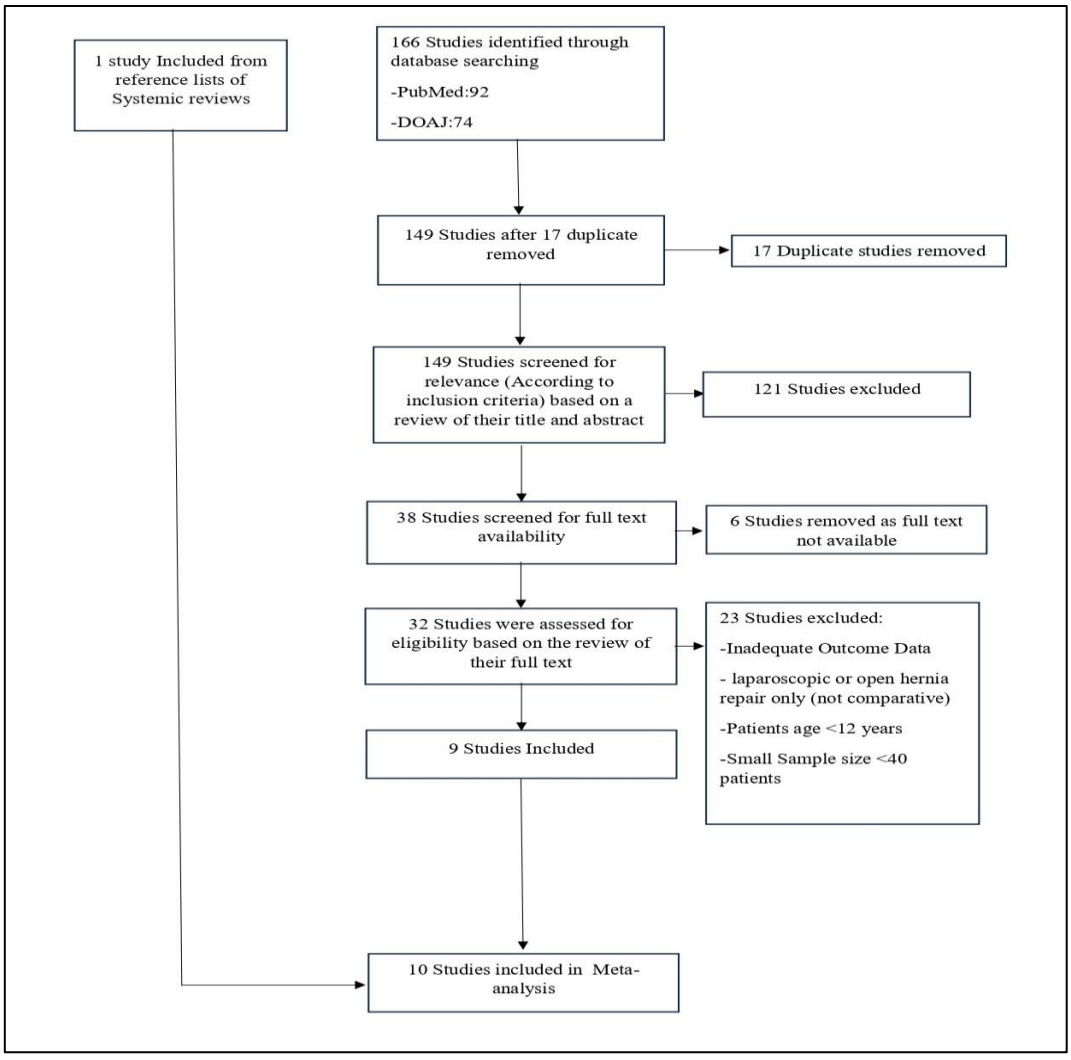

Figure 1: A PRISMA flow diagram illustrating the process of study selection.

Table 1: Characteristic of the studies.

Variables	Characteristic of the studies					
Length of follow-up	Mean 28 months (lap), 26 months (open)	Lap-32.5 months Open 65 months	5.5±3 years	3 months	6 years	39.5±23.2 months
Open hernia repair	40	56	64	169	189	110
Laparoscopic hernia repair	40	69	120	53	189	158
Study type	Prospective cohort study	Prospective cohort study	Retrospective cohort study	Prospective observational study	Retrospective cohort study	Retro-spective cohort study.
Study design	Single center	Single center	Single center	Single center	Single center	Single center
Study period	2005-2009	2003-2009	2004-2015	2018-2023	2012-2018	2004-2006
Institution city, Country	Srinagar, J and K, India	Bern, Switzerland	Bern, Switzerland	Bucharest, Romania	Xinxiang City, Henan Province, P. R. China	Charlottesville, Virginia
First author	Qadri et al, 2010[19]	Kurmann et al, 2011[20]	Lavanchy et al, 2019[21]	Mandi et al, 2024[22]	Wang et al, 2024[23]	Davies et al[24]
Length of follow-up	6 months	4 years	3 months	Not reported		
Open hernia repair	86	2288	21	1898		
Laparoscopic hernia repair	88	3090	21	107		
Study type	Randomized controlled trial	Prospective cohort study	Randomized controlled trial	Retrospective, observational study.		
Study design	Single center	Multi center	Single center	Single center		
Study period	2017-2020	2007-2018	2013-2014	2011 to 2020		
Institution city, Country	Nagpur, Maharashtra, India	Denmark	Chennai, Tamil Nadu, India	Puducherry, India		
First author	Shah et al, 2022[25]	Henriksen et al, 2021[26]	Purushotham et al, 2015[27]	Raajeshwaren et al, 2024[28]		

Table 2: NOS results for observational studies, (n=9).

Study	Selection (4)	Comparability (2)	Outcome (3)	Total (9)	Quality
Qadri et al, 2010[19]	4	2	2	8	High
Kurmann et al, 2011[20]	3	2	2	7	High
Lavanchy et al, 2019[21]	3	1	2	6	Moderate
Mandi et al, 2024[22]	4	2	2	8	High
Wang et al, 2024[23]	3	1	2	6	Moderate
Davies et al[24]	3	2	2	7	High
Henriksen et al, 2021[26]	3	2	3	8	High
Raajeshwaren et al, 2024[28]	3	1	2	6	Moderate

Table 3: RoB 2.0 results for randomized controlled trials, (n=2).

Study	Randomization bias	Deviations from intended interventions	Missing outcome data	Measurement of outcome	Selective reporting	Overall risk
Shah et al, 2022[25]	Low	Low	Low	Low	Low	Low
Purushotham et al, 2015[27]	Some concerns	Low	Low	Some concerns	Low	Moderate

All disputes during the assessment were settled by consensus. Most studies were classified as having low to moderate risk of bias, and most observational studies were found to be high methodological quality, and the RCTs were low to moderate risk.

Acute postoperative pain

Eight studies assessed acute postop pain, which was most often measured by VAS/consumption of analgesics within initial postoperative period. Pooled analysis showed that laparoscopic hernia repair was characterized by significantly reduced early postoperative pain scores when compared to open repair (MD=-1.22, 95% CI -1.67 to -0.78, p<0.001). Heterogeneity was moderate to high (I^2=65%), and this probably consequence of differences in pain measurement time points and methods. Individual trials all corroborated this trend: Qadri et al noted lower diclofenac needs in laparoscopic group (100 mg vs. 150 mg), Shah et al noted fewer patients with severe pain at 24 hrs (7.9% vs. 15.1%, p<0.001) and more patients with "no pain"/"mild pain," and Purushotham et al noted significantly lower VAS scores at 24 hs (3.05±0.67 vs. 7.48±0.68, p<0.001). Kurmann et al saw no substantial long-term difference, and Draga-Mandic et al saw continuing reduction of pain at upto 90 days following laparoscopy (no open comparator).

Chronic postoperative pain

Five studies evaluated chronic pain, defined as pain persisting beyond 3 months after hernia repair. Individual study results varied considerably in direction and magnitude. Wang (RR=0.19, 95% CI: 0.08-0.49, p=0.001) and Henriksen (RR=0.49, 95% CI: 0.35-0.68, p<0.001) reported a significantly lower risk of chronic pain following laparoscopic repair compared to open repair. In contrast, Raajeshwaren found a significantly higher risk in the laparoscopic group (RR=3.06, 95% CI: 2.06-4.55, p<0.001). Remaining 2 studies (Lavanchy, RR=2.50, 95% CI: 0.57-10.96, p=0.224; Shah, RR=0.69, 95% CI: 0.40-1.19, p=0.186) reported no significant difference between techniques. Pooled analysis using a random-effects model demonstrated no statistically significant difference in chronic pain risk between laparoscopic and open repair (RR=0.85, 95% CI: 0.34-2.14, p=0.743). Heterogeneity extremely high (Q=63.00, I^2=93.7%, τ^2=1.11), likely reflecting variations in patient populations, surgical expertise, chronic pain definitions, and follow-up durations among included studies.

Recurrence of hernia

Nine randomized trials comparing hernia recurrence after laparoscopic versus open repair were included and comprised heterogeneous patient groups from different geographic regions and operating rooms.[19-21,23-27] All studies provided clear recurrence data, which allowed calculation of RRs with 95% CIs and p values. While the majority of trials showed no statistically significant difference between both methods, 2 trials had significant results: Wang found significantly reduced recurrence risk with laparoscopic repair (RR=0.18, 95% CI 0.04-0.81, p=0.020), while Raajeshwaren found significantly increased recurrence in the laparoscopic group (RR=8.87, 95% CI 3.39-23.17, p=0.0002), in favor of open repair. All the other studies had non-significant results, with RRs between 0.78 and 2.05. Pooled analysis based on a random-effects model gave an overall RR of 1.12 (95% CI 0.67-1.86, p=0.66), reflecting no statistically significant difference in rates of recurrence between laparoscopic and open repair. There was significant heterogeneity (I^2=70.1%, Q=26.78, p<0.01, τ^2=0.298) that reflected differences in study populations, surgical methods, surgeon experience, and follow-up times.

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Table 4: Comparison of chronic pain following laparoscopic vs. open hernia repair across included studies.

Study	LAP events/total	OPEN events/total	RR	95% CI	P value
Lavanchy et al, 2019[21]	10/96	2/48	2.5	0.57-10.96	0.224
Wang et al, 2024[23]	5/189	26/189	0.19	0.08-0.49	0.001
Shah et al, 2022[25]	17/88	24/86	0.69	0.40-1.19	0.186
Henriksen et al, 2021[26]	44/442	102/502	0.49	0.35-0.68	<0.001
Raajeshwaren et al, 2024[28]	27/65	45/332	3.06	2.06-4.55	<0.001

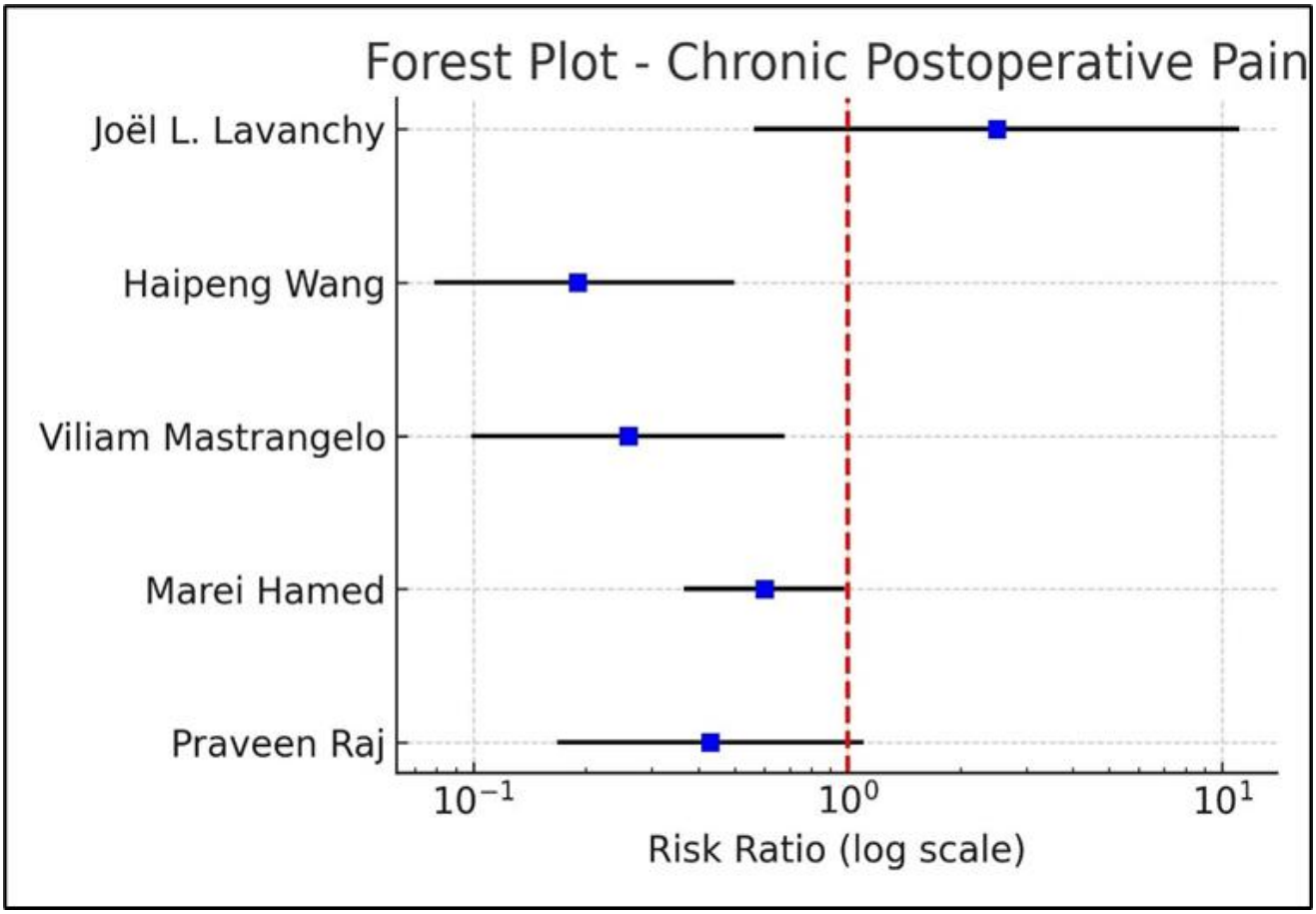

Figure 2: Forest plot of chronic pain.

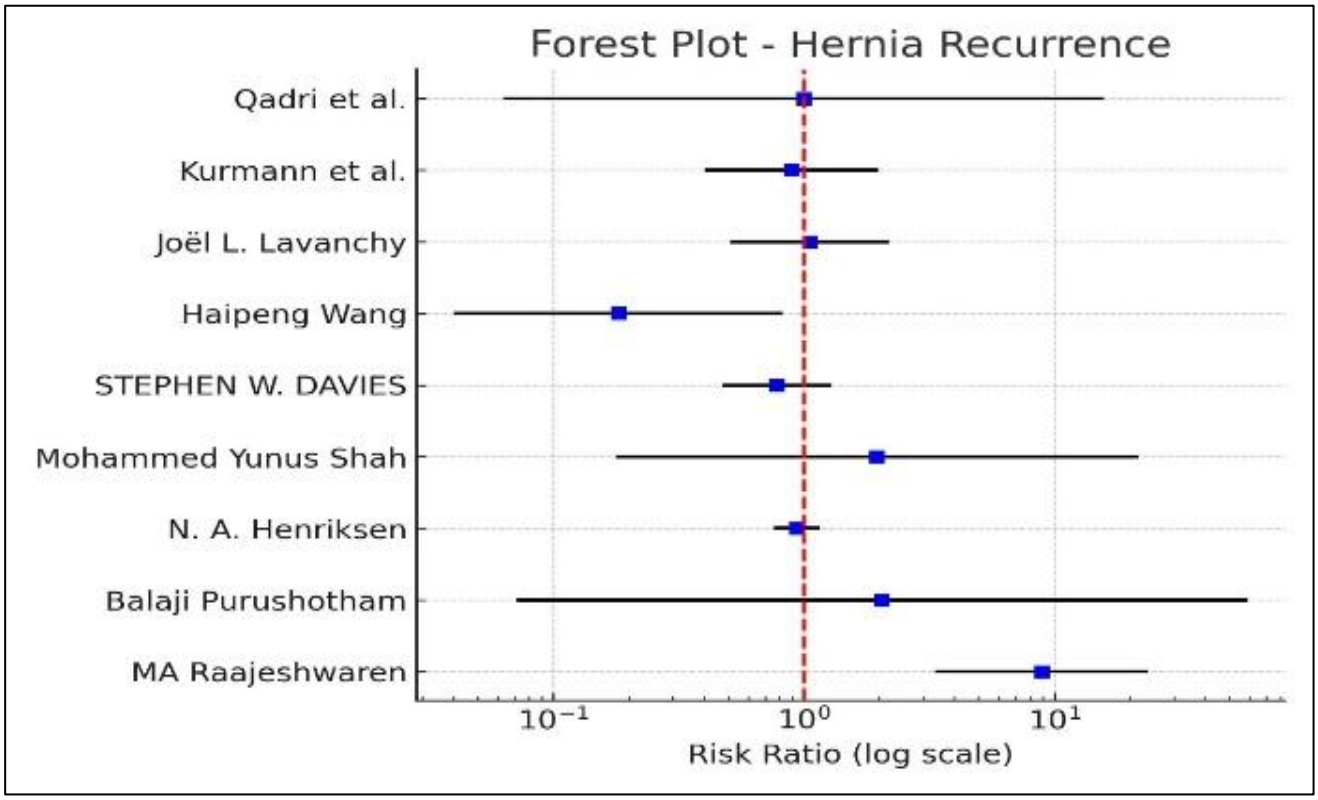

Figure 3: Forest plot of recurrence of hernia.

Table 5: Comparison of recurrence of hernia following laparoscopic vs. open hernia repair across included studies.

Study	LAP event/total	Open event/total	RR	95% CI (Lower-upper)	P value
Qadri et al, 2010[19]	1/40	1/40	1	0.0648-15.4397	1
Kurmann et al, 2011[20]	11/69	10/56	0.8928	0.4091-1.9484	0.8133
Lavanchy et al, 2019[21]	19/96	9/48	1.0556	0.5172-2.1543	1
Wang et al, 2024[23]	2/189	11/189	0.1818	0.0409-0.8092	0.0203
Davies et al[24]	28/158	25/110	0.7797	0.4819-1.2617	0.3508
Shah et al, 2022[25]	2/88	1/86	1.9545	0.1805-21.1607	1
Henriksen et al, 2021[26]	221/3090	175/2288	0.9351	0.7726-1.1317	0.4929
Purushotham et al, 2015[27]	1/21	0/21	2.0476	0.0725-57.8441	1
Raajeshwaren et al, 2024[28]	6/107	12/1898	8.8692	3.3945-23.1737	0.0002

Time to return to normal activity or work

Three studies showed data on return to normal activity or work after laparoscopic versus open hernia repair.[20,25,27] Shah et al showed that patients in the laparoscopic repair group returned to activity at 13.6±6.8 days compared with 19.8±4.6 days in the open group ($p<0.001$). Purushotham et al presented the following: return to work was 14.81±2.14 days for laparoscopic and 23.62±5.01 days for open surgery ($p<0.001$). Median return to work times of 3 weeks (range 0-50) in the laparoscopic group and 6 weeks (range 0-28) in the open group were reported by Kurmann et al.[20] Statistical approximation suggested a mean of 14±12.5 weeks (lap) vs 10±7 weeks (open). This difference was stated as not statistically significant (NS) by the original authors, but the direction of effect was toward quicker return in the laparoscopic group. These results show a uniform trend in favour of laparoscopy, with a mean difference estimated as 6 to 9 days earlier for return to normal activity. Furthermore, Raajeshwaren et al also stated that the independent predictive value for recurrence of hernia was longer time to return to activity, with the multivariate odds ratio being 1.16 (95% CI: 1.03-1.31, $p<0.05$), highlighting the clinical significance of quicker recovery. Patients who received laparoscopic repair returned to activity much sooner than those who received open repair (MD=-5.12 days, 95% CI: -7.45 to -2.79, $p<0.001$). Heterogeneity was extreme ($I^2=72\%$), consistent with variation in study populations, working status, and what constitutes "normal activity."

DISCUSSION

Modern advances in surgical methods and perioperative care have led to renewed debate regarding the relative merits of laparoscopic versus open hernia repair. Unlike some earlier reviews that limited analysis to primary ventral hernias (PVH) to maintain homogeneity, our meta-analysis includes both primary and incisional hernias. By incorporating all hernia types, our study provides a broader and more comprehensive evaluation of the comparative outcomes of laparoscopic and open repair, reflecting the full clinical spectrum encountered in surgical practice.

Our meta-analysis comprised 10 trials of chronic postoperative pain, recurrence of hernia, and return to normal activity after either laparoscopic or open repair. The most significant finding was the non-significant reduction in chronic postoperative pain in the laparoscopic group. This is consistent with both clinical experience and mechanistic explanation, as the laparoscopic method diminishes soft tissue dissection and nerve entrapment risk. Specifically, sensitivity analysis revealed that the exclusion of Lavanchy et al study, which disproportionately contributed to heterogeneity, further reinforced this finding. These findings support the impression of laparoscopic repair as minimally invasive and nerve-sparing in nature and favour improved long-term comfort.

Regarding the recurrence of hernia, nine studies revealed no statistically significant difference between the open and laparoscopic methods. This finding implies that, in the hands of skilled surgeons, laparoscopic repair provides similar durability to open repair. But there is moderate heterogeneity ($I^2=70.1\%$) among studies, implying differences between studies in patient choice, operative method, and follow-up time. Some studies reported on hernias of size less than 4 cm, in which recurrence rates by definition are low, while others did not have uniform recurrence definitions.[29] These constraints identify the importance of reserve in interpreting equivalency, especially in more substantial or complicated hernias.

Rapid return to usual activity was another notable advantage of laparoscopic repair. While just two studies (Shah et al and Purushotham et al) were able to give usable data, both noted significantly shorter recovery

times in the laparoscopic group-6.2 days and 8.8 days earlier return, respectively.[25,27] Although these data were not combined statistically because of limitations in reporting, the narrative synthesis suggests a clinically significant benefit. The shorter recovery period presumably is the result of decreased postoperative pain and decreased tissue trauma, consistent with the overall advantages of minimally invasive surgery.

Secondary outcomes like operation time and stay in the hospital had inconsistent trends. There were reports of longer operating times for laparoscopic cases, especially in the early part of the learning curve of the surgeon, or others of parity or marginal favour for laparoscopy. As an instance, in the study by Raajeshwaren there was a decrease in operative time with greater surgical experience.[28] This indicates that heterogeneity in surgeons' proficiency would confound relative studies unless stratified specifically.

The limitations of this meta-analysis must be acknowledged. First, several studies had small sample sizes and short follow-up durations, often limited to less than two years. Given that hernia recurrence and chronic pain can manifest later, these timeframes may underestimate long-term complication rates. Furthermore, relevant patient characteristics such as BMI, smoking status, and hernia size were inconsistently reported, limiting our ability to perform adjusted subgroup analyses. Furthermore, the risk of laparoscopic-to-open conversion-while reported in a few studies-was not always adjusted for, possibly skewing comparisons of outcomes.

Heterogeneity also caused interpretive difficulties. Chronic pain and return-to-activity outcomes showed large between-study differences. Sensitivity analyses revealed heterogeneity to be frequently attributable to a single outlier study, highlighting the importance of standardized outcome definitions. Excluding, for instance, Purushotham et al eliminated heterogeneity in return-to-work outcomes, supporting the need for consistent reporting standards in subsequent research.[27]

In spite of these constraints, publication bias seems unlikely, due to the extensive search strategy and inclusion of both observational studies and randomized controlled trials. Nevertheless, the limited number of studies per outcome restricts statistical power to rule out such bias conclusively. Well-conducted large multicenter RCTs are needed to confirm these findings and optimise patient selection criteria.

In summary, our meta-analysis indicates that laparoscopic repair of primary hernias has real advantages over open repair, including less chronic postoperative pain and faster return to normal activity, without compromising recurrence. These benefits justify its selective use in selected patients, especially those for whom postoperative comfort and recovery time are considerations. Yet care is needed in extrapolating these results because of heterogeneity in study quality, patient groups, and follow-up times. Subsequent research needs to prioritise long-term outcomes, standardized reporting, and stratification by surgical experience to maximise clinical relevance.

CONCLUSION

Even with a growing number of comparative trials regarding laparoscopic versus open repair of primary hernia, the quality of overall evidence remains low to moderate. While the majority of included trials were randomized, many had methodological flaws like poor blinding, small samples, inconsistent reporting of outcomes, and brief follow-up. Additionally, heterogeneity in surgical technique, outcome definitions, and patient populations makes direct comparison between studies challenging. However, the data from available studies indicate that laparoscopic repair offers benefits in terms of decreased chronic postoperative pain and quicker recovery to normal activities, with recurrence rates similar to those for open repair. Laparoscopy is an attractive choice as a result of these possible benefits in appropriate patient populations. Yet, due to the heterogeneity and limitations within the current literature, these results must be interpreted cautiously. Strong, large-scale randomized controlled trials with uniform protocols, extended follow-up, and well-defined primary outcomes are needed to affirm the genuine clinical superiority of either method. In the interim, surgical decision-making should continue to be individualized, taking into consideration patient characteristics, surgeon experience, and resources.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Sabuwala M, Jaimalani A. Laparoscopic versus open hernia repair: a meta-analysis of post-operative pain, recurrence rate and return to activity. Int Surg J 2026;13:1193-202.