

## ORIGINAL RESEARCH

### Comparative study of staplers vs simple interrupted vs sub-cuticular method of skin closure of surgical wounds

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#### ABSTRACT

**Aim:** To compare staplers vs simple interrupted vs sub-cuticular method of skin closure of surgical wounds.

**Material and method:** The present randomized prospective study was conducted in the Department of Surgery at Rohilkhand Medical College and Hospital, Bareilly from January 2020 to October 2021 among 150 subjects who underwent surgical procedures. Equal number of patients was allotted to 3 groups by random envelope allocation method i.e. Group A (Stapled skin closure), Group B (Interrupted skin closure) and Group C (Sub cuticular skin closure). Following the completion of closure, an antiseptic medicated cream was applied followed with a protective dressing for the first 24–72 h. Subcutaneous Drains were placed in selective cases according to infection and were kept till the drain content was minimal. All patients were given IV antibiotics for 5–7 days postoperatively. The closures were removed after an interval of 10–14 days, first removing the alternate sutures and then the remaining sutures after few days and pain on removal was recorded using VAS.

**Results:** Postoperative pain score at discharge was least in sub-cuticular group followed by stapled and interrupted skin closure group, though statistically there was no difference.

**Conclusion:** In this we found that time required for skin closure (in seconds) was least in stapled skin closure group while pain and POSAS score was minimum in sub-cuticular skin closure group. Wound infection was present maximum and minimum among sub-cuticular and interrupted skin closure group respectively.

**Keywords:** Diabetes, Ulcer, Amino acid, Healing

#### INTRODUCTION

Wound complications are one of the major sources of morbidity after any surgical procedures and can prolong the inpatient stay or lead to re-admission. Infections are more liable to occur in surgical wounds. The chances of infection increase as the wounds become more contaminated. The clean surgical cases are less likely to get infected i.e. 1-2%. Infections due to invasive surgical procedures are generally referred as surgical site infections (SSIs)<sup>1,2</sup>. These wound infections are associated with significant morbidity and mortality. It is estimated that over half of these SSIs are preventable. These infections range from a minor wound discharge to life threatening sepsis and septic shock.<sup>3</sup> Hospital stay and hospital costs are increased due to these infections. There are varieties of ways to reduce the SSIs. These factors include optimizing the operating room environment, pre- and postoperative

care. Skin closure after surgical procedure is one of the factor which needs further quest to decrease the SSIs to minimum<sup>4,5</sup>.

Historically, there were few surgical options for wound closure. From catgut, silk, and cotton, there is now an ever increasing array of sutures, approximately 5269 different types<sup>6</sup>, including antibiotic-coated and knotless sutures<sup>6-8</sup>. The word "suture" describes any strand of material used to ligate (tie) blood vessels or approximate (bring close together) tissues<sup>9</sup>.

Various techniques are developed to give better cosmetically results like subcuticular suture, adhesive tapes, staplers, etc. Sutured or stapled wound should be covered with a protective non-adherent dressing for at least 24 to 48 hours, until enough epithelization takes place to protect the wound from gross contamination.<sup>10</sup> Suture should be removed at the earliest possible time to prevent or minimize suture reaction and suture marks, but they should remain in place long enough to prevent wound dehiscence and scar spread<sup>11</sup>.

Interrupted sutures use a number of strands to close the wound. Each strand is tied and cut after insertion. This provides a more secure closure, because if one suture breaks, the remaining sutures will hold the wound edges in approximation. Interrupted sutures may be used if a wound is infected, because micro-organisms may be less likely to travel along a series of interrupted stitches<sup>12</sup>.

Subcuticular sutures are continuous sutures placed in the dermis, beneath the epithelial layer. Continuous subcuticular sutures are placed in a line parallel to the wound. This technique involves taking short, lateral stitches along full length of the wound. After the suture has been drawn taut, the distal end is anchored in the same manner as the proximal end. This may involve tying or any of a variety of anchoring devices.<sup>13</sup>

Wang et al. (2016)<sup>14</sup> conducted a meta-analysis describing a reduced incidence of wound complications with subcuticular sutures as compared to staples. Operative time was also significantly reduced in the stapler group, although both groups showed similar cosmetic outcomes, pain scoring and patient satisfaction. Interestingly, the most recent Cochrane database (Alderdice et al., 2003)<sup>15</sup> failed to draw any conclusive evidence with regards to CS closure recommendations, but noted that existing RCTs were limited by small sample sizes.

Therefore we decided to study the various skin closure technique in general surgery cases, with the aim to study which type of wound closure is simple, fast, tension free with no subsequent adverse reactions, creation of protective barrier to pathogens has a simple post-operative management, simple for suture removal and optimal cosmetic appearance and cost effectiveness.

## **MATERIAL AND METHOD**

The present randomized prospective study was conducted in the Department of Surgery at Rohilkhand Medical College and Hospital, Bareilly from January 2020 to October 2021. The study comprised of the subjects who underwent surgical procedures. Patients were enrolled in the study after obtaining written informed consent and approval from Institutional Ethical Committee. The study comprised of 150 subjects. Out of total patients, equal number of patients allotted to 3 groups by random envelope allocation method i.e.

**Group A:** Stapled skin closure

**Group B:** Interrupted skin closure

**Group C:** Sub cuticular skin closure

All the patients were operated in elective cases.

## **INCLUSION CRITERIA**

1. All patients in the age group of 10-60 years requiring incisions for general surgery procedures were included in this study irrespective of sex, race, religion, place of origin or socio-economic status.

2. Normal Body Mass Index.
3. Patient's/guardian who provided informed consent.

### **EXCLUSION CRITERIA**

1. Patients requiring incisions to be made over previous surgical scars.
2. Previous history of keloid or hypertrophic scar.
3. Incision to be made on palms/head and neck/soles/back.
4. Patients on anti-coagulant therapy.
5. Uncontrolled diabetes (HbA1C >7).
6. Pregnancy.
7. Immunocompromised status.
8. Patients < 10 years and > 60 years.
9. Severe organ dysfunctions.
10. Sero-status positive (HIV and HBsAg infection).

### **METHODOLOGY**

**Suture Material Used:** Synthetic Non-absorbable Monofilament (Ethilon) Nylon Skin Stapler (Ethicon Proximate)

Following the completion of closure, an antiseptic medicated cream was applied followed with a protective dressing for the first 24–72 h. Subcutaneous Drains were placed in selective cases according to infection and were kept till the drain content was minimal. All patients were given IV antibiotics for 5–7 days postoperatively. The closures were removed after an interval of 10–14 days, first removing the alternate sutures and then the remaining sutures after few days and pain on removal was recorded using VAS. Staples were removed using a staple remover that painlessly opened them sideways while sutures were removed in conventional manner. Patients were assessed on daily basis in immediate postoperative period and were followed up at the day of suture removal, 15 and 30 days after the suture removal for wound outcome and complications by an independent observer. The data obtained in the study was tabulated under three groups assigned to each of the wound closure material used in the study.

#### **The data obtained in the study included:**

1. Time taken for closure: The time taken for closure was calculated (in min) beginning from the placement of first skin staple or suture to the completion of last.
2. Pain on removal of staples and sutures Patients were evaluated for pain on removal of staples and sutures using visual analogue scale having horizontal line running from 'no pain' (0 mm) to 'worst pain' (100 mm) on the questionnaires.
3. Aesthetic outcome Close photographs of the wounds were taken at the day of staple or suture removal and on 15 and 30 days after the removal and were analyzed by an independent blinded observer as poor, moderate or good.
4. Patient comfort Patient comfort was determined by asking difficulty in movement of the neck using VAS having same scale.
5. Complications during immediate postoperative period and follow up were recorded, if any, as prolonged wound discharge, wound dehiscence etc.

### **STATISTICAL ANALYSIS**

Data so collected was tabulated in an excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). For each assessment point, data were statistically analyzed using one way ANOVA. Difference between two groups was

determined using student t-test as well as chi square test and the level of significance was set at  $p < 0.05$ .

## RESULTS

In all the groups, male was comparatively more as compared to females, hence showing male dominance in our study. In our study mean age among sub-cuticular, interrupted and stapled skin closure group was  $42.84 \pm 8.966$ ,  $42.94 \pm 10.440$  and  $44.90 \pm 7.913$  years respectively.

In our study mean pain score after 6 hours among sub-cuticular, interrupted and stapled skin closure group was  $3.06 \pm 1.17$ ,  $3.58 \pm 1.03$  and  $3.10 \pm 1.02$  respectively. Mean pain score after 48 hours among sub-cuticular, interrupted and stapled skin closure group was  $1.36 \pm 0.485$ ,  $1.88 \pm 0.895$  and  $1.78 \pm 0.616$  respectively. When groups were compared according to mean pain score after 48 hours, it was found to be statistically significant between sub-cuticular and interrupted, stapled skin closure group as  $p < 0.05$  (table 1). Postoperative pain score at discharge was least in sub-cuticular group followed by stapled and interrupted skin closure group, though statistically there was no difference.

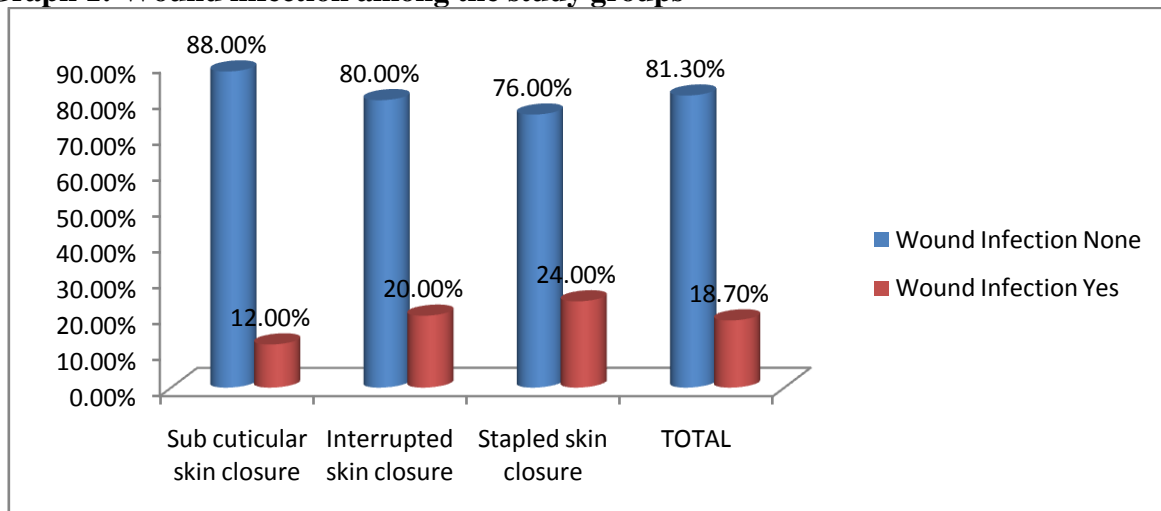
**Table 1: Post Operative Pain (VAS) after 6 and 24 hours among the study groups**

Group	VAS: 6 hours		p value		
	Mean	SD	Sub cuticular vs Interrupted	Sub cuticular vs Stapled	Stapled vs Interrupted
Sub cuticular skin closure	3.06	1.17	0.02*	0.73	0.03*
Interrupted skin closure	3.58	1.032			
Stapled skin closure	3.10	1.015			
Total	3.26	1.089			
	VAS: 48 hours				
Sub cuticular skin closure	1.36	.485	0.007*	0.004*	0.32
Interrupted skin closure	1.88	.895			
Stapled skin closure	1.78	.616			
Total	1.67	.719			

\*: statistically significant

Graph 1 shows the wound infection among the study groups. Wound infection was present among 12%, 20% and 24% of the subjects in interrupted, stapled and sub cuticular skin closure group respectively. When groups were compared according to wound infection, it was found to be statistically insignificant as  $p > 0.05$ .

**Graph 1: Wound infection among the study groups**



In our study mean POSAS score after 5<sup>th</sup> day among sub-cuticular, interrupted and stapled skin closure group was  $13.10 \pm 1.165$ ,  $24.58 \pm 1.03$  and  $23.08 \pm 1.03$  respectively. When groups were compared according to mean POSAS score after 5<sup>th</sup> day, it was found to be statistically significant among between sub-cuticular and interrupted, stapled skin closure group as  $p < 0.05$ . POSAS score at discharge was least in sub-cuticular group followed by interrupted and stapled skin closure group with statistically significant difference. POSAS score after month was least in sub-cuticular group followed by interrupted and stapled skin closure group with statistically significant difference as  $p < 0.05$  (table 2).

**Table 2: POSAS Score at 5<sup>th</sup> day, at discharge and after 1 month among the study groups**

Group	POSAS Score: 5 <sup>th</sup> day		p value		
	Mean	SD	Sub cuticular vs Interrupted	Sub cuticular vs Stapled	Stapled vs Interrupted
Sub cuticular skin closure	13.10	1.165	<0.01*	<0.01*	0.26
Interrupted skin closure	24.58	1.032			
Stapled skin closure	23.08	1.027			
	POSAS Score: At Discharge				
Sub cuticular skin closure	10.58	2.339	<0.01*	<0.01*	0.35
Interrupted skin closure	20.22	2.112			
Stapled skin closure	20.70	2.252			
	POSAS Score: After 1 Month				
Sub cuticular skin closure	8.04	4.513	<0.01*	<0.01*	0.19
Interrupted skin closure	14.36	3.691			
Stapled skin closure	15.32	5.168			

\*: statistically significant

In our study mean time required for skin closure (in seconds) among sub-cuticular, interrupted and stapled skin closure group was  $443.40 \pm 8.44$ ,  $143.62 \pm 9.83$  and  $67.90 \pm 7.84$  respectively. When groups were compared according to mean time required for skin closure (in seconds), it was found to be statistically significant between all the groups as  $p < 0.05$ . Hence time required for skin closure (in seconds) was maximum in sub-cuticular group followed by interrupted and stapled skin closure group (table 3).

**Table 3: Time required for Skin Closure (in seconds) among the study groups**

Group	Mean	SD	p value		
			Sub cuticular vs Interrupted	Sub cuticular vs Stapled	Stapled vs Interrupted
Sub cuticular skin closure	443.40	8.435	<0.01*	<0.01*	<0.01*
Interrupted skin closure	143.62	9.833			
Stapled skin closure	67.90	7.836			

\*: statistically significant

## DISCUSSION

A number of studies published have discussed the various aspects of the wound closure.<sup>16,17</sup> However, direct comparison between different suturing techniques is lacking. There is also no standardized protocol for the methods, lack of agreement in the outcome measurement and scoring system. In general, simple interrupted technique of wound closure is commonly performed, as it is easy to learn and master. However, it is thought to be time-

consuming with high complication rate and inferior cosmetic result. On the other hand, subcuticular technique is considered an elegant but difficult suturing technique. Running subcuticular closure is also time-consuming. Topical adhesives and skin staples are the recent closure methods which are developed to use either alone or in combination with traditional suturing techniques. Hence this study was conducted to evaluate which type of wound closure is simple, fast, tension free with no subsequent adverse reactions, simple for suture removal and optimal cosmetic appearance and cost effectiveness.

In our study mean age among sub-cuticular, interrupted and stapled skin closure group was  $42.84 \pm 8.966$ ,  $42.94 \pm 10.440$  and  $44.90 \pm 7.913$  years respectively with statistically insignificant difference as  $p > 0.05$ . Geeta S. Ghag et al<sup>18</sup> in their study found similar age distribution i.e. average age being 40.93 years among Group A (Stapled), which was comparable to 40.10 and 41.93 years among Group B (Subcuticular) & C (Simple Interrupted) respectively.

In our study mean pain score after 6 hours among sub-cuticular, interrupted and stapled skin closure group was  $3.06 \pm 1.17$ ,  $3.58 \pm 1.03$  and  $3.10 \pm 1.02$  respectively. After 48 hours among sub-cuticular, interrupted and stapled skin closure group was  $1.36 \pm 0.485$ ,  $1.88 \pm 0.895$  and  $1.78 \pm 0.616$  respectively. Postoperative pain score at discharge was least in sub-cuticular group followed by stapled and interrupted skin closure group, though statistically there was no difference. While a subcuticular or stapler bite at dermis/epidermis junction contains a small fraction of the corresponding nerve endings. Frishman GN, Schwartz T<sup>19</sup> reported significantly less pain following subcuticular closure at both the time of discharge ( $P < .01$ ) and the postoperative visit ( $P = .002$ ) and his results are consistent with our results. Staples also caused pain while removing. According to Blackshaw G<sup>20</sup> skin closure with staple was much more painful. In a study by Geeta S. Ghag et al<sup>18</sup>, Mean VAS score at 48 hrs was 3.87 among simple interrupted group, which was significantly more ( $p$  value = 0.004) as compared to 3.07 and 2.97 among stapled group and subcuticular group respectively. Mean VAS score at discharge was 1.13 among Subcuticular closure group, which was significantly less ( $p = 0.026$ ) as compared to 1.80 and 1.87 among stapled and simple interrupted group respectively. These findings are similar to our study.

In the present study, wound infection was present among 12%, 20% and 24% of the subjects in interrupted, stapled and sub cuticular skin closure group respectively. When groups were compared according to wound infection, it was found to be statistically insignificant as  $p > 0.05$ . Similarly Geeta S. Ghag et al<sup>18</sup> found that highest wound infection rate was in subcuticular group (60%) followed by simple interrupted group (40%) and least in stapled group (26.7%). There is a uniform agreement that skin wounds closed by staples exhibit superior resistance to infection than skin wounds contaminated by the least reactive suture and added advantage of not crossing the wound edges as opposed to other suture technique. The superior resistance of stapled wounds to infection as compared with the resistance of sutured wounds was confirmed by the experimental study of Stillman and colleagues.<sup>21</sup> Iavazzo C, Gkegkes ID<sup>22</sup> found fewer wound infection rates in the staples group compared with the sutures groups.

Cosmetic appearance of scar was found best in subcuticular group in our study. Mean POSAS score after 5<sup>th</sup> day among sub-cuticular, interrupted and stapled skin closure group was  $13.10 \pm 1.165$ ,  $24.58 \pm 1.03$  and  $23.08 \pm 1.03$  respectively. POSAS score at discharge and after one month was least in sub-cuticular group followed by interrupted and stapled skin closure group with statistically significant difference. In a study comparing staples closure with nylon wound closure in head and neck surgeries by Meiring et al<sup>23</sup> showed that the cosmetic result of staples is as good as if not better than that with nylon sutures. Lubowski D et al<sup>24</sup> compared stapled and sutured abdominal wound closure which resulted in almost equal cosmetic scores for vertical wounds. ANOsuigweet al<sup>25</sup> showed best cosmetic results with

nylon subcutaneous continuous running sutures as compared with interrupted group. Abu NGA et al<sup>26</sup> found that the skin staplers had better cosmetic scar appearance than subcuticular suture in prospective randomised trial for closure of scalp laceration in pediatric emergency department.

In our study mean time required for skin closure (in seconds) among sub-cuticular, interrupted and stapled skin closure group was 443.40±8.44, 143.62±9.83 and 67.90±7.84 respectively. When groups were compared according to mean time required for skin closure (in seconds), it was found to be statistically significant between all the groups as p<0.05. Hence time required for skin closure (in seconds) was maximum in sub-cuticular group followed by interrupted and stapled skin closure group. It was reported in Geeta S. Ghag et al<sup>18</sup> study that average time required for skin closure was least with stapler 44.63 sec (±47.23) which was significant as compared to 459.93 sec in subcuticular group and 193.33 sec in simple interrupted closure. Meiring L et al<sup>23</sup> found that time saving of 80% is possible with the stapling device but a certain amount of experience and practice facilitates its usage. Lubowski D<sup>24</sup> found proximate staple closure was a suitable and faster method for vertical abdominal wounds as compared to sutures.

The ultimate responsibility for the choice of the best material lies with the surgeon. Choosing a method of closure that affords a technically easy and efficient procedure with a secure closure and minimal pain and scarring is paramount to any surgeon.

## CONCLUSION

Skin is the most important natural barrier to infection. Several methods of skin closure are available to close skin incisions. Skill and technique of surgeon matter a lot. Wound infection is a significant hazard in skin closure, and its prevention is necessary as it may lead to ugly scar. Cosmesis is essential and necessary in modern surgical practice. In this we found that time required for skin closure (in seconds) was least in stapled skin closure group while pain and POSAS score was minimum in sub-cuticular skin closure group. Wound infection was present maximum and minimum among sub-cuticular and interrupted skin closure group respectively.

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