Research Article

A comparative study of single layer closure and conventional layered closure of laparotomy wounds in a rural setup

Namitha D[1*], Murali Mohan R[2], Yashas H R[3], Srinath R[4], Sushruta M S[5], Akshai C K[6]

[1,5,6]Senior Resident, Department of General Surgery, KIMS, Bangalore, Karnataka, INDIA.
[2,3]Assistant Professor, [4]Professor, Department of General Surgery, Adichunchanagiri Institute of Medical Sciences Balagangadharanatha Nagara-571448, Nagamangala, Mandya, Karnataka, INDIA.
Email: namithagowda@gmail.com

Abstract

Introduction: Many of the operations performed by the general surgeons take place within the abdomen and consequently incision and suturing of the abdominal layers is the most common exercise in operative surgery. Abdominal closure is very important with regard to incision, technique of repair and use of newer suture material, and has created a great interest to surgeons. Recent data suggests that technical factors are crucial and can be manipulated by the surgeon. Different suture techniques are used for closure of laparotomy wounds and each has its strong proponents. But the ideal method of abdominal wound closure is modified frequently. Commonly followed methods of abdominal closure are conventional layered closure and single layer closure. **Aim:** To compare the techniques of single layer closure and conventional layered closure of laparotomy wounds in a rural setup. **Objectives:** To study 60 cases of laparotomy, dividing them into two groups of 30 each. Patients of one group will undergo closure of the laparotomy wound by conventional methods and the other group will undergo closure in a single layer. The objectives being to: Compare the operative time and healing time for single layer closure and conventional layered closure of laparotomy wounds. Compare the post-operative complications after performing single layer closure and conventional layered closure of laparotomy wounds, like seroma, wound infection, wound gaping, burst abdomen and incisional hernia. **Result:** Comparing both the closures, single layer closure had reduced operative time than conventional layered closure, and hence, lessens anaesthetic hazards, reduces cost of anesthetic agents and saves the surgeons time. Incidence of postoperative complications like seroma, wound infection, wound gaping; burst abdomen and incisional hernia are significantly less in single layer closure technique.

Keywords: laparotomy wounds.

***Address for Correspondence:**
Dr. Namitha D, Senior Resident, Department of General Surgery, KIMS, Bangalore, Karnataka, INDIA.
Email: namithagowda@gmail.com
Received Date: 27/04/2020 Accepted Date: 07/06/2020

Access this article online	
Quick Response Code:	Website: www.statperson.com
	Volume 10 Issue 3

INTRODUCTION

Many of the operations performed by the general surgeons take place within the abdomen and consequently incision and suturing of the abdominal layers is the most common exercise in operative surgery. Abdominal closure is very important with regard to incision, technique of repair and use of newer suture material, and has created a great interest to surgeons. Recent data suggests that technical factors are crucial and can be manipulated by the surgeon. Different suture techniques are used for closure of laparotomy wounds and each has its strong proponents. But the ideal method of abdominal wound closure is modified frequently. Commonly followed methods of abdominal closure are conventional layered closure and single layer closure. Since 1973, different workers have carried out comparative studies of these two methods with encouraging results and single layer closure was found to have definite advantages over conventional closure with regard to operating time, cost, feasibility, ease and postoperative morbidity. The present

How to cite this article: Namitha D *et al.* A comparative study of single layer closure and conventional layered closure of laparotomy wounds in a rural setup. *International Journal of Recent Trends in Science and Technology* July to September 2020; 10(3): 14-21 http://www.statperson.com

study is taken up to evaluate the advantages of single layer closure in comparison with the conventional layered closure on the basis of operative time, healing time and postoperative morbidity such as wound infection, burst abdomen and incisional hernia.

MATERIAL AND METHODS

Material

This study includes 60 patients admitted in the Department of General Surgery, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Bellur, during the period of December 2011 to October 2013 for abdominal surgical problems needing either elective or emergency surgery. The patients were chosen randomly, irrespective of gender, age and nature of disease. Out of these 60 patients, 30 were randomized to have the abdominal wall closed by single layer closure technique and remaining 30 by conventional layered closure and were grouped as group 1 and group 2 respectively.

Inclusion Criteria

- Patients aged 15-75 years.
- Patients posted for laparotomy, either elective or emergency.
- Patients who underwent surgery with midline, paramedian and subcostal incisions.

Exclusion Criteria

- Patients with co-morbid conditions like immuno-compromised patients, patients on cancer chemotherapy, immunotherapy and on long term steroids.
- Patients who died within 7 days after surgery.
- Patients who underwent surgery by Grid-iron and Transverse abdominal incisions.
- Patients who underwent second laparotomy or relaparotomy.

Methods

Relevant history of the patient including any co-morbidities, personal and drug history were noted. Clinical examination was made and recorded with particular attention given to note the anemia, nutritional status, jaundice, respiratory tract infections. Routine investigations and investigations relevant and supporting the particular diagnosis were employed. Patients were prepared pre-operatively. In emergency surgery, the general condition of the patient was improved by correcting dehydration, electrolyte imbalance and by giving antibiotics. Tone of the gastric wall was improved by employing stomach wash with normal saline for all cases posted for gastric procedures. Bowel wash was given for necessary cases. In the operation theatre, the part was painted and draped. General anesthesia was used in all cases. Using suitable incision, the surgery planned was performed.

CLOSURE OF ABDOMINAL INCISIONS

In group 1: Midline incision

Closure was performed by suturing the cut edges of the peritoneum and linea alba together. Bites were taken about 1 cm from the cut edges and interval of about 1cm with continuous locking sutures using Prolene No. 1.

Paramedian incision

The peritoneum, endoabdominal fascia, posterior layer of rectus sheath, the medial fibres of rectus abdominis muscle and anterior layer of rectus sheath were sutured as a single layer. The bites were taken about 1cm from the cut edges and about 1cm interval. Continuous locking sutures were put with Prolene No.1.

Kocher's incision

The peritoneum and cut edges of anterolateral abdominal wall muscles on the lateral aspect and the peritoneum and rectus abdominis along with its sheath on the medial aspect were sutured as a single layer. The bites were taken about 1cm from cut edges and about 1cm interval. Continues locking sutures using Prolene No.1.

In group 2

Mid line Incision

The peritoneum was closed with Vicryl No.2.0 by continuous locking sutures and the linea alba closed similarly with Prolene No.1.

Paramedian Incision

The peritoneum and posterior layer of rectus sheath was closed with Vicryl No.2.0 by continuous locking sutures. The anterior layer of rectus sheath was closed with No.1 Prolene by continuous locking sutures. Skin was closed with nonabsorbable material like Nylon using interrupted mattress sutures or staplers in both groups of patients. Following surgeries, the wounds were cleaned with spirit and dressed. Time taken for closure of abdomen were recorded in all cases. Drains were used wherever necessary, through a separate stab incision.

Postoperative

All patients received antibiotics suitable for the case in post operative period parenterally, usually for 2-3 days and orally for 5-7 days. Antibiotics were continued only whenever indicated after 10 days. Analgesics were given post operatively. Blood transfusions were given wherever indicated. The wound was examined on 3rd, 5th, 7th and 9th or 10th day and the condition of the wound noted. Drains wherever employed were removed on 2nd or 3rd day unless required. The sutures were removed between 7th to 10th days in both the groups. During the post operative period, the patients were examined for abdominal distension, vomiting, hiccup and chest infection. Seroma and wound infection was also noted. Regular examination of the wounds for signs of wound gaping and burst abdomen was done.

Follow up

Regular monthly follow up were done for 3 months, and once in 3 months thereafter. During the follow up, the patients were examined for scar complications and incisional hernia.

RESULTS AND ANALYSIS

Study design: A Comparative two group study

Table 1: Mode of delivery

Mode of delivery	Single layer closure		Conventional layered closure	
	No	%	No	%
Elective	10	33.3	11	36.7
Emergency	20	66.7	19	63.3
Total	**30**	**100.0**	**30**	**100.0**

P=0.787

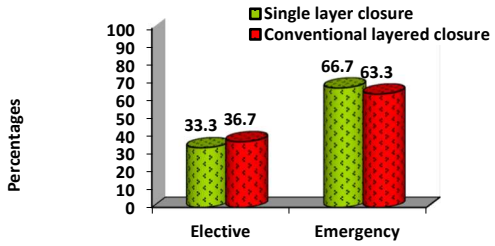

Figure 1: Mode of delivery

In our study, 10 patients underwent elective surgery and 20 patients underwent emergency surgery in group 1, 11 patients underwent elective surgery and 19 patients underwent emergency surgery in group 2.

Table 2: Type of Incision

Incision	Single layer closure		Conventional layered closure	
	No	%	No	%
1,Left paramedian incision	1	3.3	2	6.7
2.Left sub costal incision	2	6.7	2	6.7
3.Midline incision	20	66.7	20	66.7
4.Right Kocher's incision	4	13.3	4	13.3
5.Right paramedian incision	3	10.0	2	6.7
Total	**30**	**100.0**	**30**	**100.0**

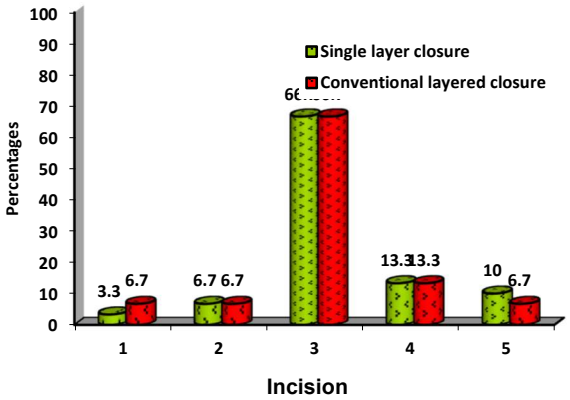

Figure 2: Type of Incision

In our study, 66.7% of patients had midline abdominal incision, 13.3% had right Kocher's incision, 8.3% had right paramedian incision, 6.7% had left subcostal incision and 5% had left paramedian incision. 66.7% of patients in single layer closure technique had midline incision, 13.3% had right Kocher's incision 10% had right paramedian, 6.7% had left subcostal incision and 3.3% had left paramedian incision. 66.7% of patients had midline incision, 13.3% had right Kocher's incision, 6.7% had right paramedian incision, 6.7% had left paramedian incision and 6.7% had left subcostal incision in conventional layered closure group.

Table 3: Material used

Material used	Single layer closure		Conventional layered closure	
	No	%	No	%
Prolene	30	100.0	0	0.0
Prolene and vicryl	0	0.0	30	100.0
Total	**30**	**100.0**	**30**	**100.0**

P=<0.001**

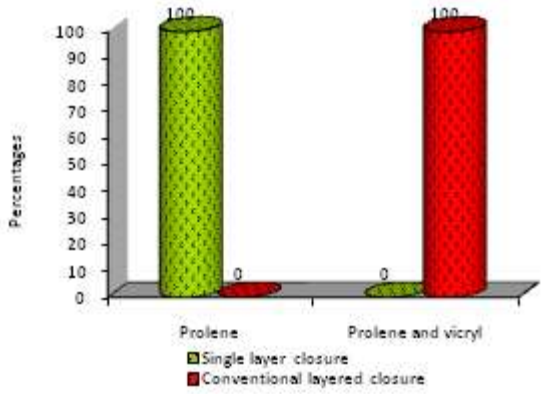

Figure 3: **Material used**

In our study, single layer closure was done with Prolene No.1, and conventional layered closure suturing was done using Vicryl No.2.0 and Prolene No.1.

Table 4: Time taken for closure

Time taken for closure	Single layer closure		Conventional layered closure	
	No	%	No	%
<30 mins	30	100.0	11	36.7
>30 mins	0	0.0	19	63.3
Total	**30**	**100.0**	**30**	**100.0**

P<0.001**

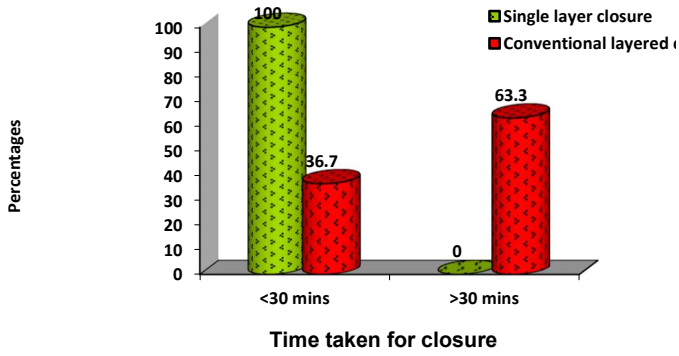

Figure 4: Time taken for closure

In our study, the mean time taken for closure of laparotomy wounds, by single layer closure technique was 19.5min and by conventional layered closure technique was 32.7min. There was a difference of about 13.2 minutes in the mean time between the two techniques used which was statistically significant (p<0.001), indicating that the time needed for single layer closure technique was significantly less than that needed for conventional layered technique.

Table 5: Associated factors

Associated factors	Single layer closure (n=30)		Conventional layered closure (n=30)	
	No	%	No	%
1.Anemia	5	16.7	6	20.0
2.Chest infection and cough	1	3.3	1	3.3
3.Diabetes mellitus	9	30.0	8	26.7
4.Epilepsy	0	0.0	1	3.3
5.Hypertension	5	16.7	7	23.3
6.Schizophrenia	1	3.3	0	0.0
7.Alcoholic	1	3.3	0	0.0

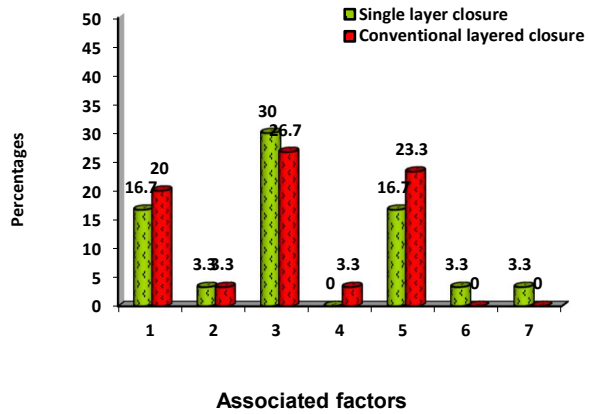

Figure 5: Associated factors

In our study, 17 patients in group 1 and 16 patients in group 2 had associated risk factors. They had single or multiple risk factors. 16.7 % had anemia, 30.0% were diabetic, 16.7% had hypertension, 1 had chest infection with cough, 1 patient had schizophrenia and 1 was an alcoholic in group 1. 20.0% were anemic, 26.7% were diabetic, 23.3% were hypertensive, 1 had chest infection with cough and 1 had epilepsy in group 2.

Table 6: Day of suture removal

Day of suture removal	Single layer closure		Conventional layered closure	
	No	%	No	%
7	13	43.3	3	10.0
8	9	30.0	16	53.3
9	6	20.0	7	23.3
10	2	6.7	4	13.3
Total	**30**	**100.0**	**30**	**100.0**

Higher time taken for suture removal in Conventional layered closures with P=0.030*

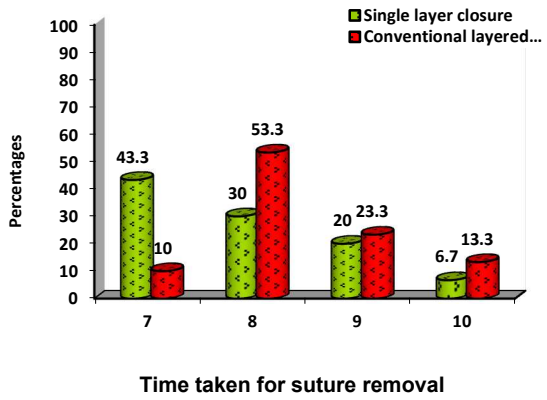

Figure 6: Day of suture removal

In our study, 26.7% of patients undergoing laparotomy had suture removal done on 7th post operative day and 41.7% on 8th post operative day. The mean time taken

was 7.9 days for single layer closure method and 8.4 days for conventional layered closure method. There was a significant difference (p=0.030) in the time taken for suture removal between the single layer closure technique and the conventional layered technique.

Table 7: Complications

Complications	Single layer closure (n=30)		Conventional layered closure (n=30)		P value
	No	%	No	%	
1.Seroma	13	43.3	21	70.0	0.037*
2.Wound infection	6	20.0	16	53.3	0.007**
3.Wound gaping	6	20.0	10	33.3	0.243
4.Burst Abdomen	1	3.3	2	6.7	1.000
5.Incisional Hernia	0	0.0	1	3.3	1.000

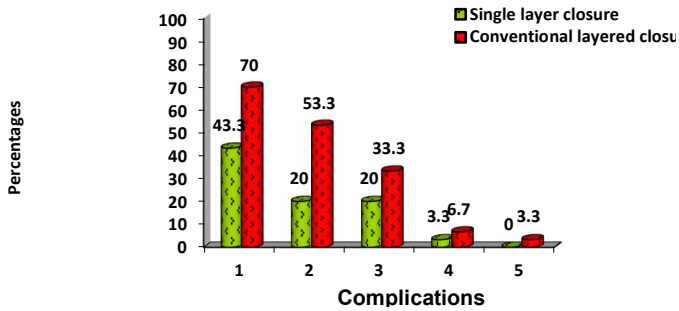

Figure 7: Complications

POST OPERATIVE COMPLICATION IN THE STUDY GROUP

In our study, 18 patients (60%) in single layer closure group and 27 patients (90%) in conventional layered closure group, had post operative complications like seroma, wound infection, wound gaping, burst abdomen and incisional hernia. Most of them had more than one complication.

Seroma

In group 1, 13 patients had seroma, out of which 11 had only seroma and 2 had other complications. 7 of them were associated with single or multiple risk factors. In group 2, out of 21 patients who had seroma, 11 of them had more than one complication. 6 had anaemia, and 13 of them underwent emergency surgery.

Wound Infection

In group 1, 6 patients had wound infection out of which 2 of them were associated with more than one complication and 3 of them underwent emergency surgery. In that two patients were anaemic and one patient was a diabetic. In group 2, out of 16 patients who had wound infection, 13 had more than one complication 9 underwent emergency surgery and 4 patients had anaemia.

Wound Gaping

In group 1, 6 patients had wound gaping, out of which 5 of them had more than one complication, 3 of them underwent emergency surgery. 2 of them were diabetic, 1 was an alcoholic, and 1 had chest infection with cough. One patient was anaemic and the other was hypertensive. In group 2, out of 10 patients who developed wound gaping, out of which 9 of them had more than one complication, 8 patients underwent emergency surgery. 3 patients were anaemic out of which one had an additional factor of diabetes, 2 were diabetic and a hypertensive and one patient had chest infection with cough and hypertension.

Burst Abdomen:

In group 1, burst abdomen occurred in one patient on 6th post operative day. This patient was a schizophrenic and had a liver contusion and mesenteric tear with peritonitis. This patient underwent emergency surgery. In group 2 burst abdomen occurred in 2 patients, both operated on an emergency basis. First patient had blunt trauma abdomen with bowel injury and peritonitis. Burst abdomen occurred on 7th post operative day. The second patient had liver trauma with multiple lacerations and contusions. He was an hypertensive. In this patient burst abdomen occurred on 8th postoperative day.

Incisional Hernia

None of the patient in group 1 had incisional hernia. In group 2, one patient had incisional hernia 4 months after the surgery. This patient underwent emergency surgery for ileal perforation and peritonitis. He had developed seroma and wound gaping in the immediate postoperative period.

Table 8: Follow up in months

Follow up in months	Single layer closure		Conventional layered closure	
	No	%	No	%
1-3	7	23.3	8	26.7
4-6	18	60.0	14	46.7
7-9	1	3.3	4	13.3
10-12	4	13.3	4	13.3
Total	30	100.0	30	100.0
Mean ± SD	**5.17±2.57**		**5.63±2.65**	

P=0.491

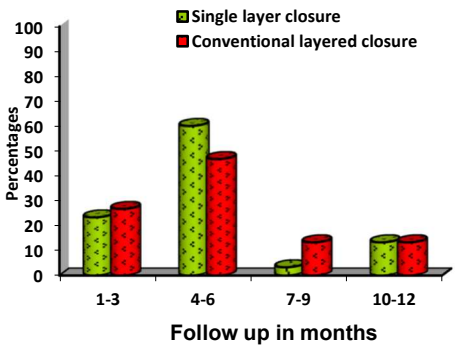

Figure 8: Follow up in months

In our study, the mean postoperative follow up of patients in the single layer closure group was 5.2 months and in the conventional layered closure group was 5.6 months.

DISCUSSION

The present study is aimed at comparing the techniques of laparotomy wound closure. The technique of laparotomy wound closure is one of the important factors in preventing post operative complications. Any error, such as a poorly placed incision, unsatisfactory method of closure or inappropriate selection of suture can lead to complications including hematoma, stitch abscess, infection, wound dehiscence or evisceration, incisional hernia or an unsightly scar. Prevention of herniation of abdominal contents through the incisional wound resulting in burst abdomen or herniation through a weak scar resulting in incisional hernia are the main aims of a surgeon closing laparotomy wounds. Relegating the paramedian vertical incision of the 1950s and 1960s to history, today's surgeon chooses a vertical midline incision or, increasingly commonly, a transverse or modified transverse incision. Though different closure techniques exist for closure of laparotomy wounds, the ideal method of closure is yet to be finalized. Hence the present study was taken up by us at Adichunchanagiri Institute of Medical Sciences, Bellur, to compare the single layer closure and the conventional layered closure of laparotomy wounds on the basis of operative time and postoperative complications. In our study the mean age of patients taken up for study was 48.8 yrs in single layer closure group and 46 yrs in conventional layered closure group, did not show any significant difference between the two groups. Many larger earlier studies and Weiland *et al*[1] study, advocated the use of monofilament nonabsorbable suture material for closure of laparotomy wounds. Weiland *et al*[1], from their meta analysis study suggested that continuous closure with non-absorbable suture should be used to close most abdominal wounds ; but however, if infection or distension is anticipated, interrupted absorbable sutures are preferred. Rucinski *et al*[2], in their meta analysis of optimal technique for closure of abdominal midline incisions compared absorbable and nonabsorbable sutures. They found no statistically significant difference between nonabsorbable and monofilament absorbable sutures with regard to postoperative wound infection, dehiscence and incisional hernia. There was, however, a higher incidence of wound infection and incisional hernia formation when braided absorbable suture material was used and a higher incidence of incision area pain and suture sinus formation was noted with nonabsorbable suture material. They advocated a continuous mass closure with absorbable monofilament suture material for laparotomy wounds. But results of larger studies showing the advantages of absorbable sutures over non absorbable sutures are still awaited. Continuous suture (polydiaxanone) has gradually begun to replace all permanent sutures, primarily because the polypropylene knots were prone to cause skin irritation, which were often required to be removed later and were not infrequently the cause of draining suture sinuses as they were permanent foreign bodies at the fascial level. Hence in our study, we used monofilament, non absorbable continuous interlocking sutures (Prolene No.1) for closure of laparotomy wounds in single layer closure and Vicryl No.2.0 and Prolene No.1 for conventional layered closure. In our study, the mean time taken for closure of laparotomy wounds by single layer closure was 19.5 minutes and by conventional layered closure was 32.7 minutes. Single layer closure took about 13.2 minutes lesser than conventional layered closure. In Banerjee and Chatterjee [3]study, single layer closure took about 10 minutes lesser time than conventional layered closure. Our study was consistent with the their study. Various studies have reported postoperative complication rates which are definitely less in single layer closure than in conventional layered closure. Prominent predisposing factors like anaemia, diabetes, chest infection with cough were considered as contributing factors for post operative complications in our study. Considering that majority of our patients were from a rural setup most of them had poor nutritional status and were associated with one or more predisposing factors. The incidence of postoperative seroma formation in our study was 43.3% in single layer closure group and 70% in conventional layered closure group, showing higher incidence in conventional layered closure group. Detection of seroma and its management in the postoperative period is important. If ignored it may lead to formation of wound infection and its sequelae.

Table 9: Comparison of post operative complications in earlier studies with our study

Study	Wound Infection		Wound Gaping		Burst Abdomen		Incisional Hernia	
	SLC	CLC	SLC	CLC	SLC	CLC	SLC	CLC
Jones *et al* 1941	-	-	-	-	0%	3.9%	-	-
Togart 1967	17%	29%	0.87%	3.4%	-	-	-	-
Shukla *et al* 1981	0.5%	16.9%	2%	13%	-	-	0%	3%
Singh *et al* 1981	6.6%	16.6%	0%	10%	-	-	0%	16.6%
Bucknall TE *et al* 1982	-	-	-	-	0.8%	3.8%	-	-
Sharma *et al* 1986	-	-	-	-	4.7%	12.3%	-	-
Banerjee and Chatterjee1989	-	-	-	-	3.6%	7.27%	-	-
Choudhary and Choudhary1994	22.5%	47.5%	-	-	0%	3.75%	-	-
Present study 2011	20%	53.3%	20%	33.3%	3.3%	6.7%	0%	3.3%

Tearing through the weak infected tissues with intact suture is the main cause for wound dehiscence. The wound infection rate for Togart [4] was 17% and 29%, Shukla *et al*[5] was 0.5% and 16.9%, Singh *et al*[6] was 6.6% and 16.6% and for Chowdhury and Chowdhury[7] was 22.5% and 47.5% in single layer closure and conventional layered closure respectively. In our study, the incidence of wound infection was 20% in single layer closure and 53.3% in conventional layered closure, showing higher incidence in conventional layered closure. Incidence of wound gaping was 0.87% and 3.4% for Togart[4], 2% and 13% for Shukla *et al*[5,] and 0% and 10% for Singh *et al*[6,] in single layer closure and conventional layered closure respectively. In our study, the incidence of wound gaping was 20% in single layer closure and 33.3% in conventional layered closure, again showing higher incidence in conventional layered closure group. Peritonitis requiring emergency surgery along with other associated factors like chest infection with cough, anaemia and hypertension were thought to be the causative factors for a higher incidence of wound gaping in our study. Irvin *et al*[8] found that wound infection was responsible for tenfold rise in the incidence of burst abdomen and incisional hernia. Incidence of burst abdomen was 0% and 3.9% for Jones[1], 0.8% and 3.8% for Bucknall *et al*[9], 4.7% and 12% for Sharma *et al*[10], 3.6% and 7.27% for Banerjee and Chatterjee[3], and 0% and 3.75% for Chowdhury and Chowdhury[7], in single layer closure and conventional layered closure respectively. In our study, incidence of burst abdomen was 3.3% in single layer closure and 6.7% in conventional layered closure, showing doubling of burst abdomen incidence in conventional layered closure group. Peritonitis requiring emergency surgery leading to wound infection and gaping, along with associated factors like chest infection with cough, anaemia and hypoproteinaemia were the contributing factors for the occurrence of burst abdomen in our study. Wound infection, wound gaping and burst abdomen increased patient's morbidity, hospital stay and cost. Incisional hernia is common after wound infection. 88% of patients requiring repair of incisional hernia had wound infection in the study of Fischer and Turner[11]. Grace and Cox[12] found that burst abdomen was an important predisposing factor for the occurrence of incisional hernia. No incisional hernias occurred in the single layer closure study group of Shukla *et al*[5] and Singh *et al*[6]. However in conventional layered closure group Shukla *et al*[38] had 3% and Singh *et al*[39] had 6.6% of incisional hernias. In our study no incisional hernia occurred in single layer closure group and in conventional layered closure group the incidence of incisional hernia was 3.3%. Our study was in consistent with the studies of Shukla *et al* and Singh *et al* showing higher chance of occurrence of incisional hernia in conventional layered closure technique. The patient who developed incisional hernia in our study, had ileal perforation with peritonitis requiring emergency surgery and had seroma and wound infection in the immediate postoperative period which contributed for the occurrence of incisional hernia. Overall incidence of incisional hernias in the best centres has been at least 10% according to the literature[21]. While it was once believed that the majority of incisional hernias presented within the first 12 months following laparotomy, longer-term data indicate that at least one-third of these hernias will present 5- 10 years postoperatively[44]. Still longer period of follow up is necessary for our study to know the exact incidence of incisional hernias

CONCLUSION

Various methods of skin closure for laparotomy wounds have occupied the attention of surgeons over the years.Success of a surgery is complete when the wound heals with minimal complications and its cosmetic appearance is satisfactory. This is seen being possible with single layer closure technique of laparotomy wounds because of the shorter time required and other favourable factors for its healing. For a long time laparotomy wounds were closed in layers. When the mass closure technique of laparotomy wound was introduced, the myth

of layered closure was broken. In our study, single layer closure of laparotomy wounds took less operative time than conventional layered closure thus reducing the risk of anaesthetic hazards and the intra operative time. In our study conducted in the rural setup, most of our patients were under nourished and had one or more associated factors which had an implication on the overall healing of the wound and hence a relative increase in the postoperative complications. The incidence of postoperative complications like seroma, wound infection, wound gaping, burst abdomen and incisional hernia were however less in single layer closure compared to conventional layered closure. Hence, we conclude that single layer closure is a better technique for closure of laparotomy wounds than conventional layered closure in terms of operative time and post operative complications. However, longer study period is required to know the exact incidence of incisional hernias in the comparison groups.

REFERENCES

1. Weiland D, Bay B, Sordi SD. Choosing the best abdominal closure by metaanalysis. Am J Surg. 1998; 17(6): p. 666-70.
2. Rucinski J, Margolis M, Panagopoulos G, Wise L. Closure of the abdominal midline fascia : metaanalysis delineates the optimal technique. Am J Surg. 2001; 67(5): p. 421-6.
3. Banerjee P, Chatterjee A. Critical evaluation of conventional abdominal closure with single layer closure in adult and elderly. J.Indian Med Assoc. 1989; 87(12): p. 277-8.
4. Togart R. The suturing of abdominal incisions. Ar J Surg. 1967; 54: p. 124 – 27.
5. Shukla H, Sandeep K, Mishra M, Naithan Y. Burst abdomen and suture material : A comparison of abdominal wound closure with monofilament nylon and chromic catgut. Ind J Surg. 1981; 43: p. 487 – 91.
6. Amarjit S, Surjit S, Dhaliwal U, Sukhdev S. Technique of abdominal wall closure. Ind J Sur. 1981; 11: p. 785 – 89.
7. Chowdhury S, Choudhury J. Mass closure versus layered closure of abdominal wound. J. Indian Med Assoc. 1994; 92(7): p. 229-32.
8. Irvin T, Stoddard C, Greany M, Duthie H. Abdominal wound healing : A prospective clinical study. Br Med J. 1977; 2(6083): p. 351-2.
9. Bucknall T, Cox P, Ellis H. Burst abdomen and incisional hernia :a prospective study of 1129 major laparotomies. Br Med J. 1982; 284(6320): p. 931 – 3.
10. SB Sharma, M. Singh, Musman, KC Sohami. Single layer abdominal wound closure. Ind J Surg. 1986; 4: p. 563-68.
11. Fisher J, Turner F. Abdominal incisional hernias – a ten year review. Can J Surg. 1974; 17: p. 202 – 4.
12. Grace R, Cox S. Incidence of incisional hernia after dehiscence of the abdominal wound. Am J Surg. 1976; 131(2): p. 210-2.
13. Harold E, Abrahamson J. Maingot's abdominal operations. 10th ed. United States of America; 1997.
14. Patrick JJ, Jacob AG, David CB. Hernias. In Michael JZ, Stanley WA, editors. Abdominal Operations.: Mc Graw Hill; 2013. p. 150.

Source of Support: None Declared
Conflict of Interest: None Declared