

A Comparative Study of Wound Closure with Disposable Skin Stapler Versus Conventional Sutures

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ABSTRACT

Context: A variety of techniques and materials are available these days for wound apposition. The surgeon's preference of a particular technique and material for wound closure depends largely on the biomechanical properties of the material, tissue configuration and the trauma wound properties.

Aim: This study was conducted to study the relevant advantages & disadvantages offered by the skin stapler over the conventional skin suturing.

Methods and Material: The study was conducted on 150 cases undergoing clean and clean contaminated surgical procedures, divided into 3 groups (A,B,C), each consisting of 50 cases. Group A selected for Stapler closure, group B taken up for skin suturing with interrupted Silk suture (2-0) and group C with Ethilon (2-0).

Results: The mean length (cm) in Stapler group was 9.34 ± 5.62 and in Silk group, the mean length was 9.59 ± 4.92 and in Ethilon group was 9.36 ± 4.80 . Stapler group vs silk group was NS (not significant) ($t=0.2367$ and $p=0.8134$), Stapler group vs Ethilon group was also NS as $t=0.191$ and $p=0.9848$ and Silk group vs. Ethilon group was again NS as $t=0.2364$ and $p=0.8136$. In Stapler group, the mean number of staples was 11.88 ± 6.75 and in Silk group, the mean number of sutures was 8.096 ± 4.38 and in Ethilon group, the mean number of sutures was 7.8 ± 4.37 . Number of sutures compared for three groups statistically showed that Stapler group vs Silk group $t=3.3529$ and $p=0.0011$ was very significant, Stapler group vs Ethilon group $t=3.5827$ and $p=0.0005$ was extremely

significant and Silk group vs Ethilon group $t=0.2966$ and $p=0.7674$ NS. The mean time taken (in sec.) per staple was minimum with value of 7.4 ± 1.1 . Time taken for one suture of Silk (in sec.) was 22.3 ± 1.7 , and the time taken for one suture of Ethilon (in sec.) was 25.0 ± 3.4 .

Conclusion: Staples are best suited in emergencies, as trauma to the tissue is minimum and saves time. Otherwise overall results are comparable to suturing with Ethilon but definitely the Stapler and Ethilon are much better than silk sutures.

Keywords: Disposable Skin Stapler, Ethilon, Silk, Wound Closure.

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INTRODUCTION

Ideally, wound closure technique should provide skin apposition till healing occurs, prevent wound infection, provide equal strength throughout the length of the incision, have a good cosmetic result and should be easy and comfortable to use. An ideal wound closure material should be non-allergenic, easy to manufacture and use and cost effective.¹

The requirement of skin approximation by any method is that it should hold the skin edges in apposition for a sufficient length of time to allow the healing to occur.² The technique and material used for wound closure have a role in wound infection because the material acts as a foreign body and lead to a variable inflammatory response which compromise tissue blood supply

resulting in ischaemia. The interstices of braided suture may provide a nidus for pathogenic bacteria.³

As a general principle, the surgeon should use the finest atraumatic sutures that has adequate mechanical strength. The suture should be removed as early as possible to minimize scarring.³

The sutures can be classified into absorbable and non-absorbable sutures. Non absorbable sutures include Silk, Ethilon etc.⁴

Silk: It is braided to give greater tensile strength. It handles and ties well. Interrupted Silk sutures are considered as the gold standard for skin wound closure, although reliable yet conventional percutaneous interrupted Silk sutures are prone to

suffer from many disadvantages. Silk tends to swell on tissue implantation and the interstices of its braids tend to become infiltrated with tissue in growth and bacterial debris.³

Ethilon: It is synthetic monofilament suture material, black in colour, good memory so little difficult in handling. The knot security is low so one has to apply several knots.⁵

Stapler: It is faster, reliable, can be easily handled. The uniform staple shape and constant depth results in even wound tension.⁶

This study was conducted to study the relevant advantages & disadvantages offered by skin stapler over the conventional skin suturing.

MATERIALS AND METHODS

The cases were divided in three groups (A,B,C). Each group consisted of 50 patients.

Group A: Fifty cases undergoing clean and clean contaminated surgical procedures were selected for Staple closure.

Group B: During the same period, fifty cases of conventional skin suturing with interrupted Silk suture (2-0)

Group C: Fifty cases with Ethilon (2-0) material were taken for comparative study.

Cases expected to have intra-abdominal sepsis, for example; peritonitis were not selected for the study. The disposable skin stapler available in a sterilized packing was used for the procedure.

The cartridge was having 35 or 55 staples. A specially designed

extract or for removal of the staples was made available with the surgeon using stapler. Pre operatively same protocols were followed for the three groups.

Closure of the subcutaneous fat layer was only performed (using interrupted vicryl sutures) if this layer was more than 1 cm deep. In group A skin was closed by using stapler, in group B and C skin suturing was done with Silk (2-0) and with Ethilon (2-0) respectively as done in routine cases.

The steps followed to close the skin with staplers were as follows: The skin edges were cleaned with povidine iodine and dried. Skin edges were everted either by the surgeon himself or by the assistant, with dissecting forceps. After positioning the alignment indicator with incision line, trigger squeezed to release the staple. Care was taken to touch skin edges lightly with staple. Instrument withdrawn with backward motion. The time taken for wound closure was observed and recorded for all the three groups.

Wound was examined on second and third post-operative days and was examined the day before removal of stitches. The verbal response scale had four options for pain: no pain, mild pain, moderate pain, severe pain. It was used to assess the amount of pain associated with serous or pus discharge. Staples were removed with the help of specially designed extractor .The verbal response scale was also used to assess the amount of pain associated with the removal of skin slips or sutures. At 6th week after surgery wound was assessed for width, colour, cross-hatching, hypertrophy and overall result for cosmetic result.

Table 1: Showing comparison of mean time taken for wound closure, staple vs silk and staple vs ethilon suture.

	Stapler	Suture	z value	p value	Significance
Mean Time taken (Staple v/s silk suture)	7.4 ± 1.1	22.3 ± 1.7	51.4	<0.001	Highly significant
Mean Time taken (Staple v/s ethilon suture)	7.4 ± 1.1	25.0 ± 3.4	35.5	<0.001	Highly significant

Table 2: Showing postoperative skin wound discharge of stapler group vs silk group vs ethilon group

Type of discharge	Stapler (Group A)		Silk (Group B)		Ethilon (Group C)	
	No.	%age	No.	%age	No.	%age
Normal (no discharge)	47	94%	21	42%	32	64%
Serous discharge	3	6%	23	46%	17	34%
Purulent discharge	0	0%	6	12%	1	2%

Table 3(a): Showing cosmetic result in stapler and silk groups

Cosmetic appearance		Stapler (Group A)		Silk (Group B)		P value
		No.(%age)		No.(%age)		
Width of Scar	<2mm	43 (86%)		33 (66%)		0.050
	<3mm	6 (12%)		12 (24%)		
	<5mm	1 (2%)		5 (10%)		
Colour of Scar	Hypo pigmented	0 (0%)		4 (8%)		0.338
	Hyper pigmented	4 (8%)		3 (6%)		
Hypertrophy	Mild	3 (6%)		9 (18%)		0.002
	Moderate	0 (0%)		7 (14%)		
Cross Hatching	Absent	50 (100%)		8 (16%)		<0.001
	Present	0 (0%)		42 (84%)		

S = Significant; NS = Non Significant

Table 3(b): Showing cosmetic result in stapler and ethilon group

Cosmetic appearance		Stapler(Group A)	Ethilon(Group C)	P value
		No.(%age)	No.(%age)	
Width of Scar	<2mm	43 (86%)	46 (92%)	0.472
	<3mm	6 (12%)	4 (8%)	NS
	<5mm	1(2%)	0 (0%)	
Colour of Scar	Hypo pigmented	0 (0%)	24%	0.169
	Hyper pigmented	4 (8%)	0 (0%)	NS
Hypertrophy	Mild	3 (6%)	0 (0%)	0.366
	Moderate	0 (0%)	2 (4%)	NS
Cross Hatching	Absent	50 (100%)	40 (80%)	<0.001
	Present	0 (0%)	10 (20%)	S

S = Significant; NS = Non Significant

Table 4: Showing severity of pain during removal of stitching material in stapler vs silk group v/s ethilon group

Pain	Stapler (Group A)	Silk(Group B)	Ethilon (Group C)
	No.(%age)	No. (%age)	No. (%age)
No pain	26 (52%)	10 (20%)	33 (66%)
Mild pain	21 (42%)	26 (52%)	16 (32%)
Moderate pain	3 (6%)	0 (0%)	0 (0%)
Severe pain	0 (0%)	14 (28%)	1 (2%)
Total	50 (100%)	50 (100%)	50 (100%)

RESULTS

Maximum number of cases for Stapler group were between 41-50 years comprising of 30%. In Silk group the maximum number of cases was between 51-60 years i.e. 36% and in Ethilon group the maximum number was between 21-30 years and 51-60 years i.e. 28%. Male: Female ratio for Group A (Stapler) was 45:5, in group B (Silk) it was 41:9 and for Group C (Ethilon) it was 37:13.

The mean time taken to close the wound and mean number of sutures used, the mean time taken per staple / suture was calculated and is shown in Table 1. Table 1 shows the mean time taken per staple was minimum with value of 7.4 ± 1.1 . Time taken for one suture of Silk was 22.3 ± 1.7 , and the time taken for one suture of Ethilon was 25.0 ± 3.4 . The mean time per staple / suture so calculated was subjected to statistical analysis and inter group comparison was made and is presented in Table 1.

The wound in all the groups were inspected daily after removing the dressing from for any evidence of serous collection, infection, gaping, overlapping or any other complication. After examination of the wound the case was dealt with accordingly.

It was observed (Table 2) that wound healed without any discharge in Stapler group in 94% cases, 6% cases had serous discharge and no infection was reported in this group. In Ethilon group 64% wound healed without complication and there was serous discharge in 34% cases and one case (2%) got infected. In Silk group no complication was observed in 42% cases and serous discharge was observed in 46% cases and in 12% cases wound infection was reported.

On statistical analysis, the Stapler proved the best followed by Ethilon and then Silk. Stapler group vs Silk group was significant ($p < 0.001$) and Stapler group vs Ethilon group significant ($p < 0.001$).

The present study shows (Table 3a and 3b) width of scar was minimum in Stapler and Ethilon groups with 86% (Stapler) and 92% (Ethilon) the would healed having less than 2mm width where as in Silk group, 66% had scar less than 2 mm. Wound healed with wider scar in Silk group as compared to Stapler and Ethilon group as 24% subjects had scar more than 2mm but 10% subjects had more than 3mm but less than 5 mm.

The analysis between Stapler vs Silk groups ($p=0.050$) was significant. The comparison between Stapler group vs Ethilon group proved non-significant with p value 0.472.

The present study revealed a good cosmetic result as colour of scar is concerned in Stapler and Ethilon group in comparison to Silk group. Hyper pigmentation was seen in 3 cases (6%) of Silk group, 4 cases (8%) of Stapler group and hypopigmentation was seen in 4 cases (8%) of Silk group and 2 cases (4%) in Ethilon group. The analysis between Stapler vs Silk groups ($p=0.338$) Not significant. The comparison between Stapler vs Ethilon proved non-significant with p value 0.169.

As regards the appearance of the scar (Table 3a and 3b) it was normal in 96% (Ethilon group), 94% (Stapler group) and 68% (Silk group). Maximum hypertrophy mild to moderate was seen in Silk group in 16 cases, mild hypertrophy was observed in 3 cases (6%) in Stapler group. In Ethilon group there were 2 cases (4%) in which moderate hypertrophy was seen. The analysis between Stapler vs Silk groups ($p=0.002$) significant. The comparison between Stapler vs Ethilon proved non-significant with p value 0.366.

Cross hatching (Table 3a and 3b) was seen in 84% cases in Silk group, in Ethilon group, cross hatching in 20% cases but no cross hatching was seen in Stapler group. The analysis between Stapler

vs Silk groups was significant. (0% to 84% with $p < 0.001$) The comparison between Stapler vs Ethilon proved significant (0% to 20% with $p < 0.001$).

Table 4 shows that severe pain during removal of staples/sutures was observed in 28% cases in Silk group, in 2% cases in Ethilon group and none in Stapler group. Mild pain was observed in maximum cases (52%) in Silk group followed by Stapler group (42%) and Ethilon group (32%). Maximum number of cases without pain belonged to Ethilon group (66%) followed by Stapler group (52%) and in Silk group (20%).

The analysis between Stapler vs Silk groups ($p = 0.000$) were extremely significant. The comparison between Stapler vs Ethilon proved non-significant with p value 0.138

DISCUSSION

Ideally a suture should be strong and easy to handle. It should not be a nidus for infection, should be stretchable to accommodate wound edema and form secure knots. An ideal suture does not exist and the selection of the suture, for better outcomes, depends on weighing the pros and cons of any suture material.⁷

Both, for the patient and surgeon, the preference of any suture material would be guided by its easy handling, speedy wound closure, low complication rate, better patient comfort and compliance, less cost and good cosmetic result. Various techniques available for closure are interrupted/ continuous wound closure using different kinds of sutures, metallic clips and adhesive tapes. The choice of technique is determined by the nature of the surgery performed i.e. clean, clean contaminated, contaminated.⁸

In our study, the mean time was for the Stapler group was 90.62 ± 54.04 seconds and in the Silk group mean time was 175.38 ± 89.49 seconds and in Ethilon group, the mean time was 191.76 ± 102.58 seconds. One stapler took 7.4 ± 1.1 seconds for insertion, one Silk suture took 22.3 ± 1.7 seconds and one suture of Ethilon took 25 ± 3.4 seconds for insertion. It was highly significant between Stapler and Ethilon group as shown in Table 3 (b) with p value < 0.001 . So a significant reduction in time required for skin closure can be achieved by using the proximate stapler. Our study is in agreement with various authors^{8,9} as far as reduction in time of application of staples is concerned. In the studies by Karbhari with Bhavikatti, and Batra et al comparing staples with prolene sutures and staples with silk suture respectively, the time taken by staples for wound closure was significantly less.^{11,12} The study by Patel et al showed that time required for skin closure was minimum with Stapler.¹³ It therefore seems to be important in emergency procedure.

In the study, it was found that 47 cases (94%) in Stapler group healed without complication as compared to 21 cases (42%) in Silk group and 32 cases (64%) in Ethilon group. There was no infection in any of the cases where Stapler was used. One case got infected in group where Ethilon was used and in Silk group, 6 cases got infected. 3 cases in Stapler group developed serous collection whereas 23 cases in Silk group developed serous collection and in Ethilon, there were 17 cases in which serous collection was noticed. Skin staples, which are metallic and hence do not provide an environment conducive to bacterial growth also do not penetrate subsequently in the relatively avascular subcutaneous tissue plane. The overall wound infection rate in the sutured wound was 12 percent for silk and 2 percent for ethilon

compared with none for stapled group ($p < 0.01$). Ritechie and Rocke found no difference in rate of wound infection between the nylon suture and staple group.⁸ In the study by Smith et al, the wound infection was significantly greater after staple use in orthopaedic procedures.¹⁴

The cosmetic result was better with skin staples as the staples come in contact with skin only at the points of skin penetration leaving pinpoint marks as compared to transverse marks across the wound left by conventional sutures. Lubowski D and Hunt D demonstrated that cosmetic results in vertical wounds were almost equal for staples and sutures.¹⁵ Stokley and Elson showed increased complication rate with staple use when compared to vertical nylon mattress suture though there was similar cosmetic appearance of the scar in uncomplicated cases.¹⁶

The present study showed width of scar was minimum (i.e less than 2 mm width) in maximum number of cases in Stapler group (86% cases) and Ethilon group (92% cases), as compared to the Silk group (66% cases). The comparison between stapler group v/s silk group proved (significant) with p value 0.050.

Colour of the scar proved best in Ethilon group followed by Stapler group and Silk group. Hyper pigmentation was less in Silk group (6% cases) as compared to Stapler group (8% cases) with p value 0.338 (Non significant) and hypo pigmentation was more in Silk group (8% cases), as compared to Ethilon group (4% cases) and stapler group (0% cases) with p value of 0.027 (significant).

As regards the appearance of the scar (Table 3a and 3b) it was normal in Ethilon group (96%), Stapler group (94%) and Silk group (68%). Hypertrophy was maximum in Silk group (Mild 18% and moderate 14%), as compared to Stapler group (Mild 6% and moderate 0%) and ethilon group (Mild 0% and moderate 4%). The statistical analysis between Stapler group vs Silk group was (significant) with p value = 0.002. The comparison between Stapler group vs Ethilon group proved (non-significant) with p value 0.366.

Cross hatching (Table 3a and 3b) was more in Silk group (84% cases), as compared to Ethilon group (20% cases) and no cross hatching was seen in Stapler group (0% cases). The analysis between Stapler vs Silk groups was (significant) with p value < 0.001 . The comparison between Stapler vs Ethilon proved (significant) with p value < 0.001 . Eaton observed superior cosmetic results with staples if removed between 48-72 hrs.¹⁷

As regards pain during removal of staplers/sutures, pain was observed more in silk group (Mild pain 52%, Moderate pain 0%, severe pain 28% and No pain in 20%) than ethilon group (Mild pain 32%, Moderate pain 0%, severe pain 2% and No pain in 66%) and stapler group (Mild pain 42%, Moderate pain 6%, severe pain 0% and No pain in 52%). As far as pain on removal of sutures it was observed that lesser pain was present in ethilon group followed by stapler group and silk group. Gatt observed that painful removal of staples were a bit more in staple group as compared to polypropylene and poly glactin. Harvey and Logan did not find any significant difference in pain scores at day 2 or on suture removal.¹⁸ The pain during suture removal can be attributed to the fact that the staple is removed by pulling, leading to a dragging skin sensation.¹⁹ The study by Karbhari and Bhavikatti showed significantly higher pain during staple removal when compared with sutures.¹¹

Skin stapling was found suitable for use in busy accidents and emergency department because of simplicity, quickness and

safety despite being expensive.²⁰ Skin stapling in a pediatric group result, a decreased incidence of infection and a decrease in overall cost compared with suture. The use of disposable mechanical skin stapling device considerably hastens skin closure and gives a good cosmetic result but its cost is usually prohibitive. Orlinsky in their study showed that the average total cost per case was \$ 17.69 (with suture kit) and \$7.84 (without suture kit) for the stapler group compared with \$ 21.58 for suture group ($p < 0.0001$) for each. They concluded that stapling is less costly than suturing and that advantage appears to increase as laceration length increases.²¹ According to Gatt, though skin stapler is costly but this fact can be overlooked considering the ease and speed of skin stapler, provided disposable skin staplers are reused until empty.

CONCLUSION

We found Stapler a faster and convenient means of skin wound closure, with no wound infection. Also the ugly cross hatching of scar by the interrupted Silk suture is avoidable with the use of Stapler. It was observed and concluded that quality of wound is quite satisfying in stapled group except the discomfort experienced during removal as compared to Ethilon but the thing that worries the patient is its cost. On the other hand the results of closure with Ethilon are almost close to stapling except the time factor which is more for ethilon but patients were more comfortable with Ethilon and more over Ethilon is cost effective. Suturing with Silk resulted into more infection rate, cross hatching and scar formed is also not very satisfying.

Therefore, it is concluded that staples are best suited, as trauma to the tissue is minimum and it saves time more so in emergencies. Otherwise overall results are comparable to suturing with Ethilon but definitely the Stapler is much better than Silk sutures.

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