

Sublay mesh versus Onlay mesh: a randomized comparative study

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ABSTRACT



Introduction. Ventral hernias are the second most common hernia; Onlay and Sublay operating techniques are procedures commonly performed in such cases. There is no consensus on the superiority of these procedures. The aim of this study was to compare the results of both procedures in order to identify the recommended technique between the two options. **Materials and Methods.** A total of 106 patients with epigastric, umbilical, paraumbilical, incisional hernias were studied. These patients were grouped into group A (onlay) and Group B (sublay). The outcomes of the two techniques were compared with respect to operative time, pain, hospital stay, seroma, infection, recurrence and patient satisfaction. **Results.** The mean operative time was 81.30 minutes in group A, and 85.85minutes in group B. Twenty-two (42.5%) patients in group A and seven (12.96%) patients in group B developed seroma. Nine (17.3%) patients in group A, 3 (5.55%) patients in group B developed post-operative infection. 30 (57.69%) patients in group A and 47(87.3%) patients in group B reported moderate pain, whereas three (5.76 %) and seven (12.96%) patients in group A and group B were reported severe pain in immediate post-operative period. At 48 hours, 20 (38.46%) and 24 (44.44%) of patients in group A and B were reported moderate pain, whereas 32 (61.53%) and 30 (55.55%) patients in group A and B reported mild pain. The mean hospital stay was 10.11 days in group A and 6.22 in group B. Three (5.76 %) patients of group A has recurrence, none of the patients in sublay group has developed recurrence. Thirty-nine (72.22%) patients of sublay group expressed their satisfaction but only 20(38.46%) patients in onlay group expressed their satisfaction. **Conclusion.** With reference to all the study parameters except one, the sub lay technique of mesh placement appears to be better. The exception is pain in the immediate postoperative period.

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Introduction

One of the most common surgical problems encountered in medical practice is abdominal wall hernia. These hernias include ventral hernias (primary and acquired), inguinal and other rare hernias. Of all these varieties, the second most common hernia after inguinal hernia is ventral hernia. Surgical repair is the treatment of choice for these ventral hernias. Various surgical techniques have been described in the literature, including open and laparoscopic approaches. Although the laparoscopic approach has additional advantages over open procedures, it is not available everywhere and is expensive. Open surgical procedures include procedures with and without mesh repair (primary tissue repair). High tissue tension leading to higher recurrence rates has been reported with primary tissue repair [1]. Hernia repair with mesh

resulted in significant reduction in recurrence rates [2,3], but is not free of mesh related wound complications. Onlay and Sublay (includes Retro rectus, Preperitoneal) mesh placements were the routinely practiced techniques for mesh placement in ventral hernia repair. However, both procedures have their advantages and disadvantages. It remains unclear regarding the superiority of both techniques over each other [4], and there is no common consensus among experts on management strategy and tissue plane in which mesh should be placed. This requires further evaluation to find the optimal treatment strategy and the ideal tissue plan for mesh placement in the management of ventral hernias [5].

The purpose of this study is to compare the results of sublay and onlay mesh techniques in the management of ventral hernias, and to identify the best surgical technique for repairing ventral hernias.

Materials and Methods

This study was conducted from May 2013 to Dec 2019 in the department of General Surgery, Narayana medical college & Hospital, Nellore, Andhra Pradesh, India.

Sample size calculation: Sample size was calculated based on primary end points (recurrence, surgical site infection). Systematic review of literature showed recurrence of ventral hernias after open mesh hernioplasty was approximately 10% (1.5-10%; 13.3%) [6-9] and infection (6-12%) [6,9,10,11], utilized for sample size calculation by using the following formula:

$$n = \frac{(Poqo+P1q1) (Z1-\alpha/2+Z1-\beta)^2}{(p1-po)^2}$$

Inclusion criteria. A total of 106 patients presented to general surgery out patient department (OPD) with or without prior diagnosis of ventral hernia irrespective of age, sex, with or without co- morbidities, were included in the study.

Exclusion criteria. All the patients presented with emergency conditions like acute obstruction, strangulation, patients with local or systemic infection, uncontrolled co – morbidities and recurrent hernias.

All these patients were admitted by OPD team after explaining about current study, surgical procedures. Consent for their willingness to participate in the study was obtained.

Patients were divided in to two groups, group A consists 52 patients (operated by Onlay technique), and group B consists 54 patients (operated by Sublay technique).

Randomization. Of the patients between the groups was done by asking the patient to pick up sealed envelope in which a slip was placed with group allocation written on it. These envelopes were opened by operating surgeon in operation theatre before starting repair.

All these patients included in the study irrespective of their group was thoroughly evaluated clinically and subjected to ultra-sonogram of abdomen to confirm diagnosis, to know the size, location, and number of the defects, and also, to exclude the other associated intra-abdominal & abdominal wall abnormalities.

Written and informed consent for surgery was taken from the patients before the surgery.

Operative technique. For study purpose operative techniques were standardized as follows;

All the patients were given a dose of antibiotics before induction of anaesthesia.

Skin incision: preferably transverse skin incision was used wherever it was feasible, vertical incision was made for multiple midline defects placed one away from another.

Onlay technique: skin flaps were raised deep from the rectus sheath, for a minimum distance of 5cm all-around from margins of the defect sufficient enough to place the

mesh. Hernia sac was identified and dissected, opened and contents were reduced into peritoneal cavity, the redundant sac was excised. The defect has been closed transversely for single defect and vertically for midline multiple defects with no 1 polypropylene suture, plication of weak and stretched out linea alba was done wherever indicated. Polypropylene mesh was placed on rectus sheath and fixed with interrupted 2o proline sutures. Wound was closed after securing thorough hemostasis over the negative suction drain, placed in subcutaneous plane (Figure 1).



Figure 1. Onlay mesh

Sublay technique: Procedure is similar to that of onlay technique up to the closure of the defect with the poly propylene suture, except dissecting skin flaps at subcutaneous level which is not required here.

Two vertical incisions on anterior rectus sheath parallel to the linea alba on either side, were made. Both the recti muscles were mobilized laterally and lifted to create the retrorectus space for to place the mesh. The medial flaps of the anterior rectus sheaths on either side were sutured together in midline to create the new linea alba. Preperitoneal space is created for lateral ventral hernias. A poly propylene mesh was fashioned and placed in retro rectus or in preperitoneal spaces and was fixed with trans fascial sutures. Lateral flaps of the anterior rectus sheaths were closed after a thorough hemostasis, wound was closed over negative suction drain placed in subcutaneous plane (Figure 2).

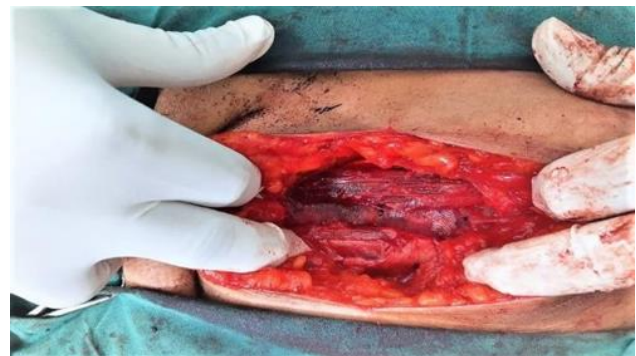


Figure 2. Sublay mesh (retrorectus).

Drains was removed whenever indicated (fluid less than 10 ml for 24 hours). In the post-operative period patients were managed with antibiotics and analgesics as per requirement.

Follow up: After discharge, these patients were followed up in OPD for a period of two years, by giving prior appointment date, and also reminding them about follow up on phone. These patients were followed up, once in 3 months in first year and once in six months in second year, for late complications mainly recurrence and for to record their satisfaction about the procedure which they had undergone. During each visit history was noted regarding their condition and thorough physical examination of the wound was done for any signs of infection and recurrence, ultrasound of the abdomen was advised if indicated on clinical examination.

There were no dropouts or deaths during the study period in either group. Results of two techniques were compared with respect to following parameters:

1. Operative time in minutes (starts from the time of skin incision to the application of last suture).
2. Severity of Pain.
3. Hospital stay in days,
4. Seroma formation,
5. Infection,
6. Recurrence,
7. Patient satisfaction.

Visual Analogue Scale was used to assess the severity of the post-operative pain. Which has scores starts from 0 (no pain) to 10 (worst possible pain). The scale is divided in to different segments starting from, '0' (no pain), 1-3 (mild), 4-6 (moderate), 7-9 (severe), 10 (worst). Severity of pain in the post-operative period was recorded in the initial 24 hours and at 48 hours, analgesics were given as per the demand by the patient.

Seroma. Collection of serous fluid at the operative site without any signs of infection like fever, cellulitis, and increased leucocyte counts etc.

Wound infection. Cellulites at operative site and purulent discharge from the wound, fever and increased leucocyte counts. Infection was confirmed by culture and sensitivity tests and antibiotics was given as per sensitivity report.

Recurrence. Suspected by appearance of swelling with cough impulse at operative site which was confirmed by physical examination and ultrasonography of abdomen.

Patient Satisfaction. Patient Satisfaction was assessed at the end of follow up period of two years with respect to recurrence, chronic pain, comfort and cosmesis, by satisfaction assessment questionnaire form. This form consists scores from 1-3, 1 = dissatisfaction, 2 = Neither satisfied nor dissatisfied, 3 = Satisfied.

Primary outcomes of the study. Surgical site infection, Recurrence of hernia, and Patient's satisfaction at the end of the two year follow up.

Secondary outcomes of the study. Severity of Post-operative pain, Seroma formation, Operative time, Hospital stay.

Statistics. Patients' data was compared between two groups, categorical data was represented in the form of frequency and percentage. Comparison of variables between the groups was done with student's T test. P value of < 0.05 was considered statically significant. Statistical analysis was done by SPSS software (version 20, SPSS Inc., Chicago, IL, USA).

Results

Majority of patients in both groups were hard working laborers 21 (40.38%) and 23 (42.59%) in group A and group B, respectively. Sixteen (30.76%) and 12 (22.22%) patients in group A and B were in non-working group. Twelve (23.07%) and 14 (25.92%) patients in group A and B were employs. Overall difference in the distribution of the patients related to occupation between the both groups was not significant.

Majority of the patients 27 (51.92%) and 26 (48.14%) patients in group A and group B did not have co-morbidities. Equal number of patients 8 (15.38%) and 8 (14.81%) each in group A and group B reported to have diabetes and COPD, respectively. Five (9.61%) and 6 (11.11%) patients reported to have both diabetes and COPD in group A and group B, respectively. Four (7.69%) in group A and 6 (11.11%) patients in group B were reported to have other co-morbidities like cardiac, renal, hepatic. Overall, difference between the both study groups related to distribution of co-morbidities was not significant.

In this study we observed that ventral hernias were more common in elderly and female population. Difference in age and sex distribution of the patients between the two study groups was not significant (Table 1).

Table 1. Demographics, mean operative time and hospital stay

Category	Group-A (n=52)	Group-B (n=54)	P value
<i>Age group</i>			
19-49 yr, n %	21 (40.38%)	22 (40.74%)	>0.05
50-70 yr, n %	31 (59.61%)	32 (59.25%)	
<i>Sex</i>			
Male, n %	20 (38.64%)	20 (37.03%)	>0.05
Female, n %	32 (61.53%)	24 (62.96%)	
Mean Operative time (minutes)	81.30 (64-104)	85.85 (70-104)	0.06
Mean Hospital stay (days)	10.11days (5-22)	6.22 (4-12)	0.03*
*significant at $p \leq 0.05$.			

The difference in mean operative time between the two (sublay and onlay) study groups ($P=0.06$) was not significant statistically. But the duration of mean hospital stay was significantly less in sublay group than in onlay group ($P=0.03$).

Seroma formation was significantly high in onlay group than in sublay group ($P=0.002$). Surgical site infection was also significantly more in onlay group than in sublay group ($P=0.02$). In onlay group, 3 (5.76%) patients developed recurrence but there was no recurrence in sublay group ($P=0.03$). Overall mesh related wound complications were significantly more in Onlay group than in Sublay group (Table 2).

Category	Group A (n=52)	Group-B (n=54)	P value
Seroma	22 (42.5%)	7 (12.96%)	0.002*
Infection	9 (17.3%)	3 (5.55%)	0.02*
Recurrence	3 (5.76%)	0 (0%)	0.03*

*significant at $p \leq 0.05$.

Category	24 hours post-surgery			48 hours post-surgery		
	Group A (n=52)	Group B (n=54)	P value	Group A (n=52)	Group B (n=54)	P value
No pain	0(0%)	0(0%)	--	0(0%)	0(0%)	--
Mild pain	19(36.53%)	0(0%)	--	32(61.53%)	30(55.55%)	0.2
Moderate pain	30(57.69%)	47(87.3%)	0.02	20(38.46%)	24(44.44%)	0.2
Severe Pain	3(5.76%)	7(12.96%)	0.1	0(0%)	0(0%)	--
Worst pain	0(0%)	0(0%)	--	0(0%)	0(0%)	--

Discussion

Ventral hernias are one of the commonest surgical problems encountered by general surgeons in their practice. Surgical repair is the treatment of choice for ventral hernias. Various operative techniques have been described for treatment of ventral hernias, which varies from simple closure of the defect to mesh repair. Repair without mesh or anatomical repair is either by direct closure of the defect with non-absorbable sutures, or by double breasting (Mayo's repair). Hernia defect less than 2.5 cm in diameter can be repaired with primary tissue repairs [10-12]. Primary tissue repair only for hernia defect more than 2.5 cm in diameter causes high tissue tension which results in higher recurrences, which is up to 30-40% [1]. Hernia repair with mesh resulted in significant reduction in recurrence rates [2,3,13], but is not free of mesh related wound complications. Onlay and Sublay are the two operative techniques used routinely for placement

In initial 24 hours of post-operative period significantly greater number of patients in sublay group reported moderate to severe pain than in onlay group ($P=0.02$). In the next 24 hours' the difference in severity of pain (both mild and moderate) reported by patients in two groups was not significant ($P=0.2$ each for both grades of pain) (Table 3).

Significantly a greater number of patients in sublay group expressed their satisfaction than the patients in onlay group ($P=0.001$) with the procedure which they have undergone. Whereas greater number of patients in onlay group has expressed their dissatisfaction than the patients in sublay group ($P=0.03$) with the procedure which they have undergone (Table 4).

Category	Group-A (n=52)	Group-B (n=54)	P value
1	9 (17.30%)	3 (5.55%)	0.03*
2	23 (44.23%)	11(20.37%)	0.004*
3	20 (38.46%)	39 (72.22%)	0.001*

1=Dissatisfied, 2=Neither satisfied nor dissatisfied, 3=Satisfied. *significant at $p \leq 0.05$.

of mesh in ventral hernia repairs. Sublay plane (includes preperitoneal, retro rectus) mesh placement with overlapping the hernia defect all around was introduced in 1980s [14]. Still there is no common consensus between the experts regarding the superiority of these two procedures.

The present study showed that ventral hernias were common in females and elderly people than in males and young people and commonest in patients with Diabetes and COPD. Incidence of these hernias were high in hard working laborers; similar findings have been noted in other studies [9,15].

In our study difference in the mean operative time between two study groups (81.30 minutes) for onlay group and (85.85 minutes) for sublay group was not significant. Other authors have noted in their studies that mean operative time for sublay group is significantly longer than onlay group. They have claimed that longer time has been taken to develop retromuscular and preperitoneal spaces and for to secure hemostasis [6,16-19]. In contrast to their

findings, we observed that, raising the wider subcutaneous flaps, securing hemostasis, and fixing the mesh in onlay technique was also more time consuming. Whereas retro muscular and preperitoneal spaces are already existing anatomical planes, which are usually avascular, and has less chance of hemorrhage, further it needs a smaller number of sutures to fix the mesh, these factors which were contributing to the findings in present study. Factors like surgeon's experience, exposure (constant for both procedures) and planning, quality of assistance, quality of Instruments and sutures etc. also play a significant role for operative time [18].

Mean hospital stay in this study was significantly less in sublay group (6.22 days) than in onlay group (10.11 days). Limited studies are available with this perspective; those authors also have noted similar findings [18,19].

Post-operative pain is an important morbidity mainly of patient concern. In this study during immediate post-operative period (initial 24 hours) significantly a greater number of patients 30 (57.9%) in sublay group reported higher degree of pain and required more analgesics than the patients 20 (38.46%) in onlay group. But in next 24 hours (at 48 hours) of post-operative period there is no significant difference in quality (severity), and quantity (number of patients) of pain in both study groups. Even though pain is a subjective factor, the flap mobilization and direct handling of muscles in anterior abdominal wall, play an important role for this. Very limited literature was available in this aspect, and chronic abdominal pain was their concern [20], which is not reported by patients in present study.

Seroma formation was the commonest morbidity encountered after ventral hernioplasty but it can also occur commonly after many types of surgery. It has been noted in this study that significantly a greater number of the patients in onlay group 22 (42.5%) developed seroma than the patients 7 (12.96%) in sublay group. Similar findings have been noted in previous studies by various authors [13,15-19,21]. None of the patients in both study groups have required additional surgical procedures for the treatment of seroma, apart from routine postoperative negative suction drain, and ultrasound guided repeated aspirations under strict aseptic precautions.

Infection is another common and serious morbidity encounter after ventral hernia repair. In present study significantly more patients 9 (17.3%) of onlay group developed infection than the patients 3 (5.55%) in sublay group. Similar findings have been reported by other authors in their studies [4-11,16-18,22]. None of the patients in either group of this study has required mesh removal due to infection.

Recurrence of hernia is quite disappointing to both patient and surgeon. Three (5.76%) patients in the onlay group of this study developed recurrence, whereas recurrence was not noted in sublay group of this study.

Similarly, higher recurrences with onlay technique have been reported by authors [23,24] and various other authors has reported '0' incidence of recurrence [6,10,16] and lower incidence of recurrence [4-8,13-19] in sublay group. Overall recurrence rate of ventral hernia after mesh repair irrespective of technique is 1.5-10% in literature [6-8].

Patient satisfaction is an important aspect of any surgical procedure for its evaluation and implementation. Majority of patients 39 (72.22%) in sublay group of this study expressed their satisfaction with procedure they had undergone than the patients 20 (38.46%) in onlay group. Reasons pointed out by Patients in Onlay group for their dissatisfaction was seroma, infection, feeling tightness of the skin overlying the mesh due to fixity of the skin to underlying mesh (observed particularly in lean individuals), feeling of the foreign body sensation at site of mesh, scar puckering and disfigurement due to infection, and recurrence. Information is not available in the literature from any of the previous studies for comparison.

Conclusions

In the presented study various outcomes (operative time, seroma, infection, hospital stay, pain, recurrence and patient satisfaction) of both sublay and onlay procedures were compared. Sublay technique has significantly less seroma, infection, recurrence rates and shorter hospital stay. In present study operative time was almost equal in both procedures in contrast to findings in other studies in which the operative time for sublay group is significantly more. Severity of pain in the immediate post-operative period was significantly more (quality, and quantity) in sublay group than in onlay group, but difference in severity of pain in late post-operative period between the two study groups was not significant. Whereas more patients in sublay group expressed their overall satisfaction with the procedure which they have undergone than the patients in onlay group. Both these criteria were not addressed in other studies. It has been concluded that the Sublay technique is superior to the onlay technique even though onlay technique is most practiced because of its technical simplicity, sublay mesh repair can be safely practiced with little more experience.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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References

1. Aurangzeb M. Tension free mesh hernioplasty: a review of 96 cases. *JPMI*. 2004;18(1):46-51. <https://jpmi.org.pk/index.php/jpmi/article/view/851>
2. Nguyen MT, Berger RL, Hicks SC, Davila JA, Li LT, Kao LS, Liang MK. Comparison of outcomes of synthetic mesh vs suture repair of elective primary ventral herniorrhaphy: a systematic review and meta-analysis. *JAMA Surg*. 2014 May;149(5):415-21. doi: 10.1001/jamasurg.2013.5014
3. Holihan JL, Nguyen DH, Nguyen MT, Mo J, Kao LS, Liang MK. Mesh Location in Open Ventral Hernia Repair: A Systematic Review and Network Meta-analysis. *World J Surg*. 2016 Jan;40(1):89-99. doi: 10.1007/s00268-015-3252-9
4. Timmermans L, de Goede B, van Dijk SM, Kleinrensink GJ, Jeekel J, Lange JF. Meta-analysis of sublay versus onlay mesh repair in incisional hernia surgery. *Am J Surg*. 2014 Jun;207(6):980-8. doi: 10.1016/j.amjsurg.2013.08.030
5. Forbes SS, Eskicioglu C, McLeod RS, Okrainec A. Meta-analysis of randomized controlled trials comparing open and laparoscopic ventral and incisional hernia repair with mesh. *Br J Surg*. 2009 Aug;96(8):851-8. doi: 10.1002/bjs.6668
6. Zollinger Jr RM, Zollinger Sr RM. *Zollinger's Atlas of Surgical operations*. 8th Ed. Mc Graw Hill publications; 2003:406-409.
7. Ibrahim AH, El-Gammal AS, Mohamed Heikal MM. Comparative study between 'onlay' and 'sublay' hernioplasty in the treatment of uncomplicated ventral hernia. *Menoufia Med J*. 2015; 28(1):11-6. doi: 10.4103/1110-2098.155904
8. Goda El-Santawy HM, El-Sisy AA, El-Gammal AS, El-Kased AF, Sultan HM. Evaluation of retromuscular mesh repair technique for treatment of ventral incisional hernia. *Menoufia Med J*. 2014;27(2):226-9. doi: 10.4103/1110-2098.141640
9. Ahmed M, Mehboob M. Comparisons of Onlay versus Sublay Mesh Fixation Technique in Ventral Abdominal Wall Incisional Hernia Repair. *J Coll Physicians Surg Pak*. 2019;29(9):819-822. doi: 10.29271/jcpsp.2019.09.819
10. Leithy M, Loulah M, Greida HA, Baker FA, Hayes AM. Sublay hernioplasty versus onlay hernioplasty in incisional hernia in diabetic patients. *Menoufia Med J*. 2014;27(2):353-8. doi: 10.4103/1110-2098.141708
11. Mellia JA, Othman S, Naga HI, Messa CA 4th, Elfanagely O, Byrnes YM, Basta MN, Fischer JP. Outcomes of Poly-4-hydroxybutyrate Mesh in Ventral Hernia Repair: A Systematic Review and Pooled Analysis. *Plast Reconstr Surg Glob Open*. 2020;8(12):e3158. doi: 10.1097/GOX.0000000000003158.
12. Demetrashvili Z, Pipia I, Loladze D, Metreveli T, Ekaladze E, Kenchadze G, Khutsishvili K. Open retromuscular mesh repair versus onlay technique of incisional hernia: A randomized controlled trial. *Int J Surg*. 2017;37:65-70. doi: 10.1016/j.ijso.2016.12.008
13. Dhaigude BD, Sugunan A, Panchbhai SV, Francis M, Patel K, Metta V. Comparative evaluation of sublay versus onlay meshplasty in incisional and ventral hernias. *Int Surg J*. 2018;5(1):187-92. doi: 10.18203/2349-2902.isj20175892
14. Raghuvveer MN, Muralidhar S, Shetty H, Veena V. Onlay versus sublay mesh repair for ventral hernia. *Int Surg J*. 2018;5(3):823-6. doi: 10.18203/2349-2902.isj20180432
15. Saber A, Emad KB. Onlay Versus Sublay Mesh Repair for Ventral Hernia. *J Surg*. 2015;4(1-1):1-4. doi: 10.11648/j.js.s.2016040101.11
16. Kaafarani HM, Hur K, Hirter A, Kim LT, Thomas A, Berger DH, Reda D, Itani KM. Seroma in ventral incisional herniorrhaphy: incidence, predictors and outcome. *Am J Surg*. 2009 Nov;198(5):639-44. doi: 10.1016/j.amjsurg.2009.07.019
17. Jat MA, Memon MR, Rind GH, Shah SQA. Comparative evaluation of "Sublay" versus "Inlay" meshplasty in incisional and ventral hernias. *Pak J Surg*. 2011; 27(1):54-8. http://www.pjs.com.pk/journal_pdfs/jan_mar11/p54.pdf
18. Saeed N, Iqbal SA, Shaikh BA, Baqai F. Comparison between onlay and sublay methods of mesh repair of incisional hernia. *J Post Med Inst*. 2014;28(4):400-3. <https://jpmi.org.pk/index.php/jpmi/article/view/1592>
19. Acar T, Acar N, Sür Y, Kamer E, Atahan K, Genç H, Hacıyanlı M. The Effects of Operation Technique on Recurrence of Incisional Hernia Repair. *Sisli Etfal Hastan Tip Bul*. 2020 Mar 24;54(1):23-28. doi: 10.14744/SEMB.2019.23334
20. Strâmbu V, Radu P, Brătucu M, Garofil D, Iorga C, Iorga R, Popa F. Rives technique, a gold standard for incisional hernias -- our experience. *Chirurgia (Bucur)*. 2013 Jan-Feb;108(1):46-50.
21. Korenkov M, Sauerland S, Arndt M, Bograd L, Neugebauer EA, Troidl H. Randomized clinical trial of suture repair, polypropylene mesh or autodermal hernioplasty for incisional hernia. *Br J Surg*. 2002; 89(1):50-6. doi: 10.1046/j.0007-1323.2001.01974.x
22. Bauer JJ, Harris MT, Gorfine SR, KreeI I. Rives-Stoppa procedure for repair of large incisional hernias:

- experience with 57 patients. *Hernia*. 2002 Sep;6(3): 120-3. doi: 10.1007/s10029-002-0071-3
23. Gleysteen JJ. Mesh-reinforced ventral hernia repair: preference for 2 techniques. *Arch Surg*. 2009 Aug;144(8):740-5. doi: 10.1001/archsurg.2009.118
24. Khan HM, Patwari TR. A comparative study of Desarda's mesh free inguinal hernia repair with modified Bassini's repair. *J Clin Investig Surg*. 2021; 6(2):104-115. doi: 10.25083/2559.5555/6.2.4