

## Effect of Stitch Length on Wound Complications Following Midline Incision Closure

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### Abstract

Incisional hernia remains the most common complication after median laparotomy, with reported incidences varying between 5-15%. Recent clinical and experimental data showed a continuous suture technique with many small tissue bites in the aponeurosis only, is possibly more effective in the prevention of incisional hernia when compared to the commonly used large bite technique or mass closure.

The length of the suture used must be at least four times the length of the wound. The suture length to wound length ratio must be at least four.

An adequate ratio should be achieved by placing many stitches into aponeurosis. The high tension on the suture should be avoided.

The aim of this prospective comparative study was to study the effect of stitch length on surgical site infection and incisional hernia in closed midline incision.

**Keywords:** Incisional hernia; Wound infection; Suture length; Suture technique;

### Introduction

Incisional hernia is a frequent complication

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following abdominal wall closure accounting for 5-15% with vertical midline incisions at one year follow-up. The evidence from randomized clinical trials and meta-analysis indicate that a continuous running non-absorbable or slowly absorbable suture such as polydioxanone is the method of choice for abdominal wall closure.[1]

Incisional hernia is one of the major elements of morbidity after abdominal surgery, with high incidence in vertical midline abdominal incisions. The increased incidence is due to the patient's related factors, hence more consideration for choice of incision, wound closure and wound healing to protect against incisional hernia.[2]

Incisional hernia can cause discomfort, impair quality of life or result in serious life-threatening conditions, such as incarceration or strangulation of the bowel. Although a lot is known about patient related risk factors and suture materials, technical risk factors such as suture techniques have not been investigated thoroughly. The different suture techniques and various suture materials are in use to close midline incisions after primary laparotomy. The ultra-long term absorbable, elastic monofilament suture material MonoMax is safe and efficient for abdominal wall closure. [3]

The important risk factor for the development of wound dehiscence and incisional hernia is the suture technique. A continuous single layer closure with a

monofilament material should be used for midline incisions. The length of suture used must be at least four times the length of the wound. An adequate ratio should be achieved by placing many stitches into the aponeurosis. The high tension on the suture should be avoided.[4]

Various randomized studies hence evaluated techniques of abdominal fascia closure but controversy remains, leaving surgeons uncertain about the optimal method of preventing incisional hernia.[5]

Since the ability of the suture line to hold wound edges in apposition during the early postoperative period is important for the development of incisional hernia, than the quality of the suture technique is essential. A suture length to wound length ratio of four or more must be achieved. The lower ratio is associated with three fold increase in the rate of incisional hernia.[6]

The suture length to wound length ratio is an important parameter for healing of midline incisions closed with a continuous suture technique. The incidence of incisional hernia is lower when such wounds are sutured with a ratio  $>$  or  $=$  4.[7]

## Methods and Material

The patients from May 2011 to April 2012, older than 18years who underwent emergency or elective surgery through a midline incision in the Department of Surgery, S. S. Medical College, were included in this study. A total of 50 patients were randomized between a standardized small bite and large bite technique. Five units of general surgery are participated in this trail.

The patients with a previous midline incision, a previous midline incision crossing the midline, or a pre-existing ventral hernia like umbilical or epigastric hernia were not eligible. The patients were randomized to wound closure with short or long stitch length. A continuous locking single-layer monofilament suture used to close the incision.

A continuous, intradermal 4-0 absorbable monofilament suture [Monocryl] used to close the skin. Randomization was achieved by using one technique or the other on alternating weeks.

In the group randomized to a long stitch length, the wound closure is done by placing stitches at least 10mm from wound edge. For the long stitch group a 1-0 polydioxanone suture on a needle with a half circle, tapered point and a diameter of 41mm was used. {PDS-2 suture & TP-1needle} For the short stitch group, stitches placed at 5 to 8mm from the wound edge and to include only the aponeurosis in the stitches. In this group, 2-0 polydioxanone suture on a needle with a half circle, tapered point and a diameter of 20mm was used. {PDS-2 suture & mh-1 needle} In the small bites technique, twice as many stitches will be placed per sutured cm, with a smaller needle and thinner suture material.

The patient's age, sex, weight and height were recorded. The body mass index was calculated as weight in kilograms divided by height in meters squared. The patient's diabetic status and previous treatment for the same was noted. The degree of wound contamination, the operation time, and the incision closure time were recorded. The length of the suture used to close the incision and the length of the wound were measured and the short length to wound length ratio was calculated. The number of stitches placed in the wound was recorded for calculation of the mean stitch length {SL/No.of stitches}, and the mean stitch interval {WL/No. of stitches}.

The incidences of burst abdomen and wound infection until the day of discharge were defined as the primary composite endpoints. The rate of incisional hernias one year after surgery, the length of post-operative hospital stay and safety parameters served as secondary endpoints.

### *Inclusion Criteria*

1. Signed informed consent
2. All laparotomies with a midline incision

3. Age > 18years

*Exclusion Criteria*

1. Previous incisional hernia after midline incision
2. Previous surgery through midline incision
3. Pregnant women

The main objective is to compare both suture techniques for incidence of incisional hernia after one year. The secondary outcomes will include post-operative complications, direct costs, indirect costs and quality of life.

Surgical site infection and wound dehiscence were recorded up to four weeks after surgery. The wound dehiscence was defined as a complete wound disruption that needed emergent re-operation. Surgical site infection was defined according to the criteria of the Centres for Disease Control and Prevention and is classified as deep or superficial. At twelve month follow-up examination, the patients were examined in supine as well as erect position for incisional hernia. The ultrasound examination was done at both times, points to measure the distance between the rectus muscles at three points and to objectify presence or absence of incisional hernia. The patients, investigators and radiologists will be blinded to the stitch length used during follow-up, although the surgeon cannot be blinded during the surgical procedure.

The SPSS Statistical Software [trialversion 18.0; SPAA Inc] was used for statistical analysis. The Fisher exact test and Mann-Whitney test were used for univariate analysis as appropriate and P <0.05 was regarded as significant.

	Complications	Stitch length		P value
		Long	Short	
1.	Wound dehiscence	2	0	0.49NS
	No. of pts (%)	8%	0%	
2.	SSI	14	6	00.4 S
	No. of pts (%)	52%	24%	

**Results**

All 50 patients were randomized. 25 patients were allocated to a long stitch length and 25 patients to a short stitch length. Wound dehiscence occurred in two patients whose wound was closed with a long stitch length and no patients affected in the short stitch length. Surgical site infection occurred in 14 of 25 patients (52%) in the long stitch group and in 6 of 25 patients (24%) in the short stitch group (p= 0.04 S).

Incisional hernia was present in 9 of 25 patients (36 %) in the long stitch group and in 4 of 25 patients (16%) in the short stitch group (p= 0.19NS).

Overweight patients were sutured with a longer stitch and there was a high rate of infection among these patients 15/50 (30%) compared with moderately built patients.

**Discussion**

In this study, a short stitch length was associated with a lower rate of both surgical site infection and incisional hernia. The current recommendation of using a long stitch length is based on experimental studies that did not consider the effect of the SL to WL ratio.[9]

Recent clinical and experimental data showed a continuous suture technique with many small tissue bites in the aponeurosis only, is possibly more effective in the prevention of incisional hernia when compared to the commonly used large bite technique or mass closure.[10]

In the midline incisions closed with a suture length to wound length ratio of at least four, a short stitch is associated with a lower rate of both wound infection and incisional hernia. [11]

Suture technique affects both early and late wound complications. The rate of incisional hernia is lower if the suture length: wound length ratio is four or more. However, a high ratio should not be achieved by suturing with

a stitch length of 5cm or more as this is associated with an increase in the rate of wound infection.[12]

Overweight is a risk factor for wound infection and incisional hernia after midline abdominal surgery but these effects may be eliminated if patients are sutured with a suture length to wound length ratio of 4.0–4.9.[13]

Midline incisions allow rapid and wide access to the abdominal cavity with minimal damage to muscles, nerves and the vascular supply of the abdominal wall.[14]

However wound complications cause patient suffering and generate costs for the health care system.[15]

Surgical site infection, which occurs in up to 16% of patients after major surgery, is a risk factor for the development of incisional hernia.[16]

The hernia often demands repair and occurs in up to 26% of midline incisions.[17]

The quality of the suture technique has a profound effect on the risk of incisional hernia. Incisions should be closed with a suture length (SL) to wound length (WL) ratio of at least 4. When the SL to WL ratio is less than 4, the risk of hernia is 3 times higher.[18]

The ratio depends on the size of each stitch and the stitch interval. Thus, a ratio of at least 4 can be achieved with many small stitches placed at close intervals or by incorporating a larger amount of tissue into stitches placed at greater intervals. Large stitches are usually recommended because experimental studies have shown that stitches placed at least 10mm from the wound edge produce a stronger wound. This has been attributed to inflammatory changes in tissue close to the wound edge diminishing its suture holding capacity.[9]

Long stitches have been associated with a high rate of surgical site infection and incisional hernia.[8]

Long stitches may augment the risk of infection because they increase the amount of necrotic tissue in the wound. Long stitches were found to compress or cut through soft

tissue included in the stitch, thereby increasing the amount of necrotic tissue. The risk of incisional hernia may be increased with the use of a long stitch length because the stitch slackens which allows wound edges to separate and increase the risk of incisional hernia. Thus, new data indicate that an SL to WL ratio of at least 4 should be achieved with small tissue bites placed at close intervals rather than with large tissue bites placed at greater intervals.[19]

The study confirms that risk of hernia is higher when closure is done with an SL to WL ratio of less than 4. The study finds several measurable factors related to the quality of the suture technique factors that greatly affect the risk of surgical site infection and incisional hernia has the potential for reducing overall complication rates. The wound closure took four minutes longer with a short stitch length but, when one considers the costs generated by wound complications and the profound effect that use of a short stitch length has on complication rates, this is likely to be cost-effective.[20]

In one study surgeon placed stitches 5-8mm from the wound edge, with minimal tension applied to the suture, this corresponds to a mean stitch length of 20 to 32 mm. The high tension sutures are avoided because clinical studies have shown this to be associated with an increased risk of surgical site infection.[21]

PDS and Prolene are equally effective for the closure of abdominal fascia following laparotomy. There are no significant differences between two suture materials. Further studies may be conducted to evaluate their cost-effectiveness and measurement of health related quality of life instead of analysing their effectiveness in laparotomy closure.

The 2-0 suture was chosen because it was the longest (150cm) commercially available polydioxanone suture mounted on such a small needle. To our knowledge, there is no obvious theoretical basis for needle size or the suture size, per se, to have affected the ratio of wound complications. With the small MH-1 needle, it

was almost impossible to place stitches >7 to 8mm from the wound edge and still retrieve the needle. It was not feasible to include tissue other than the aponeurosis into the stitch for the same reason.

### Conclusion

In midline incisions closed with a running suture and having a suture length to wound length ratio of at least 4, current recommendations of placing stitches at least 10mm from the wound edge should be changed to avoid patient suffering and costly wound complications.

The rate of wound complications for midline incisions closed with a single layer running suture is lower when an SL to WL ratio of at least 4 is achieved with short stitch length. Hence we recommend all midline incisions to be closed with single layer several small stitches incorporated in aponeurosis only to achieve SL to WL ratio of at least 4.

### References

- O'Dwyer PJ, Courtney CA. University Dept. Of Surgery, Western Infirmary, Glasgow, G 116 NT, UK. Factors involved in abdominal wall closure and subsequent incisional hernia. *Surgeon*. 2003; 1(1): 17-22.
- El-Khadrawy OH, Moussa G, Mansour O, Hashish MS. Dept. of Surgery, Gastroenterology and Laparoscopic Unit, Tanta University Hospital, Tanta. *Hernia*. 2009; 13(3): 267-74.
- Albertsmeier M, Seiler CM, Fischer L, Baumann P, Husing J, Seidlmayer C, Franck A, Jauch K W, Knaebel HP, Buchler MW. Evolution of the safety & efficacy of MonoMax (R) suture material for abdominal wall closure after primary midline laparotomy- a controlled prospective multicentre trial: ISSAAC. *Langenbecks Arch Surg*. 2012; 397(3): 363-71.
- Cengin Y, Israelssan LA. Closure of midline incisions, A lot of small same size stitches in aponeurosis improve wound healing. *Lakartidningen*. 2002; 99(24): 2742-4.
- Van'tRiet M, Steyerberg EW, Nellensteyn J, Bonjer HJ, Jeekel J. Meta-analysis of techniques for closure of midline abdominal incisions. *Br J Surg*. 2002; 89(11): 1350-6.
- Israelsson LA, Jonsson J, Knutsson A. Suture technique and wound healing in midline laparotomy incisions. *Eur J Surg*. 1996; 162(8): 605-9.
- Israelsson L A, Jonsson T. Suture length to wound length ratio and healing of midline laparotomy incisions. *Br J Surg*. 1993; 80(10): 1284-6.
- Millbourn D, Israelsson LA. Wound complications & Stitch length. *Hernia*. 2004; 8(1): 39-41.
- Hogstrom H, Haglund U, Zederfeldt B. Suture technique and early breaking strength of intestinal anastomoses and laparotomy wounds. *ActaChirScand*. 1895; 151(5): 441-443.
- Hariaar JJ, Deerenberg EB, Van Ramshort GH, Lont HE, Van der Borst EC Schouten WR, Heisterkamp J, Van Doorn HC, Cense HA, Berends F, Stockmann HB, Vrijiland WW, Consten EC, Ottow RJ, GO PM, Hermans JJ, Steyerberg EW, Lange JF. *BMC Surg*. 2011; 11: 20.
- Millbourn D, Israelsson LA. Wound complications & Stitch length. *Hernia*. 2004; 8(1): 39-40.
- Israelsson LA, Jonsson T, Knutsson A. Suture technique & wound healing in midline laparotomy incisions. *Eur J Surg*. 1996; 162(8): 605-9.
- Israelsson LA, Jonsson J. Overweight & healing of midline incisions: the importance of suture technique. *Eur J Surg*. 1997; 163(3): 175-80.
- Ellis H, Bucknall TE, Cox PJ. Abdominal incisions & their closure. *Curr Probl Surg*. 1985; 22(4): 1-51.
- Israelsson LA, Wimo A. Cost minimization analysis of change in closure technique of midline incisions. *Eur J Surg*. 2000; 166(8): 642-646.
- Bucknall TE, Cox PJ, Ellis H. Burst abdomen & incisional hernia: a prospective study of 1129 major laparotomies. *Br Med J (Clin Res Ed)*. 1982; 284(6320): 931-933.
- Israelsson LA, Jonsson T. Closure of midline laparotomy incisions with polydioxanone & nylon: the importance of suture technique. *Br J Surg*. 1994; 81(11): 1606-1608.

18. Jenkins TP. The burst abdominal wound: a mechanical approach. *Br J Surg.* 1976; 63(11): 873-876.
19. Cengiz Y, Blomquist P, Isrelsson LA. Small tissue bites & wound strength: An experimental study: *Arch Surg.* 2001; 136(3): 272-275.
20. Leaper DJ, Van Goor H, Reilly J *et al.* Surgical Site Infection- A European perspective of incidence & economic burden. *Int Wound J.* 2004; 1(4); 247-273.
21. Mayer AD, Ausobsky JR, Evans M, Poolock AV. Compression Suture of the abdominal wall: A controlled trial in 302 major laparotomies. *Br J Surg.* 1981; 68(9): 632-634.

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