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To Compare The Outcomes In Patients Undergoing Emergency Laparotomy Using Silk Sutures Vs Staplers.

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ABSTRACT

A good wound closure technique provides proper skin apposition until complete healing has taken place with minimal chances of infection.(4) Proper blood supply and no tension on suture material must be ensured to prevent wound dehiscence and surgical site infection. The target is to regain the wound strength closer to the pre-incision state in a minimal time frame and least damage to tissues. An ideal wound closure material should be cost-effective, hypoallergic, and have convenient manufacturing. Nonabsorbable sutures such as silk, prolene, and metallic staples are used for the closure of fascia, tendons, and abdominal wall, which heal slowly. present study aims at comparing patient outcomes, in terms of wound dehiscence, surgical site infection, post-operative pain, time taken for wound closure, and time taken for healing with the use of skin staples vs silk sutures in emergency laparotomies. Patients were randomly divided into two groups of 30 patients each using computer-generated random numbers. Silk 1-0 sutures were used for abdominal closure in Group A, and surgical staplers were used in Group B. sutures as well as staples were put at 1cm from each other in vertical mattress way. Data of the intra-operative time for abdominal closure, Postoperative pain at the incision site, frequency of administration of intravenous analgesics was recorded. The wound was evaluated weekly for surgical site infections and wound dehiscence. Swabs were taken for culture and sensitivity in patients showing signs of infection and appropriate antibiotic(s) started. Total time taken for the complete wound healing was recorded**.** Post-operative pain score was more with the staplers than silk sutures, the incidence of post-operative wound dehiscence was significantly higher with silk sutures than staplers and surgical site infection was more in silk sutures group than staplers, Intra-operative time for wound closure was remarkably less with staplers and time taken for the complete healing of wound is significantly lower in the use of Staplers. Staplers are a better technique for abdominal wound closure in emergency laparotomies due to blunt abdominal trauma**.**

Keywords: Laparotomy, Silk Sutures, Staplers.

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INTRODUCTION

Skin is the largest organ of the body, having a protective role. It acts as a barrier between internal organs and the external environment. A wound is the breakdown of the structural or functional integrity of the skin. Primary intention and secondary intention are the two ways by which wound healing occurs. In primary intention, the wound constitutes a clean and incised skin as made by a surgical blade. Such wounds are closed using various types of sutures or staplers or others. Healing is complete and proper cosmesis can be achieved.

In the case of wound healing by secondary intention, it occurs in cases of extensive tissue loss such as accidents or burns. It's not always possible to approximate the wound edges by sutures or staplers. Hence these wounds close by secondary healing resulting in fibrosis or disability. Various phases of healing of incisional wounds include acute inflammation, proliferation, remodeling, and scar modification [1-3].

Tissue repair after any surgical procedure is considered appropriate if the scar has good strength, low/no infection rate, and is cosmetically acceptable. A good wound closure technique provides proper skin apposition until complete healing has taken place with minimal chances of infection [4]. Proper blood supply and no tension on suture material must be ensured to prevent wound dehiscence and surgical site infection. The target is to regain the wound strength closer to the pre-incision state in a minimal time frame and least damage to tissues. Out of nosocomial infections, the most commonly reported ones are Surgical site infections (SSI) [5] 20 % of intra-abdominal operations result in SSI which affects wound healing adversely [6]. Techniques used to close the skin, and penetrate the epidermis and dermis, also providing auto-inoculation via the suture pathway. Suture closure is a significant source of foreign body reaction [7]

An ideal wound closure material should be cost-effective, hypoallergic, and have convenient manufacturing [8]. Suture material can be broadly classified into absorbable and non-absorbable sutures. Absorbable sutures such as Vicryl and Monocryl are used for applying stitches on rapidly healing tissues such as bowel, urinary, or biliary tract. Nonabsorbable sutures such as silk, prolene, and metallic staples are used for the closure of fascia, tendons, and abdominal wall, which heal slowly. Silk sutures, being braided, provide better tensile strength but these braidings act as a focus for infection. Wound closure by sutures has shown to be better than staples in the context of being less painful, yielding a much-improved cosmetic result, being significantly cheaper, with a less chance of superficial wound complications. Furthermore, for removing silk sutures, no special device is required as in the case of stapler removal.

Staples, on the other hand, have uniform shapes, and constant depth and are quick to use. Thus staples provide even wound tension across the edges [9]. It's easier to use the staplers, saves time to close the wound and there are lesser chances of skin allergies and foreign body reaction. As the staplers are smooth there is a lesser chance of bacterial nidus formation and hence decreased risk of infection. The subcuticular capillaries remain intact with the use of staplers hence the blood flow to the wound isn't hampered.

However, the use of staples has been reported to have a higher risk of wound dehiscence and postoperative pain in emergency cases as compared to sutures [10].

Therefore, the present study aims at comparing patient outcomes, in terms of wound dehiscence, surgical site infection, post-operative pain, time taken for wound closure, and time taken for healing with the use of skin staples vs silk sutures in emergency laparotomies.

Aim and Objectives

To compare patient outcomes in use of silk sutures vs staplers in emergency laparotomies in cases of blunt abdominal trauma in terms of

- Wound dehiscence
- Surgical site infections
- Post-operative pain
- Intra-operative time for wound closure
- Time taken for complete healing

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MATERIAL AND METHODS

Place Of Study

The present study was conducted in the Department of General Surgery, SBLS Civil Hospital, Jalandhar, Punjab.

Type Of Study

It was a prospective, randomized, parallel-group, open-label, interventional study.

Study Duration

The study was conducted for a period of 12 months after obtaining the Institutional Ethics Committee's approval to conduct the study.

Inclusion criteria

- Patients of age between 18 to 60 years of all genders undergoing emergency laparotomies due to blunt abdominal trauma
- Patient and/or his/her legally acceptable representative willing to provide their voluntary written informed consent to participate in the study

Exclusion criteria

- Immunocompromised status like diseases (HIV) or drugs (steroids, chemotherapy)
- Diabetes Mellitus
- Previous history of laparotomy
- Elective laparotomy
- Patients undergoing Obstetric procedures
- Multi-organ failure
- Patient and/or his/her legally acceptable representative not willing to provide their voluntary written informed consent to participate in the study.

Data collection

- Intra-operative from operative surgeon.
- Post-operative from patients (visual analog scale) for pain scores and wound examination

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Pre-operative investigations

- Complete blood count
- Renal function tests
- Complete liver function tests
- Serum electrolytes
- Viral markers
- Chest x-ray posterior-anterior view
- X-ray erect abdomen with Bilateral lobes of lungs
- Contrast-enhanced CT abdomen (when indicated)

Randomization

Randomization of the patients was done using computer-generated numbers. A total of 90 patients were enrolled, out of which 30 died on postoperative day 1. The rest of the 60 patients were randomly divided into two equal groups of 30 patients each.

Group A (silk sutures): The wounds of the patients in this group were closed by silk sutures

Group B (Staplers): The wounds of the patients in this group were closed by staplers

METHODOLOGY

After getting clearance from the institutional ethical committee, patients undergoing emergency laparotomies at SBLS Civil Hospital from July 2023- May 2024 were included in the study, as per inclusion criteria after ruling out exclusion criteria. All the eligible patients were explained about the study in detail including type of study, randomization, type of wound closure using either silk 1-0 or staplers, risks/benefits, patient compliance, data collection, etc. in their own language. After obtaining voluntary written informed consent from the patient and/or his/her legally acceptable representative for participation in the study, all the study-related procedures were initiated A comprehensive history, including demographic details, pre-operative examination of the patient, laboratory investigations, and radiological investigations including an X-ray erect abdomen and ultrasound whole abdomen was recorded. Total patients were 90 out of which 30 expired within the first week post-surgery. Patients were randomly divided into two groups of 30 patients each using computer-generated random numbers. Silk 1-0 sutures were used for abdominal closure in Group A, and surgical staplers were used in Group B. Upon admission, patients were kept nil per oral and intravenous fluids such as normal saline, ringer lactate and dextrose, intravenous antibiotics, intravenous analgesics, anti-emetics and proton pump inhibitors were started.

Ryle's tube insertion and catheterization of all admitted patients were done as well. Patients were taken to the operation theatre within 12 hours of admission. Data of the intra-operative time for abdominal closure was recorded by the operative surgeon. Silk 1-0 sutures were put at 1cm from each other in vertical mattress way. Staplers were similarly placed at the distance of 1 cm from each other. In both the groups the closed wound was cleaned by betadine. Sterile gauze placed and taped with dynaplast. Postoperative pain at the incision site was recorded on a visual analog scale along with the frequency of administration of intravenous analgesics constituting NSAIDS such as Diclofenac and Paracetamol infusion.

Post-operatively, the patients were managed by intravenous fluids, broad spectrum antibiotics, analgesics, anti-emetics, and Proton pump inhibitors as done routinely. Anti-septic dressings of the wound were done every alternate day with the use of betadine in both groups. The wound was evaluated weekly for surgical site infections and wound dehiscence. Patients showing signs of surgical site infection like redness, swelling, and discharge (serous or purulent) and wound dehiscence in terms of partial or complete wound gaping, swabs were taken for culture and sensitivity and appropriate antibiotic(s) started. Total time taken for the complete wound healing was recorded in
days.

Data Collection & Analysis

The data was collected in Case Report Form designed for the specific requirement of the study.

Outcome Measures

The outcome measures of the study encompassed various aspects to comprehensively evaluate the effectiveness and impact of the treatment interventions. Total length of the skin incision was measured in centimeters. Intra-operative time taken to close the wound was measured in minutes and documented. Post-operative incisional pain was quantified using the visual analogue scale and well documented at 30 minutes, 1, 2, 6, 12 and 24 hours. Even the frequency of administration of intravenous diclofenac and paracetamol infusion was documented. Wound dehiscence whether partial or complete was assessed from week 1 to week 4 in both Group A (silk sutures) and group B (staplers) providing insights into the comparative healing rates. Additionally, the study monitored the number of patients in each group with surgical site infections in terms of redness, swelling, discharge and nature of discharge (serous or purulent), from week 1 to week 4, offering a perspective on chances of nosocomial infiltration with respect to wound closure modality used and aiding in understanding the efficacy of the interventions in preventing or managing infections. Culture swabs were taken weekly and comparisons drawn with the above said closure modalities. Furthermore, the study tracked the number of days taken for complete wound healing. Collectively, the study showed the outcome measures aimed to provide a comprehensive understanding of the nature of sutures and staplers and their impact on pain management, wound dehiscence and infection rates, intra-operative time taken for wound closure and total time taken for wound healing.

Statistical Analysis Plan

Initially, data was collected using a self-structured case report form (CRF) and subsequently transferred to Microsoft Excel for analysis. Data was tabulated and analyzed using Statistical software JAMOVI 2.3.28 . Descriptive statistics were presented as mean, standard deviation, range. Frequency distributions in two groups were compared using Chi-Square Test and quantitative data were compared using unpaired ttest.

A value of $p < 0.05$ was considered statistically significant. The skewed data was compared using non-parametric Mann-Whitney U test.

Ethical Considerations

The protocol of the present study was submitted to the Institutional Ethics Committee for review. Study was initiated only after getting their approval. A voluntary, written, informed consent was obtained from each patient for participating in the study.

Financial Inputs And Funding

Patients were responsible for covering the costs of treatment, as per the institution's stipulated charges. No supplementary procedures or investigations were conducted solely for the study, thereby imposing no additional financial burden on either the patients or the institution. All expenses associated with conducting the study were borne by the researcher. Importantly, this study did not receive sponsorship from any pharmaceutical company or institution.

Observations

The **age** of study participants ranged from 19 -60 years. Mean age of patients was 37.2 ± 12.0 in group A, and 34.7 ± 12.3 in group B. The differences in mean age of two groups were not statistically significant ($p > 0.05$).

Gender: Number of male patients in both groups was larger than in females. (Figure 1).However the differences between two groups were not significant.(p 0.432).

There were no differences in number of anemic patients, those having their TLC and CRP raised in both the groups . Platelet counts were normal in most of the patients in both groups. However 8 patients (26.6%) in group A and 7 (23.3 %) I group B had low platelet count.

Maximum post – operative pain scores

Although, the differences in frequency distribution of pain scores, between the two groups were not significant statistically (p 0.004).

As shown in Table 1, figure 2 Pain score of 6 was shown by maximum number of patients (12= 40%) in group A , whereas Pain score 10 was shown by maximum patients (18 = 60%) in group B. Thus pain scores were higher in more number of patients in group B in whom the wound was stitched using staplers ,in comparison to wounds stitched by silk sutures in group A. The histogram , and Q-Q plot of post-operative pain scores (figure 3,4) show right skewness (0.716) in group A , and left skewness (- 1.41) in group B. Thus MannWhitney U test was used for comparing pain scores. The maximum pain scores were significantly higher in group B ,with use of staplers in comparison to group A , using silk sutures(Table 1)

Post operative Wound Dehiscence

At the end of post-operative week 1, there was no wound dehiscence in 13 patients of group A , and 24 patients of group B.Complete or partial dehiscence was seen in significantly more number of patients , in group A , where wounds were closed with silk sutures , than in group B as shown in table 2, figure 5,6 . 15 patients (50%) in silk suture group , and 6 (20%) in stapler group had partial wound dehiscence at end of week one post-operatively. Two patients (6.6%) in silk suture group had complete

wound dehiscence , whereas none of the patients in stapler group had complete dehiscence at week one. These differences in incidence of wound dehiscence were found to be statistically significant (p 0.010)

Similarly, the difference in occurrence of wound dehiscence between two groups were significant statistically at two weeks and three weeks postoperatively. However at four weeks time after the surgery, 29 (96.6%) patients in both groups had no wound dehiscence. However one patient (3.3%) in group A had complete dehiscence, and one in group B had partial dehiscence. Thus significant differences are observed in incidence of wound dehiscence in silk sututres and stapler group, in first, second and third post-operative week. However , by four weeks these differences decreased and 96.6% atients in both groups had no dehiscence at surgical site.

Surgical site infection

Table 3, Figure 7 show presence of SSI in silk suture group (A) to be significantly more than in stapler group (B) during post-operative weeks one –three. In week four also , SSI was seen in 2 cases in group A, and none in group B, However this difference in week 4 was not significant statistically.

Wound length (in cm) and Intraoperative Wound Closure Time

Mean wound length was 21.9± 1.53 cm in group A and 22 ± 1.70 in group B with a median value of 22 cm in both groups. (Student's t-value = -0.320 , p =0.750). Thus wound length in two groups was not significantly different.

The Comparison of time taken to close the wound in two groups , showed statistically significant differences, as shown in table 4 and histogram in fig 8. Mean time taken to close the wound using silk sutures was 15.5 ± 3.14 minutes. It was significantly more than that using staplers i.e. 3.83 ± 1.62 minutes. Mann –Whitney U test was used because of positive skewness in data. P value < 0.001 shows significantly less time taken with use of staplers.

Time to complete healing (in days)

Time taken for complete healing in two groups is shown in Table 5, figure 9 . In group A , after use of silk sutures , time to healing ranged from 11 to 30 days, with mean of 19.1 ± 5.89 days, and median value 19.

Whereas in Group B, in which Staplers were used to close wound, time for complete healing ranged from 10-30 days, with mean of 14.7 ± 4.82 , and median value 13.5.

Standard error skewness in both groups was 0.427.The differences in time to complete healing were found to be statistically significant (p 0.002) using independent sample t-test.

Table 1: Comparison of maximum pain scores

	Group A	Group B
Mean± S.D.	6.70 ± 1.73	8.83 ± 1.78
Median	6	10
Skewness	0.716	-1.41
Mann-Whitney U	188	
p	**< .001***	

Table 2: Number of patients with Post operative wound dehiscence

Post operative week	Wound dehiscence	Group A n (%)	Group B n (%)	χ^2. and p value
Week 1	Absent	13 (43%)	24 (80%)	χ^2 9.13
	Partial	15 (50%)	6 (20%)	
	Complete	2 (6.6%)	0	**p 0.010***
Week 2	Absent	9 (30%)	25 (83.3%)	χ^2 17.7

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	Partial	16 (53.3%)	3 (10%)	
	Complete	5 (16.6%)	2 (6.6%)	**p < 0.001***
Week 3	Absent	17 (56.6%)	27 (90%)	χ^2 8.54
	Partial	8 (26.6%)	2 (6.6%)	
	Complete	5 (16.6%)	1 (3.3%)	**p 0.014***
Week 4	Absent	29 (96.6%)	29 (96.6%)	χ^2 2.0
	Partial	0	1 (3.3%)	
	Complete	1 (3.3%)	0	**p** 0.368

Table 3: Post operative surgical site infection

Post-op time	Group A	Group B	χ^2. value	p value
Week 1	22	6	17.1	**<.001***
Week 2	21	5	17.4	**<.001***
Week 3	11	3	5.96	**0.015***
Week 4	2	0	2.07	0.150

Table 4: Intra-operative Wound Closure Time (in minutes)

Closure Time (in minutes)	Group A	Group B
Mean± S.D.	15.5 ± 3.14	3.83 ± 1.62
Median	15	4
Skewness	0.465	2.06
Mann-Whitney U	1.00	
p	**<0.001***	

Table 5: Time to complete healing (in days)

Time to healing (days)	Group A	Group B
Mean± S.D.	19.1 ± 5.89	14.7 ± 4.82
Median	19	13.5
SE Skewness	0.427	0.427
Student's t	**3.17***	
p	**0.002***	

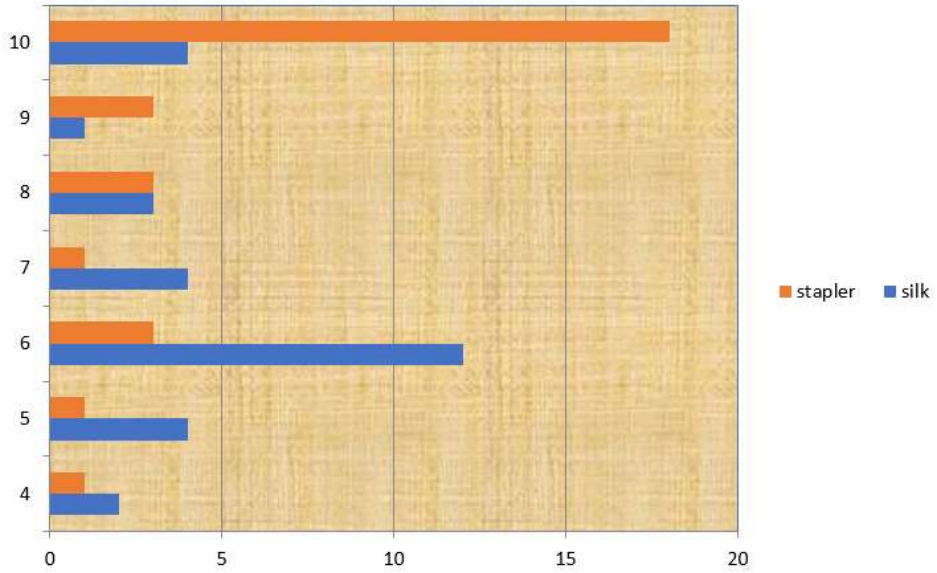

Figure 1: Pain score (Y-axis) versus number of patients (X-axis) in each group

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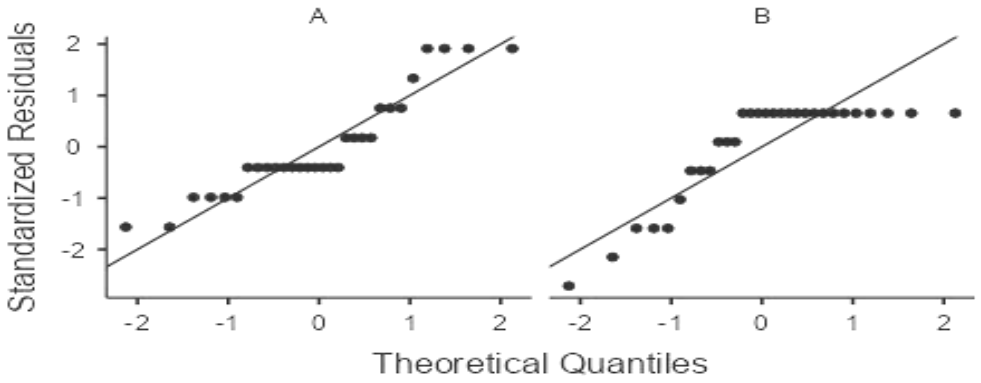

Figure 2: Q-Q plot of pain scores showing Skewness of data

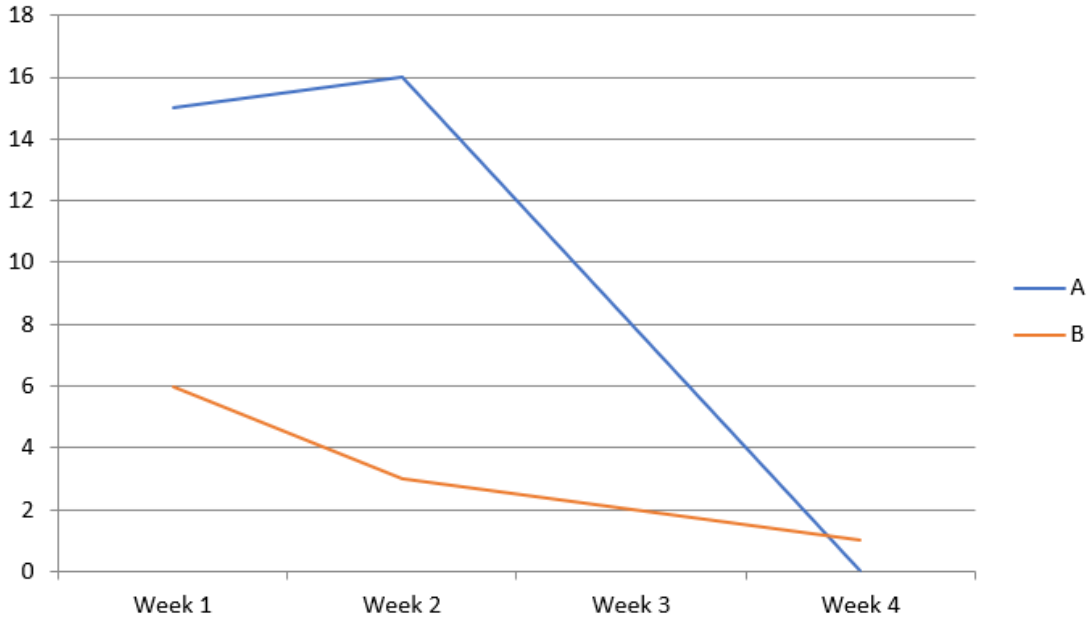

Figure 3: Post operative wound dehiscence (partial) in Groups A, B

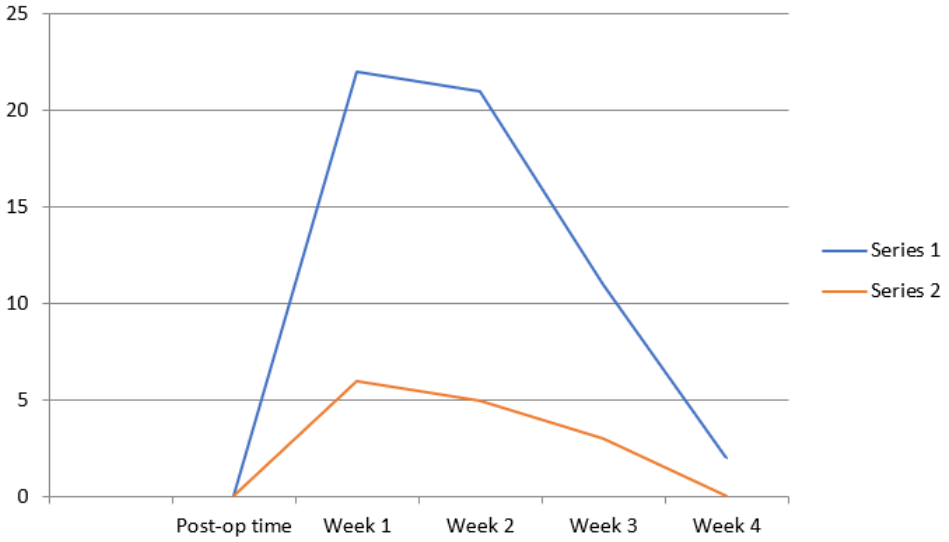

Figure 4: Post operative wound dehiscence (Complete) in Groups A, B

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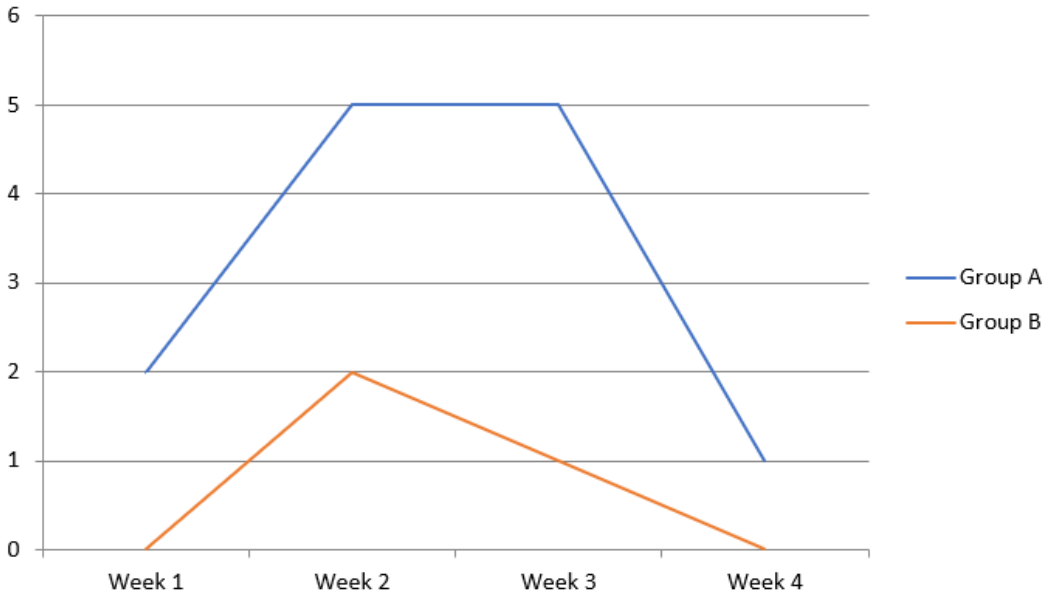

Figure 5: Line graph showing incidence of post-operative SSI in Groups A and B

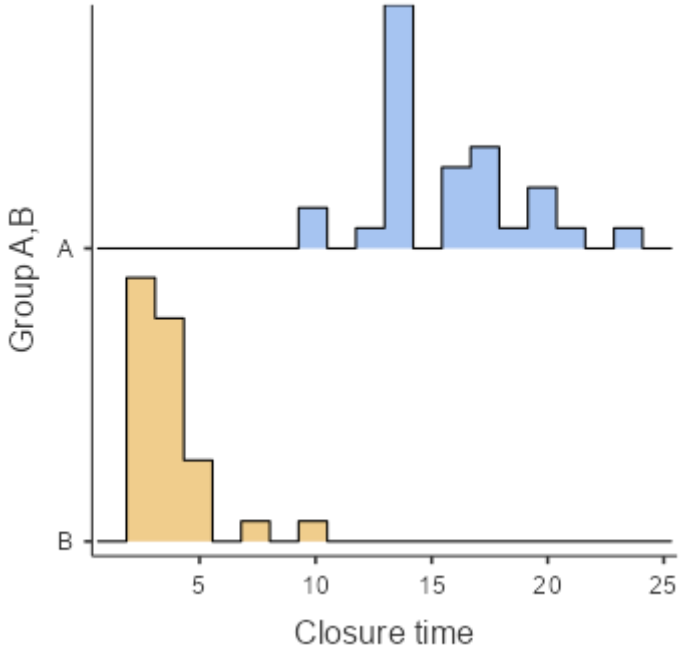

Figure 6: Histogram showing Intra-operative wound closure time in Groups A and B

DISCUSSION

Various techniques are employed by surgeons for wound closure like sutures, metallic clips, and adhesive tapes. An ideal should have be convenient handling, be timesaving,nbe easy to access, be convenient for the patient, and have a low chance ofninfection. Silk 1-0 is used frequently to close the abdominal incision in this study. This size of the silk suture (1-0) has good strength, does not give way in case of short ends and knots are secure. However, the downside is that being braided, it has inherent capillary action and allows tissue fluid through, therefore causing infections. Staplers are metallic, inert, and unfavourable for bacterial growth. Unlike sutures, staplers do not penetrate the underlying avascular

tissue. Furthermore, the rectangular shape of the staplers causes minimal trauma and minimum tissue reaction.

In this prospective study of 60 patients, undergoing emergency laparotomies due to blunt abdominal trauma, 30 patients had their abdominal skin incision closed with Silk 1-0 constituting group A. Staplers were used on another 30 patients to close the skin incision. The comparison in these groups was done on the following basis – wound dehiscence, Surgical site infection, Post-operative pain, Intra-operative time for wound closure and time taken for complete healing of the wound.

Both the groups were similar in terms of age, gender and blood parameters such as haemoglobin, total leucocyte count, C-reactive protein as well as the length of the abdominal incision.

The Post-operative pain score was assessed using VAS on post-operative day 0 and 1. In this study, the maximum pain score in the immediate postoperative period was significantly higher with the use of staplers, where patients had a maximum pain score of 10, compared to silk sutures, where the maximum pain score was 6. Similar results were reported by Sharma and Parashar, and Rajnesh where results where patients in the stapler group had more severe post-operative pain compared to the sutures group [13].

Another study by Rajnesh reported similar results. However a study by Bhushan KPS and Chandrashekhar, reported that 84 percent of patients had more pain with sutures [11].

In the present study, the incidence of the postoperative wound dehiscence was significantly higher with silk sutures than with staplers, for the first 3 weeks of the postoperative period. However, this difference was not significant in the 4th week of the postoperative period. Our results are in agreement with Vagholkar et al, who expressed wound dehiscence is significantly higher in number of patients in the sutures' group as compared to the staplers [12]. In contrast, Bhushan and Chandrashekhar, report that the post-operative dehiscence was significantly higher in the staplers group than sutures in emergency cases [11]. However, with silk sutures and staplers, Santosh Kumar et al, reported no differences in wound dehiscence [15] Anyanwu et al, also reported no wound dehiscence in either group [14]. Surgical site infection in the silk suture group was significantly more than the stapler group during the first 3 weeks of the postoperative period but this difference became statistically insignificant in the fourth week of the postoperative period. Out of the total 60 patients, 28 developed surgical site infection. *E. coli* was found in the cultures of 15 patients followed by *S. aureus* and *S.pneumonia* in 5 patients. Patients were treated with antibiotics such as intravenous ceftriazone, amikacin, metronidazole, piperacillin-tazobactum and linezolid depending upon sensitivity reporting. Pandove et all also reported an (12%) overall wound infection rate for silk sutures with none for the stapled group.[4] Similarly studies were reported by Oswal et al [16] and Batra J et all [17]. The time taken for abdominal closure is a very important step in surgeries. Increased surgery time can affect asepsis and thereby increasing the chances of wound infection along with the increased stress of anaesthesia and surgery on the patient. An important advantage of the use of staplers observed in this study is faster wound closure.

The mean time for intra-operative closure (15.5 +/- 3.14 min) with silk sutures remarkably higher than the mean time for staplers (3.83 +/- 1.62 minutes). Numerous other studies have shown similar results. Kangaye et al observed that staplers were six times faster than standard sutures.[18] PK Pandove et all, reported the mean time for stapler group to be 1 min 30 seconds and the mean time for silk sutures 2 min 55 seconds [4].

Kumar and Ranjan [15] and Anwaynu et al [14] had similar outcomes in their study as well with staplers outperforming silk sutures in the time taken to close the abdominal wound.

The time taken for complete healing was significantly lower in the use of staplers group (14.7 ± 4.82days) than silk sutures (19.1 ± 5.89 days. A study by Zainab B Abdulkareem et al, showed better and more complete healing process after the use of staplers compared to silk sutures on 21st post operative day based on histo-pathological findings [19] Valgohkar et al, reported shorter duration of hospital stay and better patient satisfaction with the use of staplers than sutures [12].

SUMMARY

- Post-operative pain score was more with the staplers than silk sutures

- The incidence of post-operative wound dehiscence was significantly higher with silk sutures than staplers
- Surgical site infection was more in silk sutures group than staplers
- Intra-operative time for wound closure is remarkably less with staplers
- Time taken for the complete healing of wound is significantly lower in the use of Staplers

CONCLUSION

Conflicting results have been reported in various studies with respect to patient outcomes in use of silk sutures and staplers. In this prospective study, it is clearly reiterated that the factors like intra-operative time for wound closure, incidence of Surgical site infection and the chance of wound dehiscence, along with the total time taken for wound healing, significantly favour staplers. However by the end of 4th week, the wound dehiscence and SSI in the two groups was not statistically significant. The immediate post-operative pain score however was found to be lesser with sutures than staplers. Therefore, it would be reasonable to conclude that staplers are a better technique for abdominal wound closurein emergency laparotomies due to blunt abdominal trauma.

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