

A Study on Safety and Efficacy of Zigzag Skin Incision in General Surgery Among Elective Cases of Acute Appendicitis, Inguinal Hernia and Soft Tissue Tumour - Randomized Controlled Trial

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ABSTRACT

Background: Straight line, the conventional incision technique, is against the principle of plastic surgery when it is not along the minimal line of tension on body. This incisional technique is widely practiced by general surgeons whilst zigzag incision if used, would be advantageous as it facilitates in enhanced exposure to surgical field and aesthetically better scar. In this study zigzag incisional technique was evaluated in terms of safety and efficacy in elective surgery cases of acute appendicitis, inguinal hernia and soft tissue tumour.

Methods: Stratified randomization done for the patients included in cases of general surgery like acute appendicitis, inguinal hernia and soft tissue tumor. These patients were divided in the two groups, conventional incision group and zigzag incision group. Exposure to the surgical field was recorded as qualitative- bad, good and excellent according to operating surgeon. Scar assessment was done after 1 week, 1 month and 6 months.

Results: Upon comparison of result, it was observed with zigzag incision, the exposure to surgical field was better than conventional straight-line technique. Additionally, the surgical scar was aesthetically better compared to the straight incision used in general surgery cases like appendectomy, inguinal hernia repair, soft tissue tumor excision but there was no significant difference in case of hernia and appendicitis cases.

Conclusion: Zigzag incision can be used safely in place of traditional incision in the elective general surgery cases of acute appendicitis, inguinal hernia and soft tissue tumour. Zigzag incision provides better exposure of surgical field although this is subjective measure of surgeon's experience, shows statistically significant difference. Zigzag incision heals better than straight line and gives aesthetically better scar, it can be used in cases such as open appendectomy, open inguinal hernia repair and excision of soft tissue swelling.

Keywords: Zigzag incision, Straight incision, aesthetic scar, exposure of surgical field.

INTRODUCTION

The demerits of straight-line incision are well to plastic surgeons. This conventional surgical incision technique being not situated along with line of minimal tension, often results in the hypertrophy of the scar upon contraction. To overcome this demerit various incisional techniques have been developed, these include division of straight-line surgical scar by z-plasty or w-plasty, which would distribute contractile forces in more than one direction. This innovative incisional technique avoids contractions of the straight scar that run at variance with lines of minimal tension [1]. In general surgery cases, surgeons prefer conventionally straight incision whereas the use of zigzag incision is usually neglected. In some cases where patients with abnormal wound healing tendency may present with hypertrophic scar or keloid, surgeons usually divide this scar and use plastic surgery principle [2]. Biomechanics of relaxed skin tension lines (RSTL), skin tension lines are studied on trunk these lines are mostly in horizontal direction [3]. Incisions conventionally placed for open appendectomy; inguinal hernia repair excision is obliquely placed. Surgeons have compared the utility of zigzag incision in place of conventional straight line in general surgery cases and have highlighted the findings that favors the use of zigzag incision for better outcome of surgical intervention in term of finer and less perceptible scar than conventional straight incision in elective general surgery cases [3-5]. Zigzag incision is also useful in preventing the formation of the pathological scar in high tension areas [6]. It has superior

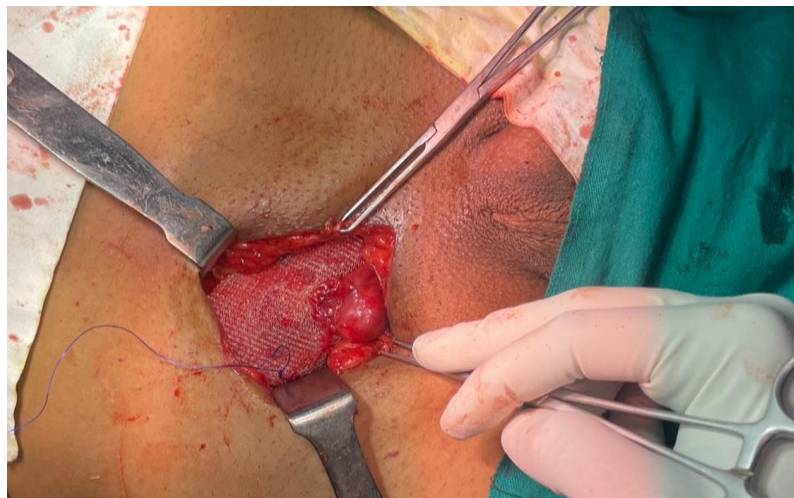
biomechanical stability compared to the straight line [7, 8]. Use of zigzag incision gives better exposure to operative field than conventional straight incision, tension on sutured wound edges is less, scar thickness is less as a result wound healing is better and aesthetics of scar are better as compared to conventional straight incision. However, the zigzag incision is not studied in conventional elective general surgeries. The present study was conducted with an aim to evaluate the outcomes of zigzag skin incision in general surgical procedures like inguinal hernia, open appendectomy, excision of benign soft tissue swelling.

MATERIALS & METHODS

The present study was conducted in the Department of General Surgery for a period of 6 months. It included the patients of inguinal hernia, soft tissue swelling and acute appendicitis without any complications. These patients were seen in OPD before posting for surgical intervention. The patients were explained about the protocol of the study and consent was obtained. The protocol of the study was approved by Institutional Ethics Committee. A total 87 patients were included in this randomized controlled trial (RCT). Stratified randomization was done. Stratification factors were age (< 40 and > 40 years), comorbidities (Yes and No) and type of surgery (Inguinal hernia, soft tissue swelling and appendicitis). Before starting of the study, the randomization schedule was generated using software. All patients were divided in the two groups as conventional group and zigzag group. Surgeons experience for exposure of wound recorded immediately after surgery. Patients followed up at 1 week, 1 month, 6 months for scar assessment using 'Vanocur aesthetic scar scale' [9].



Picture 1: Planning a zigzag incision for the open inguinal hernia repair case



Picture 2: Operative exposure after zigzag incision in open inguinal hernia case.



Picture 3: Scar of zigzag incision in open inguinal hernia repair case after 1 month.

RESULT

Table 1: Baseline characteristics

	TYPE OF SKIN INCISION		p value
	Conventional (n = 47)	Zigzag (n = 40)	
Age	37.3 SD 14.0	40.3 SD 19.9	0.335
Sex			

Female	16 (34.0)	11 (27.5)	0.643
Male	31 (66.0)	29 (72.5)	
DM	14 (29.8)	10 (25.0)	0.640
HTN	11 (23.4)	12 (30.0)	0.626
BPH	6 (12.8)	5 (12.5)	0.964
Lung Diseases	3 (6.4)	6 (15.0)	0.286
Surgery			
Excision of soft tissue swelling	10 (21.3)	8 (20.0)	0.691
Open Appendectomy	12 (25.5)	9 (22.5)	
Open Hernioplasty	25 (53.2)	23 (57.5)	

Total 87 patients were included in the study; according to type of skin incision used all patients were divided in two groups: the conventional group and zigzag group (Table 1). These included 27 ladies and 60 gentlemen. Sex distribution among the groups was non-significant. P value 0.643. A total of 14 patients were diabetic among 47 in conventional group whereas 10 out of 40 were diabetic in zigzag group. (Non-significant, $p = 0.640$). Hypertension was

noted in 11 patients in conventional group whereas 12 patients in zigzag group were hypertensive (non-significant difference $p=0.626$). Benign prostatic hyperplasia in male patients was assessed. Non-significant distribution $p=0.964$. Lung disease was noted in 6 patients from zigzag group and in 3 patients from conventional group. (significant $p = 0.286$)

Table 2: Exposure to surgical field and Aesthetic Vancour score

	TYPE OF SKIN INCISION		P value
	Conventional (n = 47)	Zigzag (n = 40)	
Exposure to surgical field			
Excellent	6 (12.8)	15 (37.5)	0.011
Good	41 (87.2)	25 (62.5)	
Complications	5 (11.0)	2 (5.0)	0.445
Aesthetic Vancour score			
One week	3.3 SD 0.66	3.3 SD 0.54	0.600
One month	4.0 SD 0.65	3.6 SD 0.54	0.838
Six months	4.0 SD 0.92	3.1 SD 0.83	0.838

Exposure to surgical field was excellent in 6, good in 41 of conventional group. Exposure to surgical field was excellent in 15 of zigzag group, good in 25 patients. There was statistically significant p value of 0.011, suggesting the definite benefit of zigzag incision to get better exposure to the surgical field.

In this study, 5 patients of conventional group had surgical site infection (SSI) whereas 2 of the zigzag group developed SSI ($p = 0.445$). Total 48 patients of inguinal hernia, 22 patients of acute appendicitis and 17 patients of soft tissue swelling were included in the study. Patients were assessed for aesthetics of the scar using Aesthetic Vanocur score at 1 week, 1 month and 6 months after the surgery. Mean score at the end of 1 week was 3.3 in both

the groups with mean standard deviation of 0.66 and 0.54 respectively. At two months, the mean score was 4.0 in conventional and 3.6 in zigzag group. The score at the 6 months were 4.0 and 3.1 in conventional and zigzag group respectively. Zigzag group had better score at the end of 1 month and 6 month duration after the surgery.

DISCUSSION

There was no statistically significant difference in the distribution of patient's as per sex, comorbidities as DM, HTN, Lung diseases. As per the observations of the present study, exposure to surgical field was excellent in 6, good in 41 of conventional group. Exposure to surgical field was excellent in 15 of zigzag group, good in 25 patients. There was statistically significant

difference ($p = 0.011$). This suggests there is the definite benefit of zigzag incision to get better exposure to the surgical field. Zigzag incision gives aesthetically better scar in comparison to the conventional straight incision. All patients were assessed for aesthetics of the scar using Aesthetic Vanocur score at 1 week, 1 month and 6 months after the surgery. Mean score at the end of 1 week was 3.3 in both the groups with mean standard deviation of 0.66 and 0.54 respectively. At two months mean score was 4.0 in conventional and 3.6 in zigzag group. The score at the 6 months were 4.0 and 3.1 in conventional and zigzag group respectively. Zigzag group had better score at the end of 1 month and 6 month duration after the surgery, but no statistically significant difference was observed between two groups.

CONCLUSION

Zigzag incision can be used safely in place of traditional incision in the elective general surgery cases of acute appendicitis, inguinal hernia and soft tissue tumour. Zigzag incision provides better exposure of surgical field although this is subjective measure of surgeon's experience, shows statistically significant difference. Zigzag incision heals better than straight line and gives aesthetically better scar, it can be used in cases such as open appendectomy, open inguinal hernia repair and excision of soft tissue swelling but there was no statistically significant difference between the two groups in our study.

Declaration by Authors

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