

Comparative Study between Skin Suture Versus Skin Stapler In Abdominal Surgery

Naresh Modi^A, Pawan Tiwari^B, Vishal A. Patel^A, Shyam Goyal^A,
Madhu Tiwari^C, Sonal Verma^D, Aditya Raval^A

A: Post-graduate resident, department of surgery, SGT Medical College, Hospital and Research Institute.

B: Professor, department of surgery, SGT Medical College, Hospital and Research Institute.

C: Professor, department of Anesthesiology, SGT Medical College, Hospital and Research Institute.

D: Final year MBBS, SGT Medical College, Hospital and Research Institute.

ABSTRACT

Background: Through the age's man sought for methods of binding wounds to promote healing. In olden days various things were used by surgeons but the secret to achieve a good wound healing lies in meticulous tissue dissection followed by selection of suture material, methods of wound closure and postoperative complications. Staplers were originally developed to address the perceived problem of patency i.e., security against leaks of blood or bowel contents in anastomosis in particular but now, it is widely accepted that both sutures and staples can achieve the basic goals of skin wound closure.

Methods: Patients admitted under various surgical units from June 2021 to June 2022 at SGT Medical College and Hospital, Gurugram. A study was carried out with 100 patients undergoing laparotomy electively and emergency.

Results: Skin approximation was much faster with staple as compared to sutures. Post-operative SSI was more common with skin suture group as compared with staples. Cosmetic appearance of the scar was found to be superior in staple group in comparison to conventional suturing group.

Conclusions: The results of the study indicate that skin closure by stapler can be preferred over conventional skin suture.

Keywords: Abdominal surgery, Skin stapler, Suturing

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I. INTRODUCTION

Different methods of binding wounds to promote healing is a very old practice. Earlier spider webs, warrior ants, horsehairs etc were used until sutures were discovered. In modern practice for the approximations of tissue, gadgets like staples or clips, sutures, glues etc are used by surgeons. Selection of suture material, methods of wound closure, and post operative care are the key principles in order to achieve a good wound healing. Through preservation of blood supply, minimal tissue damage, approximation of edges without tension, correct suture spacing and suture bites with proper selection of suture material the surgeon can achieve perfect healing. Achieving rapid strength, least tissue damage, no inflammation and cosmetically acceptable scar are the principal aims of tissue repair after surgical skin incision which can be obtained by obliteration of dead space, layered tissue closure and eversion of skin margins. type B of approximation and perfect tissue approximation influences the tissue healing rate, post operative early and late complication of surgical wound and economic burden of hospital. Staplers were originally developed to address the perceived problem of patency i.e security against leaks of blood and bowel contents in anastomoses. But now basic goals of skin wound closure can be achieved by both staplers and sutures. The main aim is to re approximate the skin by creating watertight, tension free, non inverted apposition of edges that promote rapid healing and aesthetically acceptable scar. While comparing these two methods of wound closure, multiple studies has produced conflicting results regarding the economics, efficacy, rate of complication and cosmetic outcomes³. The surgical scar remains are the only visible evidence of surgeons skill and not infrequently, all his efforts are judged on its final appearance, so it has become important to know which method of wound closure is better for a particular patient and wound. The skin itself varies throughout the body in terms of thickness, elasticity, speed of healing and tendency of scar. Hence this study was undertaken with the aim to study the operative time, the effect on wound healing, cosmetic results, the patient's acceptance and total cost with the use of sutures and staples in our institute. There is mention of suture material made from braided horse hairs, leather strips, and vegetable fibres in Sushruta samhitha 600BC. The text describes in detail about triangular, round bodied, curved and straight

needles⁴. A Roman medical journalist Aurelius Cornelius Celsus wrote a monumental book in medicine in 30 A.D known as *De Re Medicina*. He mentioned ancient origin of sutures which should be soft and not twisted. There was also a mention of small metal clips which are similar to today's Michael clips⁵. Surgical stapling was developed by Humer Hulti in Australia in 19/86. The original instrument weighed 7.5 pounds which is much higher than today's standard instrument.

Aims and objectives

To study the total cost and operative time required for conventional sutures and staple wound repairs. To study the effect on wound healing and infection rate with the use of these techniques. To study the cosmetic result of these two techniques. To study the degree of patient satisfaction with these two techniques.

II. METHODS

Study area The present study was conducted on 100 patients, who presented to the in-patient department of general surgery, SGT Medical College Gurugram who satisfied Inclusion and exclusion criteria.

Inclusion criteria

Patients undergoing abdominal surgeries with clean and clean contaminated wounds. Patients undergoing both elective as well as emergency surgeries. Patients willing to participate in the study.

Exclusion criteria

Immunocompromised patients like malignancies, AIDS and uremia, DM. Contaminated and dirty wounds. Patients unwilling to participate in the study.

Study size

100 patients were included in the study.

Study design

It was a prospective observational study.

Study period

The study was conducted from June 2021 to June 2022.

III. Methodology

A total of 100 patients were categorized into 2 groups i.e., group A which was conventional suture group and group B which was staple groups with 50 cases in each group. In group A, wound closure was done with Prolene 2-0 cutting body (Lotus) using interrupted sutures. While in group B, wound closure was done with Covidien stapler. All patients were randomized into 2 groups on the basis of chit system, which is given to patient before surgery and based on that patient sequentially divided into two groups i.e. group A: conventional suture group and group B skin stapler group. Each group contains fifty patients respectively. All investigations and surgical procedures were carried out with proper informed written consent as appropriately. Following selection of subjects and after obtaining informed consent about proposed study, data was collected from: 1) operating surgeon after operation, regarding time taken for surgery, ease of surgery and surgical procedure done, 2) patients post operatively regarding pain, cosmetic outcome, pain at suture or stapler removal, regarding wound infection etc., 3) follow up of patients in outpatient department after hospitalization. The data regarding patient profile, diagnosis, investigations, and surgical procedures were collected in a proforma and tabulated to a master chart using Microsoft Excel sheet.

Statistical analysis

Unpaired t test was used for analysis of continuous data. Pearson's χ^2 test was used for analysis of categorical data. Differences were considered statistically significant if $p < 0.05$. IBM SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, N.Y., USA) software program was used for statistical calculations.

IV. RESULTS

Age distribution

In the present study, among staples group, the youngest patient was 12 years of age and the eldest was 59 years of age. While in sutures group, the youngest patient was 13 years of age and the eldest was 57 years of age. The mean age among staples group was 35.72 years and among sutures group was 33.62 years. The distribution of age in this study is shown in the Table 1.

Table 1: Age distribution.

Age group (in years)	Staples (n=50)	Sutures (n=50)
	N (%)	N (%)
<20	6 (12)	8 (16)
20-30	10 (20)	6 (12)
30-40	16 (32)	18 (36)
40-50	10 (20)	12 (24)
50-60	8 (16)	6 (12)
Total	50 (100)	50 (100)

Sex distribution

In the present study, out of 100 patients, 52 (52%) were male and 48 (48%) were female as depicted in Table 2.

Table 2: Sex distribution.

Sex	Staples (n=50)	Sutures (n=50)
	N (%)	N (%)
Male	28 (58)	24 (48)
Female	22 (42)	26 (52)
Total	50 (100)	50 (100)

Type of incision

In the present study, out of 100 cases, the commonest type of incision for surgical wound creation was McBurney’s incision: 20 in staplers and 22 in suture group. Midline incision was given in 14 cases in staplers and 18 cases in suture group, inguinal incision was given in 10 cases in staplers and 6 cases in suture group, sub-costal incision was given in 2 case in each group, and paramedian incision was given in 4 cases in staplers and 2 in suture group. The details of type of incision in the present study are given in Table 3.

Table 3: Type of incision.

Incision	Stapels (n=50)	Sutures (n=50)
	N (%)	N (%)
Midline	14 (28)	18 (36)
Inguinal	10 (20)	6 (12)
Subcostal	2 (4)	2 (4)
McBurney’s	20 (40)	22 (44)
Paramedian	4 (8)	2 (4)
Total	50 (100)	50 (100)

Classification based on length of wounds

Wounds are classified based on the length of incision as group A, <5 cm with 20 cases in staples and 22 cases in sutures group: group B, 5-10 cm with 16 cases in staples and 10 cases in sutures group and group C, >10 cm with 14 cases in staples and 18 cases in sutures group as shown in Table 4.

Table 4: Classification based on length of wounds.

Group	Group A<5 cm	Group B 5-10 cm	Group C >10 cm	Total (%)
Stapels	20	16	14	50 (100)
Suture	22	10	18	50 (100)

Time required for closure

Time required for skin closure was classified as <5 minutes, 5-10 minutes, 10-15 minutes and >15 minutes. In staples group, time required for skin closure was <5 min in all the cases whereas in sutures group, no case completed skin closure in <5 minutes, 28 cases in 5-10 minutes, 4 cases in 10-15 minutes and 18 cases in >15 minutes. These results are shown in Table 5. Mean time for suture closure was 9.5 minutes. Mean time for staple closure is 4.9 minutes.

Table 5: Time required for closure.

Time required for wound closure (minutes)	Staples (n=50)	Sutures (n=50)
<5	50 (100%)	0
5-10	0	28
10-15	0	4
>15	0	18
Total	50 (100%)	50 (100%)

Post-operative complications

Southampton wound assessment scale was used for post-operative complications in this study⁷. We observed that in staples group, 6 cases presented with clear discharge with grade (III) and 4 cases with purulent discharge with grade (IV) whereas in suture group, clear discharge with grade (III) was seen in 10 cases and purulent discharge with grade (IV) in 8 cases, rest of the cases healed normally or by with mild bruising, as shown in Table 6.

Table 6: Post-operative complications.

Complications	Staples (n=50) N (%)	Sutures (n=50) N (%)
Clear discharge	6 (12%)	10 (20%)
Purulent discharge	4 (8%)	8 (16%)
Total	10 (20%)	18 (36%)

Staphylococcus aureus was the most common organism that was grown in culture in both groups, with 2 cases in staples group and 3 cases in sutures group. The chi-square statistic was 0.0259. The p value was 0.872081. The result was not significant at p<0.05.

Cosmetic outcome

Stony brooks scar evaluation system (SBSE) was used in this present study and we observed that, in staples group, SBSE score >3 was seen in 80% of cases and in sutures group, SBSE >3 was seen in 64% of cases, as shown in Table 7.8 The chi-square statistic was 1.5873. The p value was 0.207712. The result was not significant at p<0.05.

Table 7: Cosmetic outcome

Type of scar	Staples (n=50) N (%)	Sutures (n=50) N (%)
SBSE>3	40 (80%)	32 (64%)
SBSE<3	10 (20%)	18 (36%)
Total	50 (100%)	50 (100%)

Pain score during removal of staples/sutures

Pain while removal of staples or sutures is tabulated by using pain score with <2 and >2 in both the groups. In staples group, pain score was <2 in 88% of patients and in sutures group, it was 24% as shown in Table 8. The chi-square statistic was 20.7792. The p value was<0.00001. The result was significant at p<0.05.

Table 8: Pain score during removal of staples/sutures.

Pain score	Staples (n=50) N (%)	Sutures (n=50) N (%)
<2	44 (88%)	12 (24%)
>2	6 (12%)	38 (76%)
Total	50 (100%)	50 (100%)

Cost effectiveness

The average cost of the procedure with staples in group A, group B and group C was Rs.300. With sutures, in group A and B, it was Rs.240 and in group C, it was Rs.480.

Table 9: Cost analysis.

Group	Staples (n=50)	Sutures (n=50)
A (WL-up to 5 cm)	Rs.300	Rs.240
B (WL 5-10 cm)	Rs.300	Rs.240
C (WL >10 cm)	Rs.300	Rs.480

V. DISCUSSION

Wounds and their management are fundamental to the practice of surgery. Any elective abdominal surgical intervention will invariably result in a skin wound to gain access to underlying intra-abdominal pathology.

The surgical scar remains the only visible evidence of the surgeon's skill and infrequently, all his efforts are judged on its final appearance. Skin staplers are an alternative to regular sutures which have been intended for rapid closure of surgical wounds.

Age distribution

In the present study, it was observed that most of the cases were in the age group of 30-40 years in both staples (32%) and sutures (36%) group. The mean age among the staples group was 35.72 years and among the sutures group was 33.62 years. In Chavan et al study, the youngest patient was aged 2 years and the oldest was 62 years, with a median age of 30 years in staple group; while in the suture group youngest patient was aged 3 years and the oldest was 75 years of age.⁹ In Naireen et al study, age of the patients ranged from 35- 99 years for stapled group, with a mean age of 58.92 years and 30-80 years for suture group, with a mean age of 60.04 years.¹⁰ In Newman et al study the average age of patients in the suture group was 52.4 years and, in the staples, group was 55.2 years.¹¹

Type of incision

McBurney's incision is the commonest incision under this study; 10 in staplers and 11 in suture group. Midline incision was given in seven cases in stapler group and nine cases in suture group. Inguinal incision was given in five cases in stapler group and three cases in suture group. Sub-costal incision was given in one case in each group and paramedian incision was given in two cases in stapler and one case in suture group. The commonest incision in Chavan et al study was inguinal which comprised 22 cases in stapler and 20 in suture group. Midline incision was given in six cases each in stapler and suture group. Midline incision was given in 20 cases each in stapler and suture group. Mcburneys incision was given in 12 cases in stapler and 16 in suture group. Subcoastal incision was given in 8 cases in stapler and 16 cases in suture group and paramedian incision was given in 8 cases in stapler and 4 in suture group.

Classification based on length of wounds

Wounds under this study are classified based on the length of incision as group A with incision <5 cm with 20 and 22 cases each in staples and sutures group each, group B with incision size 5-10 cm with 16 cases in staples and 10 cases in sutures group and group C with incision size more than 10 cm with 14 case in staples and 18 cases in sutures group. In Chavan et al study in stapler group, there were 8 patients whose wound length belonged to group A (<5 cm), 30 in group B 60 (5-10 cm) and 14 patients in group C (>10 cm) and among the suture group, there were 2, 32 and 16 patients in groups A, B and C respectively.⁹

Time for closure

The average time for the closure of wounds in the present study was 294 sec (4.9 minutes) in staple group and in sutures group was 576 sec (9.6 minutes).

In Chavan et al study, 60 sec was the mean time for closure in staples group and 240 sec in suture group⁹ In another study named Kanagaye et al study, 65 sec was the mean time for closure in staples group and 397 seconds in sutures group.¹²

Ranabaldo et al study, the mean time for closure in staples group was 147 seconds and in sutures group was 224 seconds.¹³ In Naireen et al study, the mean time for closure in staples group was 104 sec and in sutures group was 546 seconds.¹⁰

In Eldrup et al study total 137 patients were analysed who were undergoing abdominal or thoracic surgery, and concluded that using staples in place of mechanical sutures saved much time of the surgeons, as closure with mechanical sutures took one third of the time required for the conventional method¹⁴.

In the present study, wound closure with staples required significantly less time as compared to sutures however overall time taken for suturing of surgical wound was higher than other studies taken here for comparison as skin closure with suture was done by various interneer and first year postgraduates hence time taken for suture application was significantly more than other studies.

The mean time required for staples was 294 seconds and that for sutures was 576 seconds. The average time required for placing staples and sutures was comparable with other studies

The scale used in his study for assessment of wound infections was Southampton wound scale ⁷. In present study out of 50 cases in staples group, 10 patients developed complications in the form of clear discharge 6 cases (12%) and purulent discharge 4 cases (8%); On the other hand in sutures group out of 50 patients, 18 patients developed complications, in the form of clear discharge 10 cases (20%) and purulent discharge 8 cases (16%). Rest of the wounds either healed normally or by very mild erythema.

For comparing the Infection rates, present study was compared with studies of dos Santos et al our infection rates were higher than Karbhari et al study with 8% in staples and 14% in sutures, Naireen et al study with 8% in staples group and 4% in sutures group and Chavan et al study with 4% in staples group and 16% in sutures group, because we have operated contaminated cases and expertise who dealt with skin suturing or stapling varies from internee to post graduate. ^{6,7,13,16}

Staphylococcus aureus was the most common organism that was grown in culture in both groups, with 2 cases in staples group and 3 cases in sutures group.

Cost analysis

For cost factor analysis the wounds were divided into 3 groups depending on the length (5 cm, 5-10 cm and >10 cm) and were named group A, group B, and group C respectively. The average cost of staples for group A, B and C was Rs.300.

The average cost of staples and sutures in the present study is comparable with studies of Karbhari et al, and Chavan et al. ^{9,16} The average cost of staples in Naireen et al study was higher than other studies. ¹⁰

The average cost of using sutures for group A wound and group B was Rs.220 and for group C was ranging from Rs.220-440.

The average cost of staple sutures in Naireen et al study was higher so it is non comparable with the present study. ¹⁰

In incisions less than 5 cm average cost of staples was more than average cost of sutures; while the average cost of staples for wound greater than 10 cm was less than the average cost of sutures.

Cost effectiveness of staples increases with wound length, especially in larger wound incisions of >10 cm, as two suture materials are required for closure of larger wounds which costs Rs.480 whereas a single stapler is sufficient for the closure which costs Rs.300 and staples closure was 3 times faster than sutures which reduces the additional factors that influence the cost such as, time consumable in the operation theatre and the surgeon time expended for skin closure which can be seen in the present study.

Cosmetic outcome

Scale used in this present study for evaluating the scar outcome is Stony Brook scar and we observed that scar appearance was good in 80% of the cases in staples group and 64% in suture group. ⁸

The cosmetic outcome in the present study was compared with studies of Karbhari et al with 90% good outcome in staples and 60% in sutures group, dos Santos et al with 80% in staples and 68% in sutures group, Naireen et al with 88% in staples and 56% in sutures group and Chavan et al with 90% in staples and 60% in sutures groups. ^{9,10,13,16}

Pain score associated with removal of staple/suture

In the present study pain while removal of staples or sutures was tabulated by using pain score with <2 and >2 in both the groups. In staples group pain score was <2 in 88% of patients and in sutures group it was 12%.

Figure 1: Midline closure with staplers.

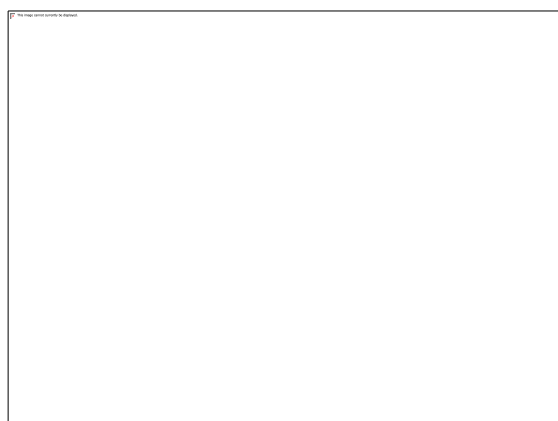
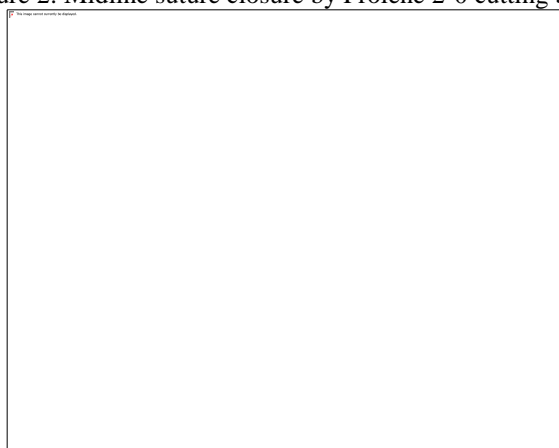


Figure 2: Midline suture closure by Prolene 2-0 cutting body.



It was also found in the study that pain during staple removal was significantly less than suture removal in suture group and was found similar to other studies. Karbhari et al in their study found that pain was significantly less during staple removal between both groups with $p < 0.0001$ and they were also same in studies done by dos Santos et al.^{13,16}

In the present study, the mean pain score in staples group was 1.2 and in sutures group is 3.8 and the results are comparable to the study of Kharbhari et al, with mean pain score of 1.1 in staples group and 4.08 in suture group.¹⁶

In Chavan et al study, the average VAS score of patients in staple group at the end of one month was 71.88 ± 5.50 ; while the average for suture group was $64.44 \pm 6.17.9$ P value calculated using Student's Unpaired 'T' test. P value was < 0.0001 which was highly significant.

There were some limitations of the study. Sample size was small in the study. Cost and availability of staplers may be difficult at times. Sutures and skin stapler were applied by different surgeons. Study was done in single institute and hence cannot be generalized.

Future aspects of the study

To ensure minimal scarring, in the upcoming modern era various methods of skin closure are being invented day by day which approximate the skin edges precisely. Their application is less time consuming, require less skills and expertise. Following are the proposed advancement in skin approximation techniques: metal or polymer staplers, non-inflammatory surgical glue, surgical tapes, zippers or zip tie lines, band grip, micro anchor skin closure are the proposed advancement in skin approximation techniques.

VI. Summary

This was a prospective study conducted to study the outcome between skin staples and sutures in wound closure of elective surgeries conducted in Department of General Surgery at SGT medical college, Gurugram for a period of 1 years on randomly selected 100 cases with 50 undergoing staple closure and 50 undergoing sutures closure respectively.

In the present study, it was observed that the maximum numbers of cases were in the age group of 30-40 years in both group A (36%) and group B (36%). There was a male preponderance with 28 cases (56%) in the staple group as compared to the suture group in which females were more with 26 cases (52%). The commonest incision of the surgical wounds in this study was McBurney's incision. Skin approximation was much faster with Staple (mean=4.9 minutes) as compared to sutures (mean time=9.6 minutes). Post-operative SSI was more common with skin suture group (36%) as compared with staples i.e. group B (20%). The average cost of the skin closure was comparable in both the groups. Cosmetic appearance of the scar was found to be superior in group B in comparison to group A. Patient satisfaction was better in group B as compared to group A in terms of experience of pain during suture or stapler removal.

VII. CONCLUSION

The results indicates that skin closure by stapler can be preferred over conventional skin suture as it is easy to apply, easy application and easy to remove with less pain on removal, easy on pockets of the patients and aesthetically acceptable. However, the basic skin closure technique should be known to every surgeon as staplers are not available everywhere. We conclude that skin staplers can be used in elective clean and clean contaminated surgically incised wound over abdomen. But further studies with large sample size and multicenter study is required to establish the role of staplers in skin approximation.

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