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INPLASY

Rigid plate fixation versus wire closure after median sternotomy: a protocol for an updated risk-stratified systematic review and meta-analysis

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 28 March 2026 and was last updated on 28 March 2026.

INTRODUCTION

Review question / Objective Among adult patients undergoing cardiac surgery through median sternotomy, does rigid plate fixation, compared with conventional wire closure, improve infection-related outcomes and postoperative recovery outcomes?

Rationale Median sternotomy remains the standard surgical approach for many adult cardiac procedures, and conventional wire cerclage has long been the most commonly used method for sternal closure. However, wire closure mainly approximates the sternal halves and may permit persistent micromotion under multidirectional physiological stress, which may contribute to sternal instability, dehiscence, and wound complications. Rigid plate fixation provides greater multidirectional stability and may better support primary bone healing. Although previous systematic reviews and meta-analyses have suggested potential benefits of rigid plate fixation, most have focused on overall pooled effects and have not adequately addressed which patients may derive the greatest benefit in clinical practice. In addition, broad sternal wound complications or surgical site infection outcomes are often pooled together with deep sternal wound infection or mediastinitis, which may obscure the clinical relevance of rigid fixation for severe infectious endpoints. Therefore, this updated review aims to reassess the comparative effectiveness of rigid plate fixation versus wire closure using a risk-stratified framework and by separating overall wound complications from deep sternal wound infection/mediastinitis.

Condition being studied Adult patients undergoing cardiac surgery via median sternotomy, with a focus on postoperative sternal closure techniques and related complications, including surgical site infection, deep sternal wound infection/mediastinitis, postoperative pain, and recovery outcomes.

METHODS

Search strategy A systematic search was conducted in PubMed, Embase, Web of Science,

Cochrane Library, and Scopus from database inception to 19 March 2026. The search strategy combined controlled vocabulary and free-text terms related to cardiac surgery, sternotomy, sternal closure, rigid plate fixation, SternaLock, Talon, wire closure, and wire cerclage. Reference lists of relevant articles were also screened when appropriate. The full database-specific search strategies are provided in the supplementary material.

Participant or population Adults undergoing cardiac surgery through median sternotomy, including coronary artery bypass grafting, valve surgery, or other median sternotomy cardiac procedures.

Intervention Primary sternal closure using rigid plate fixation or comparable rigid sternal plate-and-screw fixation systems.

Comparator Conventional wire closure or wire cerclage for primary sternal closure after median sternotomy.

Study designs to be included Randomized controlled trials and comparative observational studies, including prospective and retrospective cohort studies, that directly compare rigid plate fixation with conventional wire closure.

Eligibility criteria
Inclusion criteria:
(1) adult patients undergoing cardiac surgery through median sternotomy;
(2) intervention group treated with rigid plate fixation or a comparable primary rigid sternal fixation system;
(3) comparator group treated with conventional wire closure/wire cerclage;
(4) randomized controlled trials or comparative prospective/retrospective observational studies;
(5) reporting at least one prespecified extractable outcome.

Exclusion criteria:
(1) duplicate reports of the same study population;
(2) mixed fixation strategies that did not preserve the intended intervention contrast;
(3) studies in which rigid fixation was inseparable from other major co-interventions;
(4) conference abstracts, registry-only records, technical notes, biomechanical-only studies, or studies without usable comparative data;
(5) studies focused on reconstructive treatment after established sternal dehiscence or deep sternal wound infection rather than primary closure.

Information sources Electronic databases included PubMed, Embase, Web of Science, Cochrane Library, and Scopus. In addition, reference lists of eligible studies and relevant reviews were checked for potentially missed records.

Main outcome(s) (1) any sternal wound complication and/or surgical site infection;
(2) deep sternal wound infection and/or mediastinitis.

Additional outcome(s) Secondary outcomes include postoperative length of hospital stay, intensive care unit length of stay, early postoperative pain, and short-term analgesic/opioid consumption. Continuous outcomes will be synthesized using mean difference (MD) or standardized mean difference (SMD), with 95% confidence intervals, depending on the consistency of measurement scales across studies.

Data management Search results will be collated and deduplicated in a citation management environment. Study selection and data extraction will be conducted using a prespecified standardized form. Extracted information will include study characteristics, patient population, risk profile, intervention and comparator details, follow-up, and outcome data. When multiple reports refer to the same underlying study, they will be merged under a single study ID to avoid double counting, with outcome-level information extracted from the most relevant report(s).

Quality assessment / Risk of bias analysis Risk of bias in randomized controlled trials will be assessed using the RoB 2 tool. Comparative non-randomized studies will be assessed using ROBINS-I. The certainty of evidence for major outcomes will be evaluated using the GRADE approach.

Strategy of data synthesis Meta-analysis will be performed using RevMan 5.4.1. Dichotomous outcomes will be pooled as risk ratios (RRs) with 95% confidence intervals, and continuous outcomes will be pooled as mean differences (MDs) or standardized mean differences (SMDs) with 95% confidence intervals, as appropriate. A random-effects model will be used for all pooled analyses because of expected clinical and methodological heterogeneity across studies. Overall sternal wound complications/surgical site infection and deep sternal wound infection/mediastinitis will be analyzed separately rather than as a single composite endpoint. Statistical

heterogeneity will be assessed using the I^2 statistic. Because the number of studies for individual outcomes is expected to be small, formal publication bias assessment will not be prioritized.

Subgroup analysis Prespecified subgroup analyses will be conducted according to clinical risk profile, with studies categorized as high-risk-enriched populations versus low-risk/standard-risk populations. Additional subgroup analyses according to study design (randomized controlled trials versus non-randomized comparative studies) will also be performed where data permit.

Sensitivity analysis Sensitivity analyses will include leave-one-out analyses and analyses stratified by study design. Additional sensitivity analyses may exclude studies with substantial baseline imbalance or other major methodological concerns to assess the robustness of the pooled estimates.

Language restriction No language restriction.

Country(ies) involved China.

Keywords rigid plate fixation; wire closure; median sternotomy; sternal closure; cardiac surgery; deep sternal wound infection; mediastinitis; meta-analysis.

Dissemination plans The findings of this review will be disseminated through submission to a peer-reviewed journal and presentation at relevant academic conferences.

Contributions of each author

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