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**Original Research Article**

# Evaluation of a new technique for abdominal wall closure in midline laparotomies

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## ABSTRACT

**Background:** An efficient technique for abdominal wall closure should provide strength and be a barrier against infection. Method of closure and type of suture material are critical aspects of an effective abdominal wall closure after midline laparotomy. Dehiscence of abdominal wounds after closure is a serious complication especially in emergency laparotomies. Our study was done to know whether our method of abdominal closure was helpful in reducing incidence of wound dehiscence.
**Methods:** Present study was carried out as a retrospective randomized clinical study in the department of general surgery, Menoufia University Hospitals for one year starting from March 2017 to March 2018. 168 patients had midline laparotomies (either elective or emergent) for inflammatory, traumatic or neoplastic indications.
**Results:** In present study for this new technique of abdominal wall closure after midline laparotomies, wound infection was noticed in 12/168 (7.2%) cases and 2/168 (1.2%) patients developed wound dehiscence.
**Conclusions:** Present study demonstrates that our new technique (Moharam Repair) of abdominal wall closure after midline laparotomies) is efficient in reducing post-operative wound dehiscence (burst abdomen). So, this technique is applicable, safe, and can minimize morbidities and mortalities related to wound dehiscence (as a short-term complication) after midline exploratory laparotomies (MEL).

**Keywords:** Midline laparotomies, Moharam repair, Wound dehiscence

## INTRODUCTION

Midline Exploratory laparotomy (MEL) has always remained one of the most commonly performed operations among the surgical procedures. The method of closure of such a laparotomy wound is the key to reduce the post-operative morbidity like wound infections, dehiscence and incisional hernias.[1]

Mass closure remains the standard technique for abdominal closure (closing all layers of the abdominal wall, excluding the skin), with either non-absorbable or slow-resorbing sutures, such as polydioxanone (PDS).[2]

The European Hernia Society Guidance on the closure of abdominal wall incisions (2015) recommended the use of prophylactic mesh augmentation for an elective midline laparotomy in a high-risk patient in order to reduce the risk of incisional hernia.[3]

The eponymously titled 'Hughes Repair' (Professor Les Hughes, 1932–2011), also known as the 'far-and-near' or 'Cardiff Repair', combines a standard mass closure (two-

loop 1 PDS sutures) with a series of horizontal and two vertical mattress sutures within a single suture (1 nylon), theoretically distributing the load along the incision length as well as across it.[4,5]

Millbourn et al and Deerenberg et al, in their studies, were comparing fascial closure using smaller bites (5-8 mm) to larger bites (10 mm). They demonstrated decreased incisional hernias when smaller fascial bites were used. Small needles may encourage surgeons to take small bites. The use of smaller fascial bites to close prolonged each operation by an average of just 4 minutes; however, this was found to be cost-effective given the significant reduction in hernia formation.[6,7]

Morbidity and mortality associated with burst abdomen have been estimated at 16%. The mean time for wound dehiscence is 8-10 days after operation. Abdominal wound infection and dehiscence are common complications after midline laparotomies especially in emergency cases. Wound dehiscence after laparotomy is related to many factors as intra-abdominal infection (peritonitis), poor general condition, malnutrition, and technical defaults during wound closure.[8]

Post-operative complete wound dehiscence (burst abdomen) is a very serious complication associated with high morbidity and mortality. The optimal strategy of abdominal wall closure after midline laparotomy has remained an issue of ongoing debate. To date, various randomized clinical trials and meta-analysis have been published with heterogeneous results.[1]

Healing of abdominal incisions is similar to healing of other wounds. The inflammatory phase lasts approximately 4 days, followed by the proliferative phase for 3 weeks. The maturation phase continues for up to a year. By the end of the prolif-erative phase, the abdominal fascia has only 20% of its original strength. At 6 and 20 weeks post-surgery, the fascia has only 50% and 80% of its original strength, respectively. Postoperatively, abdominal fascia will never completely regain its original strength.[9,10]

## METHODS

Our retrospective randomized clinical study of 168/214 cases who were treated through midline exploratory incision during the period from March 2017 to March 2018 and performed at our institution (surgical department of Menoufia University Hospitals; Shibin Elkom; Menoufia). 46 patients were excluded from the statistical analysis for this study for different reasons. This will be explained in our results.

### *Inclusion criteria*

- All patients who had undergone midline exploratory laparotomy for either emergency or elective procedures which included patients with extensive generalized peritonitis, traumatic, vascular, or neoplastic indications.

### *Exclusion criteria*

- Patients have been exposed for previous midline laparotomy for any condition
- Patients who were younger than 18 years of age at time of operation.

All patients were undergone a detailed history, clinical examination by senior surgical resident and consultant. Routine as well as specific investigations like complete blood count, kidney function tests, liver profile, serum electrolyte, abdomen and chest X-ray, ultrasonography, CT scans of abdomen and pelvis…etc., Tumor markers and biopsies (for abdominal masses, elective procedures) were done according to consultant request, the condition of the patient and the possible outcomes.

Under general anaesthesia, we did an exploratory laparotomy through midline incision for all cases included in our study after preparation of the operative field with povidone iodine scrub (10%). The surgical procedure was conducted according to the need of underlying disease. Tube drains were placed in the peritoneal cavity and were brought out through stab incisions away from the exploratory incision (according to consultant advice and the condition of the patient). A modified closure technique (Moharam Repair) of the midline abdominal incision was performed in all cases included in present study.

### *(Crossing suturing technique - Moharam Repair)*

### *Technique*

After completion of intraperitoneal procedure, a space was created between anterior rectus sheath and sub-cutaneous fat on either side so as to facilitate direct visualization of anterior rectus sheath during the closure of abdominal wound by our technique.

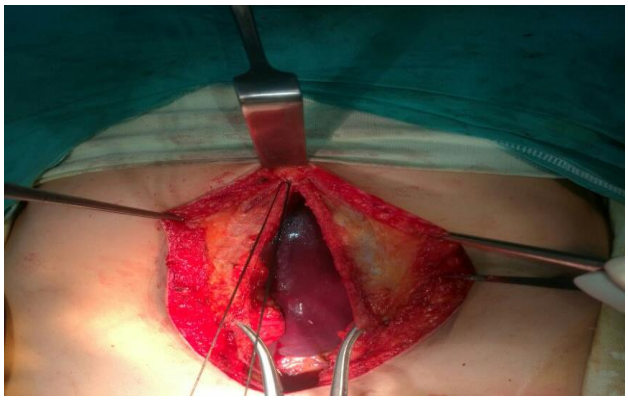

**Figure 1: Undermining the edges of the wound for 2-3 cm.**

The space was created laterally for a distance of 2 cm from the cut edge of linea Alba. Cleaning of both edges for a distance of 2 cm to facilitate mass closure of rectus sheathes on both sides without interfering loose tissues (Figure 1).

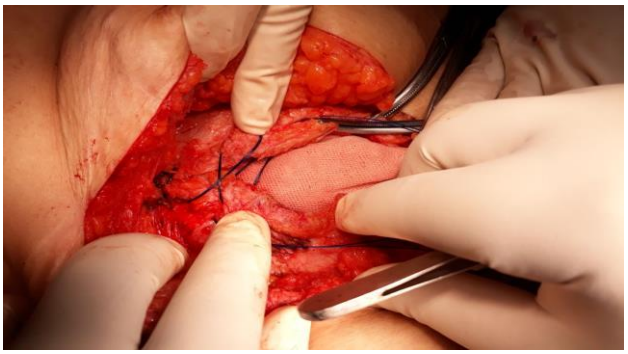

**Figure 2: Suture bites at a distance of 0.5 cm from the edge and 1cm from previous bite.**

The parietal peritoneum, posterior rectus sheath, and the anterior rectus sheath all were approximated by a single layer of continuous sutures of No. `1' or '0' monofilament non-absorbable prolene suture (MENALENE). We use two strands of the prolene suture starting from one end of the abdominal wound to the other end (Figure 1). The suture bites were assigned to be for a distance 0.5 to 1 cm from the incised edge (Figure 2) (cut edge of the Linea Alba on both sides) and separated from the previous bite by a distance of 1 cm (Figure 2). we started sutures of the wound from one end using the two strands in the same direction, one on each side, and ligated together at the start point of the suture line. After ligation of the two strands together, we gain two strands and two needles, one on each side, and both strands at the same direction of the wound at the point of start. Using the 1st needle, we start suturing from outside the wound edge to the inside then from the inside to the outside of the edge of the wound on the opposite side (out-in in one side then in-out in the other side) (crossing sutures) (Figure 3).

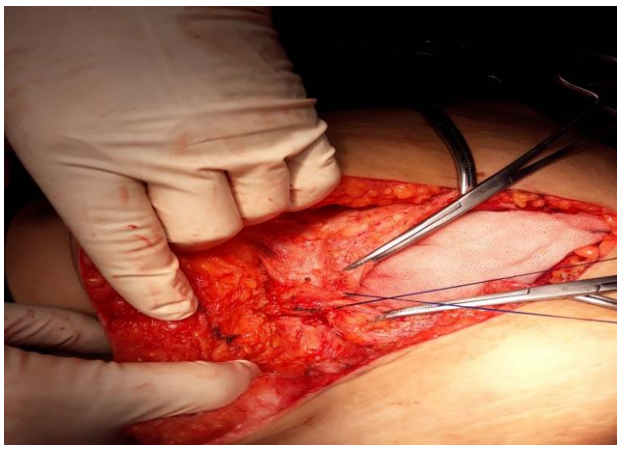

**Figure 2: Crossing of strands on both sides.**

Then, we use the other needle in the same pattern of the 1st needle but starting on the other side or edge of the wound (out-in then in-out). So, the suture line will appear to be over-crossed by using these two strands. Each stitch will make X shape stitch either on the outer surface (Figure 4) (Figure 6). of approximated edges or even underneath them (Figure 4 (Figure 7).). The edges of Linea Alba were gently approximated without strangulation with an attempt to keep suture-wound length ratio of 4:1. An additional interrupted suture are used every 3-4 cm along the wound using absorbable suture No '1' or '0'(MENASORB) (Figure 5). Traction on the suture line should be very gentle avoiding over traction to avoid overcrowding of the suture line (Figure 8).

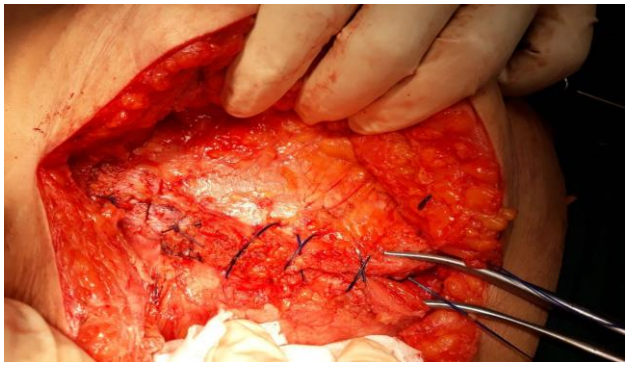

**Figure 4: Suture line with crossing stitches above the suture line (spinning).**

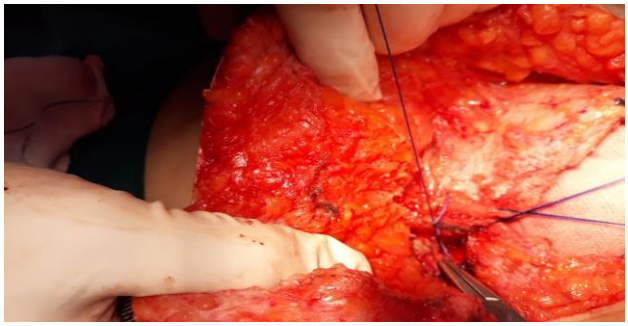

**Figure 5: Interrupted sutures every 3 cm.**

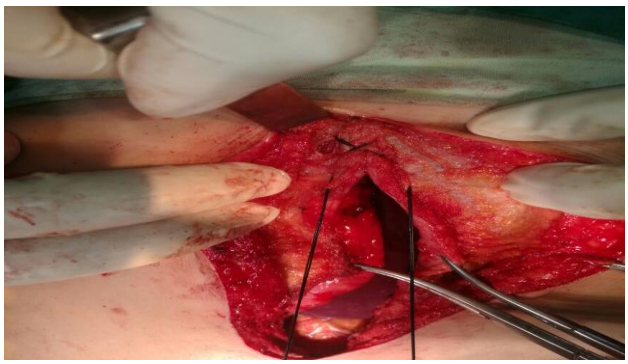

**Figure 6: Starting crossing sutures of both strands (X shape suture on outer surface).**

**Figure 7: Crossing sutures over and under neath the wound.**

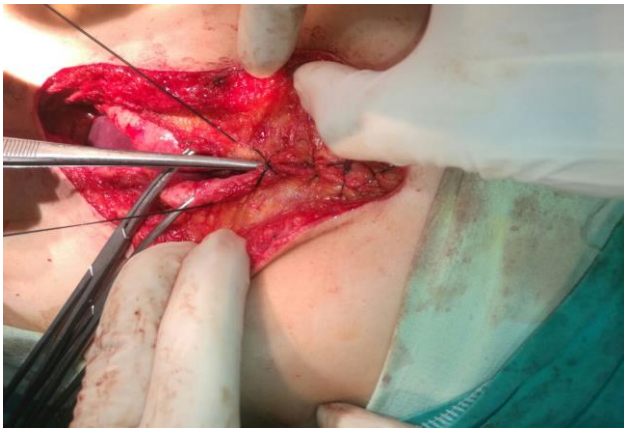

**Figure 8: Crossing sutures above and below the suture line.**

A sub-cutaneous drain was used in some cases especially in obese patients with fatty abdominal wall. This drain was brought out through a separate stab incision away from the main incision on the skin. The sub-cutaneous tissue was closed with 2-0 absorbable polygalactin (MENASORB 2\0). Skin was closed 2-0 monofilament non-absorbable prolene (MENALENE 2\0) as interrupted sutures.

All the patients were given pre-operatively antibiotics just prior to surgery or on time of induction of anaesthesia. The antibiotic course was extended (cephalosporin and metronidazole) after the surgery according to the consultant advice and the condition of each patient. The midline laparotomy wound was managed by dressing on the third day of operation except in cases of wound soakage, it was earlier. Each patient was followed up for 3-5 weeks after surgery to determine the risk of dehiscence.

***Statistical analysis***

Data was entered in SPSS and statistical analysis was done. Mean was calculated for descriptive variables like age, sex while frequency was determined for different diagnosis of cases undergoing exploratory midline laparotomies along with wound dehiscence.

## RESULTS

Present retrospective observational clinical study included 168/214 patients undergone midline exploratory laparotomy (MEL) for different causes as peritonitis, acute abdomen, traumatic, vascular, and neoplastic indications. The study conducted in General Surgery Department; Menoufia University Hospitals lasting for about one year from March 2017 to March 2018. Short term follows up was advised for 3 to 5 weeks to detect wound infection and dehiscence as a short-term complication of major wounds. Serial visits in our outpatient clinic were arranged 1, 3, 5 weeks after discharge.

**Table 1: Gender distribution of the patients.**

| Gender | No. of patients | Percent |
|---|---|---|
| Male | 95 | 56.5 |
| Female | 73 | 43.5 |
| Total | 168 | 100 |

**Table 2: Age distribution among studied patients.**

| Age distribution | No. of patients | % |
|---|---|---|
| 18-40 years | 82 | 49 |
| 40-60 years | 54 | 32 |
| >60 years | 32 | 19 |
| Total | 168 | 100 |

**Table 3: Indications for exploration.**

| Status | Cause of exploration | No. of pts. | % |
|---|---|---|---|
| Emergency (95/168) (56.5%) | Acute abdomen due to (I.O) | 12 | 7% |
| | Perforated duodenal ulcer | 42 | 25% |
| | Complicated appendicitis with GP | 22 | 13% |
| | Internal hemorrhage | 14 | 8.2% |
| | Gunshots with intestinal injuries | 05 | 3% |
| Elective (73/168) (43.5%) | Pan hysterectomy for cancer ovary | 22 | 13% |
| | Open adrenalectomy | 03 | 2% |
| | Cancer colon (colectomy) | 19 | 11.3% |
| | A P R (resection) | 08 | 5% |
| | Splenectomy with devascularization | 15 | 9% |
| | Cancer stomach | 05 | 3% |
| | Cancer pancreas | 01 | 0.5% |

I.O. = Intestinal Obstruction; GP = Generalized Peritonitis; APR= abdominoperineal resection

46 patients are excluded from this study due to different causes. Death was encountered in 13 cases. Exploration was done in age below 18 yrs old in 21 patients. Nine

patients did not complete follow up for 3-5 weeks postoperatively and 3 patients needed re-exploration within the 1st week postoperatively. The midline exploratory laparotomies (MEL) were performed for a variety of reasons under emergency or elective circumstances including inflammatory, traumatic, vascular, and neoplastic, pathologies etc. emergency cases encountered about 56.5% while elective cases encountered about 43.5%.

**Table 4: Early postoperative complications in MEL.**

| Complications | Emergency | Elective | P- value | per total-168 (%) |
|---|---|---|---|---|
| Wound infection | 10 (6%) | 2 (1.2%) | - | 12/168 (7.2%) |
| Wound dehiscence (burst) | 2 (1.2%) | 0 | - | 2/168 (1.2%) |
| Total | 12(7.2%) | 2 (1.2%) | - | 14/168 (8.4%) |

The main complication encountered in these patients was found to be local wound sepsis. It was seen in 12 cases (7.2%). 2/168 (1.2%) patients developed wound dehiscence. Dehiscence in these two patients was managed conservatively for 1 week then delayed direct sutures were applied.

**Table 5: Demographic risk factors for wound dehiscence and infection.**

| Risk factor | Wound infection (12) | Wound dehiscence(2) |
|---|---|---|
| Obesity | 7 | 1 |
| Elderly | 3 | 1 |
| Smoking | 4 | 2 |
| Diabetes mellitus | 0 | 2 |
| Malnutrition | 0 | 0 |
| malignancy | 4 | 0 |
| Steroid use | 0 | 0 |

## DISCUSSION

Different techniques for abdominal wounds especially midline laparotomies have evolved over many years, however, wound dehiscence (burst abdomen) remains a serious short-term complication. The optimal technique and suture material for abdominal wall closure have long been a matter of debate.[11]

Mass closure technique was firstly described by Smead in 1900 and Jones in 1941, and thereafter it was called the Smead-Jones technique. In 1970, in an experimental study by Dudley, mass closure was superior to layered closure.[12]

Dehiscence rate of 1% for mass closure was noticed by Golligher during its study versus 11% in layered fascial closure method. This study was done in 1975.

It should be noted, however, that chromic catgut, with its own inherent reasons for wound failure, was used for layered closure and was compared with stainless steel wire for mass closure. In 1982, a study was conducted by Bucknall et al demonstrated that mass closure was superior to layered closure technique in declining dehiscence rate (0.76% vs. 3.81%) respectively.[12]

Mass closure' remains the standard technique for abdominal closure (closing all layers of the abdominal wall, excluding the skin), with either non-absorbable or slow-resorbing sutures, such as polydioxanone (PDS).[13]

The recently published European Hernia Society guidelines on the closure of abdominal wall incisions under their weakest level of evidence recommended single layer closure of the aponeurosis.[9]

There were 4 complications involved in comparison of the different techniques of fascial closure apparent on review of the literature:

***Early Complications: short-term outcomes***

- Fascial dehiscence
- Infection

***Late Complications: long-term outcomes***

- Hernia formation
- Suture sinus/Incision pain

These 4 complications are derived from a consensus of the articles upon which the review is based. That is to say the various techniques are compared in each article that is cited on the basis of 1 or more of these 4 complications.[12]

In present study, we studied the short-term outcomes of our technique and compared it to what is settled in literature and other papers as short-term outcomes for standard mass closure technique.

The abdominal wound dehiscence (burst) is associated with risk of morbidity of upto 40% and mortality upto 18% in elderly or malnourished patients. In these patients, burst abdomen represents a major additional insult to their already stressed physiology. Burst abdomen

was encountered in 10 -30 % of cases undergone midline laparotomy (MEL) especially in emergency cases.[1]

Different mechanical reasons for wound dehiscence were encountered as (1) the suture breaks, (2) the knot slips, or (3) the suture cuts through the tissues.

Generally, wound dehiscence occurs when the suture material tears through the fascia with little effect of first two reasons. The strength of particular suture material increases as its cross-sectional diameter increases and smaller diameter sutures are associated with a greater likelihood of tearing through the tissue.[12]

Tearing may increase when the sutures are perpendicular to the incision line as it will pass in the same direction of fibers forming the Linea Alba. Authors technique makes the sutures in an oblique direction- to some extent- with the incision line decreasing the tearing effect and dehiscence.

Penninckx et al documented a 2.58% wound dehiscence in 4538 patients treated with gastrointestinal operations. They also noted that complicated neoplasms and complicated inflammatory diseases had an extremely of wound dehiscence; 15.07% and 22.73% respectively, with routine continuous suture closure technique. The frequency of wound dehiscence after emergency laparotomy was 6.7% as compared to 1.5% in elective cases.[1]

Rahman recorded abdominal wound dehiscence in 7 (23.23%) cases, among the 33 patients of spontaneous ileal perforations with acute peritonitis and an incidence of wound infection in 30.3 %.[14]

Present study had 168 patients and there were 2 cases (1.2%) of wound dehiscence (who were managed by delayed direct suturing) on use of our new abdominal wound closure technique (Moharam Repair).

## CONCLUSION

Wound infections after abdominal surgery are still frequent nosocomial infections. Authors' modified technique used in closing the midline laparotomies either in elective (malignant) or emergent cases (traumatic, inflammatory conditions) (complicated/high risk laparotomies) is associated with a low incidence of short term complications like wound sepsis and wound dehiscence.

The best abdominal closure technique should be fast, easy, and cost-effective while preventing both early and late complications. The early complications that are to be avoided are wound dehiscence and infection, and the late complications to be avoided are hernia, suture sinus, and incisional pain.

Authors' new technique (Moharam Repair) provides a technique of mass closure of midline laparotomy fulfilling the previously mentioned criteria with reduction in incidence of short term complications as wound infection and dehiscence.

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