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A Comparison between Skin Stapler and Polypropylene Sutures in Closing Laparotomy Wounds: A Study of 100 Cases

Dr. Sharif Mushfaqur Rahman[1*], Dr. Syed Mahbubul Alom[2], Dr. Gazi Md. Salahuddin[3]

[1]Junior Consultant, Department of Surgery, Directorate General of Health Services, Dhaka, Bangladesh
[2]Former Professor, Department of Surgery, Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh
[3]Assistant Professor, Department of Surgery, Cumilla Medical College Hospital, Cumilla, Bangladesh

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***Corresponding author:** Dr. Sharif Mushfaqur Rahman
Junior Consultant, Department of Surgery, Directorate General of Health Services, Dhaka, Bangladesh

Abstract **Original Research Article**

Objective: Healing of laparotomy wounds is associated with number of factors. The aim of the study was to compare skin stapler and polypropylene sutures in closing laparotomy wounds. ***Materials and method:*** This randomized controlled trial study was conducted at the Department of Surgery, Sir Salimullah Medical College Mitford Hospital, Dhaka, Bangladesh. The study duration was 6 months, from July 2010 to December 2010. A total of 100 participants were included in the study, divide in two equal groups of 50 participants. The first group received interrupted suture with 2/0 polypropylene. The other group received skin staples. ***Results:*** The mean time for closure with suture and staple were 3.7±SD and 22.5±SD cm/min respectively (p- value<0.05). Rate of wound closure was calculated in cm per minute and materials were compared statistically in pairs by t- test. Wounds were closed five times faster with staples then suture (p<0.001). In relation to post-operative infection, 17 (34%) cases developed wound infection in sutured group and 15 (30%) patients in stapled group. Most of the infection occurred in the emergency contaminated cases. There was no significant association between wound infections and method of skin closure (p> 0.05, chi square= 3.15). ***Conclusions:*** Staples were well-liked by operators and resulted in substantial and worthwhile savings in time for wound closure.

Keywords: Skin stapler, Sutures materials, Wound healing, Laparotomy wound.

BACKGROUND

The engineering of sutures in synthetic material along with standardization of traditional materials (eg, catgut, silk) has made for superior aesthetic results Wound closure techniques have evolved from the earliest development of suture materials to comprise resources which include synthetic sutures, absorbables, staples, tapes, and adhesive compounds [1]. Aesthetic closure is based on knowledge of healing mechanisms and anatomy of skin as well as an attributes of suture material and closure technique. Choosing the proper suture materials and wound closure technique ensures optimum healing process [1]. The word "suture" describes any strand of material used to ligate (tie) blood vessels or approximate (bring close together) tissues. *Sutures* are used to close wounds. Sutures and ligatures were used by both the Egyptians and Syrians as far back as 2,000 B.C. Through the centuries, a wide variety of materials—silk, linen, cotton, horsehair, animal tendons and intestines, and wire made of precious metals—have Some of these are still in use today [2, 3]. A suture tied around a vessel to occlude the lumen is called a *ligature* or *tie*. It may be used to affect hemostasis or to close off a structure to prevent leakage. The use of mechanical means for wound closure first appeared in ancient Hindu medicine. Insect mandibles were employed for wound closure in the jungles of southern Bhutan at the foot of the Himalayas [4]. Victor Fischer, an ingenious designer of surgical instruments, was the inventor of the first surgical stapler that used metal staples [5]. He designed and developed different gastrointestinal staplers for Hümér Hütl, one of the leading surgeons at the St. Rokus Hospital in Budapest. Hütl operated on his first patient with the stapler on May 9, 1908. The choice of suture materials generally depends on whether the wound closure occurs in one or more layers. In selecting the most appropriate sutures, the surgeon takes into account the amount of tension on the wound, the number of layers of closure, depth of suture placement, anticipated amount of edema, and anticipated timing of suture removal.

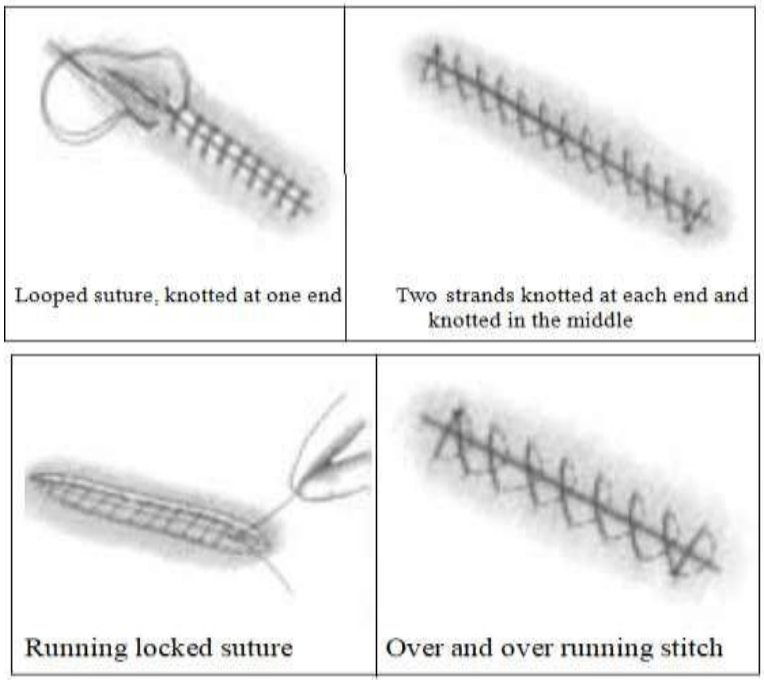

Fig 1: Continuous suturing techniques

Figure: Removing staples with staple remover

Figure: Skin staple

Of the many risk factors influencing post operative wound healing, the method of skin closure has been implicated as one of the important factors [6, 1, 7]. Conventional surgical suture is the commonly used method, and use of skin staples is relatively newer technique. There are prospective randomized trial studies performed on abdominal and other wounds only showed diverse results of outcome with some concluding skin staples as better method of skin closure (7) while other not [8]. So an attempt has been made to this prospective randomized trial study on patients in order to compare the skin stapler and polypropylene sutures in closing laparotomy wounds.

METHODS

This was an intervention study of randomized control trial type involving patients with laparotomy wounds conducted purposively at the Department of Surgery, Sir Salimullah Medical College Mitford Hospital, Dhaka, Bangladesh. The study duration was 6 months, from July 2010 to December 2010. A total of 100 participants were included in the study by non probability and purposive type of sampling after satisfying the inclusion and exclusion criteria. Samples were divided in two equal groups of control (suture) 50 & trial (Skin staples) 50. The first group received interrupted suture with 2/0 polypropylene. The other group received skin staples. Time taken in skin closure and wound length from each operation were recorded for comparison in the dimensions of centimeter per second (cm/sec). Rate of infection in two study group was compared and also cosmetic outcome after one month. All patients admitted to the surgery department of Sir Salimullah Medical College Mitford Hospital requiring laparotomy both emergency and routine were included in the study. Patients under 13 years (Pediatric patients), allergy to staples or sutures and patient with repeat laparotomy cases were excluded from the study. The study was conducted with a structured written questionnaire pre tested in the surgery department of Sir Salimullah Medical College Mitford Hospital and necessary modifications were done. Data was collected by taking history and observing the patients daily until discharge and subsequently in the hospital at one week and one month after discharge during follow up. Before data collection purpose of the study was explained to the patients in order to assure them regarding the validity of the closure techniques of the wounds. The collected data was cleaned, edited and analyzed by using computer based SPSS (statistical package for social science) software. Data were classified into different groups, frequency observed and descriptive statistics (mean, median, mode, standard deviation) were calculated. Statistical association between two groups was done by using the appropriate "test of signifance". Randomization: Patients were stratified in to those with having routine laparotomy and those with having emergency laparotomy, then were randomized to receive one of the two wound closure techniques: wound closed with surgical suture material or with skin staples. Modes of intervention: For every wound, the fascial layer was sutured by polyglicolic (dexon) 1-0 and subcutaneous layer by plain catgut where necessary. Staples were removed with staple pin remover, while polypropylene sutures removed in the conventional way. Post intervention follow up: Follow up was done to assess the outcome either as good healing or wound infection. Also appearance of the wound and cosmetic acceptance was judged. All patients observed daily until discharge and subsequently in the hospital after 1 week and 1 month after discharge. A wound infection occurred when purulent discharge was observed. All infected wounds were drained and followed up by regular dressing.

RESULTS

From the study it was found that, most 55 (55%) of the patients were in the age between 31 and 50 years. Only 10 (10%) were below the age of 20 years old. The mean age of the patients was 39.82 years and lowest and highest ages were 16 and 60 years respectively. The sex distribution of the patients appeared from the study that 69% were male and 31% were female giving a male female ratio of 2.22: 1. The marital status of the patients reported that, 78% were married and 22% were unmarried. It was observed that, majority of the patients 71 (71%) had monthly income within the range of Tk. 4000 – 10000 per month. Next to the highest 18 (18%) had monthly income of tk. < 4000 and only6 10 (10%) had monthly income of tk. > 10000 respectively (Table 1). A total of 100 patients were enrolled in this study, 50 for each group. The entire study subject was observed daily until discharge and then one month after discharge (table 2). In this study a total number of 100 patients were selected who had undergone laparotomy for different reasons. Physical and clinical findings were varied according to the diagnosis and also according to the age, mode of presentation and duration of signs and symptoms. Important clinical findings and their percentage are shown in the table 3. Rate of wound closure was calculated in cm per minute and materials were compared statistically in pairs by t- test. Wounds were closed five times faster with staples then suture ($p<0.001$). The relative cost of closing 15 mm of wound (the average of all groups) is shown in table 4. In relation to post operative infection, 17 (34%) cases developed wound infection in sutured group and 15 (30%) patients in stapled group. Most of the infection occurred in the emergency contaminated cases. There was no significant association between wound infections and method of skin closure ($p> 0.05$, chi square= 3.15) (table 5).

Table 1: Sociodemographic characteristics of the respondents

Characteristics	Number	Percentage
Age (in years)		
≤ 20	10	10
21-30	16	16
31-40	30	30
41-50	25	25
51-60	19	19
Mean= 39.82±SD (16-60)		

Gender		
Male	69	69
Female	31	31
Marital Status		
Married	78	78
Unmarried	22	22
Socio-Economic Group		
Low income group	19	19
Middle income group	71	71
High income group	10	10
Basis of classifying different income groups High income groups: Monthly income of guardian > 10,000 tk. Middle income groups: monthly income of guardian 4000 – 10,000 tk. Low income groups: monthly income of guardian < 4,000 tk.		

Table 2: Representation of study group (n= 100)

Study group	No. of cases	percentage
Suture group	50	50%
Staple group	50	50%
Total	100	100%

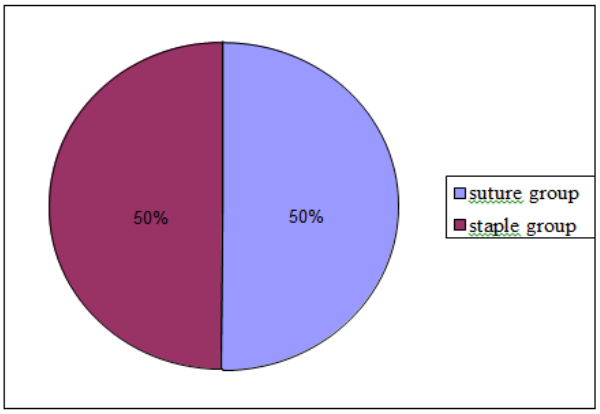

Figure 1: Study group and suture group distribution of the participants (n=100)

Table 3: Physical examination and clinical findings of the patient (n= 100)

Findings	No.	Percentage
Temperature		
less then 38.3◦C	54	54.0
more then 38.3◦C	46	46.0
Tenderness		
localized,	34	34.0
diffuse	50	50.0
Muscular rigidity		
Regional	12	12.0
Board like	38	38.0
Rebound tenderness	47	47.0
Jaundice	5	5.0
Palpable lump in the abdomen	12	12.0
Per rectal examination (tender)	37	37.0

Table 4: Relative rates of skin closure and cost between two materials (n= 100)

Study group	Rate of closure (cm per minute)	Cost for 15 cm of wound	P value
Suture group	3.7	185 BDT	p<0.001
Staple group	22.5	350 BDT	

Table 5: Proportions of wound infections (n= 100)

Material	Painful removal	Difficult removal	infection	Grading of closure at 30 days		Grading of cosmetic appearance at 30 days		Patient satisfaction		P value
Suture N = 50	12	5	17	A	B	A	B	A	B	p> 0.05 chi square= 3.15
				45	5	41	9	47	3	
Staple N = 50	9	4	15	47	3	42	8	48	2	

*A Satisfactory.
*B Non satisfactory.

DISCUSSION

The study was carried out in the department of surgery in Sir Salimullah Medical College Mitford Hospital among patients requiring laparotomy in order to comparison between skin stapler and polypropylene sutures in closing laparotomy wounds. All patients received the allocated interventions. Both groups of patients were similar in terms of age, indications and risk factors.

In this study, 100 patients with laparotomy wounds were studied. Fifty patients wound was closed with sutures and rest 50 patients got their wound closed with surgical staplers, 69 patients were male and 31 patients were female, male- female ratio was 2.22:1, most of the respondents 55 (55%) were in the age between 31 and 50 years. The mean age of the patients was 39.82± SD years and lowest and highest ages were 16 and 60 years respectively, most of the patients were in the middle income group, and monthly income within the range of Tk. 4000 – 10000 per family. Modern mechanical suture devices (skin staplers) were pioneered in former Soviet Union and later introduced at USA. The development of mechanically satisfactory skin staplers appears to represent an important advance in rapid and effective means of closing long skin incisions. There was evidence that the method causes considerably less damage to wound defense when compared with least reactive non- absorbable suture material. Surgical wound (site) infection is the commonest complication following laparotomy especially for emergency abdominal operations. Good surgical technique, choice of appropriate wound closing technique and some patient related factors contribute to the rate of surgical wound infection. The wound infection for staple group 30% and for suture group 34% in this study is comparable to that reported in other studies. The influence of staples and their configuration on the biology of skin wound repair and infection has been the subject of increasing numbers of scientific studies. Jewell and colleagues [9] compared the healing of sutured wounds to that of the stapled wounds in the rat. The skin incisions in one experimental group were closed with staples implanted at 5 mm intervals, whereas interrupted monofilament nylon sutures approximated skin incisions in the remaining group at 5 mm intervals. Staples and sutures were removed from the wounds on the seventh postoperative day. No significant difference was reported between the mean breaking strength of the wounds with either staples or sutures at 10, 42, and 180 days after closure. Pickford [7] in the only other prospective controlled trial of metal stapling and suture closure of abdominal wounds found that there was a dramatic reduction in wound infection rate with the use of metal staples. The overall wound infection rate in sutured wound was 17% compared with 6.3% in those closed by metal staples. Stillman and Ms Marino [10] stated that closure with skin stapler was most resistant to abscess formation. Presumably, percutaneous sutures provide a nidus for bacterial growth in the relatively avascular subcutaneous space. This problem is avoided by the use of skin staplers. The higher proportion of wound infection in both study groups was directly attributable to the greater proportion of contamination in emergency gastrointestinal operations. In those cases where organisms were cultured from the wound dehiscence the type was directly related to the particular operation. All infection developed after emergency gastrointestinal surgery and the organisms were invariably gastrointestinal flora- *E. coli, Strep. fecalis, bacteroids, clostridia*. This was the same for both groups. Local suture removal was necessary in moderately infected wounds to allow drainage but staples allowed satisfactory drainage without removal. Stapled group showed a slight less infection tendency but without statistical significance (p- value> 0.05) in present study. The price of one packet of polypropylene 2/0 cutting body suture was 185 BDT while a disposable stapler cost 350 to 500 BDT. The average wound of 15 cm was closed 196 sec quicker with stapler then with polypropylene at an extra cost of 170 BDT. Use of reusable stapler can effectively reduce stapler cost as they can be used on as much as 4 cases [11]. The average saving of just over three minutes in closing a 15 mm wound with staples could be extrapolated to a gain of 15 – 20 minutes on an average operating list. Apart from the more efficient use of theatre time, the psychological effect of rapid wound closure at the end of long operation on surgeon and theatre stuff was very evident. Continuous sutures save some time but have been shown to take two minutes longer then staples over 15 cm [12], whilst making partial opening of an infected wound difficult. In this study, most of the patients (78) had their stitches/staples removed in the out patient department of Sir Salimullah Medical

College Mitford Hospital. Others (22) had their stitches removed in the ward due to infectious complications. Events at removal (painful/painless/difficult) were marked by questioning the patient and by direct observation. The cosmetic results and patient satisfaction results of both groups after one month was similar and routine staple removal was no more difficult or painful then suture removal. The results were compatible with other studies. Dennis *et al*., [11] graded cosmetic outcome at 30 days as A (Excellent) and B (Moderate) and found no significant difference in between two groups (n = 63, A = 57 in suture and A = 58 in staple groups). One limitation of the study was the difficulty in analyzing the use of antibiotics because antibiotics were used not only for serious underlying intra-abdominal infections, where the duration and type of antibiotics in part depended on the clinical response of each patient, but also for a variety of concomitant indications. Robust data was needed for further study with a large sample size.

CONCLUSION

Stapling is a fast, comfortable method of closing any laparotomy wounds. Staples did not cause excessive wound pain and local staple removal was unnecessary to allow drainage of moderately infected wounds. In case of some extended laparotomy wounds, staple skin closure is not as uneconomic as previously believed.

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Conflict of interest: None declared

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

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