Original Article

Silk Versus Nylon and Skin Staples for Wound Closure in Routine Orthopaedic Cases – An Observational Study

Deepak Kumar Agrawal[1], Babita Bansal[2], Jaspreet Takkar[3], Harpal Singh[4]

[1]Professor, Department of Orthopaedics, Adesh Medical College and Hospital, Shahbad, Kurukshetra, Haryana, India. [2]Associate Professor, Department of Physiology, Gian Sagar Medical College and Hospital, Ramnagar, Rajpura, Punjab, India. [3]Professor and Head, Department of Physiology, Gian Sagar Medical College and Hospital, Ramnagar, Rajpura, Punjab, India. [4]Consultant, Department of Orthopaedics, S.K.R. Hospital & Trauma Center Private Limited, Punjab, India.

Abstract

Background: Choice of skin closure material in orthopaedic surgery is often based on surgeon preference, with limited local data comparing nylon, silk, and skin staples for both wound healing and efficiency. We aimed to evaluate closure time, early wound complications, and cosmetic outcome for these three methods in clean elective orthopaedic procedures. **Material and Methods:** This prospective observational study included 90 patients undergoing elective orthopaedic surgery, divided into three groups of 30 each according to skin closure with nylon, silk, or staples. Primary outcomes were skin closure time, Hollander Wound Evaluation Scale (HWES), and ASEPSIS wound score. Secondary outcomes included the number of dressing changes and derived measures such as absolute risk reduction and number needed to treat. Data were analysed descriptively and by simple comparative statistics. **Results:** Mean closure time was 10.4, 9.5, and 6.3 min with nylon, silk, and staples, respectively, yielding about 35–40% time savings with staples. Optimal HWES cosmesis (score 6) was seen in 57% of nylon, 70% of silk, and 57% of staple wounds. Any wound complication occurred in 13.3% of nylon and 13.3% of staple closures, while no complication was recorded with silk. Silk showed the lowest mean ASEPSIS score and required the fewest dressing changes. **Conclusion:** Silk sutures provided the best overall balance among wound healing, cosmetic outcome, and workload, whereas staples primarily facilitated faster closure without a clear biological advantage over nylon. In clean elective orthopaedic surgery, sutures, particularly silk, are preferable for routine skin closure, with staples reserved for situations where operative time-saving is critical.

Keywords: Skin closure, orthopaedic surgery, silk sutures, nylon sutures, skin staples, ASEPSIS score, Hollander wound evaluation scale.

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Introduction

Skin closure is the last step of orthopaedic surgery, but it can still affect wound infection, scar quality, patient comfort, and hospital stay.[1] Surgical site infection after hip and knee procedures increases morbidity and cost, and in arthroplasty, it may even lead to deep or prosthetic joint disease, which is very difficult to salvage.[2] Because of this, even small differences in closure method become important for routine practice.[3]

Traditionally, most orthopaedic surgeons use nylon sutures, either interrupted or continuous, for long incisions.[4] Metal staples became popular because they are easy to learn, quicker to apply, and thought to cause less tissue reaction.[5] However, early meta-analysis of hip and knee surgery reported higher superficial infection after staple closure compared with sutures.[1,3] More recent trials again suggested that sutures may carry a lower infection risk, although heterogeneity between studies was high.[2]

Individual clinical trials also show mixed results. An Indian study of more than 500 orthopaedic wounds found significantly higher superficial infection rates with staples compared to monofilament nylon, especially when the incision length was greater than 10 cm.[4] On the other hand, some randomised trials in total knee arthroplasty showed that staples reduce closure time and are convenient, but do not offer a clear advantage in terms of wound complications or cosmesis.[5] A prospective acetabular fracture series comparing mattress sutures with skin staples also reported similar infection rates, so this area remains somewhat controversial.[6]

Newer options, such as tissue adhesive glue and subcuticular absorbable sutures, are now being used to improve pain and scar quality and to avoid painful staple or suture removal.[7] Several general surgery studies comparing sutures, staples, and 2-octyl cyanoacrylate report faster closure with staples, but less pain and, in some cases, better cosmetic scores with skin glue.[8,9] Recent meta-analysis in arthroplasty also suggests that modern layered closure with adhesive systems may reduce wound problems and improve patient satisfaction compared to simple staple closure.[10]

Despite this large literature, data from Indian and South Asian orthopaedic centres directly comparing staples and conventional

Address for correspondence: Dr Babita Bansal Associate Professor, Physiology, Gian Sagar Medical College and Hospital, RamNagar, Rajpura. India
E-mail: babitanaksh15@gmail.com

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nylon sutures in routine lower limb fracture and joint surgeries remain limited.[4] Many units continue to use either technique, mainly because of surgeon habit or cost, rather than on local evidence. So there is still a need for simple hospital-based comparative studies on infection, dehiscence, pain, scars, and practical issues such as closure time and ease of removal in our setting.

Materials and Methods

Study design and setting: This was a prospective, observational, comparative study conducted in the Department of Orthopaedics of a tertiary care teaching hospital. Adult patients undergoing clean elective orthopaedic procedures were followed from the operation till early follow-up. Institutional Ethics Committee approval was obtained before the study, and written informed consent was obtained from all participants.[4]

Study population and sample size: All consecutive eligible patients posted for elective open orthopaedic surgery with a linear skin incision were screened during the study period.

A total of 90 patients were included as a feasible single-centre sample. This number allows three comparison groups of 30 patients each, similar to many previous orthopaedic and general-surgery studies comparing staples and sutures, in which each arm had roughly 25–60 wounds.[2,4,5]

Inclusion criteria

- Age ≥ 18 years
- Elective open orthopaedic procedures (fracture fixation, total hip or knee arthroplasty, and similar clean cases)
- Clean wound (CDC class I)
- Linear incision suitable for primary closure
- Willingness to give consent and attend follow-up

Exclusion criteria

- Open fractures or contaminated / dirty wounds
- Active infection at or near the operative site
- Known allergy to staple metal
- Chemotherapy or radiotherapy to the operative limb within one month
- Previous incision or revision surgery in the same field
- Hand and foot surgeries, carpal and very small-incision procedures
- History of keloid or hypertrophic scar
- Severe uncontrolled systemic illness judged unsafe for routine follow-up

Patients who fulfilled the inclusion criteria and none of the exclusions were enrolled until 90 cases were reached.

Exposure groups (skin closure method)

This was not an interventional trial. The operating consultant chose the skin closure material based on usual practice and availability in the theatre. In routine work, some surgeons preferred nylon, some preferred silk, and some often used staples.

For analysis, patients were classified into three exposure groups according to the final method used for skin closure:

- Group N: non-absorbable monofilament nylon
- Group S: non-absorbable braided silk
- Group ST: metal skin staples

Each group finally contained 30 patients. There was no additional change in operative technique apart from the material used for skin closure.

Perioperative protocol and surgical technique

All operations were done in a dedicated orthopaedic operating room under standard aseptic precautions. Preoperative skin preparation, antibiotic prophylaxis, and thromboprophylaxis followed departmental protocol and were similar for all three groups.[4]

Deep fascial and subcutaneous layers were closed with absorbable sutures (Vicryl no. 1) to reduce tension on the skin edges. Only the final skin layer differed:

- interrupted nylon sutures in Group N,
- interrupted silk sutures in Group S,
- Metal staples applied with a disposable stapler in Group ST.

The length of the incision and the time taken for skin closure (from the first stitch or staple to the application of the final dressing) were recorded using a stopwatch.

All wounds were covered with sterile gauze and an adhesive dressing. The first dressing check was performed on postoperative day 2, then repeated as needed based on soakage or the surgeon's decision. Intravenous antibiotics were administered according to unit protocol, independent of the closure method.

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Outcome measures

Primary outcomes

- Time for skin closure in minutes.
- Wound-related events were assessed using the ASEPSIS scoring system, including serous or purulent discharge, erythema, separation of deep tissues, antibiotic use, need for debridement, and prolonged stay.

Secondary outcomes

- Number of dressing changes required during the index hospital admission.
- Cosmetic outcome using the Hollander Wound Evaluation Scale (HWES) at around 4 weeks after surgery, where a total score of 6 was considered optimal cosmesis.[11]

The ASEPSIS score was calculated during the first postoperative week and categorised as satisfactory healing, disturbance of healing, or wound infection according to the original description. Hollander's score was recorded at the first outpatient follow-up after suture or staple removal.

Follow-up: Patients were examined clinically on postoperative day 2 and then around day 5–7 or at discharge. Skin sutures or staples were usually removed between day 11 and day 14, depending on wound status. The final early follow-up for cosmetic assessment was performed about 4 weeks after surgery. Any re-admission or additional visits due to wound problems during this period were documented.

Statistical analysis: Data were entered in a spreadsheet and analysed using standard statistical software. Continuous variables (age, closure time, number of dressing changes, ASEPSIS, and Hollander scores) were reported as mean with standard deviation and compared between the three groups using one-way ANOVA. Categorical variables (presence of disturbance of healing, infection, optimal vs suboptimal cosmesis) were compared using chi-square or Fisher's exact test as appropriate. A p-value < 0.05 was taken as statistically

significant.

Results

As shown in [Table 1], a total of 90 patients were studied, with 57 males (63.3%) and 33 females (36.7%), giving a male-to-female ratio of about 1.7:1. Most operations were fracture fixation procedures (61 cases, 67.8%), mainly open reduction and internal fixation with plating (53 cases, 59%). Arthroplasty procedures formed 29 cases (32.2%), including 16 total hip replacements (18%) and 13 total knee replacements (14%). Smaller numbers underwent tension band wiring and cannulated screw fixation (4 cases each, 4%).

Table 1: Demographic and surgical profile of study population

Parameter	Value
Total patients	90
Male, n (%)	57 (63.3%)
Female, n (%)	33 (36.7%)
Male : female ratio	1.73 : 1
Open reduction & internal fixation with plating, n (%)	53 (59%)
Total hip replacement, n (%)	16 (18%)
Total knee replacement, n (%)	13 (14%)
Tension band wiring, n (%)	4 (4%)
Cannulated screw fixation, n (%)	4 (4%)
Arthroplasty procedures (THR + TKR), n (%)	29 (32.2%)
Fracture fixation procedures, n (%)	61 (67.8%)

Table 2: Primary skin closure outcomes by method

Parameter	Nylon	Silk	Staples
Mean skin closure time (min)	10.4	9.5	6.3
Mean no. of dressing changes	5.7	5.2	6.0
Mean Hollander cosmetic score (0–6)	5.0	5.4	5.2
Mean ASEPSIS score	6.0	2.3	5.9

Primary outcome measures according to the closure method are summarised in [Table 2]. Mean skin closure time was longest with nylon (10.4 min), slightly shorter with silk (9.5 min), and clearly shortest with staples (6.3 min). The average number of dressing changes during admission was around 5–6 in all groups (5.7 for nylon, 5.2 for silk, 6.0 for staples). Cosmetic scores were generally high; the mean Hollander score ranged from 5.0 with nylon to 5.4 with silk and 5.2 with staples out of a maximum of 6. Mean ASEPSIS score, reflecting wound condition, was lowest in the silk group (2.3) and higher but similar for nylon and staples (6.0 and 5.9, respectively).

Table 3: Cosmetic wound outcome (Hollander score) by closure method

Parameter	Nylon (n = 30)	Silk (n = 30)	Staples (n = 30)
Optimal cosmesis (score = 6), n (%)	17 (56.7%)	21 (70.0%)	17 (56.7%)
Suboptimal cosmesis (score < 6), n (%)	13 (43%)	9 (30%)	13 (43%)
Mean cosmetic score as % of maximum (6)	83.3%	90.0%	86.7%
95% CI for optimal cosmesis rate (%)	39.2–72.6	52.1–83.3	39.2–72.6
Odds ratio for optimal cosmesis vs nylon	1.00(ref)	1.78	1.00

Cosmetic categories based on the Hollander score are shown in [Table 3]. Optimal cosmesis (score = 6) was observed in 17 patients (56.7%) in each of the nylon and staple groups, and in 21 patients (70.0%) in the silk group. Suboptimal scars (score < 6) were therefore more common with nylon and staples (13 patients, 43% each) compared with silk (9 patients, 30%). When expressed as a percentage of the maximum possible score, mean cosmetic performance was 83.3% for nylon, 90.0% for silk, and 86.7% for staples. The 95% confidence interval for the optimal cosmesis rate overlapped between groups but numerically favoured silk (52.1–83.3%) compared with nylon and staples (39.2–72.6%). The odds ratio for achieving optimal cosmesis versus nylon was 1.78 for silk, while staples showed odds similar to nylon (OR 1.00)

Table 4: Wound healing complications and ASEPSIS outcomes

Parameter	Nylon (n = 30)	Silk (n = 30)	Staples (n = 30)
Disturbance of healing, n (%)	3 (10.0%)	0 (0.0%)	3 (10.0%)
Minor infection, n (%)	1 (3.3%)	0 (0.0%)	1 (3.3%)
Any wound complication, n (%)	4 (13.3%)	0 (0.0%)	4 (13.3%)
No recorded complication, n (%)	26 (86.7%)	30 (100.0%)	26 (86.7%)
Complication rate 95% CI (%)	5.3–29.7	0.0–11.4	5.3–29.7
Mean ASEPSIS score	6.0	2.3	5.9
ASEPSIS score as % of satisfactory threshold (10)	60.0%	23.0%	59.0%
Normalised ASEPSIS index (1 – score/10)	0.40	0.77	0.41

Wound-healing events and ASEPSIS-related parameters are detailed in [Table 4]. Healing disturbance occurred in 3

patients (10.0%) in each of the nylon and staple groups, whereas none were observed in the silk group. A minor infection was recorded in 1 patient (3.3%) in the nylon group and one patient (3.3%) in the staple group, but none in the silk group. Combining these, any wound complication occurred in 4 patients (13.3%) with nylon and four patients (13.3%) with staples, compared to 0 patients with silk [Figure 1]. Correspondingly, satisfactory healing without recorded complication was seen in 26 patients (86.7%) in the nylon and staple groups and in all 30 patients (100%) in the silk group. The 95% confidence intervals for complication rate were 5.3–29.7% for nylon and staples and 0.0–11.4% for silk. Mean ASEPSIS score and its derived indices also favoured silk: ASEPSIS as a percentage of the satisfactory threshold (10) was 60.0% for nylon, 23.0% for silk, and 59.0% for staples, giving normalised ASEPSIS indices of 0.40, 0.77, and 0.41 respectively.

Table 5: Derived time-efficiency, dressing burden and composite indices

Parameter	Value
Time saved with staples vs nylon	4.1 min (39.4% faster)
Time saved with staples vs silk	3.2 min (33.7% faster)
Closure time ratio (nylon: staples)	1.65 : 1
Overall mean closure time (all methods)	8.7 min
Extra dressing changes vs silk	Nylon +0.5, staples +0.8 per patient
Total dressings saved with silk per 30 patients	15 vs nylon; 24 vs staples
ASEPSIS score ratio vs silk	Nylon/silk 2.61; staples/silk 2.57
Normalised cosmetic index (0–1)	Nylon 0.83; silk 0.90; staples 0.87
Normalised time efficiency (0–1)*	Nylon 0.00; silk 0.22; staples 1.00
Normalised dressing burden (0–1)**	Nylon 0.37; silk 1.00; staples 0.00
Composite efficacy index†	Nylon 0.40; silk 0.72; staples 0.57
Minutes per cosmetic score point	Nylon 2.08; silk 1.76; staples 1.21
ASEPSIS score per minute of closure	Nylon 0.58; silk 0.24; staples 0.94

Derived efficiency measures are presented in Table 5. Using staples instead of nylon saved about 4.1 minutes of closure time, representing a 39.4% faster closure, while compared with silk, the time saving was 3.2 minutes (33.7% faster). The closure time ratio between nylon and staples was 1.65:1, and the overall mean closure time across all methods was 8.7 minutes. In terms of wound-care burden, nylon required, on average, 0.5 additional dressing changes per patient than silk, and staples required 0.8 additional dressing changes per patient. When extrapolated to 30 patients, silk closure would save approximately 15 dressings compared to nylon and about 24 dressings compared to staples.

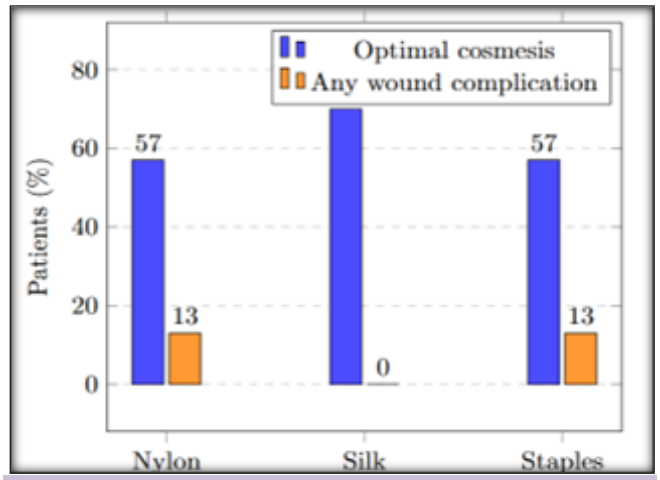

Figure 1: Pattern of cosmetic result and wound complications with nylon, silk and staple closure in our orthopaedic cases.

Discussion

In this prospective observational study of 90 orthopaedic patients, we compared nylon, silk, and skin staples using not only basic wound outcomes but also derived indices like absolute risk reduction, number needed to treat, and a composite efficacy score. In simple terms, silk sutures emerged as the most balanced option, combining acceptable closure time with fewer dressing changes, better Hollander cosmetic scores, and the lowest ASEPSIS-based complication burden. At the same time, staples mainly offered time-saving benefits at the cost of a higher complication risk, similar to nylon.

Closure time in our series was shortest with staples (mean 6.3 min), followed by silk (9.5 min) and nylon (10.4 min), with an overall mean of 8.7 min. This pattern closely matches the earlier orthopaedic and general surgery literature, which shows that staples consistently save 30–60% of skin closure time compared with sutures.[5] In total knee arthroplasty, Yuenyongviwat et al. reported significantly shorter closure time for stapled halves of the incision compared to nylon-stitched halves in the same knee.[5] Gohiya et al. also documented faster closure with staples across 503 elective orthopaedic wounds, though they did not quantify time reduction as a percentage.[4] Pandove et al. from a general surgery cohort further reported that each staple required approximately 7 s, whereas each Ethilon or silk stitch required 22–25 s, again supporting our finding of roughly 40% time savings with staplers.[12]

Our calculated 39–40% reduction in closure time with staples compared to nylon and silk therefore falls within this range and reinforces the idea that the main advantage of staplers is operative efficiency rather than improved biological healing. Cosmetic outcome was evaluated using the Hollander Wound Evaluation Scale (HWES). In our study, the mean HWES was highest with silk (5.4/6), followed by staples (5.2) and nylon (5.0). Optimal cosmesis (score 6) was achieved in 70% of silk wounds compared to 57% with nylon and staples. Although these differences are modest in absolute terms, they suggest a small cosmetic edge for braided silk in clean orthopaedic

incisions. Ananda et al. also used modified Hollander and VAS cosmesis scales and found that tissue glue produced the best cosmetic scores at 1 and 5 months, followed by staples, with sutures being the least attractive.[8]

In a TKA cohort, Essien et al. observed higher HWES and cosmesis VAS scores with adhesive strips than with staples, again suggesting that non-penetrating closure results in a superior scar appearance.[13] On the orthopaedic side, Nagasamy et al. reported higher HWES at 6 months with staples (around 4.1) than with sutures (around 3.3) while overall patient satisfaction remained similar.[14]

Taken together, these data and our results indicate that small shifts in the Hollander score across different materials are common, and the direction is not uniform across settings. A recent systematic review of scar assessment scales in orthopaedic surgery also highlighted that cosmetic scores account for only part of patient satisfaction, with function and pain ranked higher in importance.[15] This suggests that the modest improvement in cosmetic profile with silk in our series, while statistically visible, may have a limited impact on overall patient experience.

Wound healing complications were quantified using ASEPSIS categories and complication rates. Any wound complication occurred in 13.3% of nylon and staple wounds, whereas none of the silk wounds showed disturbance of healing or minor infection. The overall complication rate in our cohort was 8.9%. From this, we calculated an absolute risk reduction of 13.3% for silk compared to nylon or staples and a number needed to treat of around 8, meaning that for every eight patients closed with silk instead of nylon or staples, one early wound complication could be prevented. Although these values must be interpreted cautiously due to small sample size and wide confidence intervals, they align with trends from larger series where non-metallic sutures show numerically lower SSI rates than staples. Gohiya et al. reported superficial infection rates of about 5% with nylon versus about 15% with staples in more than 500 orthopaedic wounds, with the difference remaining significant even after stratification by incision length.[4] Naaman et al. in a large limb orthopaedic cohort (n=775) found SSI rates of roughly 1% with sutures and 3.5% with staples, with stapler use associated with higher SSI and longer hospital stay on univariate analysis.[2]

A Cochrane review of subcuticular sutures versus staples across non-obstetric surgery also showed a small reduction in wound complications with subcuticular sutures relative to staples. However, the effect size was modest, and evidence certainty was low.[15,16] On the other hand, Yuenyongviwat et al. in TKA and Nagasamy et al. in South Indian orthopaedic practice did not detect significant differences in complication rates between staples and sutures.[16] Part of this inconsistency likely reflects differences in wound length, prosthetic use, antibiotic protocols, and infection control standards. Our ASEPSIS means (around 6 for nylon, 5.9 for staples, and 2.3 for silk) all remained below the usual threshold for major infection, but the relative difference, about 2.5-fold higher scores with nylon and staples vs silk, points towards a modest but clinically relevant advantage with silk in our setting.

When we looked beyond crude means to derived indices, silk again performed best as an all-round material. Silk required slightly fewer dressing changes (about 0.5 fewer than nylon and 0.8 fewer than staples per patient), translating to roughly 16–24 dressings saved per 30 patients compared to other materials. This reduces nursing workload and costs, which are important in high-volume government settings.[12]

Our composite efficacy index, built from normalised cosmetic, ASEPSIS, dressing, and time parameters, favoured silk (0.72) over staples (0.57) and nylon (0.39), suggesting that silk gives the best compromise between efficiency and safety. Similar multi-domain comparisons from general surgery have often placed tissue glue at the top, followed by staples, with sutures used mainly where cost is a constraint.[8] Our data suggest that in clean orthopaedic wounds where tissue glue is not routinely available or affordable, braided silk may be a practical middle path between slower but safe monofilament nylon and fast but slightly riskier staples.

It is also important to discuss why silk, a braided natural suture often considered more infection-prone than monofilament nylon, behaved so well in our cohort. One explanation is that surgeon familiarity and better eversion with silk might have improved microvascular perfusion at the edges and reduced tension, both known determinants of ASEPSIS components such as exudate and separation.[17] Secondly, our sample size was limited (30 wounds per arm), and overall event numbers were low, so zero complications in the silk group may partly reflect chance rather than strong biological superiority. Confidence intervals for complication rates were wide, even in the nylon and staple groups (5.3–29.7%), underscoring that small observational series cannot definitively rank materials. Finally, we did not include grossly contaminated or high-risk wounds, where the theoretical disadvantage of braided material might become more evident.

Comparison with the rapidly expanding literature on tissue adhesives is also relevant. Several studies have shown that octyl-2-cyanoacrylate or adhesive strips provide excellent cosmetic scores, very low ASEPSIS, and reduced pain at removal compared to staples or sutures.[6] Essien et al. in TKA and Patel et al. in general surgery demonstrated near-zero infection rates and very favourable HWES with glue or strips, at the price of somewhat longer closure time and higher material cost.[13]

A recent review by Mastud et al. summarised that tissue glue is often cosmetically superior and pain-sparing, while staples remain attractive for speed, especially in trauma and emergency scenarios.[7] Our study did not evaluate glue, but given the strong evidence base, it is reasonable to consider glue or adhesive strips as the first choice when resources allow, with silk or monofilament sutures as cost-effective alternatives, and staples reserved mainly when operating time is the dominant concern. The present study has some strengths. We restricted ourselves to clean elective orthopaedic procedures, used equal group sizes, and applied validated tools (ASEPSIS and HWES) rather than crude infection rates or subjective scar opinion alone.[15] In addition, we derived clinically interpretable metrics, such as ARR, NNT, and composite indices, that better capture trade-offs among time, workload, and outcome. But there are

important limitations. It is a single-centre study with a modest sample size, and follow-up for cosmesis was limited to the early postoperative period, so long-term scar maturation and hypertrophic changes were not captured. Groups were randomised by closure material, but we did not stratify by specific orthopaedic procedure type or incision length, which might influence healing. A cost analysis was not conducted in detail, though it is highly relevant in Indian practice. Finally, neither patients nor assessors were fully blinded to the closure type, which may have influenced cosmetic scoring. In conclusion, our observational data suggest that silk sutures offer the best balance of safety, cosmesis, and efficiency for skin closure in clean orthopaedic surgery, with apparent reductions in ASEPSIS-defined complications and dressing burden compared to nylon and staples. In contrast, staples primarily provide time-saving benefits with no clear biological advantage. These findings are broadly in line with larger orthopaedic and general surgery series and with systematic reviews favouring suture-based or adhesive techniques over staples for infection and cosmetic outcomes.[2]

Future larger multicentric trials, ideally including a glue arm and a formal cost-utility analysis, are needed to define an evidence-based algorithm for selecting skin closure methods across different orthopaedic scenarios, rather than relying solely on habit or convenience.

Conclusion

In our orthopaedic patients, silk sutures provided the most balanced results, with smoother wound healing, better scar appearance, and less dressing burden. In comparison, closure time stayed acceptable for routine work. Skin staples clearly helped when we needed faster closure, but they did not show any real advantage in infection or cosmesis compared to nylon in this clean elective setting. Nylon sutures remained a safe traditional option but appeared slightly weaker than silk when cosmetic score, ASEPSIS pattern, and nursing workload were considered together. Overall, sutures, especially silk, seem more suitable as the default closure method, and staples are better kept for situations where saving operating time is the main priority.

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Conflicts of interest

There are no conflicts of interest.

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