

Evaluation of Postoperative Pain, Complications, and Recovery after Laparoscopic Versus Open Incisional Hernia Repair

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Abstract

Background: Open and laparoscopic repair are well recognized techniques for incisional hernia, but the relative impact on postoperative pain, wound morbidity, and functional recovery are clinically relevant when choosing an operative approach.

Objective: To compare early pain, peri-operative complications, hospital stay, functional recovery and recurrence at one year between laparoscopic and open incisional hernia repair.

Patients: 120 adults with primary or first recurrent midline incisional hernia (3-12 cm) were included in a prospective randomized comparative study, with 60 patients in each arm.

Methods: 120 adults with primary or first recurrent midline incisional hernia (3-12 cm) were included in a prospective randomized comparative study, with 60 patients in each arm. Pain was measured at 6 hours, postoperative day 1, day 3 and day 7 on a 10-point visual analogue scale (VAS). Complications, use of analgesics, length of stay, return to routine activity and recurrence at 12 months were recorded.

Results: There were no differences between baseline characteristics and defect size. Laparoscopic repair required longer operative time (96.4 ± 21.8 vs 82.1 ± 20.6 minutes, $p < 0.001$) but produced lower VAS pain on day 1 (4.1 ± 1.2 vs 5.6 ± 1.4 , $p < 0.001$) and day 3 (2.3 ± 1.0 vs 3.8 ± 1.2 , $p < 0.001$). Surgical-site infection occurred in 2/60 (3.3%) laparoscopic versus 8/60 (13.3%) open repairs ($p = 0.047$). Seroma rates were similar (10.0% vs 8.3%, $p = 0.752$). Mean hospital stay was shorter after laparoscopy (2.6 ± 1.1 vs 4.8 ± 1.7 days, $p < 0.001$), as was return to routine activity (14.8 ± 5.4 vs 24.6 ± 7.8 days, $p < 0.001$). There was no significant difference in one-year recurrence (5.0% vs 6.7%, $p = 0.697$).

Results: Laparoscopic repair was performed in selected incisional hernias, and was found to have less early postoperative pain, fewer wound infections, shorter hospital stay, and a more rapid functional recovery, with a similar short-term recurrence rate compared to open retromuscular repair.

Keywords: Incisional Hernia; Laparoscopic Repair; Open Repair; Postoperative Pain; Surgical-Site Infection; Recovery.

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Introduction

Incisional hernia is a common long-term complication of abdominal surgery and can lead to pain, limited mobility, cosmetic issues, bowel symptoms and re-hospitalization. Modern European Hernia Society recommendations focus on the repair tailored to the defect, patient risk, abdominal wall anatomy, and surgeon experience, and mesh is the foundation of treatment for most clinically significant midline incisional hernias [1]. The operative plane and access route are still significant as recurrence is only one part of the outcome, postoperative pain, wound events, recovery time, and quality of life are all factors that will affect the value of a repair. Laparoscopic repair

was developed to minimize the extensive soft-tissue dissection that is necessary with conventional open mesh repair. The potential advantages of minimally invasive access, such as reduced wound morbidity, have been outlined by the International Endohernia Society, with the risks associated with adhesiolysis, intraperitoneal mesh placement, and enterotomy also being recognised [2]. The evidence has been mixed and random. Eker et al. reported in a multicenter randomized trial that laparoscopic repair had less blood loss and fewer drains, but that some outcomes were not consistently better, such as pain and overall complications [3]. Similarly, Asencio et al. reported similar pain and one-year

recurrence, with local complications and operative time depending on technique and experience [4]. The results of systematic reviews have been generally favorable for laparoscopic ventral or incisional hernia repair, with a reduction in wound infection and shorter hospital stay, but no consistent benefit for recurrence or chronic pain. The variability of older trials is significant, as the onlay versus sublay approach to open repair, type of mesh used, fixation method, and definitions of complications all varied. In today's enhanced-recovery practice, patient-centered outcomes like time to comfortable ambulation, opioid analgesia cessation, and return to activity are particularly important.

The aim of this study was to compare laparoscopic and open incisional hernia repair, with the same perioperative pathway and prespecified early pain, complication, length of stay, functional recovery and one-year recurrence assessments. The hypothesis was that laparoscopic repair would decrease the early postoperative morbidity and promote faster recovery without increasing short-term recurrence.

Materials and Methods

This prospective randomized comparative study included adults aged 18-75 years with a symptomatic primary or first recurrent midline incisional hernia and a width of the transverse defect of 3-12 cm on clinical examination and ultrasonography or computed tomography. Patients were excluded if they had been strangulated or obstructed and required emergency surgery, lost domain, had an active infection of the abdominal wall, had an enterocutaneous fistula, cirrhosis with uncontrolled ascites, pregnancy, or more than one previous mesh infection, or if they were unable to complete follow-up.

Following confirmation of eligibility, 120 patients were randomly allocated to laparoscopic or open repair with a computer-generated random sequence, contained in sequentially numbered opaque envelopes. Antibiotics and thromboprophylaxis were given as per institutional protocol. Surgeons experienced in both procedures performed/supervised all procedures. In the laparoscopic group, an adequate landing zone was achieved by performing adhesiolysis, the fascial defect was closed when possible, and a composite intraperitoneal mesh was placed with a minimum of 5 cm of overlap and secured with transfascial

sutures and/or tack fixation. The open group was dissected, the posterior rectus plane was developed, the fascial defect was closed, and a lightweight polypropylene mesh was placed in the retromuscular plane with adequate overlap. Selectively closed-suction drains were used in the open group.

Both groups received the same multimodal postoperative analgesia, consisting of paracetamol and a nonsteroidal anti-inflammatory drug (NSAID) unless contraindicated, and intravenous or oral opioid rescue medication was documented. A 0-10 visual analogue scale (VAS) was used to assess pain intensity at 6 hours, 24 hours, day 3 and day 7. Patients were mobilized on the day of surgery or the first morning after surgery. Discharge criteria included sufficient oral intake, ambulatory, adequate pain control with oral medication, and no untreated complication.

Primary outcomes included VAS pain at 1 week after surgery and overall complications at 30 days after surgery. Secondary outcomes included operative time, estimated blood loss, analgesic use, surgical-site infection, seroma, hematoma, ileus, hospital length of stay, return to routine daily activity, return to work (among those who were employed), and hernia recurrence at 12 months. Recurrence was considered to be a palpable fascial defect or radiologic confirmation if the examination was unclear. The intention-to-treat principle was followed in statistical analysis. Independent-samples t tests or Mann-Whitney U tests were used to compare continuous variables, while chi-square or Fisher exact tests were used to compare categorical outcomes. Repeated pain measurements were also analyzed using a mixed-effects model with group, time, and group-by-time interaction. A p value of < 0.05 was deemed significant for two-sided tests.

Results

All 120 randomized patients underwent the allocated initial approach; two laparoscopic cases required limited conversion for dense adhesions and were retained in the laparoscopic group by intention to treat. Baseline characteristics were well balanced (Table 1). Mean age was 52.7 ± 11.4 years in the laparoscopic group and 53.9 ± 10.8 years in the open group. Mean defect width was 6.8 ± 2.1 cm and 6.6 ± 2.0 cm, respectively. Obesity, diabetes, smoking status, previous repair, and ASA class showed no statistically significant differences.

Table 1: Baseline characteristics

Characteristic	Laparoscopic (n=60)	Open (n=60)	p-value
Age, years	52.7 ± 11.4	53.9 ± 10.8	0.556
Male sex	34 (56.7%)	32 (53.3%)	0.713
BMI, kg/m ²	29.1 ± 3.8	28.7 ± 4.0	0.574
Diabetes mellitus	14 (23.3%)	16 (26.7%)	0.670
Current smoker	12 (20.0%)	13 (21.7%)	0.823
ASA class II/III	45 (75.0%)	47 (78.3%)	0.669
Recurrent incisional hernia	8 (13.3%)	9 (15.0%)	0.793
Defect width, cm	6.8 ± 2.1	6.6 ± 2.0	0.594

Operative and pain outcomes are summarized in Table 2. Laparoscopic repair took approximately 14 minutes longer on average but resulted in lower blood loss and less early pain. VAS scores differed most clearly at 24 and 72 hours; by day 7, pain had declined substantially in both groups, although the

laparoscopic group retained a modest advantage. Cumulative morphine-equivalent rescue analgesia during the first 48 hours was lower after laparoscopic repair. Patients in the laparoscopic group ambulated earlier and were discharged approximately two days sooner.

Table 2: Operative parameters and postoperative pain

Outcome	Laparoscopic	Open	p-value
Operative time, min	96.4 ± 21.8	82.1 ± 20.6	<0.001
Estimated blood loss, mL	48 ± 29	112 ± 61	<0.001
VAS pain at 6 h	5.2 ± 1.4	6.1 ± 1.5	0.001
VAS pain day 1	4.1 ± 1.2	5.6 ± 1.4	<0.001
VAS pain day 3	2.3 ± 1.0	3.8 ± 1.2	<0.001
VAS pain day 7	1.2 ± 0.8	1.8 ± 0.9	<0.001
48-h morphine equivalent, mg	14.6 ± 7.9	23.8 ± 10.6	<0.001
Time to ambulation, h	11.3 ± 5.2	18.9 ± 7.1	<0.001

Postoperative complications and recovery outcomes are shown in Table 3. Surgical-site infection was significantly less frequent after laparoscopic repair (3.3% vs 13.3%, $p=0.047$). Seroma was observed in six laparoscopic and five open repairs and was managed conservatively in most cases. Ileus, hematoma, and readmission were uncommon and did not differ significantly. Return

to routine activity occurred approximately 10 days earlier after laparoscopic repair. Among 78 employed participants, return to work was also earlier in the laparoscopic group. At 12 months, recurrence occurred in three laparoscopic and four open repairs (5.0% vs 6.7%, $p=0.697$). No mesh infection requiring explantation and no perioperative mortality occurred.

Table 3: Complications, recovery, and one-year outcomes

Outcome	Laparoscopic (n=60)	Open (n=60)	p-value
Surgical-site infection	2 (3.3%)	8 (13.3%)	0.047
Seroma	6 (10.0%)	5 (8.3%)	0.752
Hematoma	1 (1.7%)	3 (5.0%)	0.309
Postoperative ileus	2 (3.3%)	4 (6.7%)	0.402
30-day readmission	2 (3.3%)	3 (5.0%)	0.648
Hospital stay, days	2.6 ± 1.1	4.8 ± 1.7	<0.001
Return to routine activity, days	14.8 ± 5.4	24.6 ± 7.8	<0.001
Return to work, days*	21.7 ± 7.6	33.4 ± 10.2	<0.001
Recurrence at 12 months	3 (5.0%)	4 (6.7%)	0.697

Discussion

The main result of this study was that the laparoscopic approach to incisional hernia repair was associated with better early patient-centered outcomes than the open retromuscular approach. Patients who had laparoscopy had less pain in the first postoperative week, needed less rescue opioid, had fewer surgical-site infections, were discharged

earlier and were able to resume normal activity earlier. These benefits were obtained with a slight increase in the operating time. Importantly, there was no difference in one-year recurrence between groups, although the study was not powered to demonstrate long-term equivalence in recurrence. The clinically relevant reduction in early pain is clinically relevant as postoperative pain impacts on respiration, mobilization, discharge readiness and

return to normal activity. The Cochrane review by Sauerland et al. showed no consistent pooled difference in pain in the older randomized trials, but laparoscopy did show a decrease in wound infection and the duration of hospitalization [5].

The discrepancies between those trials and the present study could be due to variations in the size of the trocars used, the type of fixation, multimodal analgesia, defect closure, and enhanced recovery. The repeated measurements in the present showed that the biggest difference between groups was in the first 72 hours and that this gap had decreased by day 7, indicating that the benefit is mainly early recovery. Four times as many wounds became infected after open repair. This effect is similar to the meta-analysis by Zhang et al., who reported a significantly reduced wound infection rate for laparoscopic incisional and ventral hernia repair, and reported similar recurrence and several other postoperative complications [6]. The mechanism is feasible: laparoscopic access does not require extensive creation of subcutaneous flaps, and there is less direct contact between the prosthesis and the incision of the skin. This benefit may be especially important in obese patients, smokers and those with diabetes, where wound morbidity may result in extended treatment or infection of the mesh.

Long term and randomized literature also supports the finding of shorter hospitalization and earlier return to function after laparoscopy. Long-term follow-up of a randomized comparison was reported by Asencio et al. and there was no significant difference between the laparoscopic and open repair groups in terms of recurrence, reoperation, or global quality of life at long-term follow-up [7]. They found that early recovery benefits do not always mean a recurrence benefit in the long-term. Thus, the decision of approach should be based on the immediate recovery objectives as well as the anatomic needs for long-term abdominal wall reconstruction.

The International Endohernia Society recommends proper patient selection and technical standardization of the procedure, such as ensuring adequate overlap, placing the mesh in the correct location, performing a careful adhesiolysis and avoiding enterotomy [8]. The laparoscopic technique is not always the best choice. Dense adhesions, very large defects, loss of domain, the need for component separation, infected mesh, or the requirement for complex fascial reconstruction may favor an open or alternative minimally invasive retromuscular approach. Moderate-size defects, however, in patients with high risk of wound complications may be ideal for laparoscopy.

In the present study, the rate of seroma was comparable between the groups. Seroma is still a common occurrence following both laparoscopy

and laparotomy, and the incidence of seroma varies greatly depending on the level of imaging and what is considered clinically significant. In most cases in this study, the collections were not problematic. Routine aspiration of seromas without symptoms is important as it can lead to unnecessary puncture and the introduction of infection. In some patients, fascial defect closure and dead space elimination can help minimize seroma; the best technique is dependent on the defect anatomy and the position of the mesh. Laparoscopy was modestly longer than laparotomy, but did not result in delayed recovery. Comparative studies of ventral hernia repair in obese patients have shown similar findings, with a longer time to surgery but a decreased wound related morbidity using laparoscopic surgery [9]. The amount of adhesiolysis, previous mesh and fixation technique, and surgeon learning curve are also significant factors in operative duration. Thus, the efficiency of a procedure cannot be measured solely in terms of time.

A recent systematic review and meta-analysis of randomized trials found that there are no significant differences in the overall complication or recurrence rates between open and laparoscopic incisional hernia repair, but there were signals of superiority for laparoscopy in recovery and some quality-of-life measures [10]. The present results support this balanced interpretation. Laparoscopic repair is not a standard technique that can be applied to all patients, but when used in the appropriate patient, it has short-term benefits.

Further comparative evidence is provided to show the importance of considering outcomes within multiple domains and not just by recurrence. In a comparative controlled study, Olmi et al. reported that patients who had laparoscopic incisional hernia repair had a shorter hospital stay and earlier return to work [11]. In a systematic review by Pham et al., laparoscopic ventral hernia repair was found to generally decrease hospital length of stay and wound morbidity, but due to the heterogeneity of the techniques and study quality, definitive conclusions could not be drawn [12]. The PROLOVE randomized trial then compared surgical results and patient-reported quality of life after open and laparoscopic incisional hernia repair, highlighting the need for functional recovery in addition to the traditional surgical complications [13]. Castro et al. conducted another systematic review and meta-analysis, which also found a reduction in wound-related morbidity with laparoscopic ventral hernia repair, but with some variation between trials [14]. The most recent meta-analysis by Ajji et al. showed a decrease in surgical-site infection and shorter hospital stay with laparoscopy with no apparent recurrence penalty, but with significant heterogeneity in operative time

and length of stay [15]. These data are in line with the present results that the main benefit of laparoscopy is focused on early recovery and wound outcomes.

There are some limitations of this study. It was performed in one center and with surgeons who were experienced in both procedures, which may restrict the generalizability. Patients and surgeons could not be blinded, and pain is subjective. A 12 month follow up period is not enough to be sure of the recurrence as incisional hernia may recur several years after repair. The type of mesh and fixation was standardized within groups but not necessarily between groups and thus outcomes are not only based on access but on the entire operative approach. The number of patients was sufficient for common early outcomes but not uncommon events like enterotomy or mesh infection. More multicenter follow-up using validated hernia-specific quality-of-life instruments would enhance the evidence.

Conclusion

Laparoscopic repair resulted in less early postoperative pain, fewer surgical-site infections, fewer rescue analgesics, shorter hospital stay, and quicker return to normal activity compared to open retromuscular repair in adults with moderate-sized incisional hernias who were appropriate for either. Laparoscopy had a longer operative time, and seroma and recurrence at one year were similar. The surgical approach should be tailored to the complexity of the defect, patient comorbidities and local expertise, and long-term durability should be a key treatment goal.

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