

Review of the RibScore

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Evidence to Action: Official Journal of MDCalc

Vol. 022026, Issue 01, 2026

Article Information

Keywords: RibScore, rib fracture, trauma, pneumonia, respiratory failure, tracheostomy

<https://doi.org/10.65357/001c.161305>

Submitted: December 30, 2025 EDT

Accepted: April 24, 2026 EDT

Published: May 06, 2026 EDT

Abstract

The RibScore is a radiographic score used to predict the pulmonary complications of pneumonia, respiratory failure, and tracheostomy in emergency department patients diagnosed with rib fractures on computed tomography (CT) imaging. It assigns 1 point each for: (1) six or more ribs fractures, (2) bilateral rib fractures, (3) flail chest, (4) three or more severely displaced fractures, (5) first rib fracture, or (6) one or more fractures in each of three anatomic areas of the rib (anterior, posterior, and lateral). In retrospective studies, higher RibScores were associated with increased risk of pulmonary complications with receiver operating characteristic areas under the curve of 0.71, 0.71, and 0.75, for pneumonia, respiratory failure and tracheostomy respectively. Additionally, a RibScore of 4 or more is more than 90% specific for the development of pulmonary complications.

I. HOW TO USE

When to Use

Use in patients with blunt trauma in the emergency department who have undergone CT imaging and have been diagnosed with one or more rib fractures.

Pearls / Pitfalls

The available studies evaluating the RibScore are retrospective in nature and need prospective multicenter validation before it can be widely recommended for use. It is also missing inter-rater reliability studies and there is no evidence that score-guided care improves outcomes.

The available studies include primarily middle-aged males and may not be generalizable to other patient populations.

Combining RibScore (anatomical) with a physiological score (such as Sequential Clinical Assessment of Respiratory Function (SCARF) score) significantly increases sensitivity in identifying patients at risk of complications (up to 96.3%) or needing surgical stabilization of rib fractures (SSRF) (up to 91.9%).

This score has not been validated for rib injuries diagnosed on chest xray, clinical exam, or other diagnostic modalities.

The score calculation is currently intended only for initial evaluation, not for subsequent evaluations.

Why Use

The RibScore predicts clinically relevant pulmonary complications, which in combination with clinical exam, may help guide disposition, level of care, or therapeutic decisions.

II. NEXT STEPS

Advice

The RibScore should not be used for the sole basis of care and clinicians should use judgement and a full clinical evaluation.

This score has not been prospectively validated.

Management

A RibScore ≤ 1 may be candidates for non-operative management in the ward setting or early discharge.

A RibScore ≥ 2 may require inpatient management focused on multimodal pain management to ensure adequate pulmonary hygiene and clearance of secretions, which helps prevent progression to pneumonia.

A RibScore ≥ 4 likely requires intensive monitoring and aggressive interventions, such as consideration for early SSRF and is strongly associated with a risk of pulmonary complications.

Critical Actions

Never delay resuscitative efforts to calculate a RibScore, especially in the unstable patient.

History and physical exams should always be performed prior to calculating a RibScore.

III. EVIDENCE

Evidence Appraisal

The original derivation study was a retrospective cohort study of ED patients with confirmed rib fracture on CT scan.¹ The purpose of the study was to predict pulmonary complications secondary to rib fractures and help guide therapeutic decision-making. Complications were defined as pneumonia, tracheostomy, or respiratory failure. The risk factors evaluated in the study were

1. ≥ 6 rib fractures
2. Bilateral fractures
3. Flail chest
4. ≥ 3 severely displaced fractures
5. First rib fracture
6. ≥ 1 fracture in all three anatomic locations (anterior, posterior and lateral sections of the ribs).

Each individual risk factor was independently associated with an increased likelihood of pulmonary complications. When combined into the formal RibScore, these factors demonstrated substantially improved specificity. Overall, higher RibScore values positively correlated with the incidence of pulmonary complications. Notably, a RibScore of 4 or greater was associated with more than 90% specificity for predicting pulmonary complications.

The authors compared RibScore ROC AUC statistics to other chest wall injury scoring systems including OIS Chest Wall Grade, RFS, and CTS and found it superior.

Derivation Study

Citation	Chapman BC, Herbert B, Rodil M, et al. RibScore: A novel radiographic score based on fracture pattern that predicts pneumonia, respiratory failure, and tracheostomy. <i>J Trauma Acute Care Surg.</i> 2016;80(1):95-101. doi:10.1097/TA.0000000000000867
Type of Study	Retrospective cohort study
Number of patients	385 patients at a level one trauma center from 2012-2014
Inclusion criteria	Patients who sustained blunt trauma with 1 or more rib fractures on CT during diagnostic evaluation in the emergency department
Exclusion criteria	No CT done or incomplete medical records pertaining to pulmonary outcomes
Endpoint	Respiratory failure, pneumonia, and tracheostomy
Outcomes	RibScore was linearly associated with pneumonia ($p < 0.01$), acute respiratory failure ($p < 0.01$), and tracheostomy ($p < 0.01$). The receiver operating characteristic areas under the curve for the outcomes were 0.71, 0.71, and 0.75, respectively. Patients with a RibScore of 4 or above were associated with $>90\%$ specificity for pneumonia, tracheostomy, and respiratory failure. However, sensitivities ranged from 23.1%,

	33.3%, and 24.2% respectively. RibScore demonstrated better discrimination than other chest wall injury scoring systems across all outcomes, with an AUC of 0.69 for respiratory failure (compared to ~0.61–0.62), 0.71 for pneumonia (vs ~0.60–0.66), and 0.75 for tracheostomy (vs ~0.66–0.68). Scores compared to include OIS Chest: Organ Injury Scale – Chest wall grade; RFS: Rib Fracture Score; CTS: Chest Trauma Score. Prevalence of pulmonary complications is not explicitly stated by the authors. However, based on prevalence estimates derived from the reported test characteristics, in this cohort of 385 patients, approximately 13.5% (~52 patients) developed pneumonia, 32.2% (~124 patients) developed respiratory failure, and 15.6% (~60 patients) required tracheostomy.
Strengths	RibScore was strongly predictive of clinically relevant endpoints of pneumonia, respiratory failure, and tracheostomy.
Criticisms	Did not control for damage to other structures such as ribs, clavicle, sternum or lung which may influence a patient's clinical course. The population was primarily male and middle-aged and thus may not be generalizable to the elderly or female The population studied was largely those who had more severe injury necessitating a CT scan, the score may not be validated for those with less severe injury not requiring a CT scan Requires CT imaging to calculate score, which may lead to unnecessary imaging and undue financial cost, and may produce selection bias The nature of a retrospective study limits its generalizability.

Retrospective cohort studies

Together is better - RibScore and SCARF in the prediction of pulmonary complications and association with SSRF https://pubmed.ncbi.nlm.nih.gov/38649314/	RibScore of 1 or more was 66.7% sensitive and 50.7% specific for pulmonary complications. A RibScore of 2 or more was 86.5% sensitive and 76% specific for surgical intervention.
Physiologic parameters and radiologic findings can predict pulmonary complications and guide management in traumatic rib fractures https://pubmed.ncbi.nlm.nih.gov/38521636/	There was a positive correlation between RibScore and risk of developing pulmonary complications. A RibScore of two or more was associated with prolonged hospital and ICU LOS. RibScore was as good as second-day vital capacity measurements at predicting risk for pulmonary complications.
A Comparison of Scoring Systems to Identify Patients at Increased Risk From Traumatic Rib Fractures https://pubmed.ncbi.nlm.nih.gov/39586173/	This was a single-site study which found that a RibScore of 4-6 was associated with an increased risk of intubation (14%) compared to a RibScore of 0-3 (2.1%). A RibScore of 4-6 was also associated with increased median ICU LOS and hospital LOS when compared to a RibScore of 0-3.
Evaluation of patients with surgically stabilized rib fractures by different scoring systems https://pubmed.ncbi.nlm.nih.gov/30132024/	Used propensity matching to show that RibScore had the best predictive ability of operative vs non-operative management when compared to three other scoring tools. Mean RibScore for SSRF was 2.33. Mean RibScore for non-operative management was 1.7

Clinical practice guidelines

Best Practices Guidelines: Management of Chest Wall Injuries from the American College of Surgeons Trauma Quality Program https://www.facs.org/media/qdglajyt/2025_tr_bestpracticesguidelines_chest-wall.pdf5_tr_bestpracticesguidelines_chest-wall.pdf	Recommends using scoring systems for assessment of patients with rib fractures to assist with disposition decisions, identify high-risk patients, standardize documentation, and develop institutional protocols. There is insufficient data to guide selection of which scoring tool to use.
Surgical stabilization of rib fractures (SSRF): the WSES and CWIS position	This position paper acknowledges the RibScore

paper https://pubmed.ncbi.nlm.nih.gov/39425134/	as a superior, objective scoring system that captures the anatomical severity associated with increased adverse outcomes and the need for SSRF. However, the guidelines ultimately stress that the decision to perform SSRF should be based on clinical judgment that synthesizes the radiographic pattern, pulmonary physiology, pain status, and patient goals.
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Formula

6 or more rib fractures	+1 point
Bilateral rib fractures	+1 point
Flail chest	+1 point
3 or more severely displaced fractures	+1 point
First rib fracture	+1 point
1 or more fractures in each of the three anatomic areas (anterior, posterior and lateral)	+1 point

Facts and Figures

“Flail chest” is defined as 3 or more consecutive rib fractures in 2 or more places.

“Severely displaced” is defined as displacement greater than the diameter of the rib with a total loss of contact between the proximal and the distal segment.

“First rib fracture” refers to rib #1; not the patient’s first ever rib fracture

The posterior rib segment is defined as the head and neck of the rib to the costal angle, the lateral segment is defined as the costal angle to the serratus anterior insertion tubercle, and the anterior segment is defined as the serratus anterior insertion tubercle to the distal end of the rib.

There is no universally accepted RibScore cut-off which determines admission or requires higher-level of care. However, higher RibScores correlate with a higher

risk of pulmonary complications (pneumonia, respiratory failure, or tracheostomy). In retrospective analyses, a RibScore of 4 or greater is more than 90% specific for predicting pulmonary complications.

Literature

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