



# Analysis of Rib Fracture Location and Outcomes with Surgical Stabilization

Community  
Memorial  
HEALTHCARE  
VENTURA, CA

Tyler Wagner DO, Carrie Tackett DO, Ari Solomon DO, Jacob Spencer MPH, Mark Erfe MD, Patrick Stahl, Kian Yazdan, Anthony Kiriaki, Dana Lichtenstein, Javier Romero MD, Graal Diaz PhD, Anthony Carden MD

## INTRODUCTION

Rib plating has become a standard intervention in managing complex and unstable rib fractures. Identifying and understanding the patterns of rib fractures, along with their outcomes following rib plating, are essential for improving treatment strategies.

Over the past decade, studies have demonstrated benefit to surgical intervention for patients with multiple rib fractures or flail chest. Surgical rib fixation has been shown to reduce the length of stay in the intensive care unit (ICU), although it does not significantly affect the total hospital length of stay [1-3,9]. Additionally, rib fixation has been associated with a decrease in the duration of mechanical ventilation and a lower need for tracheostomy [1,9].

This study aimed to evaluate the effects of various factors – such as fracture location (anterior vs posterior), laterality (left vs right), the number of fractured ribs, and the timing of rib plating – on outcomes following surgical rib fixation.

## METHODS

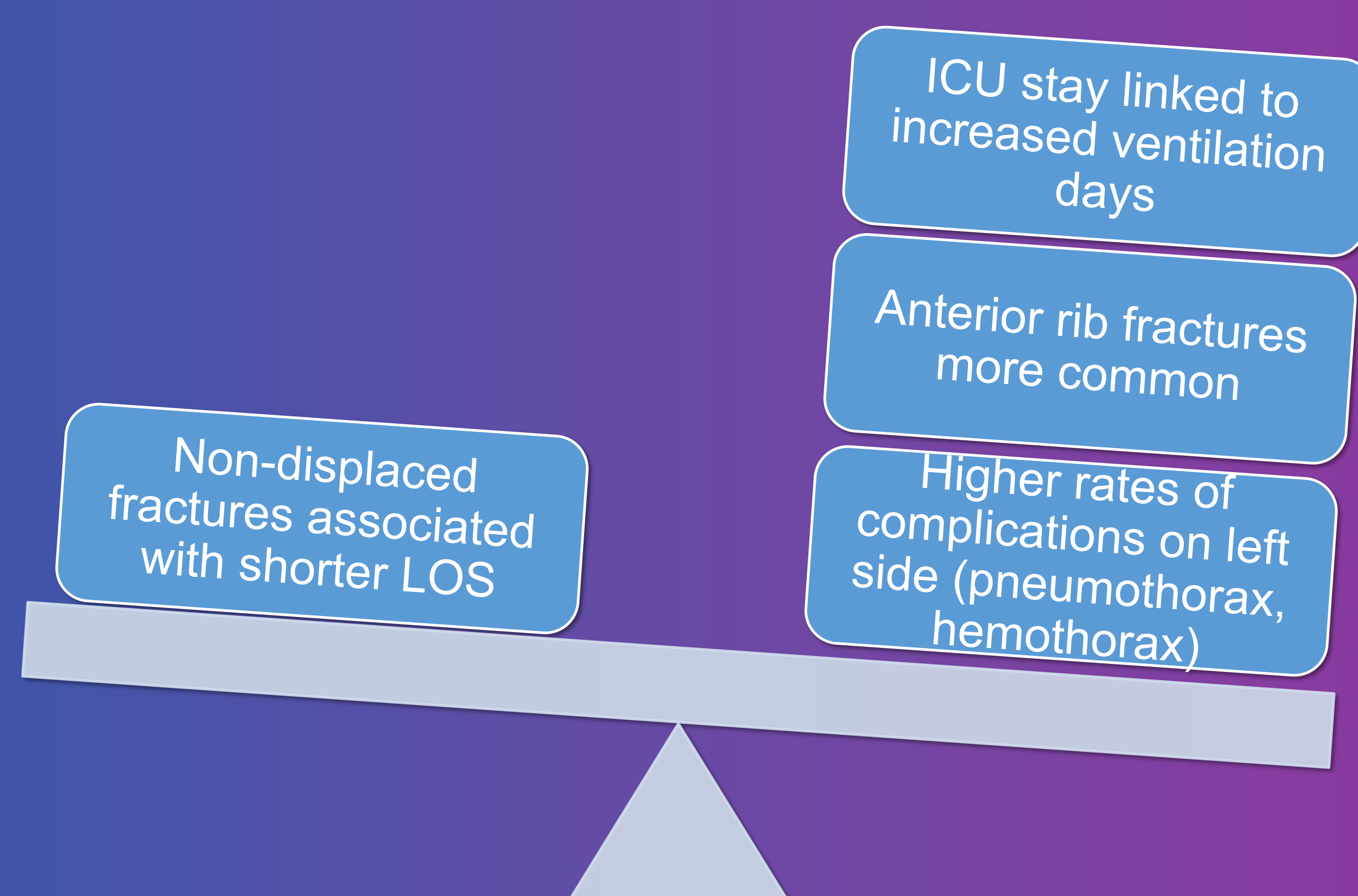
This **retrospective analysis** included trauma patients admitted to a Level II trauma center between January 2016 and August 2024 who sustained rib fractures requiring surgical rib plating. A total of **45 patients** were included in the analysis, examining the relationship between the location of rib fractures, the placement of rib plates, and their impact on clinical outcomes, with a primary focus on the number of ventilator days and ICU length of stay.

## RESULTS

The **length of hospitalization** was significantly correlated to **timing of rib fixation**, with earlier fixation (within 6 days) associated with a shorter hospital stay (4.693 days, SE=1.550, p=0.004). Delayed fixation (after 6 days) resulted in a longer hospital stay (10.349 days, SE=3.696, p=0.008). Additionally, fixation after 17 days was associated with an increased likelihood of unplanned return to the operating room (OR 2.483, p=0.037).

Patients with **12 or more fractured ribs** experienced an increase in **ventilator days** by 1.11 days (p<0.05). **Non-displaced rib fractures**, while not significantly reducing ICU stay, were associated with a **shorter length of hospital stay** (Coefficient = -4.583, p=0.027).

Categorical Variables	Percentage (%)
Gender Distribution	
Male	65.9
Female	34.2
Ethnicity	
White	92.7
Other	4.9
Asian	2.4
Comorbidities	
Hypertension	43.9
Smokers	9.8
Drug Use	12.2
Alcoholism	14.6
Diabetes Mellitus	14.6
COPD	2.4
Complications	
Reintubation	12.2
ICU Admissions	9.8
Delirium	7.3
Discharge Disposition	
AMA	2.4
SNF	26.8
Home	36.6
Home Health	17.1
Rehabilitation Center	17.1



Continuous Variables	Mean (SE)	95% CI
Average Age (years)	57.34 (2.54)	52.22, 62.47
Injury Severity Score (ISS)	18.71 (1.34)	15.99, 21.42
Average Weight (kg)	82.62 (2.94)	76.68, 88.57
ICU Stay (days)	10.26 (1.73)	6.67, 13.85
Ventilation Duration (days)	6.38 (1.09)	4.10, 8.66
Hospital Length of Stay (days)	22.18 (3.49)	15.11, 29.24
Left Side Rib Fractures (%)	63.7% (6.4)	50.8%, 76.6%
Left Side Rib Fractures (Avg Total)	8.27 (0.95)	6.36, 10.18
Right Side Rib Fractures (%)	36.3% (6.4)	23.4%, 49.2%
Right Side Rib Fractures (Avg Total)	4.22 (0.71)	2.78, 5.66
Anterior Rib Fractures (%)	56.8% (4.3)	48.2%, 65.4%
Anterior Rib Fractures (Avg Total)	6.73 (0.58)	5.55, 7.91
Posterior Rib Fractures (%)	43.2% (4.3)	34.6%, 51.8%
Posterior Rib Fractures (Avg Total)	5.76 (0.72)	4.30, 7.21
Non-displaced Fractures (%)	46.6% (4.2)	38.0%, 55.1%
Non-displaced Fractures (Avg Total)	5.71 (0.60)	4.49, 6.93

## CONCLUSION

These findings contribute to the growing evidence supporting rib fixation as an effective intervention for trauma patients with complex rib fractures. **Early surgical stabilization**, ideally within 6 days, is associated with **improved outcomes regardless of fracture location**, including shorter ICU stays, reduced hospital length of stay, and faster recovery. In contrast, delayed rib plating (>17 days) is linked to worse outcomes and higher complication rates, emphasizing the importance of timely intervention.

Despite these clinical benefits, bivariate logistic regression analysis did not identify any statistically significant predictors of unplanned intubation. Factors such as substance use history, sex, age, hypertension, diabetes, and smoking status did not significantly predict ventilator duration. These findings suggest that while rib plating plays a crucial role in improving patient outcomes, individual comorbidities may have a limited impact on specific respiratory complications.

Larger prospective studies with diverse patient cohorts are needed to refine surgical timing guidelines and optimize patient selection criteria. Further research may also help identify additional predictors of postoperative complications, ultimately guiding best practices in the management of complex rib fractures.

## REFERENCES

- [1] Beks, R. B., Peek, J., de Jong, M. B., Wessel, K. J. P., Öner, C. F., Hietbrink, F., Leenen, L. P. H., Groenwold, R. H. H., & Houwert, R. M. (2018). Fixation of flail chest or multiple rib fractures: current evidence and how to proceed. A systematic review and meta-analysis. *European Journal of Trauma and Emergency Surgery*, 45(4), 631–644. <https://doi.org/10.1007/s00068-018-1020-x>
- [2] Beks, R. B., Reetz, D., de Jong, M. B., Groenwold, R. H. H., Hietbrink, F., Edwards, M. J. R., Leenen, L. P. H., Houwert, R. M., & Frölke, J. P. M. (2019). Rib fixation versus non-operative treatment for flail chest and multiple rib fractures after blunt thoracic trauma: a multicenter cohort study. *European Journal of Trauma and Emergency Surgery: Official Publication of the European Trauma Society*, 45(4), 655–663. <https://doi.org/10.1007/s00068-018-1037-1>
- [3] Craxford, S., Owyang, D., Marson, B., Rowlin, K., Caughlin, T., Forward, D., & Ollivere, B. (2022). Surgical management of rib fractures after blunt trauma: a systematic review and meta-analysis of randomised controlled trials [Review of Surgical management of rib fractures after blunt trauma: a systematic review and meta-analysis of randomised controlled trials]. *Royal College of Surgeons of England*, 104, 249–256. <https://doi.org/10.1308/rcsann.2021.0148>
- [4] Edgecombe, L., Sigmon, D., Galuska, M., & Angus, L. (2023). *Thoracic Trauma [Review of Thoracic Trauma]*. NCBI Bookshelf.
- [5] Fitzgerald, M. T., Ashley, D. W., Abukhdeir, H., & Christie, D. B. (2017). Rib fracture fixation in the 65 years and older population. *Journal of Trauma and Acute Care Surgery*, 82(3), 524–527. <https://doi.org/10.1097/ta.0000000000001330>
- [6] Majeed, F., Zafar, U., Imtiaz, T., Ali Shah, S., Ali, A., & Mehmood, U. (2018). Rib Fixation Versus Conservative Management Of Rib Fractures In Trauma Patients [Review of Rib Fixation Versus Conservative Management Of Rib Fractures In Trauma Patients]. *J Ayub Med Coll Abbottabad*, 30(4).
- [7] Peek, J., Beks, R. B., Hietbrink, F., Heng, M., de Jong, M. B., Beeres, F. J. P., Leenen, L. P. H., Groenwold, R. H. H., & Houwert, R. M. (2020). Complications and outcome after rib fracture fixation: A systematic review. *Journal of Trauma and Acute Care Surgery*, 89(2), 411–418. <https://doi.org/10.1097/ta.0000000000002716>
- [8] Prins, J. T. H., Van Lieshout, E. M. M., Reijnders, M. R. L., Verhofstad, M. H. J., & Wijffels, M. M. E. (2019). Rib fractures after blunt thoracic trauma in patients with normal versus diminished bone mineral density: a retrospective cohort study. *Osteoporosis International*, 31(2), 225–231. <https://doi.org/10.1007/s00198-019-05219-9>
- [9] Sawyer, E., Wullschleger, M., Muller, N., & Muller, M. (2022). Surgical Rib Fixation of Multiple Rib Fractures and Flail Chest: A Systematic Review and Meta-Analysis. *Journal of Surgical Research*, 276, 221–234. <https://doi.org/10.1016/j.jss.2022.02.055>
- [10] Zhu, R., de Roulet, A., Ogami, T., & Khariton, K. (2020). Rib Fixation in Geriatric Trauma. *Journal of Trauma and Acute Care Surgery*, 1. <https://doi.org/10.1097/ta.0000000000002666>