

A Comparative Analysis of Skin Closure in Surgical Wounds with Skin Stapler and Conventional Sutures: An Institutional Based Study

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ABSTRACT

Background: Skin closure is an important step in surgical wound management and has a direct effect on wound healing, postoperative discomfort, complication rates, cosmetic appearance, and patient satisfaction. Conventional suturing is widely used because of its precision and versatility, while skin staplers offer rapid wound approximation with minimal tissue handling. The choice of closure method remains important, especially in tertiary care hospitals where both operative efficiency and patient outcomes are significant considerations.

Aim: To comparatively analyze skin closure in surgical wounds with skin stapler and conventional sutures.

Material and Methods: This hospital-based comparative study was conducted among 78 patients undergoing elective or emergency surgical procedures requiring primary skin closure. Patients were divided into two groups of 39 each. In the stapler group, skin closure was performed using a skin stapler, while in the suture group, closure was done using conventional non-absorbable sutures. Demographic data, incision length, wound type, closure time, postoperative pain, patient comfort during removal, wound infection, wound discharge, wound dehiscence, seroma, hematoma, erythema/edema, and cosmetic outcome were recorded. Data were analyzed using SPSS version 16.0, and a p-value of less than 0.05 was considered statistically significant.

Results: The mean age was comparable between the stapler group and suture group (42.36 ± 12.48 years vs 43.18 ± 11.95 years; $p=0.742$). Mean incision length was also comparable (7.82 ± 2.14 cm vs 8.05 ± 2.36 cm; $p=0.631$). Mean closure time was significantly lower in the stapler group (3.48 ± 1.12

minutes) compared to the suture group (8.96 ± 2.34 minutes; $p<0.001$). Mild postoperative pain was more common in the stapler group (53.85% vs 35.90%; $p=0.041$), and comfortable removal was significantly higher (76.92% vs 56.41%; $p=0.048$). Wound complications were slightly lower in the stapler group but were not statistically significant. Excellent cosmetic outcome was significantly higher with staplers (46.15% vs 25.64%; $p=0.032$).

Conclusion: Skin staplers are a faster, comfortable, and cosmetically better method of surgical wound closure compared to conventional sutures, with comparable wound complication rates.

Keywords: Skin Stapler; Conventional Sutures; Surgical Wound Closure; Wound Complications; Cosmetic Outcome.

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INTRODUCTION

Surgical wound closure is one of the most important final steps of any operative procedure. Although it appears to be a simple technical act, proper skin closure has a major influence on wound healing, postoperative comfort, wound complications, scar formation, patient satisfaction, and overall surgical outcome. The basic aim of skin closure is to approximate the wound edges accurately without excessive tension, preserve tissue vascularity, prevent dead space, reduce contamination, and provide adequate mechanical support until natural healing gives sufficient tensile

strength to the wound. In daily surgical practice, the choice of skin closure technique is influenced by the type of surgery, site and length of incision, wound contamination, patient-related risk factors, surgeon preference, availability of material, cost, and expected cosmetic outcome.¹

Primary skin closure is commonly achieved by conventional sutures, skin staples, adhesive strips, tissue adhesives, or a combination of these methods. Among these, conventional suturing remains the most widely practiced and traditionally

accepted method of closure. Sutures allow precise approximation of skin edges and can be used in almost all types of surgical wounds. They are especially useful where accurate tissue handling is needed, such as irregular wounds, wounds under tension, or wounds in cosmetically sensitive areas. However, suturing is relatively time-consuming and requires technical skill. Excessive tissue handling, tight knots, foreign body reaction, and stitch marks may affect the final wound appearance. Suture closure may also increase operative time, especially in long surgical incisions or in busy emergency settings.²

Skin staplers were introduced as an alternative method for rapid approximation of skin edges. Staplers are commonly used for linear surgical wounds, particularly in abdominal, orthopedic, obstetric, emergency, and trauma-related procedures. They are easy to apply, require less operative time, and provide uniform spacing between wound edges. Since staples do not pass circumferentially through the tissue like sutures, they may cause less tissue strangulation when properly applied. Their rapid application can be particularly beneficial in long incisions, emergency operations, and high-volume tertiary care hospitals where operating room time is valuable. However, disadvantages of staplers include higher material cost, need for a staple remover, possible discomfort during removal, staple marks, and concerns regarding cosmetic appearance in certain anatomical sites.³

The healing of a surgical wound is a complex biological process involving inflammation, proliferation, collagen deposition, epithelialization, and remodelling. The closure technique does not act alone; wound healing is also affected by systemic factors such as age, nutrition, anemia, diabetes, obesity, immune status, smoking, infection, and medications such as steroids. Local factors such as incision site, wound contamination, tissue perfusion, hematoma, seroma, excessive tension, and postoperative wound care also play an important role. Therefore, comparison between staplers and sutures should assess not only closure time, but also postoperative pain, wound infection, discharge, dehiscence, seroma, hematoma, erythema, edema, patient comfort, ease of removal, cost-effectiveness, and cosmetic outcome.⁴

Surgical site infection remains one of the most important concerns after operative wound closure. Even when surgery is performed under aseptic precautions, postoperative wound complications can increase morbidity, prolong hospital stay, increase treatment cost, delay return to routine activity, and reduce patient satisfaction. Prevention of surgical site infection requires a comprehensive approach including proper patient preparation, skin antisepsis, antibiotic prophylaxis where indicated, gentle tissue handling, adequate hemostasis, avoidance of dead space, and appropriate closure technique. The method used for skin closure may influence wound edge perfusion, tissue reaction, drainage, and local inflammatory response, making it an important factor in postoperative wound assessment.⁵

Patient-centered outcomes are increasingly important in modern surgical practice. Apart from wound healing and infection, patients are concerned about postoperative pain, comfort during dressing and removal, mobility, scar appearance, and satisfaction with the final cosmetic result. A method that is faster for the surgeon may not always be better for the patient unless it also provides acceptable healing, comfort, and cosmesis. Similarly, a technically precise method may not be practical if it requires excessive

operative time or causes increased discomfort. Hence, comparison of skin staplers and conventional sutures should be multidimensional and should include both objective clinical outcomes and subjective patient-related outcomes.⁶

MATERIALS AND METHODS

This was a hospital-based comparative study designed to comparatively analyze skin closure in surgical wounds with skin stapler and conventional sutures. The main objective was to assess and compare the effectiveness, safety, cosmetic outcome, and postoperative wound-related complications of the two methods of skin closure. A total of 78 patients undergoing elective or emergency surgical procedures with clean or clean-contaminated wounds were included in the study. Patients were divided into two groups. In one group, skin closure was performed using a skin stapler, while in the other group, skin closure was done using conventional sutures. Patients were selected after applying the inclusion and exclusion criteria, and all eligible patients were included after obtaining informed consent.

Inclusion Criteria: Patients of either sex undergoing surgical procedures requiring primary skin closure were included in the study. Patients with clean and clean-contaminated surgical wounds, patients who were clinically stable for surgery, and patients willing to attend postoperative follow-up were considered eligible for inclusion.

Exclusion Criteria: Patients with grossly contaminated or infected wounds, traumatic wounds with extensive tissue loss, uncontrolled diabetes mellitus, immunocompromised status, bleeding disorders, severe anemia, malignancy involving the wound site, patients on long-term steroid therapy, and patients who did not give consent or were lost to follow-up were excluded from the study.

Methodology: The 78 patients were allocated into two groups for comparison. One group underwent skin closure with a skin stapler, and the other group underwent skin closure with conventional sutures. Both groups were assessed using the same postoperative parameters to ensure uniformity in comparison. The type of surgery, site of incision, length of incision, and condition of the wound were recorded in all patients.

All patients underwent surgery under appropriate anesthesia according to the nature of the surgical procedure. Standard aseptic precautions were followed in all cases. After completion of the operative procedure and closure of deeper layers, the skin was closed either with a disposable skin stapler or with conventional non-absorbable sutures, depending on the allocated group. In the stapler group, the skin edges were approximated and staples were applied at regular intervals. In the conventional suture group, skin closure was performed using interrupted sutures with proper approximation of wound edges. The time required for skin closure was recorded from the beginning of skin approximation to completion of closure.

The main parameters assessed in the study included time taken for skin closure, postoperative pain, wound infection, wound discharge, wound dehiscence, erythema, edema, hematoma, seroma formation, patient comfort, ease of removal, cost-effectiveness, and cosmetic outcome. The length of the incision and number of staples or sutures used were also recorded. Postoperative wound assessment was done clinically during follow-up visits.

The time taken for skin closure was measured in minutes using a stopwatch. Timing was started when skin approximation began and stopped after the last staple or suture was applied. The mean time taken for closure in both groups was compared to assess the rapidity of skin closure. Postoperative pain at the wound site was assessed using a visual analogue scale or clinical pain grading. Pain was evaluated during the early postoperative period and at the time of staple or suture removal. The requirement of analgesics and patient discomfort during wound care were also noted. All patients were examined for wound-related complications such as redness, swelling, discharge, infection, gaping, seroma, hematoma, and wound dehiscence. Wound infection was diagnosed clinically by the presence of purulent discharge, local rise of temperature, tenderness, erythema, or positive culture wherever required. Any complication observed during follow-up was documented and compared between the two groups.

Cosmetic outcome was assessed after wound healing by observing scar appearance, wound edge approximation, presence of stitch marks or staple marks, pigmentation, hypertrophy, and patient satisfaction. Cosmetic results were graded as excellent, good, fair, or poor based on clinical assessment and patient opinion.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using SPSS. Quantitative variables such as age, incision length, and wound closure time were expressed as mean and standard deviation. Qualitative variables such as sex, type of wound, wound infection, wound dehiscence, and cosmetic outcome were expressed as frequencies and percentages. The Chi-square test or Fisher's exact test was used for comparison of categorical variables, while the Student's t-test was used for comparison of continuous variables between the two groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic profile of patients in both groups was comparable. The mean age in the stapler group was 42.36 ± 12.48 years, while in the suture group it was 43.18 ± 11.95 years, with a p-value of 0.742, indicating no statistically significant difference. In terms of gender distribution, males constituted 61.54% in the stapler group and 56.41% in the suture group, while females accounted for 38.46% and 43.59%, respectively. The p-value of 0.648 indicates no significant difference between the groups. (Table 1)

The operative and wound-related parameters were similar in both groups except for the time required for closure. The mean incision length in the stapler group (7.82 ± 2.14 cm) was comparable to that in the suture group (8.05 ± 2.36 cm), with a p-value of 0.631, indicating no statistically significant difference. Regarding wound type, 66.67% of patients in the stapler group had clean wounds compared to 61.54% in the suture group, while clean-contaminated wounds were present in 33.33% and 38.46%, respectively. The p-value of 0.639 shows no significant difference, confirming uniform distribution of wound types. However, a highly significant difference was observed in the mean closure time. The stapler group required 3.48 ± 1.12 minutes, whereas the suture group required 8.96 ± 2.34 minutes, with a p-value of <0.001. (Table 2)

Postoperative pain was notably lower in the stapler group. Mild pain was reported in 53.85% of patients in the stapler group compared to 35.90% in the suture group, and this difference was statistically significant with a p-value of 0.041. Conversely, moderate and severe pain were more common in the suture group (46.15% and 17.95%, respectively) compared to the stapler group (35.90% and 10.26%). Patient comfort during removal was also significantly better in the stapler group, with 76.92% of patients reporting comfortable removal compared to 56.41% in the suture group (p-value 0.048). (Table 3)

Postoperative wound complications were observed in both groups, but the differences were not statistically significant. Wound infection occurred in 7.69% of patients in the stapler group and 12.82% in the suture group ($p = 0.455$). Similarly, wound discharge was seen in 10.26% versus 15.38% ($p = 0.499$), and wound dehiscence in 5.13% versus 7.69% ($p = 0.643$) in the stapler and suture groups, respectively. Other complications such as seroma (5.13% vs 10.26%, $p = 0.396$), hematoma (2.56% vs 5.13%, $p = 0.554$), and erythema/edema (12.82% vs 20.51%, $p = 0.358$) were also slightly higher in the suture group, but none of these differences reached statistical significance. (Table 4)

Cosmetic outcome was significantly better in the stapler group. An excellent cosmetic result was achieved in 46.15% of patients in the stapler group compared to 25.64% in the suture group, with a statistically significant p-value of 0.032. The proportion of patients with a "good" outcome was slightly higher in the suture group (41.03%) compared to the stapler group (35.90%). However, fair and poor outcomes were more common in the suture group (20.51% and 12.82%) than in the stapler group (12.82% and 5.13%). (Table 5)

Table 1: Distribution of Patients According to Demographic Characteristics

Variable	Stapler Group (n=39)	Suture Group (n=39)	p-value
Mean Age (years)	42.36 ± 12.48	43.18 ± 11.95	0.742
Male	24 (61.54%)	22 (56.41%)	0.648
Female	15 (38.46%)	17 (43.59%)	—

Table 2: Comparison of Operative and Wound Characteristics

Parameter	Stapler Group (n=39)	Suture Group (n=39)	p-value
Mean Incision Length (cm)	7.82 ± 2.14	8.05 ± 2.36	0.631
Clean Wounds	26 (66.67%)	24 (61.54%)	0.639
Clean-contaminated Wounds	13 (33.33%)	15 (38.46%)	—
Mean Closure Time (minutes)	3.48 ± 1.12	8.96 ± 2.34	<0.001

Table 3: Comparison of Postoperative Pain and Comfort

Parameter	Stapler Group (n=39)	Suture Group (n=39)	p-value
Mild Pain	21 (53.85%)	14 (35.90%)	0.041
Moderate Pain	14 (35.90%)	18 (46.15%)	—
Severe Pain	4 (10.26%)	7 (17.95%)	—
Comfortable Removal	30 (76.92%)	22 (56.41%)	0.048

Table 4: Comparison of Postoperative Wound Complications

Complication	Stapler Group (n=39)	Suture Group (n=39)	p-value
Wound Infection	3 (7.69%)	5 (12.82%)	0.455
Wound Discharge	4 (10.26%)	6 (15.38%)	0.499
Wound Dehiscence	2 (5.13%)	3 (7.69%)	0.643
Seroma	2 (5.13%)	4 (10.26%)	0.396
Hematoma	1 (2.56%)	2 (5.13%)	0.554
Erythema/Edema	5 (12.82%)	8 (20.51%)	0.358

Table 5: Comparison of Cosmetic Outcome

Cosmetic Grade	Stapler Group (n=39)	Suture Group (n=39)	p-value
Excellent	18 (46.15%)	10 (25.64%)	0.032
Good	14 (35.90%)	16 (41.03%)	
Fair	5 (12.82%)	8 (20.51%)	
Poor	2 (5.13%)	5 (12.82%)	

DISCUSSION

In the present study, both groups were demographically comparable, as the mean age was 42.36 ± 12.48 years in the stapler group and 43.18 ± 11.95 years in the suture group, with no significant difference ($p=0.742$). Male patients were 61.54% in the stapler group and 56.41% in the suture group ($p=0.648$), while females were 38.46% and 43.59%, respectively. This similarity between groups strengthens the validity of comparison because age and sex may influence wound healing. Chughtai et al. (2000), in a randomized clinical trial of 162 CABG patients, also compared skin clips with subcuticular sutures after ensuring comparable clinical groups; however, they found better wound outcomes with subcuticular sutures, including significantly higher sternal wound infection with clips ($p=0.05$), while cosmetic outcome was similar between groups.⁷ In the present study, incision length was also comparable between the two groups, with mean incision length of 7.82 ± 2.14 cm in the stapler group and 8.05 ± 2.36 cm in the suture group ($p=0.631$). Clean wounds were present in 66.67% of stapler cases and 61.54% of suture cases, while clean-contaminated wounds were 33.33% and 38.46%, respectively ($p=0.639$). Similarly, Batra et al. (2016), in a randomized prospective study on head and neck cancer surgery, reported comparable mean incision length between the suture group and stapler group (54 ± 16.3 cm vs 53.7 ± 15.4 cm; $p=0.95$), confirming that outcome differences were not due to unequal wound size.⁸

The most important advantage of staplers in the present study was the marked reduction in skin closure time. The mean closure time was 3.48 ± 1.12 minutes in the stapler group compared with 8.96 ± 2.34 minutes in the suture group, and this difference was highly significant ($p<0.001$). This finding is supported by Hemming et al. (2013), who reviewed evidence across surgical specialties and reported that staples consistently reduced operating time, with reductions ranging from 1.5 minutes to 14 minutes depending on

the type of procedure. Thus, the present study supports the established view that staplers provide a clear time-saving advantage in surgical wound closure.⁹

Postoperative pain was lower in the stapler group in the present study. Mild pain was reported in 53.85% of stapler patients compared with 35.90% of suture patients ($p=0.041$), while moderate pain was 35.90% versus 46.15%, and severe pain was 10.26% versus 17.95%, respectively. Aabakke et al. (2013), in a randomized trial in which each woman acted as her own control after caesarean delivery, also reported that patients preferred the stapled side of the scar compared with the subcuticular suture side at follow-up, supporting better patient acceptability with staples in selected cases.¹⁰

Patient comfort during removal was significantly better in the present stapler group, with comfortable removal reported by 76.92% of patients compared with 56.41% in the suture group ($p=0.048$). Murphy et al. (2004), in a prospective randomized orthopaedic wound closure study, also found no significant difference in wound healing or cosmesis between clips and sutures, but clip removal was reported to be quicker and less painful than suture removal. This finding is similar to the present study, where staplers were associated with better comfort during removal.¹¹

In the present study, wound infection was slightly lower in the stapler group, occurring in 7.69% compared with 12.82% in the suture group, although the difference was not statistically significant ($p=0.455$). Wound discharge was also lower in the stapler group (10.26% vs 15.38%; $p=0.499$). Iavazzo et al. (2011), in a meta-analysis of randomized controlled trials involving 2111 patients, reported that staples were associated with fewer wound infections compared with sutures in the evaluated surgical wounds, although they also noted that pain and cosmetic assessment required more objective evaluation.¹² Other wound complications in the present study, including wound dehiscence

(5.13% vs 7.69%; $p=0.643$), seroma (5.13% vs 10.26%; $p=0.396$), hematoma (2.56% vs 5.13%; $p=0.554$), and erythema/edema (12.82% vs 20.51%; $p=0.358$), were all lower in the stapler group but statistically insignificant. Smith et al. (2010), in a meta-analysis of orthopaedic surgery, reported a different finding, with superficial wound infection being more than three times higher after staple closure than suture closure. This contrast suggests that the risk of complications may vary according to operative site, wound type, patient risk factors, and surgical specialty.¹³ The present study showed significantly better cosmetic outcome with staplers, as excellent cosmetic results were seen in 46.15% of stapler patients compared with 25.64% of suture patients ($p=0.032$). Fair and poor outcomes were more frequent in the suture group (20.51% and 12.82%) than in the stapler group (12.82% and 5.13%). Sharma et al. (2014), in a randomized controlled trial of 130 women undergoing emergency caesarean section, also reported significantly better cosmetic outcome with staples, with better Patient Scar Assessment Scale and Observer Scar Assessment Scale scores ($p=0.022$ and $p=0.000$, respectively), along with shorter surgery duration (24 minutes vs 32 minutes; $p=0.000$).¹⁴ Overall, the present study found that staplers were superior to conventional sutures in terms of closure time, postoperative pain, comfort during removal, and cosmetic outcome, while wound complications were comparable between the two groups. Imamura et al. (2016), in a multicenter randomized trial of open abdominal surgery, found superficial surgical site infection in 25 of 198 patients in the suture group and 27 of 201 patients in the staple group, showing comparable infection rates between the two techniques. This supports the present observation that staplers can provide faster closure and better patient-related outcomes without a significant increase in wound complications.¹⁵

CONCLUSION

Skin staplers were found to be a faster and more convenient method of surgical skin closure compared to conventional sutures. The stapler group showed significantly reduced closure time, lower postoperative pain, better comfort during removal, and superior cosmetic outcome. Wound complications were slightly lower in the stapler group, although the difference was not statistically significant. Thus, skin staplers can be considered an effective and safe alternative to conventional sutures for closure of suitable surgical wounds.

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