e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(3); 946-953

Original Research Article

Comparing On-lay and Sub-lay Mesh Placement Techniques in Ventral Hernia Repair

Rahul Ranjan[1], Priyanka Kumari[2], Rakesh Kumar[3]

[1]Senior Resident, Department of General Surgery, Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India

[2]Senior Resident, Department of Obstetrics & Gynaecology, Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India

[3]Prof.Professor & Head, Department of Surgery, Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India

Received: 15-01-2024 / Revised: 20-02-2024 / Accepted: 10-03-2024

Corresponding Author: Dr. Rakesh Kumar

Conflict of interest: Nil

Abstract:

Background: Hernias, defined as the abnormal protrusion of organs through an opening, often contained within a sac, has been a significant medical concern. With the prevalence rates of hernias reported between 2% and 11%, the choice of optimal hernia repair technique remains debated among surgeons. This study compares the outcomes of on-lay and sub-lay mesh repairs in open ventral hernia surgeries, focusing on their effectiveness and long-term results.

Methods: Conducted at the Department of Surgery at JLNMCH, Bhagalpur, this prospective study over two years included patients with postoperative ventral hernias. Participants were randomly assigned to undergo hernia repair using either the sub-lay or on-lay mesh technique. The study aimed to assess primary outcomes such as surgery length, suction drain time, wound complications, and secondary outcomes including chronic pain and hernia recurrence.

Results: The study analyzed data from 115 patients, finding no significant difference in the duration of operation between the sub-lay and on-lay groups. However, the duration of the suction drain was significantly shorter, and wound complications were notably fewer in the sub-lay group. Chronic pain and hernia recurrence rates did not significantly differ between the two methods.

Conclusion: The sub-lay mesh technique in open ventral hernia repairs showed advantages in reducing suction drain duration and wound complications compared to the on-lay mesh technique. However, both techniques had similar outcomes regarding chronic pain and hernia recurrence.

Recommendation: Further research with larger sample sizes is recommended to confirm these findings and guide evidence-based practices in hernia repair techniques.

Keywords: Hernia repair, Sub-lay mesh, On-lay mesh, Ventral hernias.

Introduction

The concept of hernias originates from the Greek and Latin languages, with the Greek word meaning "to bud" or "to sprout" and the Latin word translating to "rupture." [1] Hernias are characterized by the abnormal protrusion of organs through an opening, often contained within a sac. These conditions are primarily categorized into spontaneous or primary ventral hernias and incisional ventral hernias. Further classification is based on their specific location, such as epigastric, umbilical, and hypogastric hernias, among others [2]. Incisional hernias develop due to weaknesses in the musculo-fascial layer of the anterior abdominal wall, typically at the site of a previous surgical scar. They are closely associated with complications from past surgeries. The occurrence of these hernias is notably common, with prevalence rates reported between 2% and 11%, and a significant number appearing within the first two years after surgery [3,4]. Factors influencing the development of hernias include age, gender, obesity, and surgical history. Over time, hernia repair techniques have evolved from basic anatomical repairs to prosthetic meshes and laparoscopic methods, aimed at reducing the high recurrence rates seen with traditional suture-based repairs [5,6,7].

The choice of the optimal hernia repair technique, especially regarding mesh placement, remains a topic of debate among surgeons, often influenced by tradition rather than evidence-based practices [8]. Mesh placement can be on-lay, in-lay, sub-lay,

or underlay, each with its theoretical advantages and disadvantages [9]. Sub-lay repairs, which involve positioning the mesh between the fascia and muscle or pre-peritoneally, are believed to offer lower recurrence and infection rates due to the protective coverage of native tissue [10]. On the other hand, on-lay repairs are thought to reduce complications like bowel adhesion by keeping the mesh separate from the abdominal contents. Despite these theoretical benefits, empirical evidence comparing the outcomes of on-lay and sub-lay mesh repairs in open ventral hernia surgeries is limited, highlighting the need for further research into their effectiveness and long-term results [11].

The aims and objectives of the study are to assess the quality of life immediately after surgery for individuals undergoing hernia repair procedures using both sub-lay and on-lay techniques and to conduct a prospective study comparing the on-lay and sub-lay methods of hernioplasty in terms of operation time, and to examine complications that arise in the early and late stages following surgery.

Material and Methodology

Study Design: The research was conducted at the Department of Surgery at JLNMCH, Bhagalpur. It focused on evaluating the effectiveness of elective surgery using the open mesh method for treating postoperative ventral hernia. The study was carried out over two years, from October 2021 to October 2023.

Participants: The study included patients admitted to the Department of Surgery at JLNMCH, Bhagalpur, for the treatment of post-operative ventral hernias.

Inclusion Criteria: Were patients with clinically confirmed post-operative ventral abdominal hernias, who had their primary surgery at least six months prior, consented to the operation, agreed to participate in the study, and were deemed suitable for major surgery under general anesthesia. Hernia defects needed to be larger than 2cm, and patients had to be classified under American Society of Anesthesiology (ASA) grades 1 and 2.

Exclusion Criteria: Included the presence of overlying skin infection or necrosis, hernia defects exceeding 10cm, hernias accompanied by bowel strangulation, patients unfit for general anesthesia, those testing positive for specific infections, and patients expressing a preference for a specific surgical technique or refusing to participate.

Study Procedure

Participants were randomly assigned to either the Retro-muscular mesh or On-lay mesh group using a simple random sampling technique. The clinical manager, not involved in the surgeries, managed the randomization and assignment process. Participants were unaware of their assigned surgical method. Surgeries were performed by experienced surgeons under general anesthesia, with each patient receiving a dose of intravenous antibiotics before the procedure. A specific type of monofilament polypropylene mesh was used in all surgeries.

Statistical Methods

The sample size was calculated with a 95% confidence level, 80% power, a case/control ratio of 1:1, and a risk ratio of 2.0 using the Cochrane sample size formula. This resulted in a target sample size of 113 participants. To account for potential loss to follow-up, 160 subjects were initially randomized. Data from 58 subjects in the retro-muscular mesh group and 57 subjects in the on-lay group were analyzed. Descriptive statistics were used to summarize variable characteristics. Continuous variables were compared using either the independent samples t-test or the Mann-Whitney U test, based on the data distribution. Categorical variables were analyzed using the two-tailed Chi-square test or Fisher's exact test, as appropriate. Statistical significance was determined by a P-value below 0.05. Analyses were performed using OpenEpi version 3.01, Microsoft Excel, and Medcalc software.

Results

Between October 2017 and October 2019, over 200 patients underwent open incisional hernia repair surgery. For this study, 180 patients were initially selected to account for a possible 25% dropout rate, targeting a sample size of 113. However, 20 patients were later excluded for not meeting the inclusion criteria, leaving 160 patients. These patients were split into two equal groups of 80 each by someone not involved in the surgeries. Despite planning for 160 participants, 45 patients did not return for their follow-up, leaving 58 in the sub-lay group and 57 in the on-lay group for final analysis.

The study focused on primary outcomes like surgery length, suction drain time, and wound complications (infection, seroma, hematoma). It also looked at secondary outcomes, including chronic pain, limitations in abdominal wall movement, mesh infection and removal, and hernia recurrence. Factors such as sex, age, weight, American Society of Anesthesiologists risk categories, comorbidities, and hernia defect size were similar between the groups.

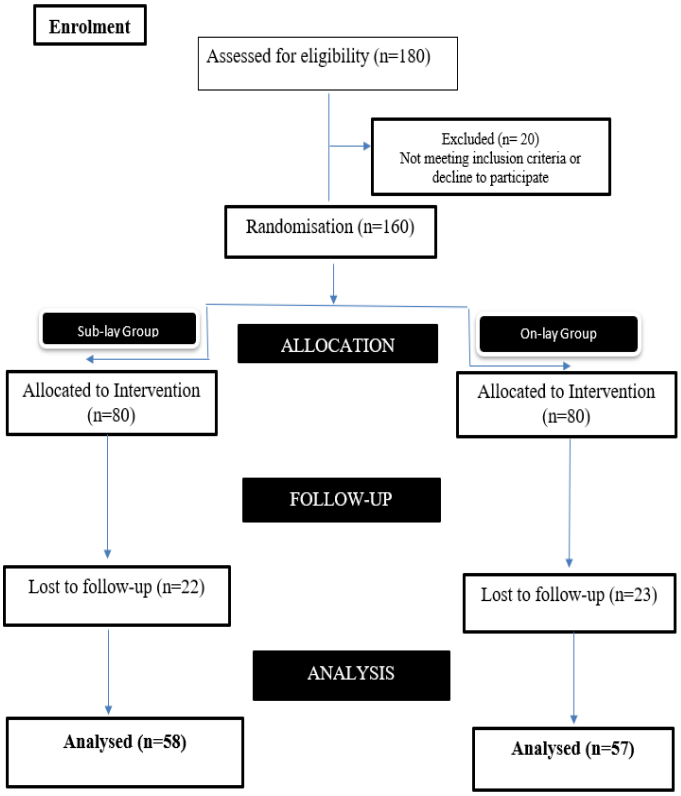
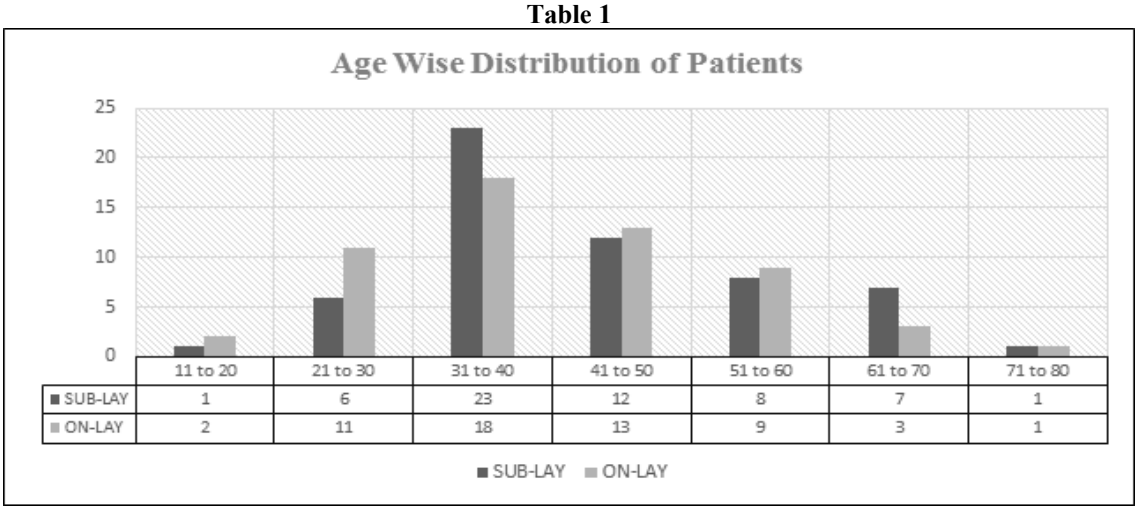


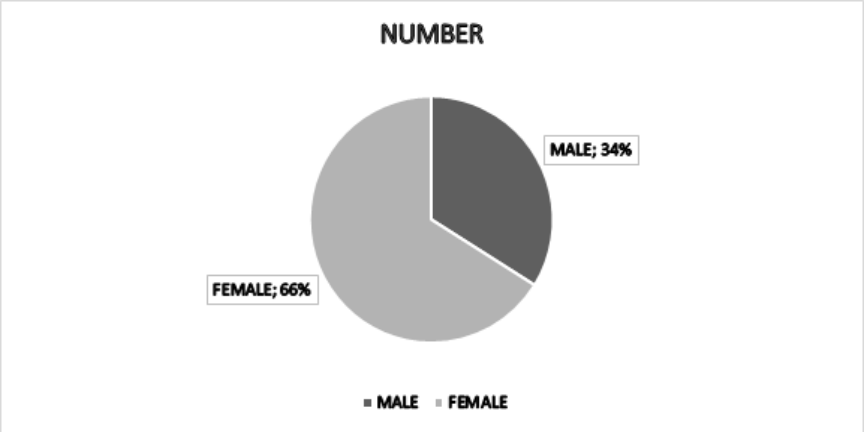
Table 1



❖ **Age Incidence**

Age Group	Sub-lay	On-lay	Total	Percentage
11 - 20	1	2	3	2.61%
21 – 30	6	11	17	14.78%
31 – 40	23	18	41	35.65%
41 – 50	12	13	25	21.74%
51 – 60	8	9	17	14.78%
61 – 70	7	3	10	8.70%
71 - 80	1	1	2	1.74%
Grand Total	58	57	115	
	Mean =43.82yr SD = 12.37yrs	Mean = 41.3yrs SD = 12.75yrs	Mean = 42.57yrs SD = 12.62yrs	
	p = 0.28 (not significant)			

The study reported an average participant age of 42.57 years, with a variation of 12.62 years. A closer look at the groups showed that individuals in the sub-lay group had an average age of 43.82 years with a variation of 12.37 years, compared to the on-lay group's average age of 42.57 years and a variation of 12.62 years, revealing no significant age difference between the groups (p = 0.28). Additionally, it was observed that ventral incisional hernias were more prevalent among individuals aged 31 to 50 years (36.4%), suggesting that middle-aged people, likely due to their higher exposure to various surgical procedures, were more prone to this condition.



❖ **Sex Incidence**

In the study involving 115 participants, there was a noticeable higher incidence of incisional hernia among females, with 76 (66.9%) female and 39 (33.1%) male participants, resulting in a roughly 2:1 female-to-male ratio. This trend aligns with the finding that a significant number of the women had a statistically significant difference (p = 0.23), suggesting that the variations in male and female undergone various obstetric and gynecological procedures. The sub-lay group included 23 males and 35 females, while the on-lay group consisted of 16 males and 41 females. The comparison of gender distribution across these groups did not revea

representation between the groups were not statistically significant.

	Sub-Lay	**On-Lay**
Male	23	16
Female	35	41
	p = 0.23 (not significant)	

❖ **Hernia Defect**

DEFECT SIZE (In Cm)	**Sub-Lay**	**On-Lay**	**Total Subjects**
Mean	5.224 cm	5.439 cm	5.317 cm
Standard Deviation	0.846 cm	0.932 cm	0.895
No. of Subjects	58	57	115
For a significance level of 0.05	**P = 0.199 (not significant)**		

This research utilized ultrasonography (USG) to measure the hernial defect size in participants, finding an average size of 5.317 cm with a variability of 0.895 cm. A closer examination of the groups revealed that the sub-lay group had an average defect size of 5.224 cm with a variability of 0.846 cm, while the on-lay group's average was slightly larger at 5.439 cm, with a variability of 0.932 cm. However, the statistical analysis showed no significant difference in defect sizes between the two groups, as evidenced by a p-value of 0.199, indicating the variations were not statistically meaningful.

❖ **Weight of Patients**

Weight	**Sub-Lay**	**On-Lay**	**Total Subjects**
Mean	55.63 Kg	56.47 Kg	56.05 Kg
Standard Deviation	7.55	7.47	7.53
No. of Subjects	57	57	114
For a significance level of 0.05	**p = 0.549 (not significant)**		

In the study, the weight of each participant (n = 114) was recorded, revealing an average weight of 56.05 kg with a standard deviation of 7.53 kg. A breakdown by the group showed the sub-lay group (n = 58) had an average weight of 55.63 kg with a standard deviation of 7.55 kg, while the on-lay group's average weight was slightly higher at 56.47 kg, with a standard deviation of 7.47 kg. However, the difference in average weights between the groups was not statistically significant, with a p-value of 0.549, indicating that the weight variations across the groups did not reach statistical significance.

- **Primary Outcomes**

1. Duration of Operation

Duration Of Operation	**Sub-Lay**	**On-Lay**
Mean	91.17 minutes	97.47 minutes
Standard Deviation	16.84 minutes	19.27 minutes
For a significance level of 0.05	**P = 0.06 (Not Significant)**	

Duration of operation was somewhat shorter in sub-lay group with mean of 91.17 minutes and standard deviation of 16.84 minutes compared to on-lay group with mean of 97.47 minutes and standard deviation of 19.27 minutes (p = 0.06). Statistically this difference was found to be NOT **significant** at $p < 0.05$.

2. Duration of Suction Drain

Duration Of Suction Drain (In Days)	**Sub-Lay**	**On-Lay**
Mean	4.155 days	6.684 days
Standard Deviation	1.0796 days	1.379 days
For a significance level of 0.05	**p < 0.0001(SIGNIFICANT)**	

Duration of the suction drain was significantly longer in an on-lay group with a mean duration of 6.684 days and a standard deviation of 1.379 days compared with the sub-lay group having a mean duration of 4.155 days and a standard deviation of 1.0796 days ($p < 0.0001$). Statistically, this difference was found to be **significant** at $p < 0.05$.

3. Wound Complication

i) Wound Infection (SSI)

	SUB-LAY (N = 57)	**ON-LAY (N = 57)**
Wound Infection	1	3
Percentage	1.75%	5.26%
For a significance level of 0.05	**Chi-square statistics = 1.0725** **p = 0.3004 (Not Significant)**	

Regarding wound infection; the on-lay group (n =57) had 3 (5.26%) cases while the sub-lay group (n = 57) had only 1 (1.75%) i.e. three times less in the sub-lay group. But the value of the chi-square statistic was 1.0725 and the corresponding p-value was 0.3004. Even with Yates correction chi-square statistic was 0.2774 with a corresponding p-value of 0.59. Hence, the statistical difference in wound infection was found to be **not significant** at $p < 0.05$.

ii) Seroma Formation

	Sub-Lay (N = 57)	**On-Lay (N = 57)**
Seroma Formation	5	18
Percentage	8.77%	31.57%
For a significance level of 0.05	**Chi-square statistic = 9.47** **p = 0.002 (Significant)**	

Regarding seroma formation; the on-lay group (n =57) had 18 (31.57%) cases while the sub-lay group (n = 57) had only 5 (8.77%) i.e. about four times less in the sub-lay group. The value of the chi-square statistic was 9.47 and the corresponding p-value was 0.002. Even with Yates's correction chi-square statistic was 8.08 with a corresponding p-value of 0.004. Hence, the statistical difference in wound infection was found to be **significant** at $p < 0.05$.

ii) Hematoma

There were no cases of hematoma in any group. Hence total wound complications for both groups are as follows

	SUB-LAY (N = 57)	ON-LAY (N = 57)
Wound Complications	6	21
Percentage	10.5%	36.84%
For a significance level of 0.05	**Chi-square statistic = 11.23** **p = 0.0008 (Significant)**	

Regarding wound complication as a whole; the on-lay group (n =57) had 21 (36.84%) cases while the sub-lay group (n = 57) had only 6 (10.5%) i.e. about three times less in the sub-lay group. The value of the chi-square statistic was 11.23 and the corresponding p-value was 0.0008. Even with Yates's correction chi-square statistic was 9.808 with a corresponding p-value of 0.0017. Hence, the statistical difference in wound infection was found to be **significant** at $p < 0.05$.

- **Secondary Outcomes**

	SUB-LAY (N = 57)	ON-LAY (N = 57)
Chronic Pain	11	4
Percentage	19.29%	7.01%
For a significance level of 0.05	**Chi-square statistic = 3.61** **p = 0.057 (Not Significant)**	

1. Chronic Pain

Regarding chronic pain after hernia repair; the on-lay group (n =57) had 11 (19.29%) cases while the sub-lay group (n = 58) had only 4 (6.89%) i.e. about three times more in the on-lay group. The value of the chi-square statistic was 3.61 and the corresponding p-value was 0.057 i.e. not significant at $p < 0.05$. Even with Yates correction chi-square statistic was 2.61 with a corresponding p value of 0.104 i.e. not significant at $p < 0.05$.

2. Hernia Recurrence

	Sub-Lay (N = 57)	On-Lay (N = 57)
Hernia Recurrence	1	3
Percentage	1.75%	5.26%
For a significance level of 0.05	**Chi-square statistic = 1.07** **p = 0.30 (Non-Significant)**	

Regarding hernia recurrence; the on-lay group (n =57) had 3 (5.26%) cases while the sub-lay group (n = 57) had only 1 (1.75%) i.e. three times less in the sub-lay group. The value of the chi-square statistic was 1.07 and the corresponding p-value was 0.3 so not significant at $p < 0.05$. Even with Yates's correction chi-square statistic was 0.2774 with a corresponding p-value of 0.598. Hence, the statistical difference in hernia recurrence was found to be not significant at $p < 0.05$.

Discussion

Incisional hernia emerges as a notable complication following abdominal surgeries, with a prevalence ranging from 2 to 11 percent among patients. This condition significantly impacts the quality of life and imposes socioeconomic burdens, making the quest for durable repair methods, particularly mesh reinforcement, a central focus in surgical advancements. The superiority of mesh over traditional suture repairs in preventing recurrence is well-documented, underscoring the mesh's role in improving long-term surgical outcomes. Despite this, the medical community continues to debate the optimal technique and placement for mesh repairs, indicating a gap in conclusive evidence guiding the most effective approach for hernia repair. [12]

Our comprehensive study aimed to shed light on this debate by comparing the outcomes of retro-muscular (sub-lay) and on-lay mesh repair techniques against global research findings, focusing on a cohort of patients undergoing elective ventral hernia repairs. The demographic analysis revealed a predominance of middle-aged females, particularly those who had undergone gynecological surgeries, highlighting a demographic vulnerability to incisional hernias. Our findings regarding operative times, though slightly longer for the on-lay group, did not show a statistically significant difference, suggesting that factors beyond mere operation duration might influence the choice of repair technique. [13]

The postoperative outcomes of our study and others indicate that on-lay procedures tend to have longer drain removal times, higher incidences of seroma formation, and slightly increased rates of surgical site infections, although not all differences reached statistical significance. However, the trend towards a higher recurrence rate in on-lay repairs, compared to sub-lay, points to the latter's potential for

providing more durable results. These insights, combined with global research findings, underscore the complexity of choosing the optimal surgical method for hernia repair. They highlight the importance of personalized surgical planning, taking into account individual patient factors and the nuanced understanding of each technique's risks and benefits**. [14]**

Summary

Incisional hernia repair is a highly debated area in the field of surgery, with techniques ranging from sutures to various mesh placements like on-lay, sub-lay, in-lay, and under-lay repairs under scrutiny for their effectiveness and complication rates. The in-lay method, criticized for higher recurrence rates and surgical site infections, has become less popular, while under-lay repairs are mainly used in laparoscopic procedures. Despite the technological advancements favoring laparoscopy, open hernia repairs remain prevalent, highlighting the ongoing search for the most reliable repair technique. This study zeroes in on the comparison between sub-lay and on-lay mesh repairs, drawing from a balanced sample of 114 patients. [15,16] It uncovers a predominance of middle-aged female patients, with a significant portion of initial surgeries leading to hernias being gynecological. The findings suggest that sub-lay repairs might be performed slightly quicker than on-lay repairs, though without significant time difference. However, on-lay repairs were associated with longer durations for suction drain, higher incidences of wound complications, and seroma formation, whereas chronic pain appeared more frequently in sub-lay repairs. [17]

Acknowledging the study's constraints, such as the exclusion of emergency repairs and the absence of data on treating recurrent hernias, alongside a brief follow-up period, underscores the necessity for more extensive research. To achieve a clearer understanding of the most effective incisional hernia repair technique, future studies should be more inclusive, covering emergency and recurrent cases, and extending the follow-up duration. Such research is crucial for enhancing post-operative quality of life and reducing the likelihood of complications, paving the way for more definitive guidelines on incisional hernia repair strategies.

Conclusion

In a comparative study of sub-lay and on-lay techniques for repairing primary incisional hernias, findings highlight that these hernias are most common in middle-aged women, particularly following lower abdominal surgeries like cesarean sections and tubal ligations. Interestingly, the study observed no significant difference in hernia recurrence rates between the two repair methods. However, the sub-lay technique demonstrated a quicker operation time and involved more meticulous dissection, contrasting with the on-lay method, which was linked to longer suction drain durations. Moreover, the sub-lay method reported notably fewer wound complications than its on-lay counterpart. These outcomes suggest the sub-lay repair method as a superior option for incisional hernia repairs, offering benefits in terms of operation efficiency and lower complication rates.

References

1. Albino FP et al. Does mesh location matter in the abdominal wall reconstruction? A systematic review of the literature and a summary of recommendations. Plast Reconstr Surg. 2013; 132(5):1295–1304
2. Aly Saber, Emad K. Bayumi. Onlay Versus Sublay Mesh Repair for Ventral Hernia. Journal of Surgery. Special Issue: Abdominal Surgery: Toward the Best. 2015;4(1-1): 1-4.
3. Chichom Mefire A, Guifo ML. Don't be scared: Insert a mesh! Pan Afr Med J 2011; 10:18.
4. Demetrashvili Z, Pipia I. Open retromuscular mesh repair versus onlay technique of incisional hernia: A randomized controlled trial. Int J Surg. 2017 Jan; 37:65-70.
5. Dhaigude BD, Sugunan A, Panchbhai SV, Francis M, Patel K, Metta V. Comparative evaluation of sublay versus only meshplasty in incisional and ventral hernias. Int Surg J 2018; 5:187-92.
6. Dharmendra BL, Vijaykumar N. A comparative study of on-lay and sub-lay mesh repair of ventral wall hernias in a tertiary health care centre. Int Surg J 2018; 5:3386-90
7. Eriksson A, Rosenberg J, Bisgaard T. Surgical treatment for giant incisional hernia: a qualitative systematic review. Hernia: the journal of hernias and abdominal wall surgery. 2014;18 (1):31-38.
8. Holihan, J.L., Nguyen, D.H., Nguyen, M.T. et al. Mesh Location in Open Ventral Hernia Repair: A Systematic Review and Network Meta-analysis World J Surg (2016) 40: 89.
9. Incisional hernia: a 10-year prospective study of incidence and attitudes. Mudge M, Hughes LE. Br J Surg. 1985 Jan; 72(1):70-1
10. J. Conze, M. Binnebosel, K. Junge, V. Schumpelick, Incisional hernia e how do I do it? Standard surgical approach, Chirurg. 2010; 81: 192e200.
11. Md. Shakeel, Sudani R, Kashyap V. A comparative study of onlay & sublay mesh repair of ventral wall hernias in a tertiary care research center. Indian J Anat Surg Head Neck Brain 2019;5(2):55-8
12. Nguyen MT, Berger RL, Hicks SC, et al. Comparison of outcomes of synthetic mesh vs suture repair of elective primary ventral herni-

orrhaphy: a systematic review and meta-analysis. JAMA surgery. 2014;149(5):415-421.
13. R. Stoppa, D. Louis, P. Verhaeghe, X. Herny, J.P. Plachot, Current surgical treatment of post-operative eventrations, Int. Surg. 72 (1987) 42e44.
14. Rosen MJ, Denoto G, Itani KM, et al. Evaluation of surgical outcomes of retro-rectus versus intraperitoneal reinforcement with bio-prosthetic mesh in the repair of contaminated ventral hernias. Hernia: the journal of hernias and abdominal wall surgery. 2013;17(1):31-35.
15. Shell DH 4th, de la Torre J, Andrades P, Vasconez LO. Open repair of ventral incisional hernias. Surg Clin North Am. 2008; 88:61-83.
16. Timmermans L, Goede BD, Dijk SMV, Kleinrensink GJ, Jeekel J, Lange JF. Meta-analysis of sublay versus onlay mesh repair in incisional hernia surgery. Am J Surg. 2014; 207:980-8.
17. W.S. Cobb, J.A. Warren, J.A. Ewing, A. Burmkel, M. Merchant, A.M. Carbonell, Open retromuscular mesh repair of complex incisional hernia: predictors of wound events and recurrence, J. Am. Coll. Surg. 2015;220: 606e613.