

## Comparative Evaluation of Laparoscopic versus Open Ventral Incisional Hernia Repair

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### Abstract:

**Background:** Incisional hernia is a common complication following laparotomy, causing pain, functional limitation, and reduced quality of life. Both open and laparoscopic ventral hernia repairs are widely practiced, but comparative data on perioperative outcomes and recurrence remain limited.

**Aim:** To compare laparoscopic versus open ventral incisional hernia repair regarding operative parameters, postoperative pain, complications, recovery, and short-term recurrence.

**Methodology:** A prospective observational study was conducted on 186 patients undergoing elective ventral incisional hernia repair at Nalanda Medical College and Hospital, Patna, Bihar, India. Ninety patients underwent open repairs and 96 laparoscopic repairs. Data on demographics, operative findings, postoperative pain, complications, recovery, and six-month recurrence were collected and analyzed using SPSS v26.

**Results:** Baseline characteristics were comparable between groups. Laparoscopic repair had longer operative time ( $104.7 \pm 28.3$  vs  $78.4 \pm 20.6$  min,  $p < 0.001$ ) but lower blood loss ( $18 \pm 12$  vs  $65 \pm 40$  ml,  $p < 0.001$ ) and fewer drains placed. Postoperative pain scores were significantly lower in the laparoscopic group at all time points ( $p < 0.001$ ). Surgical site infections were reduced (5.2% vs 17.8%,  $p = 0.006$ ), and recovery was faster with earlier ambulation, oral intake, shorter hospital stay, and quicker return to work ( $p < 0.001$ ). Six-month recurrence rates were similar (8.3% vs 11.1%,  $p = 0.52$ ).

**Conclusion:** Laparoscopic ventral hernia repair offers reduced pain, fewer infections, faster recovery, and comparable short-term recurrence compared to open repair, making it a favorable minimally invasive option.

**Keywords:** Ventral incisional hernia, laparoscopic repair, open repair, postoperative pain, surgical outcomes, recurrence.

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### Introduction

One of the most common long-term complications of laparotomy abdominal surgery is incisional hernia. Although this has led to improvement in surgical practice, peri-operative management, and suture materials the fascial failure following abdominal closure is a major clinical problem [1]. Incisional hernia is an issue that occurs in general surgical practice as up to 30 percent of all patients who receive laparotomy develop it. This is not only an anatomical defect but a disorder with several functional and psychological effects [2]. Patients often complain of discomfort, persistent pain, respiratory limitations caused by abdominal wall dysfunction and unsatisfactory cosmetic outcomes, which significantly decrease the quality of life. The morbidity

associated with them usually requires secondary surgery i.e. hernia repair, which increases healthcare costs and subjects the patients to further operative risk [3].

In the past decades, there has been an increase in the number of improvements in the treatment of incisional hernia. Implementation of mesh reinforcement of the prosthesis, optimization of the surgical methods and improved knowledge on the physiology of wound healing have transformed much on the mode of treatment [4]. Nevertheless, with all these improvements, recurrence is the most difficult and frustrating post-repair problem. Recurrence has been reported to be high, 32 to 63 percent depending

upon patient characteristics, hernia size and surgical technique applied but, unfortunately, none of the risk factors can be consistently altered or completely eliminated to reduce recurrence and decrease post-operative morbidity [5].

The development of minimally invasive surgery at the beginning of the 1990s was a paradigm shift in the practice of surgery, and it opened the prospect of the laparoscopic repair of incisional hernias [6]. Since then, laparoscopy has already proved to have obvious advantages in a broad spectrum of surgical operations, such as less tissue damage, better visualization, and shortened time to recover after the surgery. It has been adopted as the present-day gold standard of various procedures including cholecystectomy [7]. Following these advantages in general, laparoscopic incisional hernia repair became popular and is currently regarded as a valid method of conducting operations, with the presumption that the proven beneficial effects of laparoscopy can also be applicable to the ventral and incisional hernia repair.

The clinical experience and observational studies have indicated a number of possible short-term benefits of laparoscopic repair over the conventional open repair. These are reduced blood loss, reduced perioperative complications, reduced postoperative pain, and reduced hospital stay [8]. Also, laparoscopic repair presents the advantage that it does not need large skin incisions, lower wound infection rates, and it provides a better opportunity of identifying several fascial defects using magnified vision. Nonetheless, short-term results seem encouraging whereas long-term outcomes like recurrence rates are not clear and are controversial. The evidence is of high quality, and level 1 randomized clinical trials that compare laparoscopic and open approaches are few [9]. That is why the actual supremacy of one or the other approach is not clear.

The traditional method of decades has been thought to be the open ventral incisional hernia repair. It provides access to the hernia sac directly, extensive adhesiolysis and the insertion of prosthetic mesh using different reinforcement methods including onlay, inlay, sublay, or component separation repair. Open repair is, however, linked to more serious tissue dissections, bigger operation wounds, more postoperative pain, more risk of wound infection, seroma, and longtime healing. Moreover, complications in the aftermath of the surgery can also be a predisposing factor, thereby initiating the process of repeated surgeries [10] itself.

On the contrary, laparoscopic ventral hernia repair utilizes small trocar incisions, intraperitoneal mesh use, and minimal soft tissue dissection. The methodology is theoretically effective in minimizing wound complications and maintaining abdominal wall arteries and nerves. Optimal visualization of occult defects with pneumoperitoneum could be used to

identify accurate mesh overlaps outside of the margins of the hernia defect, which could play a role in reducing recurrence. Further, the idea of mobilizing earlier on and quick recovery to normal life makes laparoscopic repair especially attractive in the contemporary surgical practice in which the recovery of the patient and consumption of resources by the hospital is an issue of paramount concern.

Although such theoretical and practical benefits are observed, the laparoscopic repair is still of concern. These comprise risk of bowel damage in adhesiolysis, technical difficulty in large and complex defects, cost of special composite meshes and concerns with long-term durability. Also, the length of operative time can differ based on the experience of surgeons and complexity of cases. Thus, the two procedures should be critically assessed in controlled clinical conditions and not based only on observational or retrospective data.

The fact that the debate concerning the anticipated merits of laparoscopic and open incisional hernia repair is still on-going is indicative of the necessity of the scientific comparison to be conducted rigorously. The question that needs to be answered by the surgeons is whether laparoscopy enhances short-term recovery at the expense of long-term recovery in terms of recurrence or whether it offers better results overall. It is thus necessary to have a level 1 randomized controlled trial that will objectively compare the two techniques of surgery and give evidence-based recommendations.

This study sets out to compare laparoscopic and open ventral incisional hernia repair in terms of post-operative pain/nausea, the length of the operation, blood loss, perioperative and postoperative complication, the length of stay and the rate of recurrence. This study attempts to demystify the superiority of laparoscopic repair over open repair as per patient recovery, surgical safety and effectiveness in the long run through a systematic analysis of these parameters.

### Methodology

**Study Design:** This study was designed as a prospective comparative observational study to evaluate and compare the outcomes of laparoscopic versus open ventral incisional hernia repair. Patients undergoing elective ventral incisional hernia repair were allocated into two groups depending on the surgical technique performed: laparoscopic repair group and open repair group.

**Study Area:** The study was carried out in the Department of General Surgery, Nalanda Medical College and Hospital, Patna, Bihar, India.

**Study Duration:** The study was conducted over a period of one year from February 2024 to January 2025.

**Sample Size:** A total of 186 patients diagnosed with ventral incisional hernia and planned for elective repair were included in the study. Among them, 90 patients underwent open mesh repair and 96 patients underwent laparoscopic mesh repair. Patients were consecutively recruited during the study period until the desired sample size was achieved.

**Study Population:** The study population consisted of adult patients attending the surgical outpatient department or admitted to surgical wards with a diagnosis of ventral incisional hernia. Only patients planned for elective repair and deemed fit for anesthesia were considered eligible for inclusion in the study.

**Data Collection:** Data were collected prospectively using a structured predesigned proforma. Preoperative data included demographic characteristics, body mass index, comorbid conditions such as diabetes mellitus and hypertension, size of hernia defect, type of hernia (primary or recurrent), duration of swelling, and history of previous abdominal surgery. Intraoperative details recorded included type of procedure performed, operative time, requirement of adhesiolysis, mesh placement technique, and intraoperative complications. Postoperative parameters recorded included pain score using visual analog scale, requirement of analgesics, postoperative complications such as seroma, wound infection and ileus, duration of hospital stay, time to ambulation, and recurrence during follow-up. Patients were followed at 3 days, 1 week, 4 weeks, 3 months and 6 months postoperatively.

#### Inclusion Criteria

- Age  $\geq$  18 years
- Ventral incisional hernia with defect size 3–15 cm
- Elective surgical repair indicated
- Fit for anesthesia
- Provided written informed consent

#### Exclusion Criteria

- Contraindication to general anesthesia
- Contraindication to pneumoperitoneum
- Obstructed or strangulated hernia requiring emergency surgery
- Active intra-abdominal infection
- Previous open abdomen management
- Patients unwilling to participate

**Procedure:** All patients were admitted and evaluated preoperatively with routine laboratory

investigations and anesthetic assessment. The choice of surgical technique was made by the operating surgeon.

In laparoscopic repair, surgery was performed under general anesthesia. Pneumoperitoneum was created using a Veress needle or open technique and 3 to 5 trocars were inserted. Adhesiolysis was performed when necessary and the hernia contents were reduced without excision of the sac. A composite mesh was placed intraperitoneally with at least 5 cm overlap beyond the margins of the defect and fixed using tackers and transfascial sutures.

In open repair, an incision was made over the previous scar and the hernia sac was exposed and reduced. Mesh was placed in preperitoneal or sublay plane with adequate overlap and fixed using polypropylene sutures. Drains were placed when required and layered closure was performed.

Postoperatively, patients received analgesics including paracetamol and non-steroidal anti-inflammatory drugs, with opioids administered if necessary. Early ambulation and oral feeding were encouraged. Patients were discharged once they were ambulatory and clinically stable.

**Statistical Analysis:** All collected data were entered into Microsoft Excel and analyzed using SPSS software version 26. Continuous variables were expressed as mean and standard deviation while categorical variables were expressed as frequencies and percentages. Independent t-test was used for comparison of continuous parametric variables and Mann-Whitney U test for non-parametric variables. Chi-square test or Fisher's exact test was applied for categorical variables. Repeated measures analysis of variance was used to compare pain scores at different follow-up intervals. A p-value less than 0.05 was considered statistically significant."

#### Result

Table 1 presents the baseline characteristics of patients undergoing open versus laparoscopic hernia repair. The two groups were comparable in terms of age ( $52.8 \pm 11.4$  vs  $50.9 \pm 12.2$  years,  $p = 0.28$ ), sex distribution (male 60.0% vs 60.4%), BMI ( $27.9 \pm 3.6$  vs  $27.4 \pm 3.8$  kg/m<sup>2</sup>,  $p = 0.37$ ), and comorbidities including diabetes mellitus (24.4% vs 20.8%,  $p = 0.56$ ) and hypertension (31.1% vs 27.1%,  $p = 0.54$ ). The proportion of primary versus recurrent hernias and mean defect size were also similar between the groups, indicating well-matched cohorts for comparative analysis.

Variable	Open Repair (n=90)	Laparoscopic Repair (n=96)	P value
Mean Age (years)	52.8 ± 11.4	50.9 ± 12.2	0.28
Male	54 (60.0%)	58 (60.4%)	0.95
Female	36 (40.0%)	38 (39.6%)	
Mean BMI (kg/m <sup>2</sup> )	27.9 ± 3.6	27.4 ± 3.8	0.37
Diabetes Mellitus	22 (24.4%)	20 (20.8%)	0.56
Hypertension	28 (31.1%)	26 (27.1%)	0.54
Primary Hernia	64 (71.1%)	70 (72.9%)	0.78
Recurrent Hernia	26 (28.9%)	26 (27.1%)	
Mean Defect Size (cm)	6.3 ± 2.4	6.1 ± 2.2	0.63

Table 2 summarizes the operative findings comparing open and laparoscopic surgery. Laparoscopic procedures had a significantly longer mean operative time (104.7 ± 28.3 min) than open surgery (78.4 ± 20.6 min,  $p < 0.001$ ) but were associated with markedly lower blood loss (18 ± 12 ml vs 65 ± 40 ml,  $p < 0.001$ ). Adhesiolysis was more frequently

required in laparoscopic cases (59.4% vs 42.2%,  $p = 0.02$ ), whereas drain placement was much less common (6.3% vs 45.6%,  $p < 0.001$ ). Additionally, 5 laparoscopic cases (5.2%) were converted to open surgery. These results indicate that laparoscopic surgery, despite longer duration, is less invasive with reduced blood loss and fewer drains.

Parameter	Open (n=90)	Laparoscopic (n=96)	P value
Operative Time (min)	78.4 ± 20.6	104.7 ± 28.3	<0.001
Blood Loss (ml)	65 ± 40	18 ± 12	<0.001
Adhesiolysis Required	38 (42.2%)	57 (59.4%)	0.02
Drain Placement	41 (45.6%)	6 (6.3%)	<0.001
Conversion to Open	—	5 (5.2%)	—

Table 3 illustrates the postoperative pain scores (VAS) for open versus laparoscopic surgery. Patients in the open surgery group consistently reported higher pain at all time points: Day 1 (6.9 ± 1.2 vs 5.4 ± 1.3), Day 3 (5.8 ± 1.4 vs 4.2 ± 1.2), 1

week (3.9 ± 1.2 vs 2.6 ± 1.1), and 4 weeks (1.8 ± 0.9 vs 1.3 ± 0.8), with all differences statistically significant ( $p \leq 0.002$ ), indicating that laparoscopic surgery was associated with significantly less postoperative pain.

Time Interval	Open	Laparoscopic	P value
Day 1	6.9 ± 1.2	5.4 ± 1.3	<0.001
Day 3	5.8 ± 1.4	4.2 ± 1.2	<0.001
1 Week	3.9 ± 1.2	2.6 ± 1.1	<0.001
4 Weeks	1.8 ± 0.9	1.3 ± 0.8	0.002

Table 4 shows the postoperative complications in open versus laparoscopic surgery. Surgical site infections were significantly higher in the open group (17.8%) compared to the laparoscopic group (5.2%,  $p = 0.006$ ), while other complications such as seroma, hematoma, ileus, mesh infection, and

chronic pain were not statistically different between the groups. Overall complication rates were 36.7% for open surgery and 25.0% for laparoscopic surgery, with the difference approaching but not reaching statistical significance ( $p = 0.08$ ).

Complication	Open (n=90)	Laparoscopic (n=96)	P value
Seroma	11 (12.2%)	14 (14.6%)	0.64
Surgical Site Infection	16 (17.8%)	5 (5.2%)	0.006
Hematoma	6 (6.7%)	4 (4.2%)	0.47
Ileus	5 (5.6%)	3 (3.1%)	0.4
Mesh Infection	4 (4.4%)	1 (1.0%)	0.18
Chronic Pain (>3 months)	12 (13.3%)	7 (7.3%)	0.17
Overall Complications	33 (36.7%)	24 (25.0%)	0.08

Table 5 summarizes the recovery outcomes, showing that patients in the laparoscopic group had significantly faster recovery compared to the open surgery group. Time to ambulation was  $12.1 \pm 4.5$  hours versus  $22.4 \pm 6.2$  hours, time to oral feeding was  $14.3 \pm 5.2$  hours versus  $24.7 \pm 7.1$  hours, hospital

stay was  $3.2 \pm 1.4$  days versus  $5.6 \pm 2.1$  days, and return to work occurred at  $10.7 \pm 5.1$  days versus  $18.4 \pm 6.8$  days for laparoscopic and open groups, respectively, with all differences being statistically significant ( $p < 0.001$ ).

Outcome	Open	Laparoscopic	P value
Time to Ambulation (hours)	$22.4 \pm 6.2$	$12.1 \pm 4.5$	<0.001
Oral Feeding (hours)	$24.7 \pm 7.1$	$14.3 \pm 5.2$	<0.001
Hospital Stay (days)	$5.6 \pm 2.1$	$3.2 \pm 1.4$	<0.001
Return to Work (days)	$18.4 \pm 6.8$	$10.7 \pm 5.1$	<0.001

Table 6 shows the 6-month recurrence rates after surgery, with 11.1% (10/90) of patients in the open surgery group and 8.3% (8/96) in the laparoscopic group experiencing recurrence, while 88.9% and

91.7% had no recurrence, respectively. The difference between the groups was not statistically significant ( $p = 0.52$ ).

Outcome	Open (n=90)	Laparoscopic (n=96)	P value
Recurrence	10 (11.1%)	8 (8.3%)	0.52
No Recurrence	80 (88.9%)	88 (91.7%)	

**Discussion**

Our study shown laparoscopic ventral incisional hernia repair is a longer procedure, but has benefits of reduced postoperative pain, surgical site infections, speed of recovery and a shorter hospital stay as compared to open repair. The average laparoscopic repair time in our group was much higher in comparison with the open surgery, which is consistent with numerous findings in the literature. The study conducted by Olmi et al. (2007) [8] revealed that laparoscopic operative time used was longer than the open repair, and it was noticed that adhesiolysis and the time needed to get the mesh in place and fix it were major contributors to the difference in the two. On the same note, Misra et al. (2006) [9] found that laparoscopic operation time was longer especially when dealing with larger hernias but that this did not have a negative influence on clinical outcome. Conversely, other experiments, like Carbajo et al. (1999) [11] and Navarra et al. (2007) [12] have indicated that laparoscopic repair takes a shorter duration to operate, implying that the time difference can be countered with experience and standard procedures amongst surgeons. These results of contrast show that the time of the operation is highly situational and depends on such factors as the size of the hernia, the number of past abdominal operations, and the ability to work with the laparoscopic methods.”

blood loss during laparoscopic operations because of smaller incisions and minimal tissue dissection. Another signifier of surgical trauma is draining placement, which was much less common in the laparoscopic group, indicating lower serous fluid accumulation, and which is also supported by Misra et al. (2006) [9]. The decreased requirement of the drains does not only lead to less patient pain but can also be associated with the possibility of shorter patients staying at hospitals, as well as an earlier mobilization.

Our study showed that there was a significant lessening of the intraoperative blood loss in laparoscopic group, which was reported in previous studies highlighting the minimally invasive laparoscopic surgery. The same was indicated by Barbaros et al. (2007) [13] and Forbes et al. (2009) [10] citing lesser

In our series laparoscopic groups were always at a lower risk of postoperative pain and significant changes were noted at all times. This is in line with various research indicating the advantages of laparoscopy on early pain management. The postoperative pain scores and analgesic requirements were also reduced in similar numbers Olmi et al. (2007) [8] and Carbajo et al. (1999) [11]. Yet, in other studies, such as that of Barbaros et al. (2007) [13], there were no statistically significant differences in pain between laparoscopic and open repair, something that indicates that the perception of pain might depend upon such aspects as the use of tackers or trans fascial sutures to fix the mesh, rather than the method used (Topart et al., 2005) [14]. Our results, then, were in line with the idea that laparoscopy is less traumatizing to the tissues and the pain experienced at the time of the wound, whereas fixation procedures continue to be a significant factor that determines the pain syndrome after the operation.

The prevalence of complications in our study was generally lower in the laparoscopy group where the prevalence of surgical site infections was significantly low. This result coincides with the earlier

meta-analyses and randomized trials (Forbes et al., 2009; Olmi et al., 2007) [10,8] that documented less mishap related to the wound because of a small cut on the skin and reduced exposure of the tissue underneath the skin. Seroma, hematoma, ileus, mesh infection and chronic pain rates in the laparoscopic group were numerically lower but were not statistically significant compared to the Reticulated Group and the same has been observed by Misra et al. (2006) [9]. It is important to note that in our series, 5.2 percent of laparoscopic cases were converted to open surgery, which is similar to the rates reported in previous studies and indicates the practicability of laparoscopy even in complicated hernias (LeBlanc & Booth, 1993) [15].

Laparoscopy was a strong favorite in recovery, earlier mobilization, and earlier oral intake, reduced length of hospitalization, and faster-than-noted return to work. Such results support the findings reported by Olmi et al. (2007) [8] and Carbajo et al. (1999) [11] who proved that minimally invasive techniques help to recover faster the functions. In our group, the length of stay in the hospital was greatly reduced among laparoscopic groups, in other studies like Barbaros et al. (2007) [13], the length of stay was quite the same in both groups, probably because of the institutional protocols or comorbidity of the patients.

6-month recurrence rates were low and not different between the groups showing that hernia repair is effective no matter the method. This is in line with a wide range of literature that has indicated that laparoscopic and open repairs of the mesh have similar recurrence rates over a short-term to medium time (Burger et al., 2004; Olmi et al., 2007) [16,8]. Though some previous studies have described recurrence rates as high as 20% after mesh repair (Hesselink et al., 1993) [17] some of ours were 14% in the laparoscopic and 18% in the open group, which are lower than in the studies that have been conducted recently. Such discrepancies can be attributed to thorough follow-up and clinical evaluation, as they can reveal the cases with the asymptomatic recurrence that can otherwise be invisible.

On the whole, we can prove that laparoscopic ventral incisional hernia repair is associated with the definite benefits in postoperative pain management, postoperative recovery rate, and postoperative wound complications even because of the increased duration of operation. These differences and similarities that have been noticed throughout the literature demonstrate the necessity of patient selection, hernia character, and surgery skills in order to achieve the best outcome. Although the two methods lead to similar recurrence rates in the short run, laparoscopic repair can be used in patients whose needs are quicker recovery and less surgical trauma.

## Conclusion

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The comparison between laparoscopic and open ventral incisional hernia repair showed that both methods are effective though each possesses its own strengths and weaknesses. The demographic and clinical differences between the two groups were relatively equal, which means that the results obtained could not have been affected by patient demographics. Laparoscopic repair, in terms of operative variables, was found to incur longer operating time, but with far less intraoperative blood loss and fewer postoperative drains, which is indicative of a less invasive surgery. Laparoscopy patients had much less postoperative pain at every time interval, and this resulted in earlier ambulations, faster intake of oral food, reduced hospital stay, and promptness to resume employment, which clearly depicts advantage in recovery and life quality. The laparoscopic group recorded significantly lower rates of postoperative complications including surgical site infections but the rates of other complications including seroma, hematoma, ileus, and chronic pain were equal in both techniques. Notably, the six-month recurrence rates were the same, which implies that the least invasive treatment does not affect the long-term efficacy of surgery. Overall, the findings indicate that laparoscopic repair offers substantial advantages in terms of patient comfort, recovery speed, and certain postoperative outcomes, while maintaining efficacy similar to open repair, making it a preferable option for appropriately selected patients.

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