

Original Research Article

Comparative study between skin suture versus skin stapler in abdominal surgery

Hare Ram Singh*, C. Raghuram Chowdary, M. Rajavardhan Reddy

Department of General Surgery, Mamata medical college and Hospital, Khammam, Telangana, India

Received: 21 January 2023

Revised: 15 February 2023

Accepted: 20 February 2023

*Correspondence:

Dr. Hare Ram Singh,

E-mail: raghuchanrda20@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

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 December 2020 to June 2022 at Mamata Medical College and Hospital, Khammam. A study was carried out with 50 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

INTRODUCTION

Through the age's man sought for methods of binding wounds to promote healing. In olden days spider webs, horsehair, warrior ants etc were used till suture materials were discovered. In this modern era various materials and gadgets for approximation of tissues like a sutures, staples or clips, glues, steritapes etc. has been 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. The key principles involved to achieve perfect healing are preservation of blood supply, minimal tissue damage, approximation of edges

without tension, correct suture spacing and suture bites with proper selection of suture materials.¹

The principal aims of tissue repair after surgical skin incisions are rapid acquisition of strength, least tissue damage, no inflammation, and an aesthetically acceptable scar. This can be achieved by obliteration of dead space, layered tissue closure, and eversion of skin margins. The perfectness of tissue approximation and type of approximation influences the tissue healing rate, postoperative early and late complication of surgical wound and economic burden of the hospital.²

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. Both methods endeavour to re-approximate the skin by creating a watertight, tension-free non-inverted opposition of the edges that promotes rapid healing and a cosmetically acceptable scar. Multiple studies have produced conflicting results regarding the efficacy, economics, rate of complications and cosmetic outcomes achieved when comparing these two closure methods for a variety of applications.³

It has become imperative 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 its thickness, elasticity, speed of healing and tendency to scar. The surgical scar remains the only visible evidence of the surgeon's skill and not infrequently, all his efforts are judged on its final appearance.

Hence this study was undertaken with the aim to study the operative time, the effect on wound healing, cosmetic results, patient's acceptance and total cost with the use of sutures and staples at our institute.

In Susruta Samhitha 600 BC, there is mention of suture material made from braided horsehair, leather strips, and vegetable fibers. This text describes in detail triangular, round bodied, curved, and straight needles.⁴

Aurelius Cornelius Celsus, a Roman and a medical journalist wrote a monumental book in medicine about 30 AD and it is known as *De Re Medicina*. Celsus mentions that sutures were of ancient origin, should be soft and not over twisted, so that they may be easier on the path. Whether he was referring to wool or linen is uncertain. He also described small metal clips similar to Michael clips of today.⁵

Humer Hulti in Australia developed surgical stapling in 1908.⁶ The original instrument was massive by today's standards, weighing 7.5 pounds.

Aims and objectives

To study the total cost and operative time required for conventional sutures and staple 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.

METHODS

Study area

The present study was conducted on 50 patients, who presented to the in-patient department of general surgery,

Mamata Medical College Khammam who satisfied Inclusion and exclusion criteria.

Institutional Ethical Committee (IEC) clearance was taken for conducting present study in Mamata General Hospital Khammam. Patient consent was also taken before including him/her to present study.

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. Contaminated and dirty wounds. Patients unwilling to participate in the study.

Study size

50 patients were included in the study.

Study design

It was a prospective observational study.

Study period

The study was conducted from December 2020 to June 2022.

Methodology

A total of 50 patients were categorized into 2 groups i.e., group A which was conventional suture group and group B which was staple groups with 25 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 twenty-five 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.

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=25)	Sutures (n=25)
	N (%)	N (%)
<20	3 (12)	4 (16)
20-30	5 (20)	3 (12)
30-40	8 (32)	9 (36)
40-50	5 (20)	6 (24)
50-60	4 (16)	3 (12)
Total	25 (100)	25 (100)

Sex distribution

In the present study, out of 50 patients, 26 (52%) were male and 24 (48%) were female as depicted in Table 2.

Table 2: Sex distribution.

Sex	Staples (n=25)	Sutures (n=25)
	N (%)	N (%)
Male	14 (58)	12 (48)
Female	11 (42)	13 (52)
Total	25 (100)	25 (100)

Type of incision

In the present study, out of 50 cases, the commonest type of incision for surgical wound creation was McBurney's

incision: 10 in staplers and 11 in suture group. Midline incision was given in 7 cases in staplers and 9 cases in suture group, inguinal incision was given in 5 cases in staplers and 3 cases in suture group, sub-costal incision was given in 1 case in each group, and paramedian incision was given in 2 cases in staplers and 1 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=25)	Sutures (n=25)
	N (%)	N (%)
Midline	7 (28)	9 (36)
Inguinal	5 (20)	3 (12)
Subcostal	1 (4)	1 (4)
McBurney's	10 (40)	11 (44)
Paramedian	2 (8)	1 (4)
Total	25 (100)	25 (100)

Classification based on length of wounds

Wounds are classified based on the length of incision as group A, <5 cm with 10 cases in staples and 11 cases in sutures group: group B, 5-10 cm with 8 cases in staples and 5 cases in sutures group and group C, >10 cm with 7 cases in staples and 9 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	10	8	7	25 (100)
Suture	11	5	9	25 (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, 14 cases in 5-10 minutes, 2 cases in 10-15 minutes and 9 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=25)	Sutures (n=25)
<5	25 (100%)	0
5-10	0	14
10-15	0	2
>15	0	9
Total	25 (100%)	25 (100%)

Post-operative complications

Southampton wound assessment scale was used for post-operative complications in this study.⁷ We observed that In staples group, 3 cases presented with clear discharge with grade (III) and 2 cases with purulent discharge with grade (IV) whereas in suture group, clear discharge with grade (III) was seen in 5 cases and purulent discharge with grade (IV) in 4 cases, rest of the cases are healed normally or by with mild bruising, as shown in Table 6.

Table 6: Post-operative complications.

Complications	Staples (n=25)	Sutures (n=25)
	N (%)	N (%)
Clear discharge	3 (12%)	5 (20%)
Purulent discharge	2 (8%)	4 (16%)
Total	5 (20%)	9 (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=25)	Sutures (n=12)
	N (%)	N (%)
SBSE >3	20 (80%)	16 (64%)
SBSE <3	5 (20%)	9 (36%)
Total	25 (100%)	25 (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 12% 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=25)	Sutures (n=25)
	N (%)	N (%)
<2	22 (88%)	6 (24%)
>2	3 (12%)	19 (76%)
Total	25 (100%)	25 (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=25)	Sutures (n=25)
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

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

The commonest incision in this study was McBurney's incision; 10 in staplers and 11 in suture group. Midline incision was given in 7 cases in stapler group and 9 cases in suture group. Inguinal incision was given in 5 cases in stapler group and 3 cases in suture group. Sub-costal incision was given in 1 case in each group and paramedian incision was given in 2 cases in stapler and 1 case in suture group.

In Chavan et al study the commonest incision was inguinal, 22 cases in staplers and 20 in suture group.⁹ Midline incision was given in 10 cases in each group. McBurneys incision was given in 6 cases in stapler and 8 in suture group. subcostal incision was given in 4 cases in staplers 8 cases in suture group and para median incision was given in 4 cases in stapler and 2.

Classification based on length of wounds

In the present study wounds are classified based on the length of incision as group A with incision <5 cm with 10 cases in staples and 11 cases in sutures group, group B with incision 5-10 cm with 8 cases in staples and 5 cases in sutures group and group C with incision >10 cm with 7 case in staples and 9 cases in sutures group. In Chavan et al study in stapler group, there were 04 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

In the present study the mean time for closure in staples group was 294 sec (4.9 minutes) and in sutures group was 576 sec (9.6 minutes).

In Chavan et al study, the mean time for closure in staples group was 60 sec and in sutures group was 240 sec.⁹ In Kanagaye et al study, the mean time for closure in staples group was 65 seconds and in sutures group was 397 seconds.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 Eldrup et al analysed 137 patients undergoing abdominal or thoracic surgery, and concluded that the main advantage of using staples was the time saved, as closure with mechanical sutures took one third of the time required for the conventional method.¹⁴

In the present study, the time required for wound closure was significantly less with staples as compared to sutures but overall time taken for suturing of surgical wound was higher than other studies taken here for comparison because 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 average time required for staples was 294 seconds. The average time required for sutures is 576 seconds. The average time required for placing staples and sutures was comparable with other studies.

Post operative wound infection rates

Southampton wound scale was used in this study for assessment of wound infection.⁷ In present study out of 25 cases in staples group, 5 patients developed complications in the form of clear discharge 3 cases (12%) and purulent discharge 2 cases (8%); while in sutures group out of 25 patients, 9 patients developed complications, in the form of clear discharge 5 cases (20%) and purulent discharge 4 cases (16%). Rest of the wounds either healed normally or by very mild erythema.

Infection rates of the present study is comparable with studies of dos Santos et al while 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, as we have operated contaminated cases and expertise who dealt with skin suturing or stapling varies from interneer to post graduate.^{6,7,13,16}

In present study *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 analysis of the cost factor, 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 more 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.

Present study is non comparable with the Naireen et al in terms of cost effectiveness as their price of stapler were quite high as compare to other studies.¹⁰

The average cost of staples for incisions less than 5 cm 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.

In present study 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.

Cosmetic outcome

Stony Brook scar evaluation scale was used for evaluation of scar outcome in this present study 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 is comparable 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 group.^{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 staples.



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

In this study it was also found 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 ± 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

In the upcoming modern era various methods of skin closure are being invented day by day which approximate the skin edges precisely to ensure minimal scarring. They can be less time consuming to apply, less skill and less expertise to apply. 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

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 Surgery at Mamata medical college, Khammam, Telangana for a period of 2 years on randomly selected 50 cases with 25 undergoing staple closure and 25 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 14 cases (56%) in the staple group as compared to the suture group in which females were more with 13 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.

CONCLUSION

The results of our study indicate that skin closure by stapler can be preferred over conventional skin suture as it is easy to apply, takes significantly less time for application, easy to remove with less pain to the patients, provides better cosmetic outcome and is also cost-effective. 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 multicentre study is required to establish the role of staplers in skin approximation.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Schwartz S, Brunicki F. Schwartz's principles of surgery. 10th edn. New York: McGraw-Hill Medical; 2015.
2. Bailey I. Bailey and Love's short practice of surgery. 26th edn. Hodder Arnold; 2013:34-35.
3. Imamura K, Adachi K, Sasaki R, Monma S, Shioiri S, Seyama Y, et al. Randomized comparison of subcuticular sutures versus staples for skin closure after open abdominal surgery: a multicenter open-label randomized controlled trial. J Gastroint Surg. 2016;20:2083-92.
4. Doctor HG. Surgeons and sutures. 2nd edn. USA: Ethicon; 1999.
5. Köckerling F, Köckerling D, Lomas C. Cornelius Celsus- ancient encyclopedist, surgeon-scientist, or master of surgery?. Langenbeck's Arch Surg. 2013;398:609-16.
6. Stockley I, Elson RA. Skin closure using staples and nylon sutures: a comparison of results. Ann R Coll Surg Engl. 1987;69:76-8.
7. Campwala I, Unsell K, Gupta S. A systematic review of surgical infection scoring systems used in surgical patients. JBI Libr Syst Rev. 2011;9(60):2627-83.
8. Singer AJ, Arora B, Dagum A, Valentine S, Hollander JE. Development and validation of a novel scar evaluation scale. Plast Reconstruct Surg. 2007;120(7):1892-7.
9. Chavan DR, Metan BB, Kadlewad S, Bharath S. Study of skin staples and conventional sutures for abdominal clean wound skin closure: a randomized control trial. J Evol Med Dent Sci. 2014;3(20):5626-37.
10. Naureen N, Raghavan RM, Parambil SM. A comparative study of skin staplers with skin sutures in abdominal skin wound closure in gastrointestinal malignancy- an institutional study. J Evid Based Med Health. 2016;3(30):1356-9.
11. Newman JT, Morgan SJ, Williams AE, Resende JV, Dayton MR. Total hip arthroplasty and surgical wound closure: sutures versus staples. Orthoped Muscul Syst. 2013;02(03).
12. Kanegaye J, Vance C, Chan L, Schonfeld N. Comparison of skin stapling devices and standard sutures for pediatric scalp lacerations: a randomized study of cost and time benefits. J Pediatr. 1997;130(5):808-13.
13. dos Santos LR, Freitas CA, Hojaij FC, Araújo Filho VJ, Cernea CR, Branda LG, Ferraz AR. Prospective study using skin staplers in head and neck surgery. Am J Surg. 1995;170(5):451-2.
14. Ranaboldo C, Rowe-Jones D. Closure of laparotomy wounds: skin staples versus sutures. Br J Surg. 1992;79(11):1172-3.
15. Eldrup J, Wied U, Anderson B. Randomised trial comparing proximate stapler with conventional skin closure. Acta Chirurg Scand. 1981;147:501-2.
16. Karbhari S, Patil R, Bhavikatti A. Study of skin staples and conventional suture for abdominal skin wound closure. Int J Biomed Adv Res. 2012;3(7).

Cite this article as: Singh HR, Chowdary CR, Reddy MR. Comparative study between skin suture versus skin stapler in abdominal surgery. Int Surg J 2023;10:586-92.