

JENKIN'S VERSUS ISRAELSSON'S TECHNIQUE FOR ABDOMINAL CLOSURE AFTER LAPAROTOMY AND IT'S OUTCOME, A RANDOMISED CONTROL TRIAL

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Abstract

Background: Midline incisions provide quick and extensive access to the abdomen. Secure wound closure is important for an uncomplicated and expedient recovery after laparotomy. Method: A Randomised control trial was carried out on patients admitted within the department of surgery at a tertiary care facility from 1st November 2020 to 31st October 2021. Patients were divided into two groups by randomisation using computer generated randomisation chart. In one group midline laparotomy was closed by Jenkin's technique (Group 1) in other group by Israelsson's techniques (Group 2) and outcomes associated with closure technique were compared. Aim: to study the results of two techniques in terms of postoperative complications. Results: Total of 100 patients were enrolled during this study with age varied from 18 to 85 years. Male: female ratio was 4.5:1. The mean BMI was 21.95. Patients who were closed by Group 1, 28% developed postoperative wound infections compared to 16% in Group 2. Group 1 had a wound dehiscence rate of 18%, while Group 2 had 6%. Compared to Group 2, which saw a 2% incidence of burst abdomens, Group 1 saw a 6% incidence. In Group 1, there was a 16% incidence of incisional hernia while there was a 6% incidence in Group 2. In Group 1, only 4% of patients complained of chronic wound pain compared to the 6% in Group 2. Conclusion: Jenkin's technique is quick and cost-effective for large midline incisions, but not suitable for all patients. Israelsson's technique is safer with fewer complications and recommended for patients with small incisions and pulmonary diseases, despite longer operative time and higher cost.

Keywords: Midline laparotomy; Jenkin's technique; Israelsson's technique; wound dehiscence; incisional hernia.

Introduction

Midline incisions provide quick and thorough access to the abdomen while causing the least amount of damage to the surrounding muscles, nerves and vascular supply. Secure wound closure is important for an uncomplicated and expedient recovery after laparotomy. Wound

complications, however, result in patient suffering and place a strain on the healthcare system [1]. The most effective abdominal closure technique should be quick, easy, and affordable while avoiding both early and late complications. None strategy is considered to be the best [2]. The frequency of both early and late wound complications serves as a gauge of a method's

efficacy. Burst abdomen, wound dehiscence, and wound infection are among the early complications. The late complications include suture sinus, incisional hernia, and wound pain. Since the surgeon can control the surgical technique, pursuing the recommendations from various studies offers some way of substantially reducing the rate of wound complications [3]. The stitch interval and the size of the tissue bite are the two main wound strength factors that the surgeon can control. These variables are expressed as the ratio of the length of the suture inserted to the length of the wound, or SL: WL. When the SL to WL ratio is less than 4, the risk of herniation increases by three times [4]. Experimental research has shown that stronger wounds are produced when stitches are placed at least 10mm away from the edge of the wound [5]. Because the stitch sags and permits the wound edges to separate, long stitch lengths may increase the risk of an incisional hernia. Obesity, steroid therapy, malnutrition, nicotine abuse, and other connective tissue diseases are found to be the main risk factors for incisional hernia [6]. In order to achieve an SL to WL ratio of at least 4, new study suggests that small tissue bites spaced closely together rather than large tissue bites spaced farther apart should be used [7]. Evidence-based medicine frequently takes a backseat to surgical tradition, prejudice, familiarity, and personal conviction. Indian patients have different nutritional needs and financial capacities than their counterparts in developed nations. Data gathered from other countries may or may not be relevant to this situation. A contextualized approach to the issue is therefore suggested.

Materials and Method

This Randomised Control Trial was conducted in the Post Graduate Department of Surgery of a tertiary care hospital between 1st November 2020 to 31st October 2021. Approval for the conduction of the study was taken from Institutional Ethical Committee.

The aim of the paper is to study the results of two techniques; Jenkin's and Israelsson's for midline laparotomy wound closure, regarding the preoperative status and postoperative complications like wound infection, wound dehiscence, postoperative wound pain, incisional

hernia, and suture sinus formation during follow-up.

Inclusion criteria: Patients older than 18 years undergoing midline laparotomy irrespective of sex.

Exclusion criteria:

1. Patients who had undergone a previous laparotomy for any condition.
2. Patients unwilling to undergo treatment or reluctant to take part within the study.
3. Patients with pre or postoperative diagnosis of malignant involvement of peritoneum. (Metastatic disease).

One hundred patients presenting to post graduate department of surgery for either emergency or elective surgery were enrolled during this study. Patients were divided into two groups by randomisation using computer generated randomisation chart. In each group, 50 patients were included.

In the group randomized to Jenkin's technique, monofilament loop polydioxanone (PDS)/polypropylene size no 1 on a 50 mm heavy half circle round bodied needle was used for all closures. The wound was closed as a continuous single layer without locking with tissue bites (1 cm) which were taken on either side at ≤ 1 cm intervals with termination using an Aberdeen knot. within the group randomized to Israelsson's technique, monofilament PDS/prolene, size number 2-0, single suture with a needle was used for all closures. The wound was closed as an intermittent single layer including only the aponeurosis with tissue bites 5-6mm from the edge at 5mm intervals. The incision's length and, consequently, the length of the wound were measured, and the SL to WL ratio was computed. All complications following surgery were documented. All patients were followed up weekly for one month and then monthly for 3 months in surgery OPD and examined for incisional hernia unless they were required to be seen at other times for other clinical reasons and so followed at 6 month and 1 year by telephone calls and data recorded for analysis. Patient having any complaint were advised to attend surgery OPD. Post operative wound pain was measured by VAS (visual analogue scale) from 0-10. A postoperative wound dehiscence rate and surgical site infection

were noted. At one- and three-months follow-up patients were examined for incisional hernia and suture sinuses.

Results

Among 100 patients enrolled within the study, age of patients varied from 18 to 85 yrs. Overall male: female ratio was 4.56:1. 72% subjects enrolled within the study had normal BMI, 11% of subjects were overweight, 3% were Obese and only 14% of the patients were underweight. The mean BMI was 21.95 (SD-3.166) and ranged from 17-32. Among the enrolled subjects 22% smoked cigarettes, 23% consumed alcohol, 21% had pulmonary disease and 7% had tuberculosis. Around 28% of the subjects had hypoalbuminemia and 46% of patients had anemia. The two suturing techniques had an equal distribution of risk factors. 98% of the study participants had emergency surgery, while only 2% had elective surgery. Among post operative complications 22% of patients presented with wound infection, 12% wound dehiscence, 11% incisional hernia, 7% suture sinus, 4% Burst abdomen and 5% chronic wound pain as shown in Figure 1. 28% of patients in Jenkin's technique and 16% of subjects in Israelsson's technique developed postoperative wound infection as shown in Figure 2.

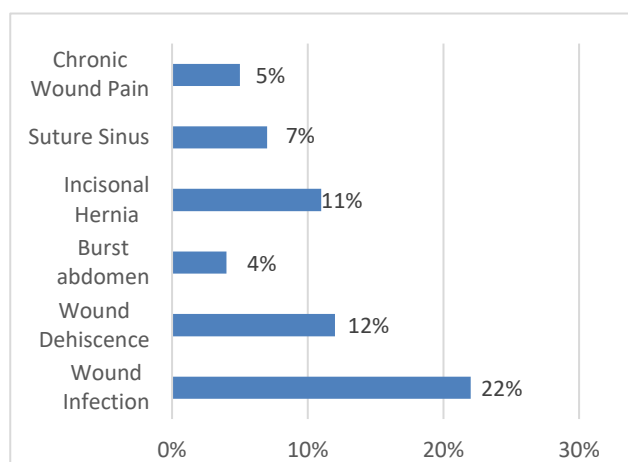


Figure 1 – Distribution of wound complications of patients who underwent midline laparotomy.

Many of the patients who endured postoperative wound infections led to wound dehiscence, burst abdomen, incisional hernia and chronic wound pain. Incisional hernia development due to prior wound infection was statistically significant (p=0.006), even though

the development of wound dehiscence, burst abdomen and chronic wound pain wasn't statistically significant as shown in Table 1.

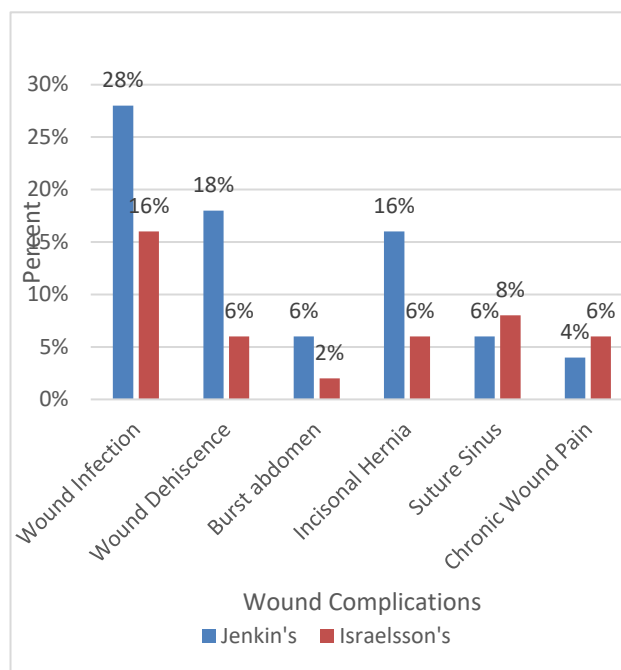


Figure 2 – Comparison of postoperative complications between the suturing techniques in patients undergoing Midline laparotomy.

Complications	Patients presenting with Preceding Wound Infection	No Wound Infection	P-value	χ^2
Wound Dehiscence	5	7	0.080	3.07
Burst abdomen	2	2	0.168	1.90
Incisional Hernia	6	5	0.006	7.63
Suture Sinus	0	7	0.145	2.12
Chronic Wound Pain	1	4	0.912	0.12

Table 1 – Prevalence of wound infection in subjects who develop other wound complications in midline laparotomy

Wound closed using Israelsson's technique aggregated to a mean suture cost per procedure of Rs 1113, whereas patients closed using Jenkin's technique required a mean cost of Rs 927 per procedure. The difference in suture cost for abdominal wound closure was statistically significant (p<0.05). Jenkin's technique required a mean of 15.9 minutes with timing ranging from 10 to 22 minutes and Israelsson's technique required a closure time of 25.22 minutes per operative procedure on an average, with procedure time ranging from 15 to 35 minutes.

Association was noted between various factors and postoperative complications. Smoking ($p=0.03$), pulmonary infections ($p=0.01$), tuberculosis ($p=0.02$), and hypoalbuminemia ($p=0.039$) were all associated with wound infection. Wound dehiscence and increasing BMI were associated ($p=0.03195$). Age and pulmonary infections were linked to incisional hernia ($p=0.015$ and $p=0.004$, respectively). No association was found between

gender, hypertension and Jaundice with suturing technique for postoperative wound complication. In patients closed using Jenkin's technique, wound infection was associated with pulmonary infections ($p=0.003$) and tuberculosis ($p=0.006$). Wound dehiscence was related to increasing BMI ($p=0.00834$) as show in Table 2.

Complications	Technique	Gender		Age				BMI		
		Male	Female	15-30 (in years)	31-45 (in years)	46-60 (in years)	61-90 (in years)	Normal	Over- weight	Under- weight
Wound Infection	Jenkin's	12	2	5	4	3	2	10	2	2
	Israelsson's	7	1	3	3	2	0	5	2	1
Wound Dehiscence	Jenkin's	7	2	3	1	2	3	5	3	1
	Israelsson's	3	0	2	0	1	0	3	0	0
Burst Abdomen	Jenkin's	2	1	0	0	2	1	1	2	0
	Israelsson's	1	0	0	1	0	0	1	0	0
Incisional hernia	Jenkin's	7	1	1	2	1	4	5	2	1
	Israelsson's	3	0	1	1	1	0	3	0	0
Suture Sinus	Jenkin's	3	0	1	0	2	0	3	0	0
	Israelsson's	3	1	1	3	0	0	4	0	0
Chronic Wound Pain	Jenkin's	2	0	0	1	1	0	1	1	0
	Israelsson's	2	1	2	0	1	0	2	0	1

Table 2 – Association of post-operative wound complication with physical parameters in patients undergoing midline laparotomy closed using different Suture techniques.

The incisional hernia was related to Increasing age ($p=0.014$), pulmonary infection ($p=0.003$) and tuberculosis ($p=0.005$) and also burst abdomen was related to increasing BMI ($p=0.0005$). In patients closed using Israelsson's technique, Wound infection was associated with

increasing BMI ($p=0.0456$), alcohol intake ($p=0.029$) and smoking ($p=0.005$). Wound pain was related to CKD ($p=0.039$). Suture sinus was associated with diabetes mellitus ($p=0.025$) and anemia ($p=0.024$) as shown in Table 3.

Complications	Technique	Diabetes	Hypertension	Tuberculosis	Jaundice	CKD	Pulmonary disease
Wound Infection	Jenkin's	1	1	4	2	1	7
	Israelsson's	0	0	0	0	1	3
Wound Dehiscence	Jenkin's	1	0	2	2	0	3
	Israelsson's	0	0	0	0	0	0
Burst Abdomen	Jenkin's	1	0	1	1	0	1
	Israelsson's	0	0	0	0	0	0
Incisional hernia	Jenkin's	0	1	3	2	0	5
	Israelsson's	0	0	0	0	0	1
Suture Sinus	Jenkin's	0	0	0	0	0	0
	Israelsson's	1	0	0	0	0	0
Chronic Wound Pain	Jenkin's	1	0	0	0	0	0
	Israelsson's	0	0	0	0	1	0

Table 3 – Association of post-operative wound complication with co-morbidities in patients undergoing midline laparotomy closed using different Suture techniques.

Discussions

In this study, patients who underwent midline laparotomies were evaluated to compare the effectiveness of two suturing methods in reducing early and late postoperative complications. The people who participated in the study had an average age of 38.3 years. In the Israelsson's and Jenkin's techniques, the subjects' median ages were 35.66 years and 40.94 years, respectively. The subject profile had a predominance of males. 82% of the participants in the study were men, and only 18% were women. Many authors have reported similar results as in our study [8-10], but some authors have reported studies during a more aged population [11],[12]. In our study, almost 2/3rd subjects were of normal BMI (72%) with a mean BMI of 21.95 kg/m² (SD-3.166), and BMI ranged from 17-32 kg/m². Patients with high BMI than our study were reported by Millbourn D [11]. The incidence of wound infection was 22% in our study. Several conflicting results are reported; some showed lower infection rates [9],[13],[14] and a few showed higher infection rates [12]. In contrast to (28%) Jenkin's technique, 16% of the subjects closed by Israelsson's technique experienced postoperative wound infection which was similar to our study [15]. Given that most of the procedures were done in an emergency situation, intra-abdominal contamination during the procedure may be indicative of the high incidence of wound infection. Malnutrition or advanced sepsis brought on by a delayed presentation to the medical facility are two additional factors that may be at play. Western literature rarely mentions these factors. Most of the wound dehiscence in our study occurred from the 6th to 12th postoperative day, which was similar as reported in other study [16]. A total of 12% of patients had abdominal wound dehiscence in our study. Jenkin's group had a wound dehiscence rate of 18% while 6% within the Israelsson's group. Several authors have reported conflicting results for this complication, with some reporting less dehiscence rate [9],[11],[14], whereas some reported similar rates to our study [10],[15]. This discrepancy could be explained by the fact that most of the wounds in our study were contaminated, which made it more likely for the subject to succumb to wound infection and

dehiscence. According to our research, 41.7% of the patients who experienced wound dehiscence also had an infected wound. In our study population, the incidence of overall burst abdomen was 4%. This figure was beyond other studies [12],[17], but almost like some of the studies [18]. 2% of burst abdomens occurred with Israelsson's technique as opposed to 6% with Jenkin's technique. Other authors [8],[13],[19] have reported findings that are comparable. Additionally, wound infection increases the risk of an abdominal rupture. 50% of the participants in our study who experienced burst abdomen had an initial wound infection. Similar findings have been reported by some authors [19]. Increasing BMI was related to a burst abdomen in Jenkin's technique group. Incidence of incisional hernia in our study was reported to be 11% which was the same as some studies [17], but more than that as reported by other studies [12],[20]. Incisional hernias occurred 6% of the time with Israelsson's technique versus 16% with Jenkin's technique. The findings of the other study were remarkably similar to those of our study population [11]. The incidence of suture sinus formation in Jenkin's technique was 6% and 8% in Israelsson's technique. Several studies reported lesser rate of suture sinus formation. [9],[14]. diabetes mellitus and anemia were related to suture sinus formation in Israelsson's suturing technique for which the rationale couldn't be ascertained.

Chronic wound pain was present in 5% of patients in our study. In Jenkin's technique, 4% of patients complained of chronic wound pain compared to 6% in Israelsson's technique. Several studies have reported conflicting results, with some studies showing results just like our study [21],[22]. 20% of patients with chronic wound pain had previous wound infections, this might be attributed to intermittent knotting with a large number of knots predisposing to nerve compression. The mean duration of time taken in Jenkin's technique was 15.9 minutes and in Israelsson's technique it had been 25.2 minutes. Some studies required even longer for the abdominal closure [23]. In our study, the price of sutures in Jenkin's technique was cumulative of of Rs 46,350 with a mean cost per patient being Rs 927, and in Israelsson's technique, it had been Rs 55,650 with a mean cost per patient being Rs 1113. Similar result was reported by other studies [24].

Conclusion

We concluded that Jenkin's abdominal closure technique should be used in closing large midline incisions in procedures requiring less operative time. This method requires less operative cost, and lesser time but this method isn't recommended for all patients because the Israelsson technique results in lesser wound infections, wound dehiscence, burst abdomen and incisional hernia. Hence, it's recommended that in patients who can tolerate an additional amount of operative time, extra cost, have small midline incisions and have associated pulmonary diseases, Israelsson technique should be preferred over Jenkins technique.

References

- [1] L. A. I. Wimo A., "Cost Minimisation Analysis of Change in Closure Technique of Midline Incisions," *The European Journal of Surgery*, vol. 166, no. 8, pp. 642–646, Aug. 2000
- [2] A. Ceydeli, J. Rucinski, and L. Wise, "Finding the best abdominal closure: An evidence-based review of the literature," *Current Surgery*, vol. 62, no. 2, pp. 220–225, Mar. 2005
- [3] L. A. Israelsson and D. Millbourn, "Closing midline abdominal incisions," *Langenbeck's Archives of Surgery*, vol. 397, no. 8, pp. 1201–1207, Nov. 2012
- [4] T. P. N. Jenkins, "The burst abdominal wound: A mechanical approach," *British Journal of Surgery*, vol. 63, no. 11, pp. 873–876, Nov. 1976
- [5] D. J. Leaper, A. V. Pollock, and M. Evans, "Abdominal wound closure: A trial of nylon, polyglycolic acid and steel sutures," *British Journal of Surgery*, vol. 64, no. 8, pp. 603–606, Aug. 1977
- [6] R. H. Fortelny, "Abdominal Wall Closure in Elective Midline Laparotomy: The Current Recommendations," *Frontiers*, Apr. 09, 2018.
- [7] E. B. Deerenberg et al., "Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial," *The Lancet*, vol. 386, no. 10000, pp. 1254–1260, Sep. 2015.
- [8] A. Srivastava et al., "Prevention of burst abdominal wound by a new technique: A randomized trial comparing continuous versus interrupted X-suture," *Indian Journal of Surgery*, vol. 66, no. 1, pp. 19–27, Jan. 2004.
- [9] V. Gurjar et al., "Study of Two Techniques for Midline Laparotomy Fascial Wound Closure," *Indian Journal of Surgery*, vol. 76, no. 2, pp. 91–94, Jul. 2012
- [10] R. K. Bansiwali et al., "Comparative study of abdominal wound dehiscence in continuous versus interrupted fascial closure after emergency midline laparotomy," *International Surgery Journal*, vol. 6, no. 3, p. 886, Feb. 2019
- [11] D. Millbourn, "Effect of Stitch Length on Wound Complications After Closure of Midline Incisions," *Archives of Surgery*, vol. 144, no. 11, p. 1056, Nov. 2009
- [12] I. S. Elkheir and S. A. Idris, "Evaluation of Abdominal Wall Closure Technique in Emergency Laparotomies at a Peripheral Hospital," *Scholars Journal of Applied Medical Sciences*, vol. 2, no. 5B, pp. 1591–1595, 2014.
- [13] M. Albertsmeier et al., "Effects of the short-stitch technique for midline abdominal closure: short-term results from the randomised-controlled ESTOIH trial," *Hernia*, vol. 26, no. 1, pp. 87–95, May 2021.
- [14] M. K. Diener, S. Voss, K. Jensen, M. W. Büchler, and C. M. Seiler, "Elective Midline Laparotomy Closure," *Annals of Surgery*, vol. 251, no. 5, pp. 843–856, May 2010
- [15] S. Chatterjee and T. Bhattacharya, "A study to evaluate the effects of various abdominal closure techniques on midline laparotomy wounds in a tertiary care hospital in West Bengal," *International Surgery Journal*, vol. 8, no. 4, p. 1129, Mar. 2021.
- [16] J. T. Mäkelä, H. Kiviniemi, T. Juvonen, and S. Laitinen, "Factors influencing wound dehiscence after midline laparotomy," *The American Journal of Surgery*, vol. 170, no. 4, pp. 387–390, Oct. 1995
- [17] T. E. Bucknall, P. J. Cox, and H. Ellis, "Burst abdomen and incisional hernia: a prospective study of 1129 major laparotomies.," *BMJ*, vol. 284, no. 6320, pp. 931–933, Mar. 1982
- [18] A. E. Cameron, C. J. Parker, E. S. Field, R. C. Gray, and A. P. Wyatt, "A randomised comparison of polydioxanone (PDS) and polypropylene (Prolene) for abdominal wound closure," *The Annals of The Royal College of Surgeons of England*, vol. 69, no. 3, pp. 113–115, 1987.
- [19] C. S. Agrawal et al., "Interrupted Abdominal Closure Prevents Burst: Randomized Controlled Trial Comparing Interrupted-X and Conventional Continuous Closures in Surgical and Gynecological Patients," *Indian Journal of Surgery*, Aug. 2012
- [20] R. H. Fortelny et al., "Effects of the Short Stitch Technique for Midline Abdominal Closure on Incisional Hernia (ESTOIH): Randomized Clinical Trial," *British Journal of Surgery*, Jun. 2022.
- [21] J. Wissing, T. J. M. V. van Vroonhoven, M. E. Schattenkerk, H. F. Veen, R. J. G. Ponsen, and J. Jeekel, "Fascia closure after midline laparotomy: Results of a randomized trial," *British Journal of Surgery*, vol. 74, no. 8, pp. 738–741, Aug. 1987
- [22] L. W. Lai, A. C. Roslani, Y. Yan, K. M. Bhojwani, and M. F. H. Jamaluddin, "Comparison

of post - operative pain in short versus long stitch technique for abdominal wall closure after elective laparotomy: a double - blind randomized controlled trial," ANZ Journal of Surgery, vol. 91, no. 5, pp. 896–901, Feb. 2021.

[23] P. M. McNeill, "Continuous Absorbable vs Interrupted Nonabsorbable Fascial Closure," Archives of Surgery, vol. 121, no. 7, p. 821, Jul. 1986

[24] D. Millbourn, A. Wimo, and L. A. Israelsson, "Cost analysis of the use of small stitches when closing midline abdominal incisions," Hernia, vol. 18, no. 6, pp. 775–780, Jul. 2013