International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Website: https://ijmpr.in/

Original Article

A Prospective Randomized Controlled Study Comparing Open and Laparoscopic Ventral Hernia Repair with Mesh Placement Beneath The Anterior Lamina of The Anterior Rectus Sheath in A Tertiary Care Centre

Dr Subhrajeet Nayak[1*], Dr Ankur Maheshwari[2], Dr Nilesh Rawat[3]

[1]Senior Resident, Department of General Surgery, MGM Medical College and MY Hospital , Indore (M.P.)
[2]Professor, Department of General Surgery, MGM Medical College and MY Hospital , Indore (M.P.)
[3]Senior Resident, Department of General Surgery, MGM Medical College and MY Hospital , Indore (M.P.)

OPEN ACCESS

Corresponding Author:

Dr Subhrajeet Nayak
Senior Resident, Department of General Surgery, MGM Medical College and MY Hospital , Indore (M.P.)
Email: kingofsoccer1.000@gmail.com

Received: 17-03-2026
Accepted: 16-04-2026
Published: 23-04-2026

Copyright© *International Journal of Medical and Pharmaceutical Research*

ABSTRACT

Background: Ventral hernia is a common surgical condition, frequently occurring as an incisional defect following abdominal surgery. With evolving surgical techniques, mesh placement under the anterior lamina of the anterior rectus sheath (MUAR) has emerged as a promising alternative to conventional intraperitoneal mesh repair, aiming to reduce complications related to bowel handling. The present study aimed to compare the recurrence and postoperative complications of MUAR mesh placement in open versus laparoscopic ventral hernia repair and evaluate its clinical efficacy.
Methods: This prospective randomized controlled study was conducted in the Department of General Surgery at M.G.M. Medical College & M.Y. Hospital, Indore, over a period of six months. A total of 40 patients aged >18 years with ventral hernia (defect size ≤5 cm) were randomly allocated into two groups: Group A (open repair) and Group B (laparoscopic repair), with MUAR mesh placement in both. Preoperative evaluation, standardized surgical procedures, and postoperative follow-up were performed. Outcomes assessed included operative time, complications, drain usage, hospital stay, and recurrence. Statistical analysis was done using SPSS version 25.0.
Results: Demographic parameters were comparable between groups. Operative time was significantly higher in the laparoscopic group ($p<0.001$). However, duration of drain placement and length of hospital stay were significantly lower in the laparoscopic group ($p<0.001$). No intraoperative complications were observed. Postoperative complications were minimal, with no cases of seroma, hematoma, dehiscence, or mesh infection. Surgical site infection occurred only in the open group. Pain reduced faster in the laparoscopic group. No recurrence was observed in either group during follow-up.
Conclusion: MUAR is a safe and effective technique for ventral hernia repair. Laparoscopic repair offers advantages of faster recovery and shorter hospital stay despite longer operative time. Open repair remains suitable for larger defects. Further large-scale studies are recommended.

Keywords: *Ventral hernia, MUAR, Laparoscopic repair, Open repair, Mesh placement.*

INTRODUCTION

Ventral hernias (VH), defined as defects in the fascial layers of the anterior abdominal wall other than inguinal and hiatal, usually manifest as incisional hernias following previous surgeries on the abdomen [1]. Incisional hernia is one of the commonest long-term complications following abdominal surgeries, resulting from weakness or breakdown of the musculofascial closure [2]. Ventral hernia repair accounts for a large surgical burden, with an estimated 350,000 procedures performed annually worldwide. The incidence reported for prospective studies is between 7.4% and 11%, with nearly 65% of hernias occurring within five years from first surgery (although delayed presentations are also well known) [3,4]. LSHs

can affect patients quality of life in a negative way and when untreated may even pose morbidity and mortality in complicated cases [5,6].

The approach toward the management of ventral hernia has undergone significant evolution over time with the basic principle of performing a tension-free repair to decrease recurrence rates. Other fundamental surgical principles are sufficient overlap of mesh (3–5 cm), proper handling of mesh, avoidance of stroke, optimal positioning (ideally sublay) [7]. The Rives–Stoppa technique, an open retrorectus mesh procedure, has traditionally been the gold standard of chronic ventral hernia repair with superior outcomes reported [8]. Historic open repair was popularized by Rives, Stoppa, and Wantz, but laparoscopic ventral hernia repair (LVHR), introduced by LeBlanc and Booth in 1991, has achieved widespread acceptance as a minimally invasive option [2,8].

Laparoscopic repair has shown to provide benefits as decreased postoperative pain, shorter hospital stay, earlier return to normal activities and lower overall complication rates. It also provides the improved view of the abdominal wall which allows for identification of occult or "swiss-cheese" defects that might otherwise be overlooked in open surgery [7,10]. On the other hand, it is technically challenging and involves a risk of visceral injury due to intraperitoneal mesh placement. The laparoscopic approach works on Pascal's law, which means that higher intra-abdominal pressure keeps the mesh tightly pressed against the abdominal wall and reinforces repair [9].

However, challenges remain with intraperitoneal mesh placement, particularly concerning bowel handling and adhesion formation. In this scenario, new methods such as mesh under anterior rectus sheath (MUAR) have been proposed. In this technique, mesh is placed between the anterior rectus sheath and the rectus muscle, so that bowel-related complications are avoided while enjoying the advantages of sublay repair [11]. However, data are scarce regarding the outcomes of MUAR in open and laparoscopic approaches.

Considering this, the current prospective randomized controlled study aims to evaluate and compare recurrence rates and complications of mesh placement under the anterior lamina of anterior rectus sheath in open and laparoscopic ventral hernia repair techniques along with its clinical efficacy significance.

MATERIAL AND METHODS

This prospective randomized controlled study was done in the Department of General Surgery, M.G.M. Medical College & M.Y. Hospital, Indore over a period of 6 months from October 2025 to March 2026 after permission from Institutional Ethics Committee. Before enrollment in the study, all patients signed a written informed consent form in their vernacular language. One hundred adults aged >18 years, regardless of sex, with a ventral hernia defect size ≤5 cm and planned for elective surgical repair were enrolled. Patients were evaluated pre-operatively by detailed history, clinical examination and investigations as per institutional protocol.

Sample size was determined using G*Power software version 3.1.9.2 based on studies with similar prevalence and a confidence interval of 95% at 80 power. A final sample of 40 patients was analyzed to increase statistical reliability and enable better group comparison.

Inclusion Criteria

- Age >18 years
- Both male and female patients
- Ventral hernia with defect size up to 5 cm
- Patients willing to provide informed consent

Exclusion Criteria

- Previous lower abdominal surgeries or irradiation
- Extensive intra-abdominal adhesions
- Disproportionately large hernia through a small defect
- Strangulated or incarcerated hernia
- Recurrent ventral hernia
- Immunocompromised patients (e.g., HIV)
- Chronic obstructive pulmonary disease (COPD)
- Pregnancy
- Patients not willing to participate

METHODOLOGY

After providing informed written consent, all patients who satisfied the inclusion criteria were recruited. Baseline data were abstracts with the prestructured proforma, which include demographic details such as age & sex and clinical presentation. All patients underwent routine preoperative investigations, including complete blood count (CBC), Liver function test (LFT), renal fuction test (RFT) and serum electrolytes. The pre-anesthetic evaluation consisted of chest X-ray, ECG, and

screening for HIV, HBsAg, and HCV. An ultrasonography (USG) of the local swelling was done to measure the size of ventral hernia defect.

Patients with ventral hernia (defect size ≤ 5 cm) were randomly allocated by envelope method to open or laparoscopic repair. In both groups, meshes were placed under the anterior lamina of the anterior rectus sheath (MUAR technique).

The two techniques were compared in terms of operating time, intraoperative and postoperative complications (including bleeding), cosmetic outcomes, and technical feasibility.

Outcome and complications assessments were done on follow-ups at 3 days, 7 days, 14 days, 1 month, 3 months and 6 months.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS software version 25.0 (IBM, Chicago). The Kolmogorov–Smirnov test was used to assess data distribution. Continuous variables were reported as median (interquartile range) and categorical variables represented as frequencies and percentages. Categorical variables were examined using the Chi-square test, and continuous variables were evaluated using the Mann–Whitney U test. Statistical significance was defined as a P-value <0.05.

RESULTS

The present study included 40 subjects who were equally distributed into two groups: Group A (Open repair of ventral hernia) and Group B (Laparoscopic repair of ventral hernia). In all the subjects, hernia repair was performed using 15×15 mm mesh. The age of the study population ranged from 34 to 68 years. The median (interquartile range) age was 59.0 (50.75–61.0) years in Group A and 52.5 (48.25–57.0) years in Group B, with no statistically significant difference between the groups (p = .078). The majority of patients (45.0%) belonged to the 51–60 years age group. Males constituted 57.5% of the study population, indicating a male predominance; however, there was no significant difference between the groups with respect to gender distribution (p > .05). Most patients presented with incisional hernia (70.0%), followed by umbilical (20.0%) and epigastric hernia (10.0%). A statistically significant difference was observed between the groups in terms of type of hernia (p = .006). The median defect size was significantly higher in Group A [3.9 (2.85–4.475) cm] compared to Group B [2.5 (2.25–3.65) cm] (p = .002). Comorbidities were present in 15.0% of patients, with no significant intergroup difference (p = .376). [Table 1]

Table 1: Baseline Characteristics of Study Subjects

Variable	Category	Group A	Group B	Total	Test Value	df	p-value
Age group	<40 years	2 (10.0%)	1 (5.0%)	3 (7.5%)	2.933	3	.402
	41–50 years	3 (15.0%)	7 (35.0%)	10 (25.0%)			
	51–60 years	9 (45.0%)	9 (45.0%)	18 (45.0%)			
	61–70 years	6 (30.0%)	3 (15.0%)	9 (22.5%)			
Gender	Male	13 (65.0%)	10 (50.0%)	23 (57.5%)	.921	1	.337
	Female	7 (35.0%)	10 (50.0%)	17 (42.5%)			
Type of hernia	Incisional	18 (90.0%)	10 (50.0%)	28 (70.0%)	10.286	2	.006*
	Epigastric	2 (10.0%)	2 (10.0%)	4 (10.0%)			
	Umbilical	0 (0.0%)	8 (40.0%)	8 (20.0%)			
Defect size (cm)	Median (IQR)	3.9 (2.85–4.475)	2.5 (2.25–3.65)	—	-3.080	—	.002*
Comorbidities	Yes	4 (20.0%)	2 (10.0%)	6 (15.0%)	.784	1	.376
	No	16 (80.0%)	18 (90.0%)	34 (85.0%)			

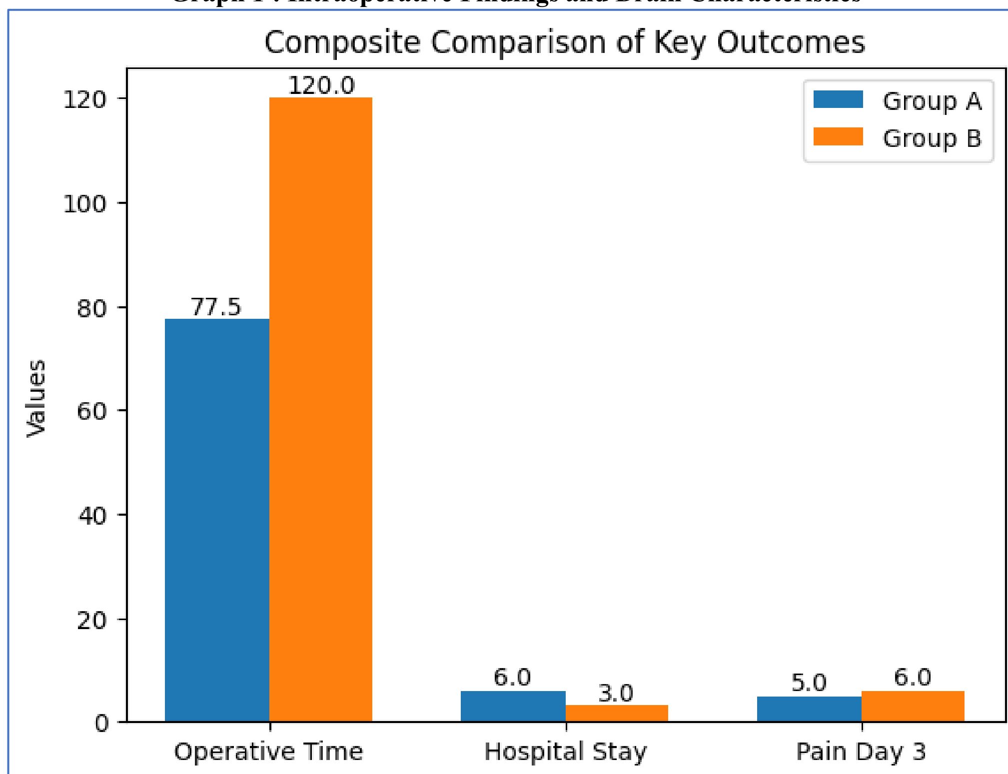
The comparison of operative parameters revealed that the median operative time was significantly higher in Group B [120.0 (111.25–123.75) minutes] compared to Group A [77.5 (75.0–85.0) minutes] (p < .001). The duration for which drains were placed was also significantly longer in Group A [5.0 (4.0–5.0) days] than in Group B [2.0 (2.0–3.0) days] (p < .001). Similarly, the length of hospital stay was significantly greater in Group A [6.0 (6.0–6.75) days] compared to Group B [3.0 (2.0–3.0) days] (p < .001). [Table 2]

Table 2: Operative and Perioperative Parameters

Variable	Group A	Group B	Z-value	p-value
Operative time (minutes)	77.5 (75.0–85.0)	120.0 (111.25–123.75)	-5.466	<.001*
Duration (drain placed in days)	5.0 (4.0–5.0)	2.0 (2.0–3.0)	-5.568	<.001*
Length of hospital stay (days)	6.0 (6.0–6.75)	3.0 (2.0–3.0)	-5.479	<.001*

Intraoperative findings showed that none of the patients in either group developed any intraoperative complications. Regarding drain placement, a significant difference was observed between the groups (p < .001), with 95.0% of patients in Group A requiring two drains, whereas 95.0% of patients in Group B required only one drain. [Table 3]

Graph 1 : Intraoperative Findings and Drain Characteristics



Postoperative complications were minimal in both groups. No cases of seroma, hematoma, dehiscence, mesh infection, or other postoperative complications were observed. Pain at the mesh site was reported in 20.0% of patients in Group A and 30.0% in Group B (p = .465). Surgical site infection occurred in 15.0% of patients in Group A and none in Group B (p = .072). [Table 4]

Table 4: Post-operative Complications

Variable	Category	Group A	Group B	Total	Chi-square value	df	p-value
Presence of seroma	Yes	0 (0.0%)	0 (0.0%)	0 (0.0%)	-	-	-
	No	20 (100.0%)	20 (100.0%)	40 (100.0%)			
Presence of hematoma	Yes	0 (0.0%)	0 (0.0%)	0 (0.0%)	-	-	-
	No	20 (100.0%)	20 (100.0%)	40 (100.0%)			
Presence of pain at MESH	Yes	4 (20.0%)	6 (30.0%)	10 (25.0%)	.533	1	.465
	No	16 (80.0%)	14 (70.0%)	30 (75.0%)			
Presence of surgical site infection	Yes	3 (15.0%)	0 (0.0%)	3 (7.5%)	3.243	1	.072
	No	17 (85.0%)	20 (100.0%)	37 (92.5%)			
Presence of dehiscence	Yes	0 (0.0%)	0 (0.0%)	0 (0.0%)	-	-	-
	No	20 (100.0%)	20 (100.0%)	40 (100.0%)			

No recurrence of hernia was observed in either group during follow-up. Postoperative pain was present in 25.0% of patients in Group A and 30.0% in Group B on day 3 (p = .723). At one week, 15.0% of Group A patients had pain, whereas none in Group B reported pain (p = .072). Intra-group comparison showed a significant reduction in pain in Group B (p = .031). [Table 5]

Table 5: Recurrence and Post-operative Pain

Variable	Category	Group A	Group B	Total	Chi-square value	df	p-value
Recurrence of hernia	Yes	0 (0.0%)	0 (0.0%)	0 (0.0%)	-	-	-
	No	20 (100.0%)	20 (100.0%)	40 (100.0%)			

Post-operative pain at day 3	Yes	5 (25.0%)	6 (30.0%)	11 (27.5%)	.125	1	.723
	No	15 (75.0%)	14 (70.0%)	29 (72.5%)			
Post-operative pain at week 1	Yes	3 (15.0%)	0 (0.0%)	3 (7.5%)	3.243	1	.072
	No	17 (85.0%)	20 (100.0%)	37 (92.5%)			
Intra-group (Group A)	Day 3 vs Week 1	5→3	—	—	—	—	.500
Intra-group (Group B)	Day 3 vs Week 1	6→0	—	—	—	—	.031*

DISCUSSION

The aim of the present study was to compare outcomes in patients with ventral hernia repair using mesh under the anterior lamina of anterior rectus sheath (MUAR) by open vs laparoscopic approach. As interest in minimally invasive surgery has increased, and newer techniques for placing mesh have evolved, there has been greater focus on optimizing outcomes while minimizing complications. MUAR reflects at extraperitoneal approach that excludes bowel manipulation and consequently minimizes intraabdominal complications related to standard intraperitoneal mesh placement [11].

In the current study, there were no significant differences in demographic characteristics of patients between these 2 groups which suggested appropriate randomization and reduced selection bias. The most common age group was 51–60 years, which corresponds to the expected natural evolutionary pattern for ventral hernias since aging correlates with deterioration of abdominal wall musculature [3,4]. Liang MK et al. [12] also reported similar findings showing no statistically significant differences in demographic variables between comparison groups. Pereira C et al. (2021) [13] also recognized similar mean age between open and laparoscopic groups corroborating the validity of present findings.

In this study, we observed a marginally greater proportion of males. However, previous studies have reported different gender distributions. Badiger et al. (2016) and Pereira et al. Another study by Kawano et al [2] reported a relatively higher percentage of female patients than what we noted in our study and this may be due to increasing health-seeking behavior and increased cosmetic concerns by the females. These differences notwithstanding, gender had no significant effect on outcomes in the current study.

The most frequently observed type was incisional hernia (N = 14; 70%) which corroborates with the current literature declaring this subtype as the most prevalent type of ventral hernia [3]. However, they detected a statistically significant difference in the distribution of hernia types in between both groups, probably as a result of their relatively small sample size. Pereira et al. the most frequent hernia was the paraumbilical, followed closely by an incisional hernia [13], suggesting variation in different populations.

The size of the defect was much larger in the open group. This could represent a more common rationale for open technique to manage larger defects, as adequate exposure is often obtained and facilitates mesh positioning. Pereira et al. [13] reported similar size of the defects among groups that was not statistically significant. The variation noted in this study may have affected operative parameters and postoperative recovery.

The laparoscopic group had significantly longer operative time, a finding consistent with those reported by Pereira et al. (2021) [13]. This is related to the extra actions performed during laparoscopic surgery, such as port insertion, pneumoperitoneum induction and intracorporeal mesh handling. However, there are certain studies such as the one conducted by Badiger et al. (2016) have also found laparoscopic repair to reduce operative time, emphasising the role of surgical experience and learning curve [2].

No intraoperative complications occurred in either group, indicating that both techniques are safe when performed by experienced surgeons. The most notable result of this analysis was a significant drain utilization difference, with the open group utilizing more drains and needing them for longer. This can be attributed in part to greater tissue dissection and dead space of open approaches.

Another consistent finding across multiple studies was that the laparoscopic group had a significantly shorter length of stay. Badiger et al. (2016), Pereira et al. (2021) and Kumar et al. [2,13,14] have described shorter postoperative recovery and length of stay in IDH laparoscopic repair. This is mainly attributable to decreased postoperative pain, smaller incisions and less tissue trauma. However, Liang MK et al. (2013) suggested that laparoscopic repairs may be associated with longer hospital stay depending on patient factors and institutional practices [12].

Both groups had little to no postoperative complications. Seroma, hematoma, dehiscence, or mesh infection was not seen. Surgical site infection (SSI) was only noted in the open group, but there was no statistically significant difference. These results are in agreement with literature that reported lower rates of SSIs in laparoscopic repair due to less exposure of the wound [6,15]. Liang MK et al. also described lower SSI rates for laparoscopic repairs but experienced more postoperative ileus and bulging75.

Mesh site pain was comparable between groups with no statistically significant difference. But post hoc analysis showed that pain decreased more quickly in the laparoscopic group. Pereira et al. also reported similar observations (2021) and by Cobb WS et al., which both reported reduced postoperative pain as well as decreased analgesic need following laparoscopic repair when compared to open repair [13,16].

Moreover, the follow-up revealed no recurrence of hernia in either group confirming that this technique is feasible both laparoscopically and robotically. However, longer follow-up is needed to evaluate extended recurrence rates. Liang MK et al. (2013) found similar rates of recurrence with open and laparoscopic repairs, although a small risk of port-site hernia recurrence was noted for laparoscopic repair [12].

This is one of the few prospective randomized studies evaluating the MUAR technique in open and laparoscopic ventral hernia repair. Although very promising results were obtained, some limitations have to be remarked. The sample size was relatively small, and the study was conducted in a single tertiary care center, which may affect generalizability. Moreover, non-blinding and variability of surgical expertise, which may contribute to clinical outcomes. The lack of extensive stratification of patient comorbidities may impact complication rates.

CONCLUSION

Mesh placement under the anterior lamina of the anterior rectus sheath (MUAR) is a safe, effective, and reliable technique for ventral hernia repair in both open and laparoscopic approaches. While both methods show comparable outcomes in terms of recurrence and complications, laparoscopic repair offers advantages such as shorter hospital stay, reduced drain requirement, and faster recovery. Although operative time is longer with the laparoscopic approach, its overall benefits are significant. Open repair remains a valuable option for larger defects. The choice of technique should be individualized, and further large-scale studies are needed to establish long-term outcomes and standardized guidelines.

REFERENCES

1. Cho JE, Helm MC, Helm JH, Mier N, Kastenmeier AS, Gould JC, Goldblatt MI. Retro-rectus placement of bio-absorbable mesh improves patient outcomes. Surg Endosc. 2019 Aug;33(8):2629-2634
2. Badiger S, Koppad SN, Kulkarni A, Kodliwadmath H. Comparative analysis of Open versus laparoscopic ventral hernia repair. Int Surg J 2016;3:1167-72
3. Cassar K, Munro A. Surgical treatment of incisional hernia. Br J Surg. 2002;89:534-45.
4. Mudge M, Hughes LE. Incisional hernia: A 10 year prospective study of incidence and attitudes. Br J Surg. 1985;72:70-1
5. Petro CC, Haskins IN, Perez AJ, Tastaldi L, Strong AT, Ilie RN, Tu C, Krpata DM, Prabhu AS, Eghtesad B, Rosen MJ. Hernia repair in patients with chronic liver disease - A 15-year single-center experience. Am J Surg. 2019 Jan;217(1):59-65.
6. Schlosser KA, Arnold MR, Otero J, Prasad T, Lincourt A, Colavita PD, Kercher KW, Heniford BT, Augenstein VA. Deciding on Optimal Approach for Ventral Hernia Repair: Laparoscopic or Open. J Am Coll Surg. 2019 Jan;228(1):54-65
7. Smith J, Parmely JD. Ventral Hernia. [Updated 2023 Aug 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499927/
8. Constanza MJ, Heniford BT, Arca MJ. Laparoscopic repair of recurrent ventral hernias. Am Surg. 1998;64:1121-7
9. Stoppa RE. The treatment of complicated groin and incisional hernias. World J Surg. 1989;13:545-54.
10. Cobb WS, Kercher KW, Henniford BT. Laparoscopic repair of incisional hernias. Surg Clin North Am. 2005;85:91-1036.
11. Miyake Y, Watanabe S, Mizojiri G, Maruyama K, Lee K, Oka H. Mesh repair under the anterior lamina of the rectus sheath (MUAR) for abdominal incisional hernia. *Surg Today*. 2021;51(10):1649-1654.
12. Liang MK, Berger RL, Li LT, Davila JA, Hicks SC, Kao LS. Outcomes of laparoscopic vs open repair. JAMA Surg. 2013;77030:1043–8.
13. Pereira C, Rai R. Open Versus Laparoscopic Ventral Hernia Repair: A Randomized Clinical Trial. Cureus. 2021 Dec 17;13(12):e20490
14. Kumar S, Sinha R, Singh PV, Dubey NK, Gitkumar HS. A comparative study on laparoscopic versus open ventral hernia repair. International Journal of Contemporary Medical Research 2021;8(12):L1-L5.
15. Holihan JL, Hannon C, Goodenough C, Flores-Gonzalez JR, Itani KM, Olavarria O, et al. Ventral hernia repair: A meta-analysis of randomized controlled trials. Surg Infect (Larchmt). 2017;18(6):647-658. https://doi.org/10.1089/sur.2017.029
16. Cobb WS, Kercher KW, Henniford BT. Laparoscopic repair of incisional hernias. Surg Clin North Am. 2005;85:91-1036.