# Predictive Value of Preoperative CXR and Chest CT-Based Sternal Metrics for Postoperative Sternal Wound Healing in Open Heart

**Ahmed H. Lamloum[1]*, Ali Abbas Ahmed Shaltout[1],**
**Mohsen Saber Mohammed Ahmed[2], Yasser Abdelkarim Amin[3]**
Department of [1]Cardiothoracic Surgery, Faculty of Medicine, Cairo University, Egypt
Departments of [2]Cardiothoracic Surgery, and [3]Diagnostic and Interventional Radiology,
Faculty of Medicine, Sohag University, Egypt
***Corresponding author: Ahmed H. Lamloum**, **Mobile:** (+20) 01017886273, **E-mail:** alamloumcts@gmail.com

## ABSTRACT

**Background:** Sternal wound infection (SWI) is a serious complication of open-heart surgery that affects up to 5% of cases, resulting in tripled hospital expenditures and considerable mortality. Most preoperative risk stratification models for SWI have concentrated on clinical perioperative variables, ignoring the critical role of imaging-derived data on chest wall and sternal metrics in predicting and preventing SWI.

**Objectives:** This research sought to explore the significance of sternal measurements derived from preoperative chest imaging, as indicated by chest X-ray (CXR) and chest computed tomography (CT), in forecasting sternal wound healing results.

**Patients and Methods:** 240 adult patients who underwent elective open-heart surgeries via a sternotomy incision at Kasr Al-Ainy and Sohag University Hospitals from January 2021 to June 2025 were included in this study. Preoperative CXR and CT images were revised for sternal thickness, width, and cortical bone density. Postoperative sternal wound healing was evaluated both clinically and through imaging, after which patients were divided into two groups based on the occurrence of SWI.

**Results:** Impaired wound healing occurred in 32 patients (13.3%). Compared with patients with normal healing, those with impaired healing had significantly lower mean sternal thickness (12.8 ± 1.9 mm vs. 15.1 ± 2.3 mm, $p < 0.001$) and reduced CT-measured bone density (420 ± 65 HU vs. 520 ± 70 HU, $p < 0.001$). ROC analysis demonstrated that CT-based parameters had higher discriminative ability (AUC = 0.84, 95% CI: 0.77–0.91) compared with CXR-derived metrics (AUC = 0.68, 95% CI: 0.60–0.77).

**Conclusions:** Preoperative sternal thickness and bone density obtained from chest CT scans are robust, independent indicators of poor wound healing after open-heart surgery. Integrating these imaging-based metrics into preoperative evaluations could enhance risk stratification and assist in directing customized preventive approaches.

**Keywords:** Sternal wound complications, Chest X-ray, Chest CT, Sternal thickness, Bone density, Open-heart surgery.

## INTRODUCTION

As many as 5% of patients who have undergone a sternotomy may experience postoperative sternal wound infection[(1)], and no matter its severity, it is recognized as a significant risk factor affecting surgical results, leading to prolonged hospitalization, the necessity for reoperation, and potentially septic shock or death[(2)]. Too many perioperative variables have been recognized as significant predictors of postoperative SWI, including senility, debility, obesity, chronic obstructive pulmonary disease, bilateral mammary artery harvesting for coronary artery grafting, and others[(3-5)]. Depending on this fact, the traditional models suggested for SWI risk stratification incorporated these clinical and operative variables, missing the variations among centers, populations, and their skeletal differences[(6,7)].

Recent reports have identified lower bone density and a thinner sternum as objective predictors for postoperative SWI but without naming the most feasible and practical method to identify this risk prior to sternotomy[(8-10)].

Chest X-rays and computed tomography are almost always indicated in preparing for open-heart surgeries; yet, the vital quantitative information describing sternal metrics, such as sternal thickness and cortical bone density needed to predict sternal wound healing, is usually ignored[(11)].

Despite the insights mentioned above, we have very little data describing the value of chest-imaging-derived sternal measurements in the prediction and avoidance of sternal wound dehiscence and/or infection. In this study, we aimed to address this gap between preoperative sternal imaging and the predictability of SWI following open-heart surgeries through detailed statistical data analysis in patients who developed such a potentially lethal condition and those who did not.

## PATIENTS AND METHODS

### Study design and population:

This retrospective observational study included 240 adult patients who underwent elective open-heart surgery via median sternotomy at Kasr Al-Ainy and Sohag University Hospitals between January 2021 and June 2025. Postoperatively, patients were stratified into two groups based on the occurrence of SWI within 30 days of surgery: **Group A** (no SWI; 208 patients) and **Group B** (SWI group; 32 patients).

Baseline demographic, anthropometric, clinical, and laboratory variables were collected, with special emphasis on preoperative sternal and chest wall metrics,



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including sternal thickness and cortical bone density, assessed by chest X-ray and computed tomography (CT). Postoperative outcomes, including incidence of SWI, length of hospital stay, need for surgical re-intervention, and early mortality, were prospectively recorded and analyzed.

**Inclusion Criteria:** All adult patients who underwent median sternotomy for cardiothoracic procedures from January 2021 to June 2025, with accessible chest imaging data in the form of CXR and chest CT performed within 30 days prior to the intervention, along with postoperative clinical and laboratory data, were included in this study.

**Exclusion criteria:** Patients were not included if they received emergency cardiac surgery or repeat procedures, had a background of chest wall deformities, trauma, or past thoracic surgeries involving the sternum, or experienced chronic infections, immunosuppression, or extended corticosteroid treatment. Furthermore, individuals with incomplete or low-quality preoperative chest imaging or insufficient postoperative follow-up within 30 days were also omitted from the study.

**Definitions:**

- **Radiological Definitions: Figures 1 and 2.**

- Preoperative chest radiographs (CXR) were routinely obtained in both posteroanterior (PA) and lateral projections, with patients positioned upright at full inspiration and a source-to-image distance of 180 cm, following the standard radiographic protocol for comprehensive evaluation of thoracic and sternal structures[12].
- All preoperative chest CT scans were performed using a standardized protocol with a 64-channel multislice CT scanner (sharp reconstruction filter, 2-mm slice thickness, 1-mm slice increment, and a field of view ranging from 100 to 250 mm) to ensure uniform image acquisition and reproducibility of sternal measurements[13].
- Sternal thickness and sternal width were defined as measured at the manubrium and mid-body levels on the CXR and CT chests. Cortical bone density was assessed on CT scans and quantified in Hounsfield units (HU). Bone density values exceeding 450 HU indicated preserved bone density, and values below 450 HU were considered indicative of osteopenia or reduced bone mineralization[14].

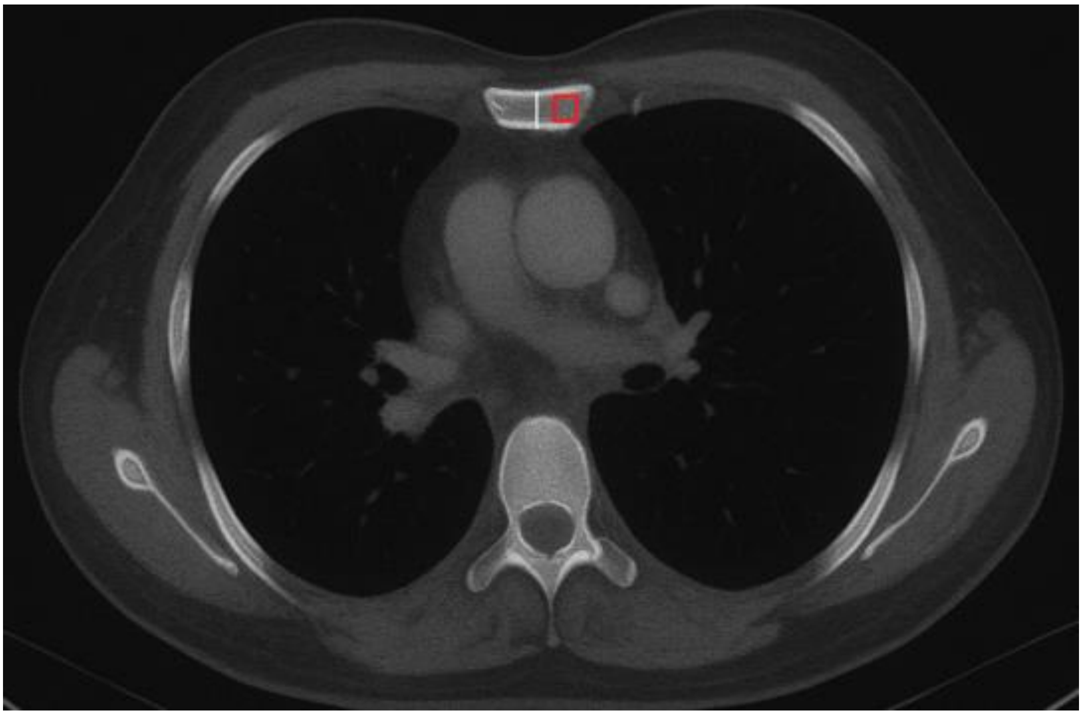

**Figure (1):** Preoperative axial CT chest demonstrating sternal thickness (white line) and cortical bone density measurement (ROI red box, expressed in Hounsfield Units > 450; considered normal).

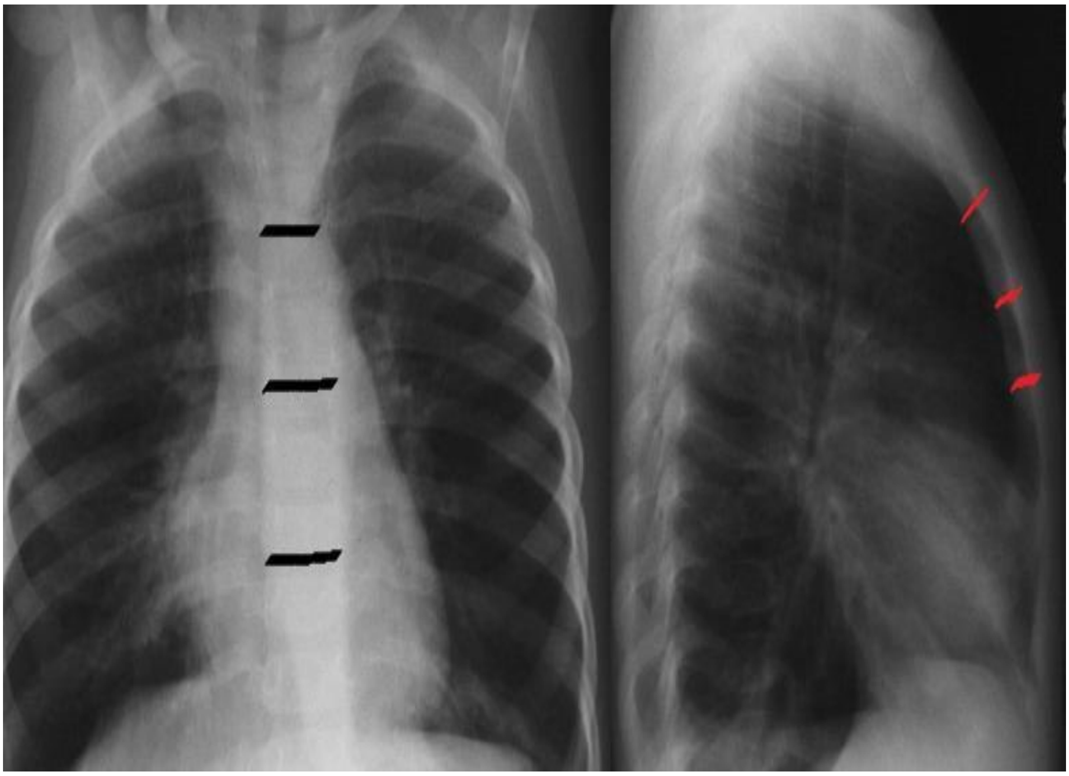

**Figure (2):** Preoperative chest radiographs (posteroanterior and lateral views) showing measurement of sternal width (PA view, black horizontal line) and sternal thickness (lateral view, Red semi-vertical line).

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- **Clinical Definitions:**

- Indications and recommendations for CABG and the other cardiac procedures were all decided following the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines [15,16].
- Impaired wound healing and SWI occurring within the 30 days following operation were defined according to the center for Disease Control and Prevention criteria (CDC) [17,18].
- Prolonged MV (> 24 hours), prolonged ICU stay (> 3 days), prolonged hospital stays (> 14 days), and early postoperative mortality (within 30 days postoperatively) were defined regarding guidelines from the Society of Thoracic Surgeons (STS) [19].

**Data collection:**

Beside the baseline variables and demographic data that were collected including age, sex, body mass index (BMI), smoking status, comorbidities (hypertension, dyslipidemia, COPD) and preoperative left ventricular ejection fraction (LVEF), data extracted from our medical records regarding the preoperative chest wall and sternal metrics as detected by chest imaging (CXR and CT) were collected and analyzed.

After the operation, data collected preoperatively were statistically linked to the incidence of postoperative SWIs to assess the ability of these variables to predict such potentially life-threatening complication and its possible hazards including prolonged ICU and hospital stays besides the need for re-intervention.

All imaging measurements were evaluated objectively by an experienced radiologist who was not aware of the postoperative outcomes. Clinical and laboratory data were cross-checked against hospital computerized medical records to reduce reporting bias.

**Study endpoints:**

- The endpoints we determined in this study were selected to reflect both the direct burden of the defective sternal healing and its broader influence on perioperative morbidity and mortality.
- Our primary endpoints of this study were the incidence of impaired sternal wound healing or SWI within 30 days after surgery, as defined by the Centers for Disease Control and Prevention (CDC) criteria, and the predictability of preoperative sternal measurements on this complication.
- Taking into consideration the secondary endpoints, we included prolonged mechanical ventilation (>24 hours), prolonged intensive care unit (ICU) stay (>3 days), prolonged hospital stays (>14 days), the need for surgical re-intervention due to wound-related complications, and early postoperative mortality occurring within 30 days.

- **Measures before surgical intervention:**

Throughout the preoperative preparatory period, all of our patients underwent fully comprehensive clinical and laboratory examinations, including standard echocardiographic study with special emphasis on the left ventricular ejection fraction and routine chest imaging in the form of posteroanterior and lateral chest radiographs along with chest computed tomography

(CT) scans. Metrics measured included sternal thickness, sternal width, and cortical bone density, measured in Hounsfield units (HU).
Data collected from the chest imaging done were analyzed in relation to the postoperative sternal wound healing outcome to establish objective preoperative predictive variables.

- **Intraoperative Measure:**

Using the typical cardiopulmonary procedures and either cold or warm $K^+$ cardioplegic solution for myocardial protection, we operated on all of our patients through a standard median sternotomy. The type of surgery, operative time, cross-clamp time, total bypass time, number of grafts in coronary artery grafting patients, need for blood product transfusion, need for high inotropic support, and patients transferred with packed open chest were among the operational data collected and analyzed from surgical notes and anesthetic sheets.

- **Postoperative measures:**

Data on postoperative outcomes were acquired from ICU charts and hospital medical records. The duration of mechanical ventilation (MV), the length of ICU admission, the overall hospital stays, and the need for re-exploration due to bleeding or wound concerns were all taken into account. The incidence of SWI within 30 days was carefully recorded in accordance with CDC guidelines, and wound healing outcomes were assessed clinically and by imaging. Additional unfavorable outcomes, such as the necessity for prolonged inotropic/vasopressor support and early postoperative death (within 30 days), were noted. Postoperative parameters were investigated in conjunction with preoperative imaging-based sternal measurements to assess the predictive usefulness.

**Follow up after hospital discharge:**

On a monthly basis, our patients were followed for at least 3 consecutive months. Throughout this period, patients were clinically evaluated and fully investigated regarding their cardiac status and the possible delayed sternal wound problems, particularly delayed mediastinitis, which occurred more than 30 days following the operation[20]. This well-structured follow-up allowed for prompt diagnosis and efficient postoperative complication handling.

**Sampling method:**

To minimize selection bias and ensure that all cases meeting the inclusion criteria were included within the specified time frame of this retrospective observational study, the consecutive sampling method was employed. All elective cases accessed through full sternotomy at Kasr Al-Ainy and Sohag University Hospitals between January 2021 and June 2025 were subjected to screening for eligibility to join our study; then, all eligible patients with both verbal and written consent were included till reaching the targeted sampling size.
A total number of 240 patients were enrolled in this study, and their data were prospectively analyzed to link the preoperative sternal metrics as detected by chest imaging and other perioperative variables and the sternal wound healing outcomes.

**Ethical approval:**

**The Ethical Committee of Sohag University Hospitals, Sohag University, Egypt, approved the study protocol. Ethical Approval Number was Soh-Med-25-7-9PD. Every patient signed an informed written consent for acceptance of the operation. The study adhered to the Helsinki Declaration throughout its execution.**

***Statistical analysis***

Data collection and statistical analysis were performed with IBM SPSS Statistics for Windows, Version 26.0. A student's t-test was utilized to assess continuous data, which were checked for normality through the Shapiro-Wilk test. These variables were presented as mean ± SD (standard deviation). The chi-square test or Fisher's exact test was utilized to analyze categorical data shown as percentages. Univariate and multivariate logistic regression evaluated the factors predicting SWI, and 95% CIs were utilized to calculate the adjusted odds ratios (ORs) for the SWI.
To evaluate the forecasting capability of preoperative sternal measurements observed in preoperative chest imaging for postoperative SWI, we conducted receiver operating characteristic (ROC) curve analysis, calculating the area under the curve (AUC). Statistical significance was established as P values less than 0.05, and all reported P values are two-tailed. Each statistical analysis was aided by a qualified statistician.

**RESULTS**

- **Demographic and preoperative variables; Figures 3 and 4, Table 1:**

This study included 240 patients who were operated on electively via conventional median sternotomy and were divided according to the incidence of postoperative SWI into two groups. Reviewing their preoperative data revealed that the impaired wound healing group (n = 32) showed significantly older patients, with lower mean sternal thickness and reduced cortical bone density compared with those with normal healing (n = 208). No statistically significant differences were noted regarding sex distribution, BMI, smoking status, or baseline LVEF between the two groups.

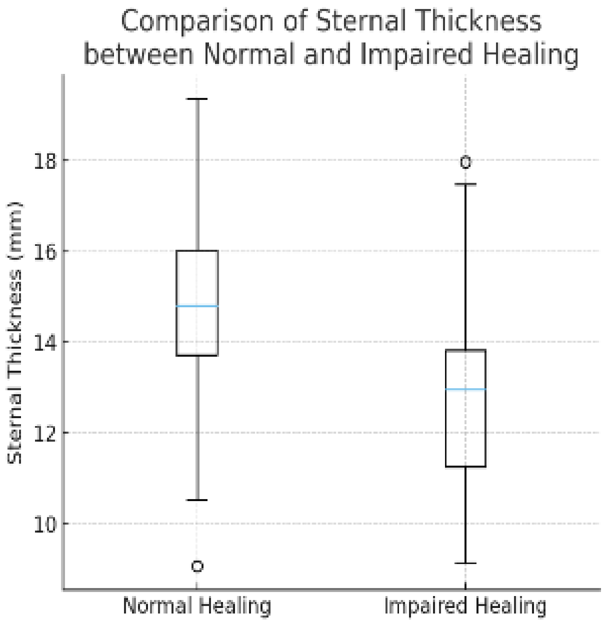


**Figure (3):** Box-and-whisker plot illustrating the distribution of preoperative sternal thickness (mm) among patients with normal wound healing and those with impaired healing following median sternotomy. Patients with impaired healing demonstrated significantly lower sternal thickness values ($p < 0.001$).

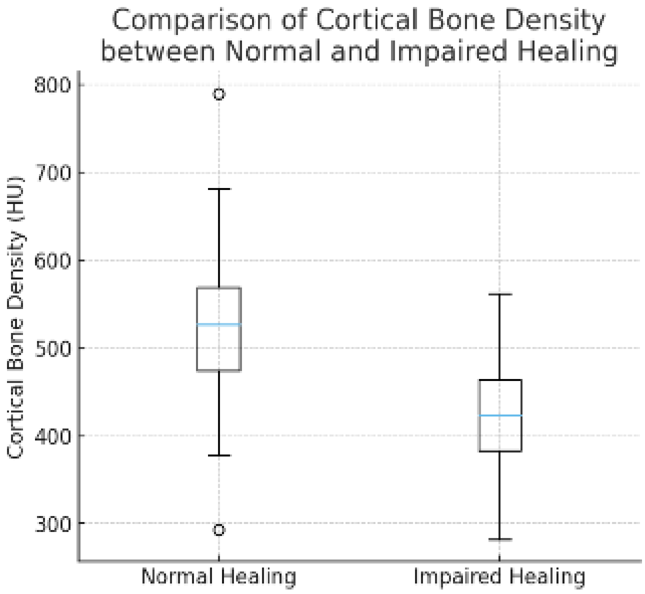


**Figure (4):** Box-and-whisker plot showing cortical bone density (Hounsfield units, HU) in patients with normal healing versus impaired healing. A markedly reduced bone density was observed in patients with impaired healing ($p < 0.001$).

**Table (1): Preoperative parameters of the studied patients.**

| Variable | Total (n=240) | Normal healing (n=208) | Impaired healing (n=32) | P value |
|---|---|---|---|---|
| **Age (years, mean ± SD)** | 59.4 ± 9.2 | 58.7 ± 9.0 | 62.8 ± 8.6 | 0.012 |
| **Male sex, n (%)** | 171 (71.3%) | 148 (71.2%) | 23 (71.9%) | 0.941 |
| **BMI (kg/m², mean ± SD)** | 28.5 ± 3.7 | 28.6 ± 3.6 | 28.2 ± 3.8 | 0.614 |
| **Smoking, n (%)** | 122 (50.8%) | 106 (51.0%) | 16 (50.0%) | 0.912 |
| **Hypertension, n (%)** | 164 (68.3%) | 145 (69.7%) | 19 (59.4%) | 0.248 |
| **Dyslipidemia, n (%)** | 134 (55.8%) | 115 (55.3%) | 19 (59.4%) | 0.672 |
| **COPD, n (%)** | 52 (21.7%) | 44 (21.2%) | 8 (25.0%) | 0.623 |
| **LVEF (mean ± SD)** | 52.3 ± 7.9 | 52.5 ± 7.8 | 51.2 ± 8.1 | 0.402 |
| **Sternal thickness (mm, mean ± SD)** | 14.7 ± 2.4 | 15.1 ± 2.3 | 12.8 ± 1.9 | <0.001 |
| **Cortical bone density (HU, mean ± SD)** | 505 ± 75 | 520 ± 70 | 420 ± 65 | <0.001 |

*BMI, Body Mass index, COPD, Chronic Obstructive Pulmonary Disease, LVEF, Left Ventricular Ejection Fraction, HU,* Hounsfield units.

- **Intraoperative variables; Table 2:**

When analyzing the intraoperative data, we observed no statistically significant difference between the two groups concerning the type of surgeries performed, CPB, aortic clamp, and total bypass durations. Although a larger percentage of patients with open chests were moved to the postoperative ICU and there was a greater rate of blood product transfusions in the impaired healing group (31.3% compared to 19.2% and 6.3% versus 2.9%, respectively), the difference was not statistically significant.

**Table (2): Intraoperative variables of the studied patients:**

| Intraoperative Variable | Group A: No SWI (n = 208) | Group B: SWI (n = 32) | P value |
|---|---|---|---|
| **Type of surgery (CABG/Valve/Combined)** | 140 / 48 / 20 | 20 / 8 / 4 | 0.774 |
| **Operative time (min, mean ± SD)** | 255 ± 40 | 265 ± 45 | 0.212 |
| **CPB time (min, mean ± SD)** | 92 ± 18 | 95 ± 20 | 0.356 |
| **Aortic cross-clamp time (min, mean ± SD)** | 62 ± 14 | 65 ± 15 | 0.298 |
| **Number of grafts (CABG only, mean ± SD)** | 3.1 ± 0.7 | 3.2 ± 0.8 | 0.421 |
| **Blood product transfusion, n (%)** | 40 (19.2%) | 10 (31.3%) | 0.084 |
| **High-dose inotropic support, n (%)** | 28 (13.5%) | 7 (21.9%) | 0.198 |
| **Transfer to ICU with open chest, n (%)** | 6 (2.9%) | 2 (6.3%) | 0.274 |

*CABG, Coronary Artery Bypass Graft, CPB, Cardio Pulmonary Bypass, ICU, Intensive Care Unit.*

- **Postoperative variables; Tables 3:**

Analyzing data following intervention, we found that significantly more patients among the impaired sternal wound healing group experienced prolonged mechanical ventilation, ICU and hospital stays, need for reintervention, and early mortality (P value < 0.05 for all). Other unfavorable outcomes, such as postoperative atrial fibrillation (POAF), cerebrovascular strokes (CVS), and the need for prolonged vasopressor support, were numerically more in the same group. However, the difference was statistically insignificant.

**Tables (3): Postoperative variables in the studied patients.**

| Parameter | Group A (No SWI, n=208) | Group B (SWI, n=32) | *p* value |
|---|---|---|---|
| **Prolonged MV (>24 h), n (%)** | 28 (13.5%) | 12 (37.5%) | 0.001 |
| **Prolonged ICU stay (>3 days), n (%)** | 31 (14.9%) | 14 (43.8%) | <0.001 |
| **Prolonged hospital stay (>14 days), n (%)** | 26 (12.5%) | 15 (46.9%) | <0.001 |
| **Re-exploration for bleeding/wound, n (%)** | 12 (5.8%) | 5 (15.6%) | 0.048 |
| **POAF, n (%)** | 34 (16.3%) | 9 (28.1%) | 0.092 |
| **CVS, n (%)** | 10 (4.8%) | 4 (12.5%) | 0.074 |
| **Prolonged inotropic/vasopressor support, n (%)** | 29 (13.9%) | 10 (31.3%) | 0.015 |
| **Early mortality (30-day), n (%)** | 9 (4.3%) | 4 (12.5%) | 0.038 |

- **Univariate analysis; Table 4:**

Univariate logistic regression analysis identified reduced sternal thickness and bone density from preoperative chest imaging, along with advancing age, as risk factors for poor sternal wound healing and infection.

Monitoring hazards, individuals with compromised healing experienced poorer outcomes related to both morbidity and mortality. This included extended durations in the ICU and prolonged needs for ventilatory support, as well as an increase in early postoperative deaths.

**Table (4): Univariable analysis to evaluate the factors predicting SWI in the studied patients.**

| Variable | SWI Group (n=32) | Non-SWI Group (n=208) | P value | OR (95% CI) |
|---|---|---|---|---|
| **Sternal thickness (<13.5 mm)** | 20 (62.5%) | 38 (18.3%) | <0.001 | 3.12 (1.64–5.93) |
| **Bone density (<450 HU)** | 22 (68.8%) | 42 (20.2%) | <0.001 | 3.45 (1.84–6.47) |
| **Age (>65 years)** | 14 (43.8%) | 42 (20.2%) | 0.004 | 2.57 (1.33–4.97) |
| **Prolonged MV (>24 h)** | 11 (34.4%) | 27 (13.0%) | 0.006 | 2.91 (1.35–6.27) |
| **Prolonged ICU stay (>3 d)** | 12 (37.5%) | 29 (13.9%) | 0.003 | 2.98 (1.40–6.32) |
| **Early mortality (<30 d)** | 5 (15.6%) | 9 (4.3%) | 0.041 | 2.67 (1.02–7.01) |

MV, Mechanical Ventilation, ICU, Intensive Care Unit.

- **Multivariate Logistic Regression Analysis, Table 5:**

Only bone density <450 HU (adjusted OR 2.87; 95% CI: 1.42–5.79; p= 0.016) and sternal thickness <13.5 mm (adjusted OR 2.41; 95% CI: 1.42–5.79; p= 0.003) were found to be independent predictors of impaired sternal wound healing following open heart surgery in multivariate logistic regression analysis. After adjustment, other factors such as advanced age, prolonged ventilation, prolonged intensive care unit stays, and early mortality lost their statistical significance, suggesting that the most accurate indicators of postoperative SWI are sternal measurements derived from preoperative imaging.

**Table (5): Multivariate logistic regression analysis to evaluate the factors predicting SWI in the studied patients.**

| Predictor | Adjusted OR | 95% CI | P value |
|---|---|---|---|
| Sternal thickness (<13.5 mm) | 2.41 | 1.18 – 4.91 | 0.016 |
| Bone density (<450 HU) | 2.87 | 1.42 – 5.79 | 0.003 |
| Age (>65 years) | 1.89 | 0.92 – 3.87 | 0.082 |
| Prolonged MV (>24 h) | 1.64 | 0.77 – 3.51 | 0.197 |
| Prolonged ICU stay (>3 d) | 1.53 | 0.71 – 3.29 | 0.267 |

- **ROC Curve Analysis; Figure 5, Table 6:**

Receiver operating characteristic (ROC) curve analysis demonstrated that CT-derived bone density had the highest discriminative ability for predicting SWI, followed by sternal thickness. In contrast, CXR-derived sternal width showed only modest predictive performance. Optimal cut-off values of <13.5 mm for sternal thickness and <450 HU for bone density yielded sensitivities of 72.0% and 76.5%, and specificities of 70.5% and 74.3%, respectively.

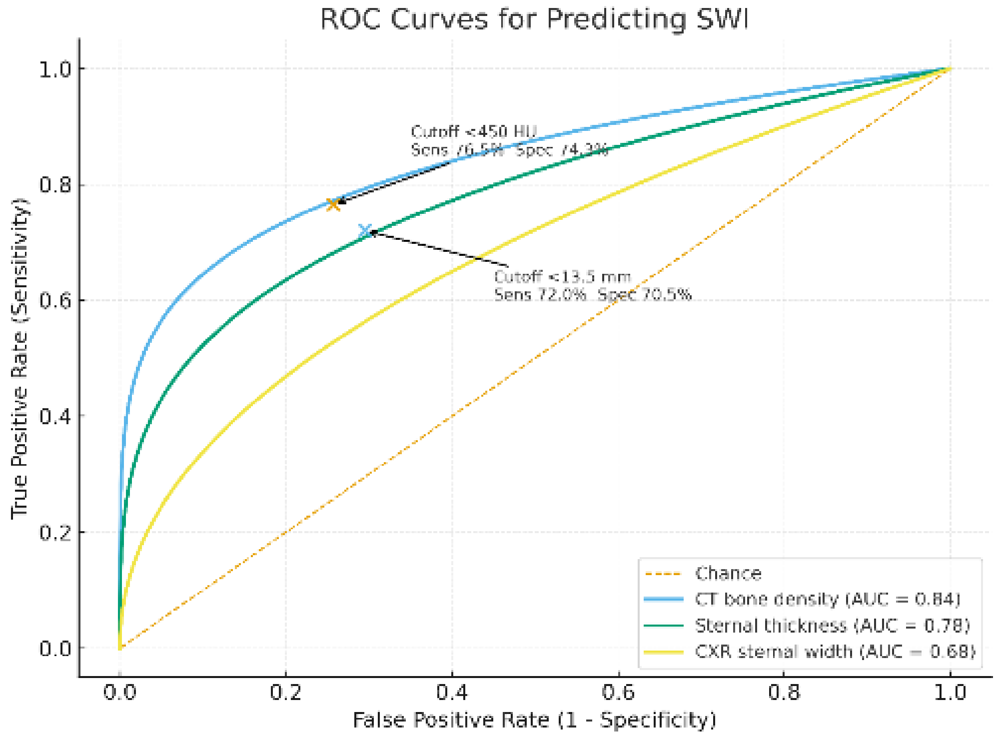


**Figure (5):** ROC curve Analysis to evaluate the diagnostic accuracy of sternal thickness, bone density, and CXR-derived width to discriminate SWI.

**Table (6): ROC curve analysis to evaluate the diagnostic accuracy of sternal thickness, bone density, and CXR-derived width to discriminate SWI**

| Predictor | AUC | 95% CI* | Cut-off | Sensitivity | Specificity | P value |
|---|---|---|---|---|---|---|
| Sternal thickness | 0.78 | 0.71 – 0.85 | 13.5 mm | 72.0% | 70.5% | <0.001 |
| Bone density (HU) | 0.84 | 0.77 – 0.91 | 450 HU | 76.5% | 74.3% | <0.001 |
| CXR-derived width | 0.68 | 0.60 – 0.77 | 120 mm | 61.3% | 63.8% | 0.004 |

AUC; Area Under the Curve, * CI approximation based on AUC distribution.

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**DISCUSSION**

Irrespective of the type of procedure performed via sternotomy, SWI may significantly deteriorate the results, and no matter the resources available at the treating facility, SWI can impact as many as 5% of patients, leading to up to a threefold rise in morbidity, mortality, and treatment expenses[21-23].

Numerous perioperative models have been proposed to assess the postoperative risk of developing potentially deadly conditions that often involve comorbidities like diabetes mellitus, obesity, COPD, and senility[24,25], while neglecting the unique anatomical characteristics of a patient's sternum that could significantly impact their wound healing capacity.

In this multicenter research, we retrospectively gathered preoperative information on sternal thickness and bone density from standard preoperative chest imaging, specifically CXR and CT chest, and subsequently conducted a statistical analysis to evaluate the predictive capabilities of these variables for the occurrence of postoperative SWI.

Our results showed that decreased sternal wound thickness and diminished cortical bone densities noted in CT reports were more effective than CXR-derived metrics in forecasting SWI. Additionally, the analysis of data via multivariable logistic regression identified both variables as strong independent predictors, while ROC analysis revealed that parameters derived from CT (AUC 0.84) outperformed those derived from CXR (AUC 0.68).

These results bolster the theory that the quality of sternal bone and structural integrity, rather than merely systemic comorbidities, significantly influence sternal wound stability.

In 2018, **Lee *et al.*** [(26)] emphasized the negative impact of poor preoperative sternal mineralization on sternal wound healing. They reported that reduced bone density is an independent risk factor for impaired sternal wound healing, as well as for dehiscence and infection following open-heart surgeries.

In a similar vein, **Choi *et al.*** [(27)] demonstrated that sternal thickness assessed via CT predicted wound complications post-surgery, especially in older or more vulnerable patients. This evidence is reinforced by the present study, which indicates that a combined assessment of sternal thickness and bone density enhances predictive accuracy and could be included in preoperative risk evaluation.

When comparing the variables we employed to those typically used by other publishing institutions[(28,29)], which relied mostly on clinical indices, our findings demonstrated the predictive utility of image-based sternal measures and factors in determining postoperative sternal wound dangers.

In this study, we also outperformed CT-based evaluation in terms of reliability over CXR; that is, despite its widespread availability and feasibility, it was less accurate in evaluating sternal cortical density and detecting early postoperative dehiscence.

CT-based screening may be critical in high-risk populations, such as the elderly, postmenopausal women, and diabetics with poor management. Both sternal thickness <13.5 mm and bone density <450 HU were identified as threshold metrics associated with significantly increased SWI risk. These cut-off values could be used in future risk prediction algorithms to help surgeons adapt preventive interventions.

Practically speaking, identifying patients with thin or osteopenic sternums before surgery could allow for preventive actions, such as implementing improved sternal fixation methods (like rigid plate fixation or reinforcement wires), enhancing bone health, and adopting stricter infection control measures during the perioperative period[(30,31)]. Additionally, these patients could gain from enhanced postoperative monitoring, which includes prompt imaging follow-up and proactive wound management.

Although the study has notable strengths, such as its multicenter design and fairly large cohort, it also has specific limitations. Initially, the retrospective design could lead to selection bias even with consecutive sampling. Secondly, CT-derived bone density quantified in Hounsfield units is not a direct alternative to dual-energy X-ray absorptiometry (DEXA), even though previous research has confirmed its application as a proxy for bone mineral density [(32)]. Ultimately, extended follow-up beyond 30 days is necessary to evaluate late complications such as chronic sternal instability or delayed mediastinitis.

## CONCLUSION

Our research validates that sternal thickness and bone density assessed via CT scans before surgery are strong, independent indicators of compromised sternal wound healing following open-heart surgery. Integrating these imaging-based factors into preoperative assessments may enhance risk assessment, facilitate tailored preventive measures, and ultimately lessen the impact of SWI.

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