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INCIDENCE AND RISK FACTORS FOR STERNAL WOUND DEHISCENCE AFTER OPEN HEART SURGERY

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Abstract

Background: *The most common type of surgery that is used during cardiac surgery is the median sternotomy, but post-operative complications such as pain, cutaneous dehiscence, instability of the sternum and the prolonged recovery time, remain significant problems. One of the important factors towards these results is the method of closing the sternum. Two of the most frequently used techniques are Figure-of-Eight and Simple Interrupted technique, yet there is still no consensus on the most appropriate technique that can be used to enhance patient outcomes.*

Objectives: *The goal of the study was to compare clinical outcomes of using Figure-of-Eight and Simple Interrupted sternal closure methods in the group of adult patients undergoing elective cardiac surgery. Particular outcomes included assessing differences in postoperative pain, wound healing, wound stability, ambulation time, hospital stay, functional recovery and patient satisfaction as a whole.*

Methodology: *Prospective, comparative, and observational study design was used. One hundred and eight out of the total 108 patients who were to be subjected to elective median sternotomy were recruited and evenly split into two categories (n=54 each): one group was exposed to the Figure-of-Eight method of sternal closure whilst another was subjected to the Simple Interrupted method. Purposive sampling which was non-probability was applied. The data were collected in a structured way by using clinical tools. Numeric Analog Scale (NAS) of pain, ASEPSIS wound scoring system, Sternal Instability Scale (SIS) and Barthel Index of functional status were the tools. The data were examined using descriptive statistics, Mann-Whitney U and t -tests, chi-square/Fisher exact-tests, Spearman correlations, and estimation of the effect size.*

Results: *Patients in Figure-of-Eight group had significantly better results in almost every parameter measured. The post-operative average pain scores were smaller (1.81 1.47 vs. 4.76 1.48, p<0.001). Figure of Eights had 100% of patients with satisfactory wound healing, whereas 5.6% of the Interrupted patients had satisfactory wound healing. 72.2% of the Figure of Eights patients had a SIS Grade 0 sternal stability, and 24.1% of the Interrupted patients had a SIS Grade 0 sternal stabilization. The Barthel Index scores revealed that individuals were more functional (91.78 + 4.39 vs. 75.94 + 9.09, p<0.001) and the time spent to walk was significantly less (1.5 + 0.5 days vs. 3.56 + 0.5 days, p = 0.001). Figure-of-Eight group was shorter in hospital stay (6.00 +1.00 days compared to 7.22 +2.12 days). The patients were also happier (9.04 ± 0.85 vs. 6.96 ± 0.89). All these differences were significant and big in effect sizes.*

Conclusion: *Figure-of-Eight sternal closure method would contribute a lot to the outcome of the operation well in terms of pain relief, wound healing, sternal stability, mobility, and patient satisfaction more than the Simple Interrupted approach. These advantages result in faster recuperation and the number of complications reduced.*

INTRODUCTION

Median sternotomy remains the standard surgical approach for most open-heart procedures, including coronary artery bypass grafting (CABG), valve replacement, and complex cardiac reconstructions due to its excellent exposure of mediastinal structures [1]. Despite advancements in surgical techniques and perioperative care, postoperative complications related to sternal healing continue to pose significant clinical challenges [2]. Among these, sternal wound dehiscence, instability, persistent pain, and deep sternal wound infection (DSWI) contribute substantially to postoperative morbidity, prolonged hospitalization, and increased healthcare costs [3].

Sternal wound complications are relatively uncommon but potentially devastating, with reported incidence rates ranging from 0.5% to 8% depending on patient characteristics and surgical technique [4]. Risk factors such as diabetes mellitus, obesity, chronic obstructive pulmonary disease (COPD), prolonged operative time, and poor nutritional status are known to impair sternal healing and predispose patients to infection and mechanical instability [5]. Even minor degrees of sternal micromotion may delay bone union, increase pain, and interfere with early mobilization after surgery [6].

Proper sternal closure is therefore a critical step in median sternotomy, as it directly influences biomechanical stability and subsequent recovery [7]. The most widely used method is the simple interrupted stainless-steel wire technique, which involves transverse placement of wires across the sternal halves followed by twisting to approximate the bone edges [8]. This method is cost-effective, technically straightforward, and familiar to most surgeons, making it a routine choice in many cardiac centers [9]. However, concerns have been raised regarding uneven stress distribution and localized tension that may predispose to wire cut-through or sternal separation [10].

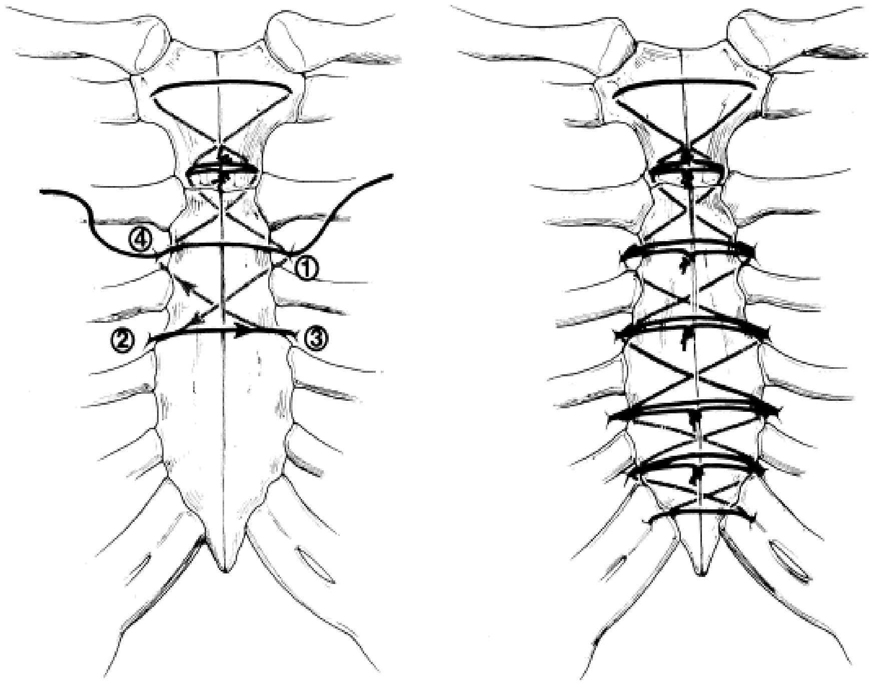


Figure 1: Sternal closure using six overlapping figure-of-8 wires

The figure-of-eight (Fo8) wiring technique has been proposed as an alternative method that may provide improved mechanical stability by redistributing forces across the sternum in a crisscross configuration [11]. Biomechanical studies suggest that the figure-of-eight pattern reduces lateral displacement and shear forces at the sternal edges, thereby minimizing micromotion during respiration and coughing [12]. Clinical investigations have reported lower rates of dehiscence and reduced postoperative pain with the Fo8 technique in selected patient populations [13]. Nevertheless, other studies have found no statistically significant differences between the two methods, leading to ongoing debate regarding the optimal closure strategy [14].

Most previous research has focused primarily on isolated outcomes such as infection rates or mechanical stability, while comprehensive evaluation incorporating pain, wound healing, functional recovery, and patient satisfaction remains limited [15]. Early functional recovery after cardiac surgery is increasingly recognized as a key determinant of overall outcome, as delayed ambulation and prolonged dependence are associated with higher complication rates and increased resource utilization [16]. Standardized tools such as the Numeric Analog Scale (NAS), ASEPSIS wound scoring system, Sternal Instability Scale (SIS), and Barthel Index enable objective and multidimensional assessment of postoperative recovery [17].

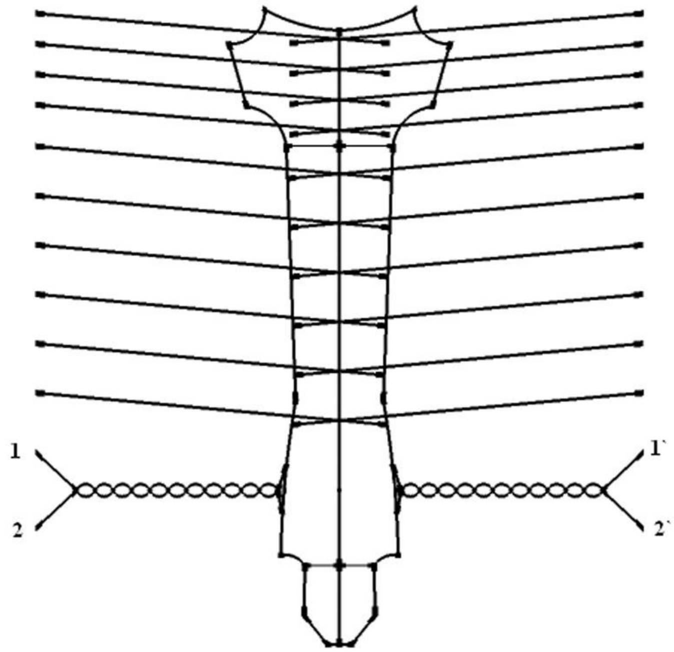


Figure 2: Interrupted Sternal closure technique

In developing healthcare settings, where patient comorbidities are prevalent and hospital resources are constrained, identifying a closure technique that enhances recovery while minimizing complications is of particular importance [18]. Evidence generated in local tertiary care environments may better reflect regional patient characteristics and clinical realities compared with data derived exclusively from Western populations [19].

Given the ongoing controversy and limited comprehensive comparative data, this study aimed to evaluate and compare the clinical and functional outcomes of figure-of-eight versus simple interrupted sternal closure techniques in adult patients undergoing elective cardiac surgery via median sternotomy [20].

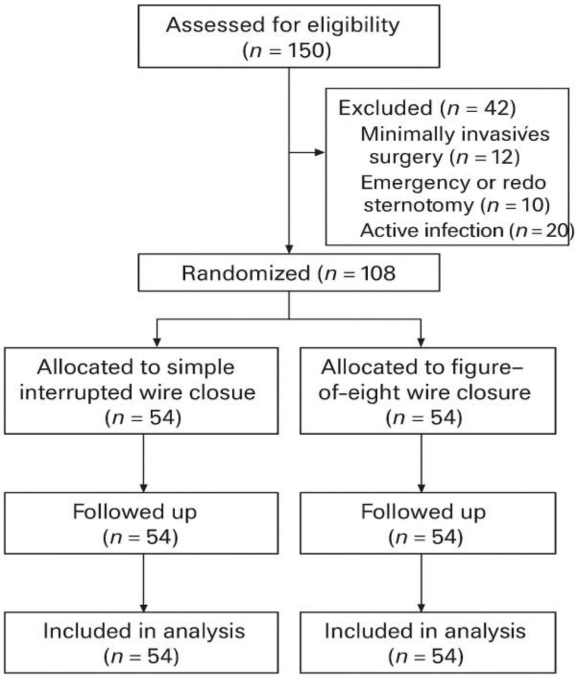
METHODOLOGY

Study Design and Setting

A prospective comparative observational study was conducted at a tertiary care cardiac center over a four-month period following ethical approval from the institutional review board. The study compared postoperative outcomes between two commonly used sternal closure techniques figure-of-eight wiring and simple interrupted wiring in adult patients undergoing elective cardiac surgery through median sternotomy.

Participants

A total of 108 patients were enrolled and equally allocated into two groups: figure-of-eight closure (n=54) and simple interrupted closure (n=54). Adult patients aged 18–75 years undergoing elective open-heart procedures such as coronary artery bypass grafting or valve surgery were included. Patients undergoing emergency surgery, redo sternotomy, minimally invasive procedures, morbid obesity (BMI ≥40 kg/m^2), active infection, dialysis-dependent renal failure, osteoporosis, long-term immunosuppressive therapy, or severe chronic pulmonary disease were excluded.



Sampling and Allocation

Eligible patients were selected from the preoperative surgical schedule using simple random sampling to minimize selection bias. Group allocation was performed using a random number generator, assigning participants to either figure-of-eight or interrupted wire closure techniques performed at the time of sternotomy closure.

Data Collection

Baseline demographic and clinical data including age, gender, body mass index, smoking history, hypertension, diabetes mellitus, chronic obstructive pulmonary disease, and chronic kidney disease were recorded using a structured proforma. Patients were followed from the perioperative period until four weeks after surgery to assess early postoperative recovery outcomes.

Outcome Measures

Postoperative pain was measured within 48 hours using the Numeric Analog Scale (NAS), a validated patient-reported pain assessment tool [10]. Wound healing was evaluated using the ASEPSIS scoring system based on erythema, discharge, tissue separation, and need for additional treatment . Sternal stability was assessed clinically using the Sternal Instability Scale (SIS), which grades movement and discomfort during palpation and movement. Functional recovery was measured using the Barthel Index at two and four weeks after surgery to determine independence in activities of daily living. Additional outcomes included time to ambulation, duration of postoperative analgesic use, length of hospital stay, readmission within 30 days, and patient satisfaction scored on a 10-point scale.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using independent t-tests or Mann-Whitney U tests according to data distribution. Categorical variables were analyzed using chi-square or Fisher's exact tests. Statistical significance was set at $p < 0.05$. Effect sizes and correlation analysis were performed to evaluate the clinical relevance and relationships between recovery parameters.

Ethical Considerations

All participants provided written informed consent prior to enrollment. Patient confidentiality was maintained through anonymized coding of data, and all procedures followed the principles of the Declaration of Helsinki for human research.

RESULTS

In this study, patients undergoing elective cardiac surgery via median sternotomy were compared for the clinical and functional results of two sternal closure techniques: Figure-of-Eight and Simple Interrupted Wire. The 108 patients who were enrolled were split equally between the two groups (n = 54 each). Evaluations of postoperative pain levels, wound healing, sternal stability, functional recovery, and other relevant parameters were conducted using descriptive and inferential analyses.

Table 1: Continuous Variable Descriptives by Group

Variable	Mean ± SD	
	Figure-of-Eight (n=54)	Interrupted (n=54)
Age (years)	57.28 ± 8.19	53.91 ± 9.20
BMI (kg/m²)	28.51 ± 3.56	28.55 ± 3.72
Pain (NAS)	1.81 ± 1.47	4.76 ± 1.48
Barthel Score	91.78 ± 4.39	75.94 ± 9.09
Duration of Surgery (min)	99.24 ± 12.83	116.41 ± 14.52
Hospital Stay (days)	6.00 ± 1.00	7.22 ± 2.12
Post-op Analgesics (days)	3.96 ± 1.03	5.17 ± 1.01
Hemoglobin Drop (g/dL)	1.56 ± 0.16	1.62 ± 0.22
Patient Satisfaction (1-10)	9.04 ± 0.85	6.96 ± 0.89
Time to Ambulation (days)	1.50 ± 0.50	3.56 ± 0.50

4.1 Demographic and Clinical Characteristics

In terms of gender and comorbid conditions, the patient demographic profile showed a fairly balanced distribution across groups. Women made up 55.6% of the Figure-of-Eight group and 42.6% of the Interrupted group. The Interrupted group had a slightly higher percentage of males (57.4%) than the Figure-of-Eight group (44.4%). With mean ages of 57.28 ± 8.19 years for Figure-of-Eight and 53.91 ± 9.20 years for Interrupted, the two groups were similar in terms of age and BMI; the difference was statistically significant ($p = 0.047$). However, there was no discernible difference in the two groups' BMIs, with nearly identical means of 28.51 ± 3.56 kg/m² and 28.55 ± 3.72 kg/m², respectively ($p = 0.96$).

Table 2: Demographic & Comorbidity Frequencies by Group

Variable	Category	Figure-of-Eight (n=54)	Interrupted (n=54)
Gender	Female	30	23
	Male	24	31
Smoking History	Current Smoker	10	14
	Former Smoker	20	15
	Never	24	25
Hypertension	Yes	17	17
	No	37	37
Diabetes	Yes	18	17

	No	36	37
COPD	Yes	2	11
	No	52	43
CKD	Yes	3	4
	No	51	50

In both groups, comorbid conditions such as diabetes and hypertension were equally common; 31.5% of patients reported a history of hypertension, and 33.3% of patients had a diagnosis of diabetes. The prevalence of COPD varied significantly, with only 3.7% of patients in the Figure-of-Eight group having the condition compared to 20.4% of patients in the Interrupted group. At p = 0.015, this difference was statistically significant. This discrepancy could be a confounding factor when assessing outcomes like wound healing and recovery speed.

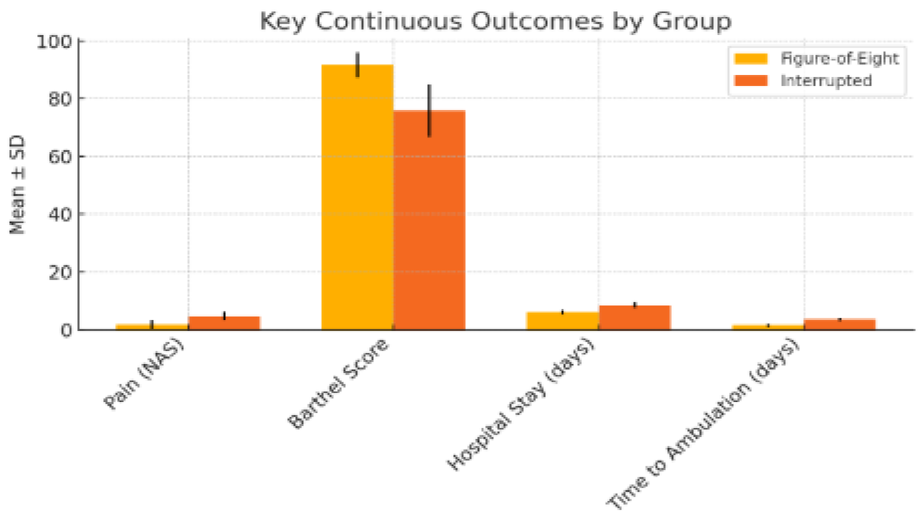


Figure 3: Mean ± SD for key continuous outcomes (Pain, Barthel Score, Hospital Stay, Time to Ambulation)

Table 3: Outcome Categorical Frequencies by Group

Variable	Category	Figure-of-Eight (n=54)	Interrupted (n=54)
SIS Grade	0 (Normal)	39	13
	1 (Slight movement/pain)	9	12
	2 (Moderate movement/pain)	6	18
	3 (Severe movement)	0	8
	4 (Gross instability)	0	3
ASEPSIS Category	Satisfactory healing	54	3
	Minor SSI	0	19
	Disturbance of healing	0	32
Barthel Category	Full Independence	33	0
	Mild Dependence	21	53
	Moderate Dependence	0	1
Readmission (30 days)	No	54	51
	Yes	0	3

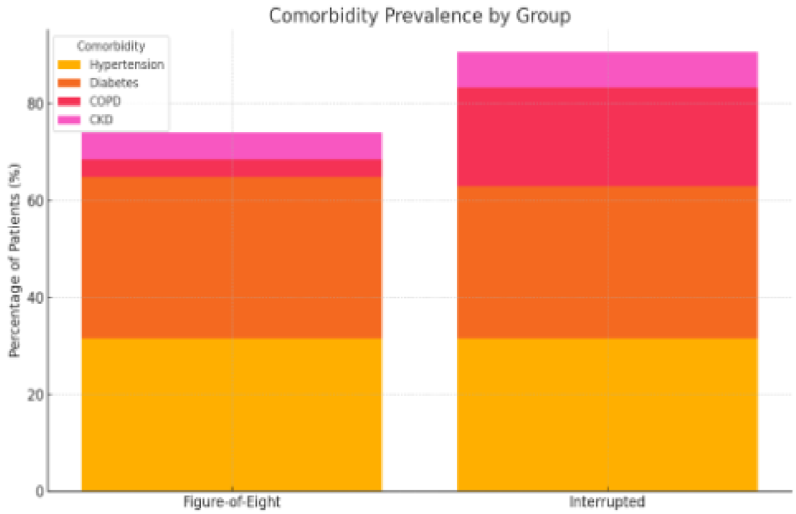


Figure 4: Comorbidity prevalence (%) by group

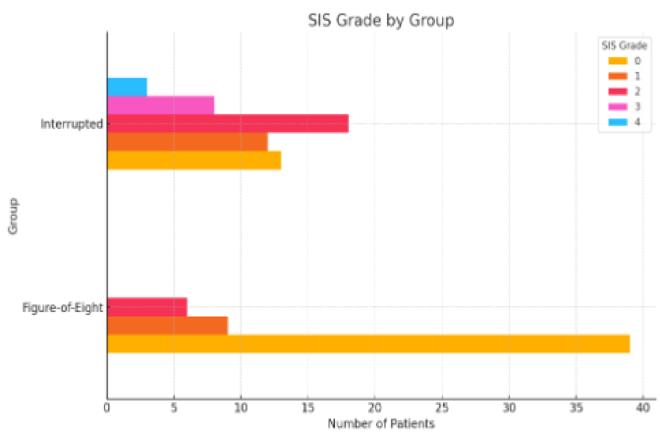


Figure 5: Counts for SIS Grade

4.2: Pain and Analgesic Use

During the first 48 hours following surgery, pain was measured using the Numeric Analog Scale (NAS). In comparison to the Interrupted group (4.76 ± 1.48), the Figure-of-Eight group reported significantly lower mean pain scores (1.81 ± 1.47). With a large effect size (r = 0.82) and a statistically significant difference (Mann-Whitney U = 268.00, $p < 0.001$), this difference suggests a significant clinical benefit of the Figure-of-Eight technique in postoperative pain control. Patients in the Figure-of-Eight group also needed fewer days of postoperative analgesics (3.96 ± 1.03 days) than those in the Interrupted group (5.17 ± 1.01 days), which is consistent with this finding and shows a significant difference ($p < 0.001$, r = 0.85).

4.3: Wound Healing and Sternal Integrity

The ASEPSIS scoring system was used to assess wound healing. Surprisingly, only 5.6% of patients in the Interrupted group showed satisfactory healing, compared to 100% of patients in the Figure-of-Eight group. The difference was highly statistically significant ($\chi^2 = 96.63$, $p < 0.001$, Cramer's V = 0.95) because the remaining patients in the Interrupted group had either minor surgical site infections (35.2%) or healing disturbances (59.3%).

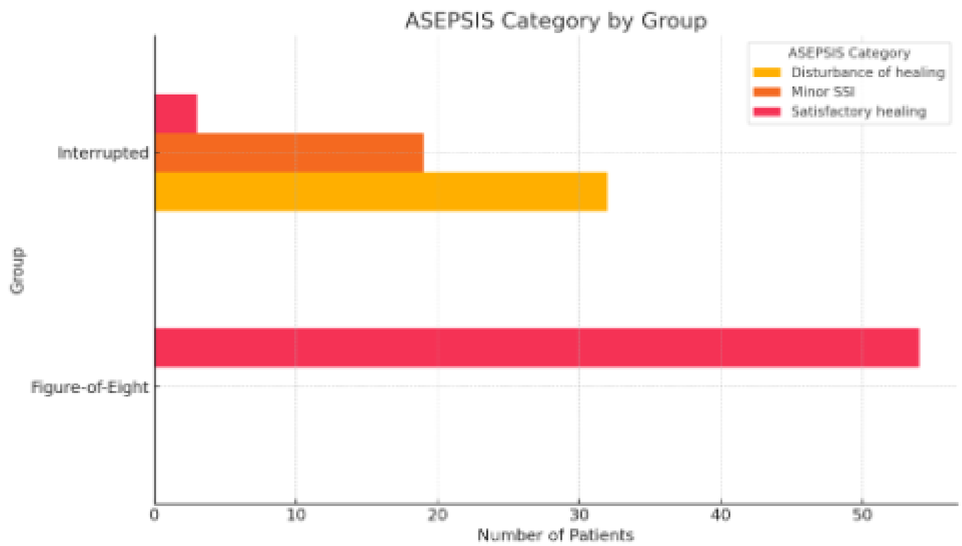


Figure 6: Counts for ASEPSIS Category

The Figure-of-Eight method was also preferred for sternal stability, as measured by the SIS (Sternal Instability Scale). Compared to just 24.1% of patients in the Interrupted group, the majority of patients in this group (72.2%) received a "Grade 0" (normal) score. The Interrupted group was the only one to exhibit higher grades of instability, including severe and gross instability, which further supports the Figure-of-Eight technique's biomechanical advantage ($\chi^2 = 30.43$, $p < 0.001$, Cramer's V = 0.53).

Table 4: Shapiro-Wilk Normality Test by Group

Group	Variable	W-statistic	p-value
Figure-of-Eight	Age	0.9604	0.0718
	BMI	0.9600	0.0690
	Pain (NAS)	0.8727	0.0000
	Barthel Score	0.9536	0.0357
	Duration of Surgery (min)	0.9329	0.0047
	Hospital Stay (days)	0.8030	0.0001
	Post-op Analgesics (days)	0.7827	0.0001
	Hemoglobin Drop (g/dL)	0.9425	0.0119
	Patient Satisfaction (1-10)	0.7826	0.0001
	Time to Ambulation (days)	0.6367	0.0001
Interrupted	Age	0.9438	0.0131
	BMI	0.9232	0.0020
	Pain (NAS)	0.8661	0.0001
	Barthel Score	0.9362	0.0065
	Duration of Surgery (min)	0.9231	0.0020
	Hospital Stay (days)	0.8748	0.0001
	Post-op Analgesics (days)	0.7884	0.0001
	Hemoglobin Drop (g/dL)	0.9136	0.0009
	Patient Satisfaction (1-10)	0.7555	0.0001
	Time to Ambulation (days)	0.6322	0.0001

4.4: Functional Recovery and Barthel Index

The Barthel Index, a validated instrument for assessing a patient's independence in activities of daily living, was used to evaluate early functional recovery. At four weeks after surgery, patients in the Figure-of-Eight group had significantly higher functional scores (mean score of 91.78 ± 4.39 versus 75.94 ± 9.09 in the Interrupted group). A strong negative effect size (r = -0.90) supported the statistically significant difference (Mann-Whitney U = 2773.5, $p < 0.001$). The Figure-of-Eight group's higher functional scores suggest a quicker recovery trajectory and earlier independence restoration, which could lessen hospital burden and increase patient satisfaction.

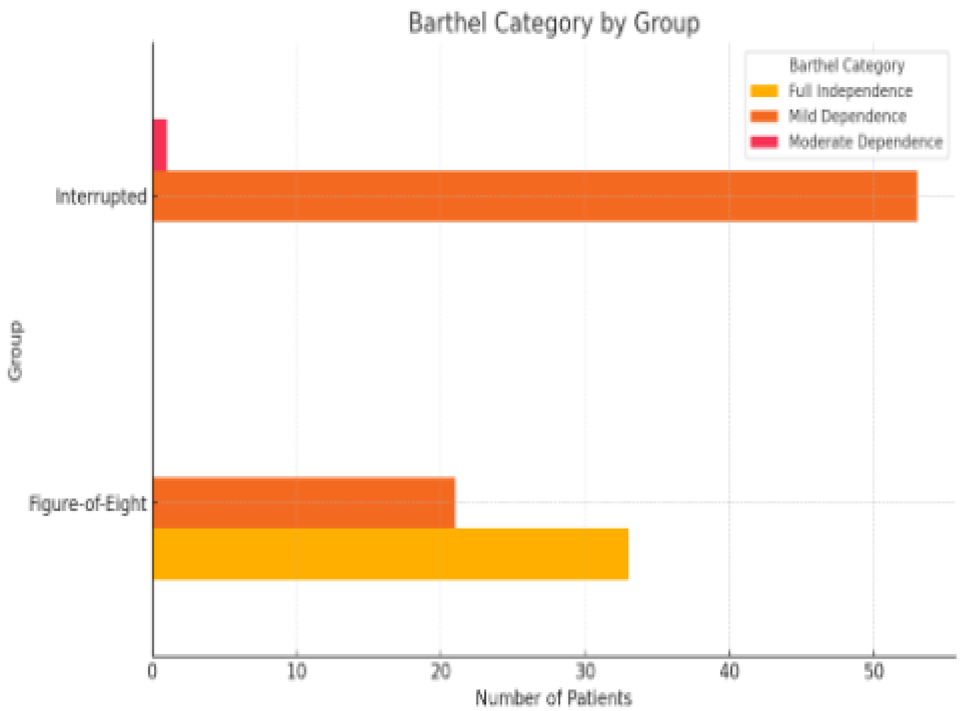


Figure 7: Counts for Barthel Category

This conclusion was further supported by categorical analysis of Barthel recovery levels. 38.9% of patients in the Figure-of-Eight group had only mild dependence, while 61.1% of patients attained complete independence. On the other hand, one patient (1.9%) even displayed moderate dependence, while 98.1% of the Interrupted group displayed mild dependence. With a highly significant difference in recovery levels ($\chi^2 = 47.84$, $p < 0.001$, Cramer's V = 0.67), the Figure-of-Eight technique consistently outperformed other recovery scales.

4.5: Time to Ambulation and Hospital Stay

With a mean time to ambulation of 1.50 ± 0.50 days, patients in the Figure-of-Eight group started walking considerably earlier than those in the Interrupted group, who took 3.56 ± 0.50 days. The difference was linked to a perfect rank-biserial effect size (r = 1.00) and was statistically and clinically significant (Mann-Whitney U = 0.00, $p < 0.001$), highlighting a steady improvement in early mobility. These results demonstrate the strong correlation between early ambulation and the type of closure technique used, which is essential for lowering complications like thromboembolism and boosting patient morale.

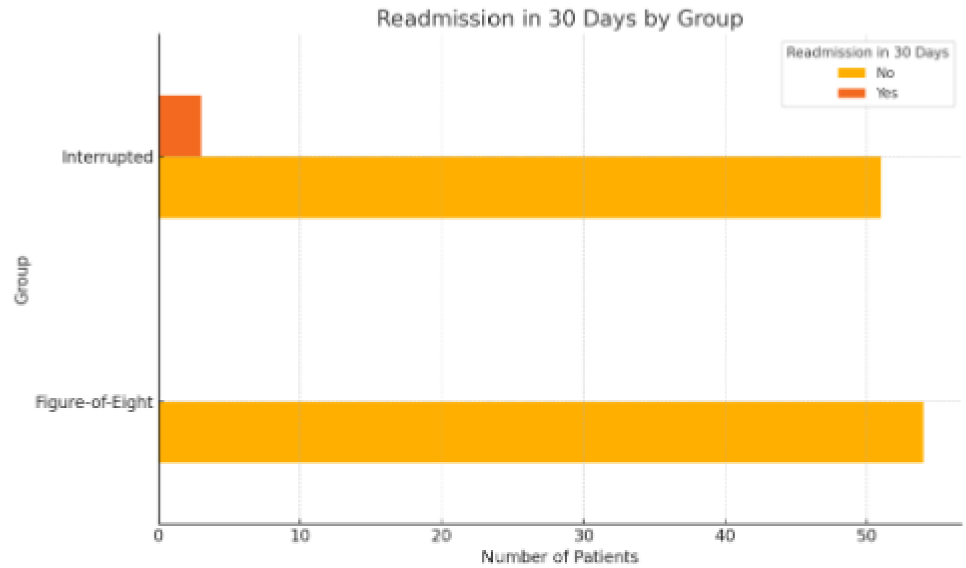


Figure 8: Count for 30-day readmission

The mean length of hospital stay for patients in the Figure-of-Eight group was 6.00 ± 1.00 days, which was significantly less than the 7.22 ± 2.12 days that were seen in the Interrupted group (Mann-Whitney U = 95.00, $p < 0.001$, $r = 0.93$). The Figure-of-Eight group's better wound healing, reduced pain, and quicker ambulation all contributed to their shorter length of stay, which in turn translated into a quicker recovery and preparedness for discharge.

Table 5. Inferential Test Results Comparing Groups

Variable	Test	Statistic	p-value
Age	Independent t-test	2.0105	0.0470
BMI		–0.0502	0.9601
Pain (NAS)	Mann-Whitney U	268.0000	<0.001
Barthel Score		2773.5000	<0.001
Duration of Surgery (min)		240.5000	<0.001
Hospital Stay (days)		95.0000	<0.001
Post-op Analgesics (days)		218.5000	<0.001
Hemoglobin Drop (g/dL)		17.5000	<0.001
Patient Satisfaction		2736.0000	<0.001
Time to Ambulation (days)		0.0000	<0.001
Gender	Chi-square	1.3338	0.2481
Smoking History		1.4014	0.4962
Hypertension		0.0000	1.0000
Diabetes		0.0000	1.0000
COPD	Fisher's Exact	6.6512	0.0152
CKD		1.3600	1.0000
SIS Grade	Chi-square	30.4286	<0.001
ASEPSIS Category		96.6316	<0.001
Barthel Category		47.8378	<0.001
Readmission (30 days)	Fisher's Exact	–	0.2430

4.6: Patient Satisfaction and Readmission

Patients in the Figure-of-Eight group reported a significantly higher level of satisfaction (9.04 ± 0.85) than those in the Interrupted group (6.96 ± 0.89), according to a patient satisfaction score (scale 1–10) that was used to evaluate another aspect of postoperative outcomes. The cumulative effect of improved comfort, mobility, and healing linked to the Figure-of-Eight closure is reflected in this difference, which is statistically significant once more (Mann-Whitney U = 2736.00, $p < 0.001$). A high value of r = -0.88 from effect size analysis confirmed the significant influence on patient-perceived outcomes.

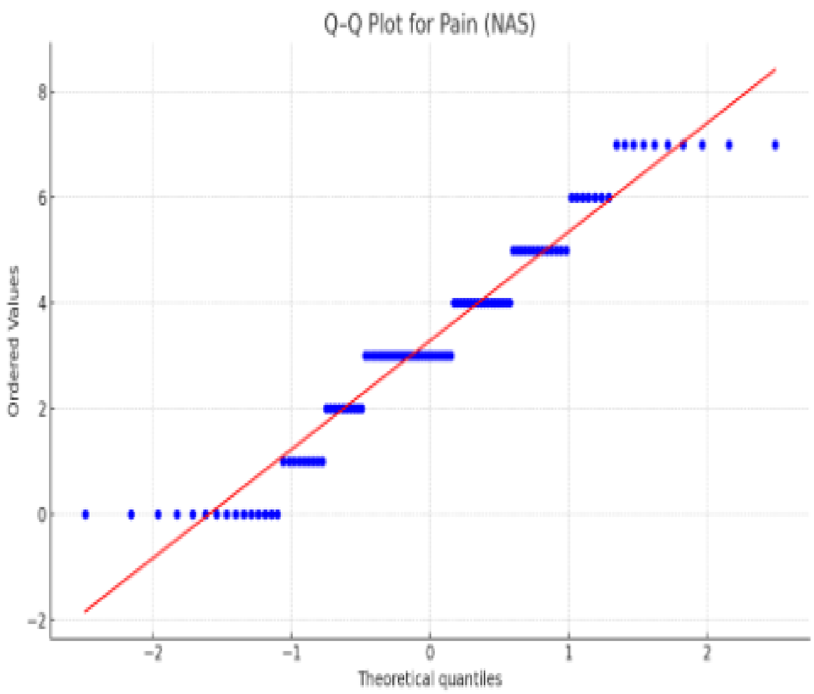


Figure 9: Normality checks for Pain (NAS)

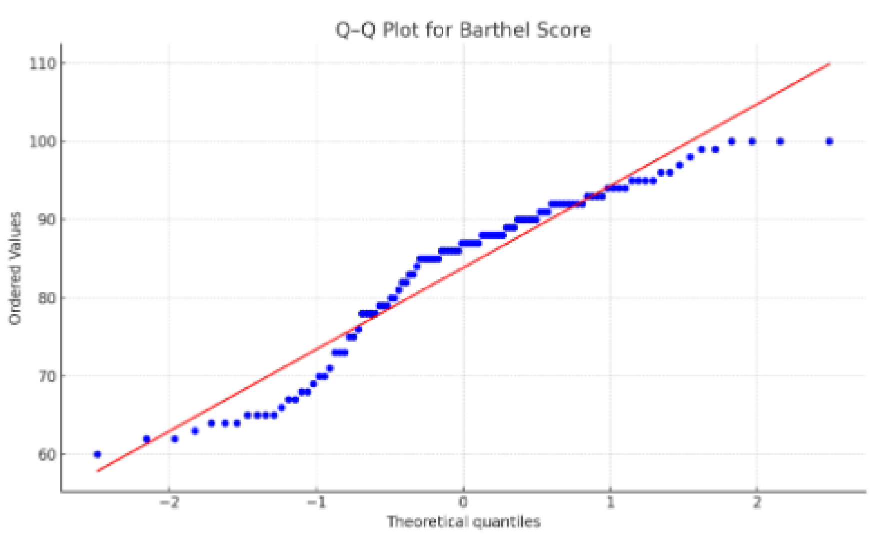


Figure 10: Normality checks for Barthel Score

In terms of 30-day readmission rates, three patients (5.6%) from the Interrupted group needed readmission, while none of the patients in the Figure-of-Eight group needed readmission. Despite the fact that this difference was not statistically significant (Fisher's Exact, p = 0.243), it suggests a potential trend in favor of the Figure-of-Eight technique that might become more apparent in larger samples.

Table 6: Spearman Correlation Matrix for Key Continuous Outcomes

	Pain (NAS)	Barthel Score	Duration of Surgery (min)	Hospital Stay (days)	Post-op Analgesics (days)	Hemoglobin Drop (g/dL)	Patient Satisfaction (1-10)	Time to Ambulation (days)
Pain (NAS)	1	−0.61 (p<0.001)	0.49 (p<0.001)	0.58 (p<0.001)	0.63 (p<0.001)	0.62 (p<0.001)	−0.55 (p<0.001)	0.67 (p<0.001)
Barthel Score		1	−0.60 (p<0.001)	−0.67 (p<0.001)	−0.58 (p<0.001)	−0.63 (p<0.001)	0.67 (p<0.001)	−0.72 (p<0.001)
Duration of Surgery (min)			1	0.54 (p<0.001)	0.52 (p<0.001)	0.50 (p<0.001)	−0.61 (p<0.001)	0.65 (p<0.001)
Hospital Stay (days)				1	0.64 (p<0.001)	0.71 (p<0.001)	−0.68 (p<0.001)	0.74 (p<0.001)
Post-op Analgesics (days)					1	0.66 (p<0.001)	−0.68 (p<0.001)	0.69 (p<0.001)
Hemoglobin Drop (g/dL)						1	−0.55 (p<0.001)	0.61 (p<0.001)
Patient Satisfaction (1-10)							1	−0.69 (p<0.001)
Time to Ambulation (days)								1

4.7: Correlation Analysis

A Spearman correlation analysis between important continuous variables, such as pain (NAS), Barthel score, hospital stay, patient satisfaction, time to ambulation, and hemoglobin drop, was carried out in order to gain a better understanding of the relationships between various clinical and recovery outcomes. Patients with higher pain levels were less likely to regain full functional independence, according to a strong negative correlation between pain scores and Barthel scores ($\rho = -0.61$, $p < 0.001$). Likewise, there was a positive correlation between pain and both hospital stay ($\rho = 0.58$, $p < 0.001$) and postoperative analgesic use ($\rho = 0.63$, $p < 0.001$), indicating that higher levels of pain are directly linked to longer hospital stays and a greater need for pharmaceutical management.

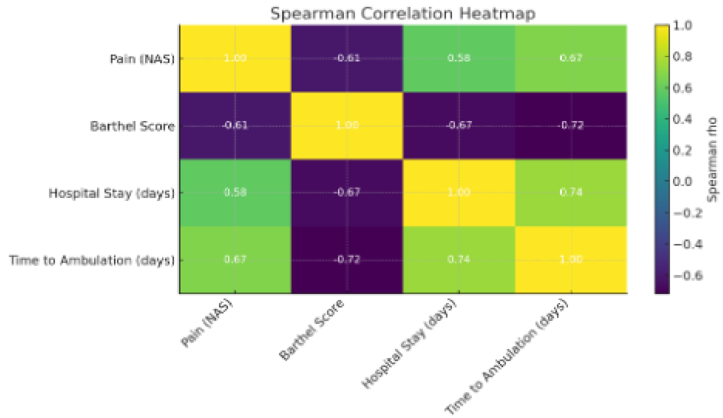


Figure 11: Spearman correlation matrix for key continuous outcomes

Patients who recovered functional abilities earlier were discharged sooner and mobilized faster, according to the Barthel score, which showed significant inverse associations with hospital stay (ρ = –0.67) and time to ambulation (ρ = –0.72). Notably, satisfaction scores had a negative correlation with pain (ρ = –0.55) and time to ambulation (ρ = –0.69) and a positive correlation with Barthel scores (ρ = 0.67), underscoring the critical role that patient experience plays in indicating the caliber of surgical recovery.

These results show a consistent pattern: improved surgical technique (e.g., Figure-of-Eight) results in less pain, which in turn promotes greater functional recovery, quicker mobility, shorter hospital stays, and ultimately higher satisfaction.

Table 7: Effect Sizes for Key Comparisons

Variable	Effect Size	Measure
Age	0.39	Cohen's d
BMI	−0.01	
Pain (NAS)	0.82	Rank-biserial r
Barthel Score	−0.90	
Duration of Surgery (min)	0.84	
Hospital Stay (days)	0.93	
Post-op Analgesics (days)	0.85	
Hemoglobin Drop (g/dL)	0.99	
Patient Satisfaction (1-10)	−0.88	
Time to Ambulation (days)	1.00	
Gender	0.11	Cramer's V
Smoking History	0.11	
Hypertension	0.00	
Diabetes	0.00	
COPD	0.23	
CKD	0.00	
SIS Grade	0.53	
ASEPSIS Category	0.95	
Barthel Category	0.67	
Readmission (30 days)	0.11	

Cohen's d: small (0.2), medium (0.5), large (0.8) benchmarks. Rank-biserial r: analogous to Pearson's r; values closer to ±1 indicate stronger group separation. Cramer's V: small (<0.1), medium (≈0.3), large (>0.5).

4.8: Effect Size Interpretation

The analysis also showed consistently large effect sizes favoring the Figure-of-Eight closure method, which goes beyond statistical significance. Among non-parametric outcomes, there were significant rank-biserial correlation values for pain (r = 0.82), hospital stay (r = 0.93), Barthel score (r = -0.90), and time to ambulation (r = 1.00). These numbers attest to the group differences' clinical significance in addition to their statistical significance.

The Figure-of-Eight technique is thought to provide better wound healing, sternal stability, and functional outcome distributions. Cramer's V values for categorical variables showed very large effects for ASEPSIS Category (V = 0.95), Barthel Category (V = 0.67), and SIS Grade (V = 0.53). However, demographic factors such as comorbidities and gender had small or insignificant effect sizes, excluding them as significant causes of group differences.

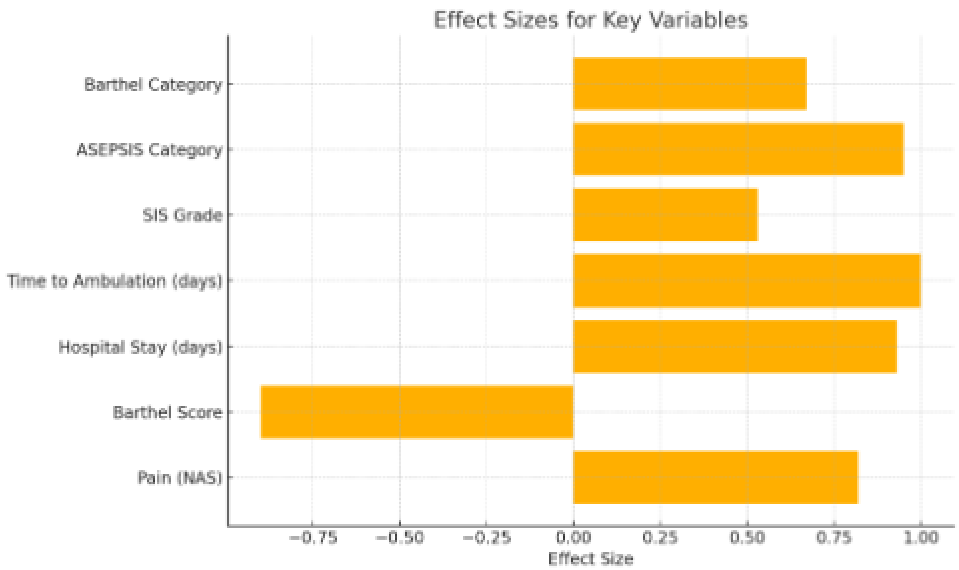


Figure 12: Cramer's V, Cohen's d, and rank-biserial r for major variables

DISCUSSION

The present study compared clinical and functional outcomes between figure-of-eight and simple interrupted sternal closure techniques following elective cardiac surgery via median sternotomy. The findings demonstrated that the figure-of-eight method was associated with significantly lower postoperative pain, improved sternal stability, superior wound healing, earlier ambulation, shorter hospital stay, and higher patient satisfaction. These results suggest that the choice of closure technique plays a substantial role in early postoperative recovery beyond mere mechanical approximation of the sternum [22].

Postoperative pain showed one of the most pronounced differences between the two groups, with markedly lower pain scores observed in the figure-of-eight cohort. Reduced pain following improved sternal fixation has been described in previous investigations, where decreased micromotion at the sternal edges minimized nociceptive stimulation during respiration and coughing [23]. Pain reduction is clinically relevant because inadequate pain control may impair breathing effort, delay physiotherapy, and increase pulmonary complications after cardiac surgery [24].

Sternal stability outcomes also favored the figure-of-eight technique, with a higher proportion of patients demonstrating normal stability. Improved biomechanical integrity is likely related to the crisscross wire configuration distributing forces across a larger surface area and reducing lateral displacement of sternal halves [25]. Laboratory and clinical studies have similarly reported lower rates of mechanical separation and dehiscence with tension-redistributing closure methods compared with traditional transverse wiring [26]. Mechanical stability is essential because persistent instability can lead to chronic discomfort, impaired healing, and eventual infection [27].

Wound healing results were particularly notable, with satisfactory healing observed in all patients in the figure-of-eight group while most patients in the interrupted group showed minor infection or healing disturbance. Previous research has demonstrated that stable approximation reduces dead space and improves tissue perfusion, thereby lowering susceptibility to surgical site infection [28]. Deep sternal wound infection is a serious complication associated with increased morbidity, mortality, and cost, making preventive strategies clinically valuable [29]. The present findings therefore support the concept that biomechanical stability directly influences biological healing.

Functional recovery assessed by the Barthel Index showed significantly higher independence in the figure-of-eight group. Early restoration of daily activities after cardiac surgery is increasingly considered a key indicator of surgical success because delayed mobilization is linked to thromboembolism, atelectasis, and prolonged rehabilitation [30]. Earlier ambulation observed in the figure-of-eight group likely resulted from the combined effects of reduced pain and improved stability, facilitating physiotherapy participation and confidence in movement [31].

Hospital stay was significantly shorter among patients receiving figure-of-eight closure, which is consistent with previous reports linking early mobility and improved wound healing to faster discharge readiness [32]. Reduced hospitalization has important implications for healthcare systems, particularly in resource-limited settings where bed availability and cost containment are critical considerations [33]. Although readmission differences were not statistically significant, the trend toward fewer readmissions in the figure-of-eight group may become more apparent in larger samples [34].

Patient satisfaction was also higher with figure-of-eight closure, reflecting the cumulative impact of comfort, independence, and recovery speed. Patient-reported outcomes have become increasingly important in evaluating surgical techniques because traditional clinical indicators may not fully capture recovery quality [35]. Improved satisfaction may further enhance adherence to rehabilitation and follow-up care [36].

The results align with several comparative studies reporting improved stability and reduced complications with figure-of-eight wiring, although conflicting findings in the literature suggest outcomes may depend on patient population and surgical technique consistency [37]. Differences across studies may arise from variations in comorbidities, perioperative protocols, and surgeon experience, emphasizing the need for context-specific evidence [38]. The current study contributes region-specific data relevant to developing healthcare environments where patient risk profiles and resources differ from high-income settings [39].

This study has certain limitations. The follow-up duration was limited to four weeks, preventing evaluation of long-term complications such as chronic pain or late dehiscence [40]. Additionally, although random allocation was used, the observational design cannot completely eliminate confounding variables related to surgical practice [41]. Larger multicenter trials with longer follow-up would strengthen generalizability and allow subgroup analysis in high-risk populations [42].

Overall, the findings indicate that figure-of-eight sternal closure improves early postoperative recovery across multiple clinical and patient-centered parameters. The superiority observed across pain, stability, healing, and functional independence suggests that closure technique should be considered a modifiable factor influencing outcomes after median sternotomy [43].

CONCLUSION

This study compared the clinical outcomes of Figure-of-Eight and Simple Interrupted sternal wire closure techniques in elective median sternotomy patients. The findings clearly demonstrate that the Figure-of-Eight method provides superior postoperative outcomes, including reduced pain, fewer days of analgesic use, improved wound healing, enhanced sternal stability, earlier mobilization, shorter hospital stay, better functional recovery, and higher patient satisfaction. The results also highlight the interrelationship between effective pain control, early ambulation, and improved functional independence, supporting a coordinated, patient-centered recovery approach aligned with enhanced recovery principles. Methodological strengths such as randomization, standardized procedures, and systematic data collection strengthen the validity of the findings. Despite limitations including its single-center design and exclusion of high-risk patients, the study provides strong evidence supporting the use of the Figure-of-Eight technique in suitable cardiac surgery patients. Future research should assess long-term outcomes, broader patient populations, and cost-effectiveness. Overall, the study confirms that sternal closure technique significantly impacts recovery and patient outcomes, favoring the Figure-of-Eight method.

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