

Comparative Analysis of Suture and Staples as Methods of Wound Closure in Orthopedic Surgery

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Abstract:

Background:

Within the realm of surgical decision-making, wound closure material is frequently overlooked. Recent findings from a meta-analysis indicate a heightened risk of surgical site infections (SSIs) associated with the use of staples for wound closure. However, the impact of closure material on non-infectious wound complications remains less defined. In this study, we aim to compare sutures and staples with regard to the clinical outcome of wound closure using the Hollander wound evaluation score (HWES) and Visual analogue patient satisfaction scale (VAS).

Materials & Methods:

In this randomized prospective study, 60 patients with closed fractures were divided randomly into two groups with 30 patients in each - Group A: Suture, Group B: Staple and evaluated for their wound closure outcome at the 4th and 12th week using HWES and VAS.

Result:

Group B had a shorter mean closure time (6.8 minutes) compared to Group A (11.3 minutes), but the time to heal was slightly longer in Group B (12 days) than in Group A (11 days). While the cost of materials was higher in Group B than Group A, there were more cases of infection (5 cases) and wound dehiscence (6 cases) in Group B compared to Group A (3 cases each). Additionally, the pain experienced during removal, as per VAS, was higher in Group B (3.1) than in Group A (1.9). However, the assessment of overall cosmesis at 4 and 12 weeks favored Group B (2.1) over Group A (3.2).

Conclusion:

Sutures vs. Staples in orthopedic surgery in our study show similar healing times, but staples show higher infection risk and cost but overall better cosmesis; sutures have less pain during removal. Further research is needed for conclusive guidance.

Keywords: Suture, Staples, Wound

Introduction:

The closure of surgical site wounds holds paramount importance for post-operative recovery, especially in commonly performed elective orthopedic procedures. The choice between sutures and staples for skin approximation remains a topic of debate, with potentially significant implications for patient safety and surgical outcomes.

Following orthopedic procedures, wound complications emerge as a primary source of post-operative illness. They can potentially prolong a patient's hospital stay or even necessitate readmission. Moreover, there exists a correlation between superficial wound infections and deeper infections. Despite these considerations, the optimal method of skin closure remains elusive.

Orthopedic surgeons utilize both metallic staples and sutures for wound closure. While staples are lauded for their speed and ease of use compared to sutures, concerns have been raised regarding their potential to increase the risk of infection and their potentially higher cost.

CDC defines Surgical Site Infections (SSIs) into three categories:

1. Superficial Incisional SSI:

- Occurs within 30 days after the operation and involves only the skin and subcutaneous tissue of the incision.
- Criteria for diagnosis include:
 - Presence of purulent drainage with or without laboratory confirmation from the superficial incision.
 - Isolation of organisms from a culture of fluid or tissue from the superficial incision.
 - Signs or symptoms of infection such as pain, tenderness, swelling, redness, or heat, and deliberate opening of the superficial incision by the surgeon unless culture-negative.
- Diagnosis is made by a surgeon or attending physician.

2. Deep Incisional SSI:

- Occurs within 30 days after the operation if no implant is left in place or within one year if an implant is in place.
- Infection involves deep soft tissue (e.g., fascia, muscle) of the incision.
- Criteria for diagnosis include:
 - Purulent drainage from the deep incision but not from the organ/space component.
 - Spontaneous dehiscence or deliberate opening of a deep incision by a surgeon when the patient exhibits sign or symptoms such as fever ($>38^{\circ}\text{C}$) or localized pain or tenderness, unless culture-negative.
 - Evidence of infection involving the deep incision found during direct examination, reoperation, or by histopathologic or radiologic examination.
- Diagnosis is made by a surgeon or attending physician.

3. Organ/Space SSI:

- Occurs within 30 days after the operation if no implant is left in place or within one year if an implant is in place.
- Infection involves any part of the anatomy (e.g., organs and spaces) other than the incision that was opened or manipulated during an operation.
- Criteria for diagnosis include:
 - Purulent drainage from a drain placed through a stab wound into the organ/space.
 - Isolation of organisms from a culture of fluid or tissue in the organ/space.
 - Evidence of infection involving the organ/space found during direct examination, reoperation, or by histopathologic or radiologic examination.
 - A diagnosis is made by a surgeon or attending physician.

Materials & Methods:

We conducted this prospective randomized study at Bundelkhand Medical College, Sagar (M.P.). 60 patients were included in this study and were randomly divided into 2 groups. Group A had 30 patients with wound closure by suture and Group B had 30 patients with staples as the method of wound closure. The inclusion criteria were - age >18 years, 2. All elective orthopedic surgeries or closed fractures, 3. Incision size > 6cm. Patients with 1. Open fractures, 2. Active infections (any site), 3. Immunocompromised patients, 4. Foot surgery (any site) or Hand-surgery (any site), 5. Arthroscopic procedures or Minimally invasive surgeries like closed nailing, pinning, percutaneous screw fixation were excluded from this study.

Both study groups adhered to standard preoperative preparation and antibiotic protocols. Upon completion of surgery, wound closure involved layer-by-layer closure using absorbable sutures till the subcutaneous layer. Subsequently, skin closure was performed using either non-absorbable sutures (such as Ethilon) or staples, based on the patient's group allocation. The duration of skin closure time was recorded for both groups. Various factors like length of the incision, tourniquet time (if utilized), type and duration of surgery, and the use of drains were taken into consideration. Intravenous antibiotics were administered to each patient until the second postoperative day.

Assessment of wounds was done on the 2nd and 4th postoperative days, as well as during suture/staple removal between the 10th and 14th postoperative days. Evaluations of wounds encompassed parameters such as health status, presence of inflammation, discharge characteristics, culture results, marginal necrosis, dehiscence, and the necessity for any secondary procedures. The duration of suture/staple removal will be noted, and any pain experienced during removal was documented using the Visual Analog Scale (VAS). Follow-up evaluations in the 4th and 12th weeks involved assessing patient satisfaction using the Visual Analog Scale (VAS) and the Hollander Wound Evaluation Score system to evaluate cosmesis.



(a)

(b)

Figure 1: An incisional wound (a) closed by Staples, (b) follow up at 12 days



(a)

(b)

Figure 2: An incisional wound (a) closed by Nylon suture, (b) follow up at 12 days



Figure 3: An incisional wound closed by Nylon Suture showing wound dehiscence on 5th day



Figure 4: An incisional wound closed by Staples showing wound dehiscence on 6th day

Results:

In this study, a total of 60 patients were included, and divided into two groups with 30 patients in each. Group A: Suture, Group B: Staple and evaluated for their wound closure outcome at 4th and 12th week using HWES and VAS.

The mean closure time in Group A was 11.3 minutes and in Group B was 6.8 minutes. The time to heal was 11 days in Group A and 12 days in Group B. The cost of material was higher in Group B than in Group A. There were 3 cases of infection in Group A and 5 such cases in Group B. Wound dehiscence was recorded in 3 patients in Group A and 6 patients in Group B. The pain during removal as per VAS was 1.9 in Group A and 3.1 in Group B. The assessment of overall cosmesis at 4 and 12 weeks' intervals was better for Group B (2.1) than Group A (3.2)

Table 1: Distribution of cases based on Type of Surgery and Area involved

| | Group A | Group B |
|-------------------------|----------------|----------------|
| Type of surgery | | |
| Intramedullary nailing | 12 | 14 |
| ORIF | 13 | 10 |
| Total/Hemi arthroplasty | 5 | 6 |
| Areas Involved | | |
| Upper Limb | 12 | 11 |
| Lower Limb | 18 | 19 |

Table 2: Outcome parameters for both the methods employed

| | Group A | Group B |
|---------------------|----------------|----------------|
| Closure Time | 11.3 minutes | 6.8 minutes |
| Time to heal | 11 days | 12 days |
| Cost | Lower | Higher |

| | | |
|--------------------------------------|-----|-----|
| Infection | 3 | 5 |
| Wound Dehiscence | 3 | 6 |
| Pain during removal (VAS) | 1.9 | 3.1 |
| Overall cosmesis (HWES) | 3.2 | 2.1 |

Discussion :

Wound closure may be one of the most underrated concerns of surgery for an orthopedic surgeon. Effective wound closure in orthopedic surgery is crucial for ensuring optimal postoperative outcomes and patient satisfaction. It not only facilitates proper healing but also minimizes the risk of complications such as infection, dehiscence, and delayed wound healing. Properly closed wounds promote the restoration of functional integrity, which is particularly vital in orthopedic procedures where joint mobility and stability are paramount. Additionally, meticulous wound closure techniques contribute to cosmetically appealing results, enhancing patient confidence and overall satisfaction with the surgical experience.

The frequency of wound complications following orthopedic surgery remains inadequately characterized. Surgical site infections (SSIs) not only lead to disability but also result in a significant escalation of treatment expenses. However, the precise ramifications of non-infectious complications have yet to be delineated. [1] In a prospective study focusing on hip and knee arthroplasty, a notable wound complication rate of 32% (32 out of 165 cases) was observed. Among these cases, a suspected infection rate of 9.7% (16 out of 165 cases) were identified. [2] Patel et al. further demonstrated that more than 50% of arthroplasty patients, totaling 1437 individuals, exhibited persistent wound drainage by postoperative day four. Their study revealed that this drainage was associated with prolonged hospital stays and exhibited a positive correlation with the early onset of surgical site infections (SSIs). [3]

Slade Shantz et al. reported a significant time saving of approximately 7 minutes when staples were utilized for skin closure compared to other methods. Extrapolating this finding, if an average orthopedic surgeon were to perform five surgeries daily, adopting staples could potentially save approximately 35 minutes of operative time. This time-saving measure has the potential to mitigate over-scheduling issues and subsequently reduce hospital costs. [4] Liew and Haw observed a notable efficiency advantage with staples for skin closure, approximately 7 times faster compared to sutures. Despite this, the perceived benefits of staples may potentially lead to a "false economy," influenced by surgeon perceptions and biases. [5] Staples have

traditionally been regarded as a "more expensive method" for skin closure compared to sutures. Additionally, patients who undergo skin stapling typically require a greater number of dressing changes compared to those treated with sutures. [6,7]

Krishnan et al. discovered no significant difference when comparing sutures to staples across all post-operative complications and subgroups. Their findings suggest that there may be no clinically relevant distinction in the effect between the two skin closure methods within this specific population. [8] According to Hemming et al., evidence spanning various surgical specialties indicates that wound closure with staples leads to a reduction in mean operating time. However, despite incorporating several thousand observations, no definitive evidence of superiority emerged for either staples or sutures concerning surgical site infection, post-surgical complications, or length of hospital stay. [9]

Due to the absence of consensus in various studies, we conducted a study at our center, which revealed no significant difference in healing time between sutures and staples. However, we observed higher infection rates and wound dehiscence in the staples group. Factors such as cost and pain during removal favored the suture group. While closure time was shorter in the staples group and the overall cosmesis was better, further investigation with a larger patient cohort is needed to solidify our findings.

Conclusion:

In conclusion, the comparison between sutures and staples for wound closure in orthopedic surgery reveals a significant picture. While both methods demonstrate similar healing times, the staples group tends to exhibit higher rates of infection and wound dehiscence. Factors such as cost and pain during removal favor the use of sutures. However, staples offer the advantage of shorter closure times. Further research with larger patient cohorts is necessary to solidify these findings and provide more definitive guidance on the optimal choice of wound closure method in orthopedic surgery.

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