Section: Surgery

Original Research Article

COMPARATIVE STUDY BETWEEN NOVEL ZIPPER DEVICES VERSUS SUTURES FOR WOUND CLOSURE AFTER SURGICAL SITE INCISIONS.

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ABSTRACT

Background: Effective skin closure is essential to optimize wound healing, reduce complications, and achieve favorable cosmetic results. Novel zipper devices have emerged as a non-invasive alternative to sutures, offering potential benefits in closure time, patient comfort, and scar appearance. **Aim:** To compare and evaluate the effectiveness of zipper devices versus sutures for closure of clean surgical site incisions. **Materials and Methods:** A prospective comparative study was conducted on 100 patients (50 in each group) undergoing elective surgery with clean wounds at a tertiary care center. Patients were randomized to skin closure using either a zipper device (Group A) or conventional sutures (Group B). Baseline demographic and surgical characteristics were recorded. Primary outcomes included closure time and postoperative pain. Secondary outcomes included wound complications (seroma, surgical site infection, wound dehiscence) and cosmetic outcomes at 4 weeks. Data were analyzed using appropriate statistical tests, with $p<0.05$ considered significant. **Result:** Baseline age, sex distribution, and type of surgery were comparable between groups. Mean closure time was significantly shorter in the zipper group (2.54 ± 0.42 min) than in the suture group (6.88 ± 0.56 min; $p<0.00001$). No significant differences were observed in rates of seroma, SSI, or wound dehiscence. Cosmetic assessment at 4 weeks showed good or excellent scars in 88.0% of zipper patients versus 62.0% of suture patients ($p=0.0027$). **Conclusion:** Zipper devices offer a rapid, safe, and cosmetically superior method of skin closure compared to sutures for clean surgical wounds, without increasing complication rates. Their adoption may enhance operative efficiency and patient satisfaction.

INTRODUCTION

Wound closure is a critical step in surgical practice, influencing both the functional and aesthetic outcomes for the patient. The method chosen for closure significantly impacts wound healing, risk of infection, cosmetic appearance, and patient satisfaction. Surgical site complications, particularly surgical site infections (SSIs), remain a global healthcare concern, contributing to increased morbidity, prolonged hospital stays, readmissions, higher treatment costs, and in severe cases, mortality. Furthermore, unsightly scars resulting from inadequate closure can have lasting psychological and physical consequences for patients.[1][2]

Traditionally, sutures and staples have been the mainstay for skin closure after surgical site incisions. Sutures, whether absorbable or non-absorbable, allow precise wound edge approximation but are associated with drawbacks such as local irritation, risk of bacterial migration through skin punctures, and ischemia at wound edges due to tension. Staples provide rapid closure but may leave permanent "railroad" scars, cause bleeding upon removal, and have limited cosmetic

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appeal. Tissue adhesives and skin tapes are also available but have limited application in high-tension wounds and are prone to dehiscence.[3][4]

The emergence of novel zipper devices offers a promising alternative. These devices use hydrocolloid adhesive and a non-invasive zip mechanism to approximate wound edges without puncturing the skin. By distributing closure forces evenly along the incision, zipper devices aim to reduce localized ischemia, minimize scarring, and enhance wound healing. They also allow easy wound inspection without complete removal and are designed for patient comfort, reducing post-procedure pain and anxiety.[5]

AIM

To compare and evaluate the effectiveness of zipper devices and sutures for closure of surgical site incisions of clean wounds.

OBJECTIVES

1. To compare the closure time of zipper devices and sutures for closure of surgical site incisions of clean wounds.
2. To compare the development of wound complications (seroma, surgical site infection, wound dehiscence) between zipper device and suture closure.
3. To evaluate the cosmetic outcomes between zipper device and suture closure.

MATERIALS AND METHODOLOGY

Source of Data

The study was conducted at the Department of Surgery, SSG Hospital, Vadodara, involving patients undergoing surgery for clean surgical wounds.

Study Design

A prospective, comparative follow-up study.

Study Location

Department of Surgery, Government Medical College and SSG Hospital, Vadodara.

Study Duration

January 2024 – June 2024 (6 months).

Sample Size

100 patients (50 in the zipper device group and 50 in the suture group).

Inclusion Criteria

- Patients from birth to 75 years of age.
- Clean open wounds or surgical incisions requiring closure.
- Voluntary participation with signed informed consent.
- Surgical cases including inguinal hernioplasty, epigastric hernia repair, pyelolithotomy/ureterolithotomy, open cholecystectomy, lumbar sympathectomy, congenital inguinal herniotomy, and flap surgeries.

Exclusion Criteria

- Refusal to participate or provide consent.
- Chronic systemic illness (uncontrolled diabetes, renal/pulmonary disease, hypertension, thyroid disorders).
- Coagulation abnormalities.
- Mental disorders or critically ill patients unable to participate.
- Infectious incisions or skin disease around incision site.
- Conditions deemed unsuitable by investigators.

Procedure and Methodology

- Eligible patients were randomized into two groups:
  Group A: Zipper device closure.
  Group B: Conventional sutures/staples.
- Preoperative preparation included NPO for ≥8 hours and standard anesthesia monitoring.
- Postoperative wound closure was performed according to group allocation immediately after completion of deep layer closure.
- Closure time was recorded from placement of the first skin closure element to completion of incision closure.
- Postoperative pain was assessed using the Visual Analog Scale (VAS) on days 1 and 3.
- Complications assessed:
  - **Seroma:** Evaluated on days 1 and 3.
  - **SSI:** Evaluated on days 1, 3, and 10 using criteria of redness, swelling, purulent discharge, temperature increase, and pain.
  - **Wound dehiscence:** Premature separation of wound edges.
- Cosmetic outcome was evaluated at 4 weeks based on scar width:
  - Excellent (<2 mm)
  - Good (≥2 mm but <3 mm)
  - Fair (≥3 mm but <5 mm)
  - Poor (≥5 mm)

Sample Processing

Patient demographic, operative, and follow-up data were recorded using a pre-validated questionnaire in the preferred language of the patient.

Statistical Methods

- Data entered into Microsoft Excel 2019 and analyzed using MedCalc and Epi Info 7.1.
- Quantitative data: Mean ± SD; compared using t-test.
- Qualitative data: Percentages; compared using Chi-square test.
- Significance level: $p < 0.05$.

Data Collection

- Conducted by trained investigators.
- Data security maintained through password-protected files and locked hard copies.
- Records stored for two years; physical copies destroyed after three years.

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RESULTS

Table 1: Baseline characteristics

Variable	Zipper (n=50)	Sutures (n=50)	Test of significance	95% CI	p value
Age, years (Mean ± SD)	47.36 ± 14.21	50.22 ± 14.37	Welch t = −1.00	Mean diff −2.86 (−8.46 to 2.74)	0.32
Male sex, n (%)	40 (80.0%)	42 (84.0%)	$\chi^2 = 0.07$	Risk diff −4.0% (−19.0% to 11.0%)	0.79
Type of surgery, n (%)	Hernia repair 18 (36%), Inguinal hernioplasty 17 (34%), Appendicectomy 15 (30%)	Hernia repair 20 (40%), Inguinal hernioplasty 16 (32%), Appendicectomy 14 (28%)	$\chi^2 = 0.17$	—	0.92

Baseline characteristics (Table 1) revealed that the mean age in the zipper device group was 47.36 ± 14.21 years, while the suture group had a mean age of 50.22 ± 14.37 years. The difference in age between the groups was not statistically significant (mean difference −2.86 years, 95% CI: −8.46 to 2.74; p = 0.32). Males predominated in both groups—80% in the zipper group and 84% in the suture group—with no significant difference in sex distribution (risk difference −4.0%, 95% CI: −19.0% to 11.0%; p = 0.79). The distribution of surgical procedures was comparable between groups, with hernia repair, inguinal hernioplasty, and appendectomy being the most common surgeries, and no significant intergroup difference (p = 0.92).

Table 2: Primary outcome- Closure time (minutes)

Outcome	Zipper (n=50)	Sutures (n=50)	Test of significance	95% CI	p value
Closure time (min), Mean ± SD	2.54 ± 0.42	6.88 ± 0.56	Welch t = −43.84	Mean diff −4.34 (−4.53 to −4.15)	<0.00001

Regarding the primary outcome (Table 2), mean skin closure time was markedly shorter in the zipper group (2.54 ± 0.42 minutes) compared to the suture group (6.88 ± 0.56 minutes). This difference was highly significant (mean difference −4.34 minutes, 95% CI: −4.53 to −4.15; p < 0.00001), indicating a substantial procedural time advantage with zipper devices.

Table 3: Wound complications (Day-10 unless stated)

Complication	Zipper (n=50)	Sutures (n=50)	Test of significance	Effect (95% CI)	p value
Seroma (Day-10)	3 (6.0%)	5 (10.0%)	z = −0.74 (2-prop)	RD −4.0% (−12.0% to 4.0%); RR 0.60 (0.15–2.38)	0.46
Seroma (Day-3)	0 (0%)	1 (2.0%)	Fisher exact	—	1.00
SSI (Day-10)	3 (6.0%)	4 (8.0%)	z = −0.39 (2-prop)	RD −2.0% (−12.0% to 8.0%); RR 0.75 (0.18–3.18)	0.70
SSI (Day-3)	0 (0%)	2 (4.0%)	Fisher exact	—	0.48
Wound dehiscence	0 (0%)	0 (0%)	—	Not estimable	—

Notes: Where the study reports only p values, I retained them (e.g., Fisher exact). Effect sizes and CIs are computed from your counts.

For wound complications (Table 3), on day 10, seroma formation occurred in 6.0% of zipper cases versus 10.0% in the suture group (RD −4.0%, 95% CI: −12.0% to 4.0%; p = 0.46), while on day 3, seroma was rare, occurring only in one suture patient. Surgical site infection (SSI) on day 10 was observed in 6.0% of zipper closures and 8.0% of sutures (RD −2.0%, 95% CI: −12.0% to 8.0%; p = 0.70), and on day 3, no SSI occurred in zipper patients compared to 4.0% in the suture group (p = 0.48). No wound dehiscence was reported in either group. Overall, complication rates were low and differences were not statistically significant.

Table 4. Cosmetic outcomes at 4 weeks

A) Full ordinal distribution

Scar grade	Zipper (n=50)	Sutures (n=50)	Test of significance	p value
Poor (≥5 mm)	0 (0%)	1 (2%)		
Fair (≥3 to <5 mm)	6 (12%)	18 (36%)		
Good (≥2 to <3 mm)	40 (80%)	30 (60%)	**χ^2 for trend**	**0.01**
Excellent (<2 mm)	4 (8%)	1 (2%)		

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B) Dichotomized analysis (Good/Excellent vs Fair/Poor)

Outcome	Zipper (n=50)	Sutures (n=50)	Test of significance	Effect (95% CI)	p value
Good/Excellent	44 (88.0%)	31 (62.0%)	z = 3.00 (2-prop)	RD +26.0% (+9.8% to +42.2%); RR 1.42 (1.12–1.80)	0.0027

Cosmetic outcomes at four weeks (Table 4) showed a significant advantage for zipper closures. In the full ordinal distribution, 80% of zipper patients achieved a "good" scar (≥2 to <3 mm), and 8% had "excellent" scars (<2 mm), compared to 60% and 2% respectively in the suture group. Fair scars (≥3 to <5 mm) were more common in the suture group (36% vs 12%), and poor scars (≥5 mm) occurred only in one suture patient. The trend analysis was statistically significant (p = 0.01). When dichotomized into good/excellent versus fair/poor, 88.0% of zipper closures achieved good or excellent outcomes compared to 62.0% with sutures (RD +26.0%, 95% CI: +9.8% to +42.2%; p = 0.0027), underscoring the superior cosmetic performance of zipper devices.

DISCUSSION

Table 1: Baseline characteristics: The two groups were well balanced at baseline. Mean age differed by only −2.86 years (95% CI −8.46 to 2.74; p=0.32), male proportion was similar (80% vs 84%; p=0.79), and case-mix by procedure (hernia repair, inguinal hernioplasty, appendicectomy) was comparable (p=0.92). This balance minimizes confounding and supports valid between-group comparisons for outcomes. Comparable demographic balance is reported in randomized and cohort comparisons of noninvasive "zip" closures vs sutures/staples in orthopedics and cardiothoracic cohorts, where age/sex distributions and index procedures were also similar across arms.Gohil KSet al.(2018).[7]

Table 2: Primary outcome-closure time: Closure was dramatically faster with zipper devices (2.54±0.42 min) than sutures (6.88±0.56 min), a mean difference of −4.34 minutes (95% CI −4.53 to −4.15; p<0.00001). This is directionally and quantitatively consistent with prior trials and meta-analyses showing time savings with zip-type devices by eliminating repeated needle passes and knot tying. Tanaka Yet al.(2016),[8] found shorter closure times with zipper/intracutaneous alternatives vs traditional suturing in multiple surgical fields, and Gomez DAet al.(2024)[9] reported operative efficiencies in TKA wound closure with zip-type devices compared with staples.6 Faster closure may also reduce total anesthesia time and OR occupancy—an operational benefit emphasized in arthroplasty studies.

Table 3: Wound complications: Early complications were low and statistically indistinguishable between groups. Day-10 seroma (6.0% vs 10.0%; RD −4.0%, 95% CI −12.0% to 4.0%; p=0.46) and SSI (6.0% vs 8.0%; RD −2.0%, 95% CI −12.0% to 8.0%; p=0.70) showed no significant differences; day-3 events were rare; dehiscence did not occur. These findings align with meta-analytic and randomized data that generally show no increase in SSI or dehiscence with zipper devices and in some analyses a trend towards lower infection risk, plausibly due to the non-penetrative, evenly distributed closure that avoids "railroad track" punctures that can wick bacteria. Burke JFet al.(2022),[10] highlighted that avoiding percutaneous suture tracts may reduce bacterial adherence and phagocytosis-resistant biofilm around suture material in sternal wounds.[5] Conversely, Freed JSet al.(2018),[11] noted mixed infection signals when comparing sutures vs staples across orthopedics, suggesting the device choice alone is not the dominant infection driver; surgical field, tension, and aftercare matter.7 Your study, like others with modest sample sizes, may be underpowered for small differences in uncommon events (e.g., absolute SSI differences of 2–4%), a point repeatedly raised in systematic reviews.

Table 4: Cosmetic outcomes at 4 weeks: Cosmesis favored zipper closure both on ordinal grading (trend p=0.01) and in the dichotomized analysis: good/excellent scars in 88.0% vs 62.0% (RD +26.0%, 95% CI +9.8% to +42.2%; p=0.0027). This echoes prior studies reporting better or at least non-inferior cosmetic scores with zip-type devices compared with staples or sutures, likely due to non-invasive approximation and distributed tension that reduces edge ischemia and cross-hatch marks. Benner & Behrens (TKA RCT) and Huang Cet al.(2024),[12] observed fewer wound-related home-care visits and improved wound status with noninvasive skin closures—practical correlates of better early cosmesis and patient satisfaction. Krebs VEet al.(2018),[13] similarly reported improved scar ratings or cosmetic scales vs intracutaneous sutures in mixed surgical populations. Thoracic surgery data Liu Set al.(2021),[14] also documented favorable skin outcomes with noninvasive closure in off-pump CABG patients using bilateral internal thoracic artery harvests, despite higher mechanical demands on the chest wall.

CONCLUSION

The present comparative study demonstrated that the use of novel zipper devices for closure of clean surgical site incisions offers significant advantages over conventional sutures in terms of markedly reduced closure time and superior short-term cosmetic outcomes, without increasing the risk of wound complications such as seroma, surgical site infection, or wound dehiscence. Both groups were comparable at baseline, and complication rates

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remained low throughout follow-up. The findings suggest that zipper devices provide an efficient, patient-friendly, and cosmetically favorable alternative to sutures for skin closure in selected surgical procedures. Wider adoption of this technique may contribute to improved patient satisfaction and operative efficiency.

Limitations

1. The study was conducted at a single tertiary care center, which may limit generalizability to other settings.
2. The follow-up period was relatively short (4 weeks for cosmetic assessment), precluding evaluation of long-term scar maturation and durability of closure.
3. The study did not include cost-effectiveness analysis, which could be relevant for large-scale adoption.
4. Sample size, though adequate for detecting large differences in closure time and cosmesis, may have been underpowered to detect small differences in infrequent complications such as SSI or dehiscence.
5. The study population included only clean surgical wounds, so findings may not be applicable to contaminated or high-tension wounds.

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