



Effectiveness of Delayed Absorbable Suture Material for Abdominal Fascial Closure after Midline Laparotomy Compared to Non-Absorbable Suture Material

Dr. Ram Milan Prajapati

Associate Professor, Department of General Surgery, Muzaffarnagar Medical College and Hospital, Ghasipura, Muzaffarnagar (U.P.)

ARTICLE INFO

Research Article

Received 09 March.2016

Accepted 20 April.2016

Corresponding Author:

Dr. Ram Milan Prajapati

Associate Professor, Department of General Surgery, Muzaffarnagar Medical College and Hospital, Ghasipura, Muzaffarnagar (U.P.)

ABSTRACT

BACKGROUND:

Early in embryonic development, the lateral plate of the intraembryonic mesoderm initiates the development of the abdominal wall. The embryo at this stage is made up of three main layers: the mesoderm, the inner endoderm, which provides nutrients, and the ectoderm, which serves as the outside protective layer. The developing abdominal wall or somatopleure is formed by proliferating cells that are segmented off of the intraembryonic mesoderm into myotomes or somites. The transversus abdominis and the internal and external oblique muscles are ultimately derived from the three layers of the growing mesoderm of the future anterolateral abdominal wall. **AIM:** To compare the efficiency of non-absorbable versus delayed absorbable suture material in the closure of the abdominal fascia after midline laparotomy.

MATERIAL AND METHOD:

This is a single institution-based randomized trial conducted at the Hospital in the endoscopic unit of the Department of Surgery. The topic was approved by the Institutional Ethics Committee of the University. The required sample size was 200 which has been calculated with help of Epi Info™ 3.5.3 software. However, due to the pandemic and the reduction in OPD and emergency admissions, there was a reduction in sample size, and we were able to achieve 100 patients during my study tenure. Patients who were operated on by midline laparotomy in the department of General Surgery, during the aforementioned study period.

RESULTS:

In the PDS group, there were 50 cases out of which 2 cases had wound dehiscence. In 50 cases of Polydioxanone, the overall incidence of wound dehiscence was 5.5%. In the Polypropylene, out of 50 cases, 5 cases had wound dehiscence. In 55 cases of Polypropylene (PPL) dehiscence rate was 14.5%. Using the chi-square test there is no statistical significance in the incidence of suture sinus between the two groups. In the PDS group, there were 50 cases out of which 0 cases had incisional hernia with 0% incidence. In Polypropylene, out of 50 cases, 2 cases had incisional hernia with an incidence of 3.6%. higher incidence of wound infection in emergency cases in the case of PDS, and amongst Polypropylene (PPL) incidence of wound infection was higher in emergency cases.

CONCLUSION:

Based on the observations made in this study, it has been concluded that the continuous self-anchored interlocking suture technique using no.1 Polydioxanone (PDS) for closure of midline laparotomy incision is superior to no.1 Polypropylene (PPL) suture material are superior in preventing major post-operative complication wound complications like wound infection, dehiscence, incisional hernia & suture sinus. Duration of operation and stay in hospital is similar in both the groups. PDS was superior to Prolene with respect to impact on the patient's quality of life considering complications. Thus, there was an advantage of Polydioxanone (PDS II) suture material over Polypropylene (Prolene) suture material.

KEYWORDS: Abdominoperineal resection, Gastric outlet obstruction, Abnormal Renal Parameters, Intestinal obstruction, Abdominal Wound Closure.

INTRODUCTION

Every wound, whether accidental or suffered during surgery, is just a break in the usual continuity of tissue. Until the healing process gives the wound the strength to tolerate stress without mechanical support, tissue that has been badly damaged and cannot heal normally (without problems or potential disfiguration) must be held in opposition. The surgeon's ability and technique are crucial, but so is the material they choose to close the wound with.^{1,2} The goal of every surgeon is to properly close abdominal wounds in order to avoid complications including scar hypertrophy, intraperitoneal adhesions, wound infection, dehiscence, incisional hernia, and sinusitis.^{3,4}

Numerous variations of suture materials and techniques have been tested and supported at various points in time since the beginning of the history of surgery. Regarding vertical midline abdominal incisions, which are required in every emergency laparotomy, no suture material or technique has produced a completely satisfying result. From time to time, new recommendations and modifications have been made, urging the use of layered closures rather than single-layer closures and alternative suture materials such as nylon, vicryl, proline, steel wires, chromic catgut, PDS, etc. This just demonstrates that no single approach has met all ideal criteria. Any suture used to close a wound should at least partially adhere to the principles of wound healing.⁵ There is no perfect technique for closing abdominal wounds. It should be technically so straightforward that the outcomes are just as good in a novice surgeon's hands as they are in a master surgeon's, do not interfere with the pathophysiology of wound healing, and have the least chance of the previously listed post-operative problems. Significant morbidity and mortality as well as an increase in the cost of care are associated with wound dehiscence. To lower postoperative morbidity and mortality, it must be prevented. Numerous individuals are malnourished, and patient presentations are frequently sluggish. As a result, the issue of wound dehiscence is both more prevalent and serious.⁶

The method of abdominal closure and the type of suture utilised have an impact on wound dehiscence. There have been numerous research done comparing a dizzying array of suture materials and closure methods.⁷ Since there is generally no discernible difference reported between the two in most research, the current consensus in the west is around some type of running mass closure of the abdomen in emergency and elective circumstances.^{8,9} In order to avoid cutting out the benefits of continuous sutures, which shown a decreased incidence of wound dehiscence, a novel interrupted X technique was developed.¹⁰ In elective patients who have adequate nutrition, no risk factors for dehiscence, and are ready for surgery, the decision may not be as crucial. However, in emergency patients, who

frequently have multiple risk factors for developing dehiscence and for whom strangulation of the sheath is the proverbial last straw in precipitating wound failure, it may prove to be absolutely essential.¹¹ According to a study, the rate of ruptured abdomen was 11% when wounds were closed with two layers of catgut and 7% when the peritoneum and anterior rectus sheath were closed with interrupted steel wire and catgut, respectively. After steel-wire closure with interrupted mass far-and-near sutures encompassing all layers of the abdominal wall except for the skin, only one burst abdomen happened in 81 surgeries. The Smead-Jones method is another name for this approach.¹² A new suture material Polydioxanone (PDS) was introduced to reduce the morbidity and mortality rate of laparotomies by its newer properties. Polydioxanone (PDS) is monofilament. It absorbs slowly, approximately 70% remains at 2 weeks, 4 approximately 50% remains at 4 weeks, approximately 14% remains at 8 weeks and there is minimal absorption until about 90 days.¹³ Tensile strength of Polypropylene is Infinite (> 1 year).¹³

MATERIAL AND METHODS

This is a single institution-based randomized trial conducted at the Hospital in the endoscopic unit of the Department of Surgery. The topic was approved by the Institutional Ethics Committee of the University. The required sample size was 200 which has been calculated with help of Epi Info™ 3.5.3 software. However, due to the pandemic and reduction in OPD and emergency admissions, there was a reduction in sample size, we were able to achieve 100 patients during my study tenure.

Inclusion criteria:

- All the patients undergoing an elective or emergency midline laparotomy for various indications in the dept of surgery at the hospital
- Both male and female patients.
- Patients older than 18 years.
- Consent to participate in the study.
- The study included both emergency and elective laparotomies
- Only a continuous suture technique was used.
- Only vertical midline abdominal incision closures were included.

Exclusion criteria:

- Presence of abdominal hernia
- Patients not willing the study
- Previous history of laparotomy
- Pregnancy
- Presence of coagulopathy/immunodeficiency
- Patients on cytotoxic drugs

Source of Data:

Patients who were operated on by midline laparotomy in the department of General Surgery, during the aforementioned study period.

Method of Data Collection:

After meeting the Inclusion and exclusion criteria, after a thorough examination of the patient, patients were posted for laparotomies through midline vertical incisions. Patients were randomly assigned into two groups by computer-generated randomization for midline fascial closure. The patient was shifted to the operation room, anesthesia was administered and surgery was done. The preop, interop, and postop data were loaded to the master chart as per study proforma on a biweekly basis.

Suture material used:

- ✓ Patients in group A received Polydioxanone (PDS) for midline fascial closure
- ✓ Patients in group B received Polypropylene (PPL) for midline fascial closure

- ✓ Skin closure was done either with ethilon or staples.
- ✓ Dressing was done.
- ✓ Postoperatively all patients were administered iv fluids and antibiotics.

STATISTICAL ANALYSIS

The Chi-Square Test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either whether all categories contain the same proportion of values or whether each category contains a user-specified proportion of values. The chi-square test of Independence was applied to find out the association between selected rows with columns.

RESULT: -

Table 1: Distribution of cases according to nature of operation and suture material

Suture	Elective	Emergency
PDS	28	20
PRO	29	23

28 patients underwent elective surgery and 20 patient’s emergency surgery in the PDS II suture group. 29 patients underwent elective surgery and 23 patient’s emergency surgery in the PPL group. Overall, 57.3% of cases underwent elective laparotomy and 42.7% underwent emergency laparotomy

Table No.2: Wound Infection in relation to PDS and PRO suture material and nature of the operation

Suture	yes	No
Elective	2	25
Emergency	2	19
PRO suture material and nature of the operation		
Suture	yes	No
Elective	2	27
Emergency	6	17

From table 2 it is seen that there was a higher incidence of wound infection in emergency cases in the case of PDS, and amongst Polypropylene (PPL) incidence of wound infection was higher in emergency cases. However, using the chi-square test, there is no statistical significance in the incidence of wound infection between the two closure techniques.

Table No.3: Incidence of wound dehiscence and incisional hernia in Polydioxanone and Polypropylene

Suture	yes	No
PDS	2	48
PRO	5	45
Incidence of Incisional Hernia		
Suture	yes	No
PDS	0	50
PRO	2	48

In the PDS group, there were 50 cases out of which 2 cases had wound dehiscence. In 50 cases of Polydioxanone, the overall incidence of wound dehiscence was 5.5%. In the Polypropylene, out of 50 cases, 5 cases had wound dehiscence. In 55 cases of Polypropylene (PPL) dehiscence rate was

14.5%. Using the chi-square test there is no statistical significance in the incidence of suture sinus between the two groups. In the PDS group, there were 50 cases out of which 0 cases had incisional hernia with 0% incidence. In Polypropylene, out of 50 cases, 2 cases had

incisional hernia with an incidence of 3.6%. There is no statistical significance in the incidence of suture sinus between the two groups.

DISCUSSION

Most surgeons believe that closing the abdominal wound in layers was most sacrosanct since the layered closure brings about the opposition and exact anatomical layers together once the abdomen was closed. It is now fully realized, both from clinical observation and laboratory animal studies that healing of the incision takes place by the formation of a dense fibrous block of tissues however meticulously closed. This fact is quite evident when the abdomen is opened from the previous scar, it is not possible to identify separately the anatomical layers as closed in the previous surgery. Hence, the opposing faces of laparotomy wounds heal *masse*. Wide bites must be taken a minimum of 1 centimeter from the wound edge and placed at 1-centimeter intervals. The suture length should measure at least 4 times the length of the wound.^{4,13,14, 15}

Proper healing of the abdominal incisions so as to restore the structural integrity and strength of the wound has always been the most important factor in surgeons' minds. In spite of the modern surgical techniques and skills the morbidity associated with abdominal wounds is high. There are many factors that delay wound healing such as systemic and local factors.^{1,20} Systemic factors include obesity, jaundice, diabetes, malnutrition, protein deficiency, elderly patients, patients on steroids, and immunosuppressants. Local factors which delay wound healing after laparotomy are wound infection, hematoma, and foreign body reaction. All these impose stress on the freshly sutured abdominal wound.¹⁶

Postoperative wound infection was considered present when there was purulent discharge from the wound. Superficial wound infection is the infection of superficial layers of the abdomen like skin and subcutaneous tissue. Deep wound infection is the infection of deeper layers of the abdomen, Linea alba, and peritoneum. In both cases, the finding of seropurulent discharge from a stitch or from the incision, with signs of inflammation, with or without constitutional symptoms are present.^{4,17,18,19}

Clinically it is diagnosed when postoperatively there is pink discharge from the suture line and when observed carefully after removal of a stitch and inspecting the layers of the abdomen, all layers give way all of a sudden, which may or may not cause evisceration of the abdominal contents. This may occur any day from the 7-10th postoperative day. Burst abdomen being a mechanical process no single cause can be held responsible for its disruption. The following factors are the main local factors responsible for disruption.²⁰

The ideal method of wound closure would be one that provides adequate tensile strength to the tissues until

the wound has healed, approximates the tissue in such a way that normal healing takes place under optimum conditions, and remains secure in presence of local and systemic factors.⁶ Incidence of burst abdomen and the associated mortality rate has not decreased during this century. A number of factors have been associated with dehiscence, the most common cause being intraperitoneal sepsis.

Incisional hernias occur as a result of excessive tension and inadequate healing of a previous incision, which may be associated with surgical site infection. These hernias enlarge over time, leading to pain, bowel obstruction, incarceration, and strangulation. The main causes of incisional herniation are technical inadequacy and wound infection.²¹ Incisional hernias have been reported in 10–50 cent of laparotomy incisions^{22,23,24} and others have shown that there is no difference between absorbable and non-absorbable sutures, but there still exists an incisional hernia rate of 3% to 9%. Although the decrease in the incidence of wound dehiscence by the mass closure technique is encouraging, the incidence of late incisional herniation has remained high.

The suture sinus is a blind-ending tract leading from the skin into surrounding tissue with the presence of suture material in it. The incidence of suture sinus formation in previous studies is reported to be 2% - 25%. The frequency of suture sinus formation is directly related to the degree of contamination and suture material used.¹² In our study there was 2 case of suture sinus formation in the Polydioxanone (PDS II) group and 7 cases in the Polypropylene (PPL). So the risk of developing suture sinuses was more with polypropylene. Our study is a smaller one for estimating any statistical difference between two suture materials but the results have been found superior with Polydioxanone as compared to Polypropylene suture material

CONCLUSION:

Based on the observations made in this study, it has been concluded that the continuous self-anchored interlocking suture technique using no.1 Polydioxanone (PDS) for closure of midline laparotomy incision is superior to no.1 Polypropylene (PPL) suture material are superior in preventing major post-operative complication wound complications like wound infection, dehiscence, incisional hernia & suture sinus. Duration of operation and stay in hospital is similar in both the groups. PDS was superior to Prolene with respect to impact on the patient's quality of life considering complications. Thus, there was an advantage of Polydioxanone (PDS II) suture material over Polypropylene (Prolene) suture material. The overall morbidity from abdominal closure was considerably reduced in the Polydioxanone (PDS II) group.

REFERENCES: -

1. Hodgson NC, Malthaner RA, Ostbye T. The search for an ideal method of abdominal fascial closure: a meta-analysis. *Ann Surg* 2000; 231: 436-42.
2. Orr JW, Orr PF, Barret JM. Continuous or interrupted fascial closure: a prospective evaluation of no. 1 Maxon suture in 402 gynecologic procedures. *Am J Obstet Gynecol* 1990; 163:1485-89.
3. Chana RS, Saxena VC, Agarwal A. A prospective study of closure technique of abdominal incisions in infants and children. *J Indian Med Assoc* 1980; 88:359-69.
4. Carlson MA: Acute wound failure. *Surg Clin North Am* 1997;77:607-636.
5. Shukla HS, Kumar S, Misra MC, Naithani YP. Burst abdomen and suture material: a comparison of abdominal wound closure with monofilament nylon and chromic catgut. *Indian J Surg* 1981;43:487-91.
6. Dudley HAF. Layered and mass closure of the abdominal wall. *Br J Surg* 1970;57:664-7.
7. Jones TE, Newelle ET, Brubaker RE. The use of alloy steel wire in the closure of abdominal wounds. *Surg Gynecol Obstet* 1941;72:1056-9.
8. Irvin TT. Wound repair. Closure of the abdominal wound. *Ann R Coll Surg Eng* 1978;60:224-6.
9. Choudhary SK, Choudhary SD, Mass closure versus layer closure of abdominal wound: a prospective clinical study. *J Indian Med Assoc* 1994;92:229-32.
10. Srivastava A, Roy S, ShayaKB, Kumar A, Chumbar S, et al. Prevention of burst abdominal wound by a new technique: A randomized trial comparing continuous versus interrupted X sutures. *Ind J Surg* 2004;66:19-27.
11. Niggebrugge AH, HansenBE, Trimbos JB, Van de Velde CJ, Zwaveling A, Mechanical Factors influencing the incidence of burst abdomen. *Eur J Surg* 1995;161:655-61.
12. Weiland DE, Bay C, Del Sordi S. Choosing the best abdominal closure by meta-analysis. *Am J Surg*. 1998; 176:666-70
13. Russel RCG, Norman SW, Christopher JKB. Basic surgical skills and anastomoses. In: Bailey and love's Short practice of surgery. 25th ed. London: Arnold Hodder: 2008:237-8.
14. Jenkins TPN. The burst abdominal wound: a mechanical approach. *Br J Surg* 1976;63:873-6.
15. Harwood D, Mueller K. Goat medicine and surgery. New York, NY: Productivity Press; 2018.
16. Ceydeli A, Rucinski, Wise L et al, Finding the best abdominal closure: an evidence-based review of the literature *Curr. Surg* .2005 Mar-Apr;62(2):220-5 .
17. Ellis H: Incisions, Closures and Management of the Wound. In Zinner MJ, Ellis H, Nathanson K (eds): Maingot's Abdominal Operations, ed10. Connecticut, Appleton
18. Vinay k, Abbas AK, Fausto N: Robbins and Cotran Pathologic Basis of Diseases. New Delhi, Elsevier, 2005,7 p 87-118
19. Robson MC: Wound Infection. *Surg Clin North Am* 1997; 77:637-50.
20. Hodgson NCF, Mathaner RA, Ostbye T. The search for an ideal method of abdominal fascial closure: A meta-analysis. *Ann Surg* 2000;231:436-442.
21. Schessel ES, Ger R, Ambrose G, Kim R. The management of the postoperative disrupted abdominal wall. *Am J Surg* 2002;184:263-68.
22. Camaron AE, Gray RC, Talbot RW, Wyatt AP. Abdominal wound closure: atrial of Prolene and Dexon. *Br J Surg* 1980;67(7):487-88.
23. Irvin TT, Koffman CG, & Duthie HL. Layer closure of laparotomy wounds with absorbable and non-absorbable suture materials. *Br J Surg*. 1976; 63(10): 793-6.
24. Bucknall TE, Cox PJ, & Ellis H. Burst abdomen and incisional hernia. A prospective study of 1129 major laparotomies. *Br Med J (Clin Res Ed)*. 1982;284(6320): 931-3