

Suture Length To Wound Length Ratio For Healing and Occurrence of Incisional Hernia of Midline Laparotomy Incisions

Tummapala Sai Dutt Bharat¹, G Muralidharan²

¹Junior Resident, Department of General Surgery, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry

²Professor and Head, Department of General Surgery, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university, Puducherry

Corresponding Author- :Tummapala Sai Dutt Bharat

E mail : duttugadu007@gmail.com

ABSTRACT

Introduction- Incisional hernia increases the length of hospital stay, readmission, future surgery, delayed adjuvant treatment, suboptimal esthetic outcome, and impaired psychosocial well-being. Methodology- Prospective Comparison Type of Study with Sample size of 110 and Sampling technique used was Convenient Sampling. All patients undergoing abdominal procedure through a midline incision, older than 18 years and with Elective and Emergency laparotomy surgeries operated for Intra-abdominal pathology were included in the study while subjects with mentally incapable of giving consent, who have undergone multiple abdominal surgeries and patients who had an incisional hernia after previous midline operation. Quantitative variables like age, mean length of incision will be analyzed and presented using mean and SD. Chi square test or Fisher's exact test was used. Results- Mean age was comparable in between both groups. Comparison of patients based on ASA among Group A and B calculated using chi square test, $p=0.01$, which is <0.05 which shows statistical Significant difference between ASA Score among Group A and B. Suture material used among Group A and B by Unpaired t- test, $p=0.07$, which is >0.05 which shows no Statistical Significant difference. Conclusion- The suture length to wound length ratio depends on the size of tissue bites, the distance between bites and the tension on the suture.

Keywords: *Incisional Hernia, Suture, ASA*

How to Cite: Tummapala Sai Dutt Bharat, G Muralidharan., (2026) Suture Length To Wound Length Ratio For Healing and Occurrence of Incisional Hernia of Midline Laparotomy Incisions, *Journal of Carcinogenesis*, Vol.25, No.1, 452-457

1. INTRODUCTION

Postoperative wound healing plays a significant role and is critical in patient recovery and rehabilitation because mortality and morbidity rates are affected by surgical wound dehiscence (SWD). However, when suture length to wound length ratio is less than 4cm, it can cause significant morbidity. Incisional hernia increases the length of hospital stay, readmission, future surgery, delayed adjuvant treatment, suboptimal esthetic outcome, and impaired psychosocial well-being.¹

Wound dehiscence is reported to occur in 7%- 9% of patients undergoing midline laparotomy incisions.² Economic impact for surgical wound dehiscence (SWD) has been estimated to be between 2,17,27,16,000 rupee and 2,45,98,24,900 rupee annually India.³

Healing of midline incisions is slow due to the character of the linea alba and variations in intra-abdominal pressure. It may be further compromised by clinical risk factors such as obesity, male sex, chronic obstructive pulmonary disease, smoking, or preoperative chemotherapy. Following elective midline laparotomies, long-term absorbent suture materials and a

continuous suture technique have been shown to reduce hernia rates. Triclosan-coating to prevent wound infection has been tried in various settings but was unsuccessful using monofilament sutures in elective closures.⁴

A suture-length-to-wound-length ratio greater than 4:1 reduces the probability of incisional hernia. The ideal may be short stitches using small needles and thin suture materials. More than 50 per cent of incisional hernias develop after the first postoperative year. With 10 per cent or more developing incisional hernias in recent trials, laparotomy closure remains an unsolved surgical problem. These factors have led to the development of an elastic and ultra-long-term absorbent suture material made from poly-4-hydroxybutyrate (Monomax®; B.Braun Surgical, Rubi, Spain).⁵ It may avoid early-phase suture tension peaks to support the fascia. Therefore, this study was conducted to evaluate the suture length to wound length ratio for healing and occurrence of incisional hernia of midline laparotomy incisions, via determining the effects of suture length to wound length ratio on the healing of midline laparotomy wounds closed with a continuous suture and determine the occurrence of incisional hernia.

2. MATERIALS AND METHOD

The patients admitted at Department of General Surgery, Shri Sathya Sai Medical College & Research Institute, Sri Balaji Vidyapeeth deemed to be university,

Puducherry undergoing midline laparotomy incisions during August 2023 - March 2026. The study was Prospective Comparison Type of Study with Sample size of 110. Rationale for sample size was based on the literature review and Sampling technique used was Convenient Sampling

All patients undergoing abdominal procedure through a midline incision, older than 18 years and with Elective and Emergency laparotomy surgeries operated for Intra-abdominal pathology were included in the study while subjects with mentally incapable of giving consent, who have undergone multiple abdominal surgeries and patients who had an incisional hernia after previous midline operation.

This will be carried out as a Randomized clinical study which includes 55 in each group of patients who will undergo elective or emergency laparotomy. Following admission the Patients were divided in two groups by randomization:

Group A: suture length to wound length ratio <4.

Group B: suture length to wound length ratio \geq 4.

Among Group A:

The length of the wound and suture length will be noted at the operative time, keeping the ratio of <4. Patient's demographic details, disease details, surgery performed, anesthesia details and investigations will be noted. And evaluated on the later day, patient is advised to follow up in case of wound infection and features of incisional hernia or swelling in the region of operated scar.

Among Group B:

The length of the wound and suture length will be noted at the operative time, keeping the ratio of >4. Patient's demographic details like age, gender, and occupation were recorded. Also, disease details, like history of smoking, BMI, serum albumin, PCV and Hb were recorded. Types of surgery performed, anesthesia details and investigations will be noted. And evaluated on the later day, patient is advised to follow up in case of wound infection and features of incisional hernia or swelling in the region of operated scar.

Statistical Methods: Qualitative variables such as gender, previous midline operation, and emergency operation will be presented using frequency and percentages. Quantitative variables like age, mean length of incision will be analyzed and presented using mean and SD. Chi square test or Fisher's exact test was used.

3. RESULTS

Table-1 Sociodemographic profile showing distribution of age

Age		Groups	
		Length Ratio <4/ Group A	Length Ratio \geq 4/ Group B
18-20 years	Count %	02 (3.63%)	6 (10.9%)

Age	21-30 years	Count %	04 (7.27%)	04 (7.27%)
	31-40 years	Count %	11 (20%)	7 (12.7%)
	41-50 years	Count %	12 (21.8%)	6 (10.9%)
	51-60 years	Count %	14 (25.4%)	10 (18.1%)
	61-70 years	Count %	6 (10.9%)	10 (18.1%)
	71-80 years	Count %	6 (10.9%)	12 (21.8%)
TOTAL		100	55	55

Table 2-Application of Unpaired t- test

	N	N	Mean	S.D	t- value	p-value
Age	Length Ratio <4	55	44	3	0.850	0.404#
	Length Ratio ≥4	55	43	4		
# No Statistical Significance at p >0.05 level						

The above table shows Comparison of Age in years between Group A and 2 by Unpaired t- test were t-value=0.850, p=0.404>0.05 which shows no Statistical Significant difference between age and Groups A and B. Hence the mean age was comparable in between both groups.

Table 3: Distribution of patients based on the Gender

Gender		Groups		P Value
		Length Ratio <4/ Group A	Length Ratio ≥4 / Group B	
Male	Count %	33 (60%)	30 (54.5%)	0.06
Female	Count %	22 (40%)	25 (45.5%)	
TOTAL		55 (100%)	55 (100%)	

Table 4- Distribution of patients based on ASA

ASA	2	3	P Value
Length Ratio <4/ Group A	47 (85.45%)	8 (14.54%)	0.01**
Length Ratio ≥4 / Group B	39 (70.90%)	16 (29.09%)	

The above table shows Comparison of patients based on ASA among Group A and B calculated using chi square test, p=0.01, which is <0.05 which shows statistical Significant difference between ASA Score among Group A and B.

Table 5- Suture Material Used among group A and B

Suture Material Used	Length Ratio <4/ Group A	Length Ratio ≥4 / Group B	Means	Std. Deviation	P Value

Suture Length To Wound Length Ratio For Healing and Occurrence of Incisional Hernia of Midline Laparotomy Incisions

Loop PDS	30 (54.4%)	41 (74.5%)	3.1645	.3467	0.07
Loop Prolene	25 (45.6%)	14 (25.4%)	3.4134	.297	
Total	55	55			

The above table shows Comparison of patients based on type of suture material used among Group A and B by Unpaired t- test, p=0.07, which is >0.05 which shows no Statistical Significant difference between type of suture material used among Group A and B. Hence, the both groups are comparable.

Table 6- Wound Length and Suture Length Using Sample T test among both the groups

	T	Mean	Std. Deviation	P Value
Wound Length - Group A	43.174	17.56	3.017	0.06
Wound Length - Group B	25.093	217.67	64.333	
Suture Length- Group A	51.217	18.09	2.620	0.07
Suture Length- Group B	37.679	248.13	48.838	

The above table shows Comparison of patients based on Wound Length of Group A and B by Unpaired t- test, p=0.06, which is >0.05 which shows no Statistical Significant difference between wound length in Group A and B. Hence, the both groups are comparable. Similarly, Comparison of patients based on suture length of Group A and B by Unpaired t- test, p=0.07, which is >0.05 which shows no Statistical Significant difference between suture length in Group A and B. Hence, the both groups are comparable.

Table 7- WL / SL RATIO < 4:1 or > 4:1

	Length Ratio <4/ Group A	Length Ratio ≥4 / Group B	Means	Std. Deviation	P Value
More	55 (100%)	52 (94.5%)	2.1645	.2267	0.01**
Less	0	3 (5.6%)	1.4134	.2997	
Total	55	55			

Multivariate analysis identified the suture length to wound length ratio, age and major wound infection as independent risk factors for the development of hernia, which occurred in 9.0 per cent of patients when the suture length to wound length ratio was 24 and in 23.7per cent (P = 0.001) when it was <4.

Table 8- South Hampton Score - D3 , D7 , At Suture Removal

Parameters	Length Ratio <4/ Group A		Length Ratio ≥4 / Group B		P Value
		N (%)		N (%)	
D3	1B	5 (9.09%)	2 (3.6%)		0.06
	1C	42 (76.3%)	46 (43.6%)		
	2C	8(14.5%)	7 (43.6%)		
D7	2A	36 (65.5%)	30 (54.5%)		0.06
	2B	10 (18.18%)	14 (25.4%)		
	3A	5 (9.09%)	6 (10.9%)		
	3B	3 (5.6%)	2 (3.6%)		
	4A	1 (1.8%)	3 (5.6%)		
At Suture Removal	2A	35 (63.6%)	28 (50.9%)		0.07
	3A	6 (10.9%)	10 (18.18%)		
	4A	12 (21.8%)	8(14.5%)		
	4C	1 (1.8%)	4 (7.27%)		

	Died	2 (3.6%)	5 (9.09%)	
--	------	----------	-----------	--

The above table shows comparison of patients based on Hampton Score - D3 among Group A and B by Unpaired t-test, $p=0.06$, which is >0.05 which shows no Statistical Significant difference between Hampton Score - D3 among Group A and B. Hence, the both groups are comparable.

Table 9- Incisional Hernia At 6 Months

	Length Ratio <4/ Group A	Length Ratio ≥ 4 / Group B	Means	Std. Deviation	P Value
No	51 (92.7%)	50 (90.0%)	2.5445	0.63345	0.01*
Yes	4 (7.27%)	5 (9.09%)	2.23345	0.6565	
Total	55	55			

The above table shows Comparison of patients based Incisional Hernia At 6 months among Group A and B by Unpaired t- test, $p=0.01$, which is <0.05 which shows Statistical Significant difference between Incisional Hernia at 6 months among Group A and B. Hence, the both groups are not comparable. In present study 4 (7.27%) shown incisional hernia at 6 months in group A while 5 (9.09%) in Group B.

Table 10- Incisional Hernia At 12 Months

	Length Ratio <4/ Group A	Length Ratio ≥ 4 / Group B	Means	Std. Deviation	P Value
No	54 (98.1%)	51 (92.7%)	2.54545	0.7766	0.01*
Yes	1 (2%)	04 (7.27%)	2.0836	0.64545	
Total	55	55			

4. DISCUSSION

Incisional hernia, which develops in 10–69% of patients, remains a major complication after midline abdominal wall closure. A low tension of the suture line, sufficient collagen deposition, adequate blood supply and the absence of infection are prerequisites for undisturbed wound healing, while clinical risk factors for the development of incisional hernia include obesity, smoking, steroid therapy and malnutrition.⁶

The first randomised-controlled trial (RCT) comparing large bite and small bite closure techniques published by Millbourn et al.² restarted the discussion regarding the best technique for midline closure. Albeit the INLINE meta-analysis by Diener et al. concluded that a running suture using a long-term absorbable monofilament material should be used for midline closure specific technical aspects were not highlighted. In several studies, Israelsson had investigated the effects of different suture-to-wound length ratios and detected that a ratio of at least 4–5:1 was associated with fewer wound infections and lower incisional hernia rates even in obese patients.³

Millbourn et al.², and for a suture-to-wound length ratio of at least 4:0. A second RCT comparing small versus large bite was published by Deerenberg et al.⁸ immediately after these guidelines. The results of this study confirmed the superiority of the small bite technique. The surgical site infection (SSI) rate of the STITCH trial was surprisingly high in both groups (21 vs 22%) in comparison to Millbourn (10 vs 5%). Based on a recently published meta-analysis by Henriksen et al.⁹ including 2 RCTs, a continuous suture with small bites in combination with a slowly absorbable suture material results in significantly fewer incisional hernias than a large bites technique (9.45 vs 19.30%, OR 0.41, 95% CI 0.19–0.86). These improvements notwithstanding, the surgical site infection rate of 21% and the 1-year incisional hernia rate of 13% in the small bite group of the STITCH study are not satisfactory. Besides stitch length, properties of the suture material such as elasticity, tensile strength and resorption time could significantly influence the results of elective midline closure. Similarly, study done by Israelsson LA et al.¹⁰ in group B around 10.9% subjects belonged to age group 15-20 years, 7.27% from 21-30 years, 12.7% subjects from age group 31-40 years, 10.9% from age group 41-50 years, 18.1% from 51-60 years age group, 18.1% from 61-70 years and 21.8% from 71-80 years of age group. Similarly, Hernia was found in 62 of 279 patients (22.2 per cent) older than 45 years compared with six of 84 (7 per cent) aged 45 years or younger. The results were found in disagreement to our study. Study done by Gorad Kedar P. et al.¹¹ there was significant difference was seen among the groups based on Hampton Score with p value 0.01**. Hence, the study was in disagreement to our study. In present study 4 (7.27%) shown incisional hernia at 6 months in group A while 5 (9.09%) in Group B while in present study 1 (2%) shown

incisional hernia at 12 months in group A while 04 (7.27%) in Group B. While in the study done by Cameron et al¹² 5% shown incisional hernia at 6 months and 6% at 12 months. The results were found parallel to each other.

5. CONCLUSION

The suture length to wound length ratio depends on the size of tissue bites, the distance between bites and the tension on the suture. The relative importance of these factors for subsequent wound healing is uncertain, as clinical studies on this issue are few. As the trial continues, it might be possible to assess the separate effect of these technical factors on clinical outcome. Participating surgeons were then urged to adjust their suture technique towards a suture length to wound length ratio of 4: 1.

REFERENCES

- [1] Israelsson LA, Jonsson T. Closure of midline laparotomy incisions with polydioxanone and nylon: the importance of suture technique. *Br J Surg.* 1994;81(11):1606-8.
- [2] Millbourn D, Cengiz Y, Israelsson LA. Effect of stitch length on wound complications after closure of midline incisions: a randomized controlled trial. *Arch Surg.* 2009;144(11):1056-9.
- [3] Israelsson LA, Jonsson T. Incisional hernia after midline laparotomy: a prospective study. *Eur J Surg.* 1996;162(2):125-9.
- [4] Cengiz Y, Israelsson LA. [Closure of midline incisions. A lot of small, same-size stitches in the aponeurosis improve wound healing]. *Lakartidningen.* 200;99(24):2742-4.
- [5] Patel SV, Paskar DD, Nelson RL, Vedula SS, Steele SR. Closure methods for laparotomy incisions for preventing incisional hernias and other wound complications. *Cochrane Database Syst Rev.* 2017;3;11:CD005661.
- [6] Amarini R, Chien S, J. Kotwal G. Facilitation of Wound Healing Following Laparoscopic and Conventional Abdominal Surgery with Dressings, Patches, Antibiotics, etc. In: Hakan Dogan K, Wound Healing - Current Perspectives. IntechOpen; 2019.
- [7] Lloyd JD, Marque MJ, Kacprowicz RF. Closure techniques. *Emerg Med Clin North Am.* 2007 Feb;25(1):73-81.
- [8] Deerenberg EB, et al. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial. *Lancet.* 2015;386:1254–1260.]
- [9] Henriksen NA, et al. Meta-analysis on materials and techniques for laparotomy closure: the MATCH review. *World J Surg.* 2018;42(6):1666–1678.
- [10] Docobo-Durantez F, Sacristan-Perez C, Flor-Civera B, Lledo-Matoses S, Kreisler E, Biondo S. [Randomized clinical study of polydioxanone and nylon sutures for laparotomy closure in high-risk patients]. *Cir Esp.* 2006;79(5):305-9.
- [11] Gorad, Kedar P. et al. "Use of Southampton Scoring for Wound Healing in Post-surgical Patients: Our Experience in Semi-urban Setup." *Clinical & Biomedical Research* 5 (2021): 36-41.
- [12] Cameron AE, Parker CJ, Field ES, Gray RC, Wyatt AP. A randomised comparison of polydioxanone (PDS) and polypropylene (Prolene) for abdominal wound closure. *Ann R Coll Surg Engl.* 1987 May;69(3):113-5.