

## Evaluation of the advantages of single layer closure over en-masse closure in abdominal surgeries

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### Abstract

**Background:** Many of the operations performed by the general surgeons take place within the abdomen and consequently incision and suturing of the abdominal layers are the commonest exercises in operative surgery. Abdominal closure is very important as regards to incision, technique of repair and use of newer suture material, and has created a great interest to surgeons. **Aim:** Evaluated the advantages of mass (single layered) closure in comparison with the layered closure in abdominal surgeries. **Subjects and Methods:** 60 patients selected 30 are randomized to have mass closure technique and remaining by layered closure technique and grouped as 1 and 2 respectively. These patients are compared based on Operative time, infection, Burst Abdomen and followed on post op. day 1, day 3, day 7, day 10 respectively and followed up monthly for 3 months and then after 6 months. **Results:** The incidence of wound infection is higher in layered closure group (group 2) compared to mass closure group (group 1). Overall the rate of wound infection in the layered group is 36.66% whereas it is 13.33% in the mass closure group. **Conclusion:** Hence the use of mass closure is significantly better (p value <0.05) than layered closure technique in so far as the wound infection is concerned.

**Keywords:** Mid-Line Incision, Paramedian Incision, Mass Closure and Layered Closure.

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### Introduction

Many of the operations performed by the general surgeons take place within the abdomen and consequently incision and suturing of the abdominal layers are the commonest exercises in operative surgery. Abdominal closure is very important as regards to incision, technique of repair and use of newer suture material, and has created a great interest to surgeons.[1]

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.[2]

Though, approach was the main aim of the surgeon in the beginning, the complications of surgery became common with increase in number of surgeries performed. This has led to changes in the closure of laparotomy incisions.

In the beginning much stress was on the type of suture material used for closure. This led to advent of synthetic and natural, absorbable and non-absorbable suture materials. Use of various combinations of suture materials for closure of laparotomy incisions, did not bring down the rate of complications of laparotomy to an appreciable level. This led to changes in technique of closure of laparotomy incisions.

The conventional closure of layer by layer was given up and all the layers were closed en masse. Harold Ellis in his text on closure of laparotomy incisions says "My preferred technique of closure of laparotomy incisions is, by mass closure, using nylon". Until recently, layered closure of abdominal wall was considered better,

with great emphasis particularly on closure of peritoneal layer.[3]

It is now fully realized, both from clinical and laboratory animal studies that healing of an incision takes place by formation of a dense fibrous scar that unites the opposing faces of the laparotomy wound en masse. The purpose of sutures is to co-apt the wound edges, and to act as a splint, while this dense fibrous scar deposits and matures.

The sutures can potentially cut through the tissues when wound is closed using small bites, and not enough length of suture is left in wound, for later wound expansions. A wound may lengthen by 30% if distension occurs.

An adequate reserve of suture length in the wound is necessary to allow this lengthening to occur and to ensure a minimal resulting rise in tension between the sutures and the tissues. Wound disruption is associated with the use of SL: WL ratio (Suture length: Wound length) of 2:1 or less – the lower the ratio, the greater is the risk of a burst wound. Wound disruption because of cutting out of sutures can be prevented by the use of non-absorbable continuous sutures at 1cm intervals and a SL: WL ratio of 4:1 or more (Jenkins rule).[4]

The ideal method of wound closure should be:

- Technically simple;
- Free from complications of burst abdomen, incisional hernia and persistent sinuses;
- Comfortable to the patient;
- Leave a reasonably aesthetic scar.

Conventionally the abdominal incisions are closed layer by layer, meticulously. The peritoneum with transversalis fascia is closed as a layer. However laboratory and clinical observations have shown that closure of peritoneal layer makes no difference in abdominal wound healing[1]. Hence, it can be omitted without any adverse effect on wound healing. The raw peritoneal defects heal rapidly.

In Gilbert and Ellis study of peritoneal closure in the lateral paramedian incisions, wound disruption rates did not alter in both

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groups in whom peritoneum was closed with number one chromic catgut and in those in whom peritoneum was not closed. However layer by layer closure of abdominal incision has a strong aesthetic appeal. Hence, if technically easy to accommodate, the peritoneum may be closed with synthetic absorbable material. In the words of Lord Moynihan "every unnecessary stitch is a bad surgery" and avoidance of unnecessary step of peritoneal closure leads to a saving in time and cost.[5]

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 as regards to operating time, cost, feasibility, ease and postoperative morbidity.

Some studies have shown an increased incidence of burst abdomen and incisional hernia with layered closure and some studies show no difference in these complications, but no studies demonstrate advantage of layered over mass closure.[6]

The present study was taken up to evaluate the advantages of mass (single layered) closure in comparison with the layered closure on the basis of operative time, healing time and postoperative morbidity such as wound infection, burst abdomen and incisional hernia.

#### Subjects and Methods

This prospective study was conducted at department of general surgery at government medical college, Bettiah. The study was approved by the institutional research and ethical committee. An informed and written consent was taken from all the subjects prior to commencement of the study. The study was conducted over a period of January 2020 to September 2020.

Thorough clinical examination of the patients was made and recorded. Particular attention was given to note the anaemia, nutritional status, jaundice, respiratory tract infections. Apart from the examination of the system involved, routine examination of CVS, RS & CNS were carried out.

#### Preoperative Preparations

- In emergency surgery, the general condition of the patient was improved by correcting dehydration, electrolyte imbalance and by giving antibiotics.
- Hypertension was brought under control. Suitable antibiotics were given preoperatively to treat infections.
- 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.
- Routine preoperative anaesthetic check-up was done in elective cases. The parts were prepared by good bath and shaving. In the operation theatre, the part was painted and draped. General anaesthesia\ spinal anaesthesia\epidural anaesthesia was employed depending on the case.
- 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 1 cm with continuous locking sutures using Vicryl No. 1.

Paramedian incision: The peritoneum, endo-abdominal 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 1 cm from the cut edges and about 1 cm interval. Continuous locking sutures were put with Vicryl No. 1

#### Closure of Abdominal Incisions 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 Vicryl 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 Vicryl 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 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.

Signs of wound infection (superficial and deep) and/or burst abdomen were specifically looked for.

Cases of wound infection included both those with superficial infection and those with deep wound infection.

Superficial wound infection cases were those in which the infection limited to superficial layers of the abdomen i.e. skin and subcutaneous tissue. Deep infection was infection spreading beyond the subcutaneous tissue upto the peritoneal layer.

Wound infection was said to be present if:

- The wound became red and swollen.
- The wound required opening, even partially.
- The wound exuded serous fluid or pus.

Wound dehiscence is synonymous with burst abdomen. Partial burst abdomen was diagnosed when there was disruption of all layers of the abdominal wall except either the peritoneum or skin. Complete burst abdomen was diagnosed when all layers of abdominal wall including peritoneum were disrupted.

#### 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

In this study overall infection rate is 25%. The rate of infection in mass closure group was 13.33%, as compared to layered closure which was 36.66%.

This was found to be statistically significant with a p value <0.05 i.e. the rate of wound infection was significantly lower in the mass closure group as compared to the layered closure group.[Table 1]

**Table 1: Wound infection in relation to the type of closure**

Wound Infection	Group-1 Mass Closure Technique N=30	Group-2 Layered Closure Technique N=30	Statistical Analysis
Yes	4(13.33%)	11(36.66%)	$\chi^2 = 4.36$ , p<0.05
No	26(86.67%)	19(63.34%)	

In this study burst abdomen was noted in total of 8 cases .  
In the mass closure group burst abdomen was noted in 0.033% cases.  
In layered closure group burst abdomen was noted in 0.23% cases.

The p value obtained is <0.02, which is statistically significant i.e the rate of burst abdomen was significantly lower in the mass closure group as compared to the layered closure group. [Table 2]

**Table 2: Burst abdomen in relation to the type of closure**

Burst Abdomen	Group-1 Mass Closure Technique N=30	Group-2 Layered Closure Technique N=30	Statistical Analysis
Yes	1(3.33%)	7(23.33%)	$\chi^2 = 5.19$ , P<0.02
No	29(96.67%)	23(76.67%)	

In mass closure group, patients who underwent elective surgery wound infection was noted in 10%, burst abdomen noted in 5%

where as in patients who underwent emergency surgery wound infection noted in 10%, no burst abdomen reported.[Table 3]

**Table 3: Mass Closure Technique**

Variables		Emergency N=20		Elective N=10	
		Burst Abdomen		Burst Abdomen	
		Yes	No	Yes	No
Wound Infection	Yes	0	2	1	1
	No	0	18	0	8

In layered closure, patients who underwent elective surgery wound infection noted in 44.4% and burst abdomen in 55.55%. in emergency

surgeries wound infection noted in 33.33% and burst abdomen in 14.28% [Table 4].

**Table 4: Layered Closure Technique**

Variables		Emergency N=21		Elective N=9	
		Burst Abdomen		Burst Abdomen	
		Yes	No	Yes	No
Wound Infection	Yes	3	4	4	0
	No	0	14	1	4

## Discussion

Wound infection is the most common and troublesome disorder of wound healing. A primarily closed wound has no resistance at all to bacteria swabbed on its surface during the first 6 hours. After this time, it becomes increasingly difficult to infect the wound, until at 5 days it is as resistant as the surrounding skin. Thus, an occlusive dressing is advisable only during the first few days unless there is an obvious nearby source of contamination e.g. colostomy. The main source of wound infection is endogenous, from the patient's own bacteria at the time of surgery. The nature of the operation is an important factor and the lowest incidence is encountered after clean procedures.

### Other Factors predisposing to wound infection include

- Local trauma from excessive retraction, extensive electrocoagulation, defective hemostasis
- The presence of foreign material: the presence of a single Piece of sterile silk suture material doubles the chance of a contaminated wound becoming infected
- Diminished perfusion

Overall infection rate in this study is 25%. The rate of infection in mass closure group was 13.33%, as compared to layered closure which was 36.66%. This was found to be statistically significant with a p value <0.05 i.e; the rate of wound infection was significantly lower in the mass closure group as compared to the layered closure group.

In mass closure group, patients who underwent elective surgery wound infection was noted in 10%. Where as in patients who underwent emergency surgery wound infection noted in 10%

In the layered closure group:

In layered closure, patients who underwent elective surgery wound infection noted in 44.4%, in emergency surgeries wound infection noted in 33.33%.

Disruption of wound has been ascribed various names as separation of abdominal wounds, broken down abdominal incisions, dehiscence of abdominal wounds, postoperative eventration, and burst abdomen. It is a grave and tragic complication that may follow any abdominal operation in either sex at any age, and it occurs, it presents many serious problems in the management of the case.

The death rate from this complication Varies considerably although the average operative mortality in a collective review is 18.1% (range 9.4% to 43.8%).<sup>[7]</sup>

### Factors involved in wound disruption include

#### A) Preoperative patient predisposition

- Nutritional: Hypoproteinaemia, anaemia, advanced age.
- Metabolic: Diabetes, uraemia, steroid therapy.
- Prior irradiation.
- Malignancy.
- Obesity.
- Pulmonary disease.
- Chemotherapy.

#### B) Intraoperative technique

- Incision choice
- Suture- Tensile strength, Knot strength
- Closure technique-suture cutting through fascia, Pressure necrosis

#### C) Postoperative increased tension on suture line

- Increased intra-abdominal pressure: ascites, ileus, bowel obstruction, vomiting
- Pulmonary disease -coughing
- Wound infection.[8]

In our study the overall the rate of burst abdomen was 13.33%. The rate of burst in the mass closure was 3.33% as compared to 23.3% in the layered closure group.

In mass closure group, patients who underwent elective surgery, burst abdomen noted in 5%. Where as in patients who underwent emergency surgery no burst abdomen reported.

In layered closure, patients who underwent elective surgery and burst abdomen in 55.55%.In emergency surgeries burst abdomen noted in 14.28%

Burst abdomen is the early complication in the post- operative period and the majority occurs between 6 th and 9 th day after surgery.

Basically wound disrupts either when the suture breaks, the knot slips, or when the sutures cut through the tissue.

Suture breakage is seldom a problem. It may occur either because it is too weak for the tension placed upon it or because it is destroyed rapidly in the tissues. This can be avoided by correct selection of suture material knot slippage does occur, though rarely.[9]

The major cause of wound rupture seems to be cutting of the sures through the tissue. They may cut through either because they are placed too close from the wound edge or because of excessive weakening of the tissues from such systemic factors like jaundice, uraemia, protein depletion, neoplasia, sepsis and this will be compounded if the tension placed on the healing wound is increased by abdominal distension, coughing or straining.[10]

Sutures are inserted in to abdominal wounds for two purposes, to obtain coaptation and to resist stress and strains to which the wall is exposed until it has reacquired its own intrinsic strength. In this regard extrinsic strength is defined as the one bestowed on the wound by its sutures. The method of insertion of sutures can influence the pattern of healing if It fails to ensure continued cooptation or It interferes with the gain in intrinsic strength during the same period. Failure of maintenance of overall cooptation will result from sutures "cutting out"

This phenomenon in turn is, in theory, the result of two things- pressure per unit area on the tissue and ischaemic necrosis from continued pressure.

In the mass closure group an average of 15.73 minutes was required for closure of the incision while in layered closure group an average of 25.03 minutes was required for closure of the incision. This was found to be statistically significant (p less than .05, Significant).

Hence the incision can be closed a lot faster by using the mass closure technique.

This in turn would reduce the exposure to anaesthesia and overall influence the post-operative morbidity. Rapid closure may be particularly important in emergency contaminated surgeries and in high risk surgical patients.

**Conflict of Interest: Nil**

**Source of support:Nil**

### Conclusion

The incidence of wound infection is higher in layered closure group (group 2) compared to mass closure group (group 1). Overall the rate of wound infection in the layered group is 36.66% whereas it is 13.33% in the mass closure group.

Hence the use of mass closure is significantly better (p value <0.05) then layered closure technique in so far as the wound infection is concerned.

The incidence of burst abdomen is higher in the layered closure group as compared to mass closure group. Overall the rate of burst abdomen in the layered group is 23.33% whereas it is 3.33% in the mass closure group.

Mass closure of abdominal incisions was faster than layered closure; the average time taken in the mass closure group is 15.73 minutes and 25.03 minutes in the layered closure group. This was found to be statistically significant (p value<0.05).

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