

Impact of Injury Region and Severity on Outcomes in Noncontiguous Spinal Fractures: A Retrospective Multivariable Analysis

Zahra Vafaei Naeini, Anna Lejeune, Callie Dickinson, Daniel Zuckerman, Amit Bhandutia M.D.
School of Medicine, Department of Orthopaedics, Louisiana State University Health Sciences Center – New Orleans



School of Medicine
Department of Orthopaedics

Introduction

Noncontiguous spinal fractures (NCSFs) are rare yet clinically significant injuries that occur when multiple spinal levels are fractured with at least three intact vertebrae separating them. These injuries are often the result of high-energy trauma such as motor-vehicle collisions and are associated with instability, neurological compromise, and delayed diagnosis in up to **28%** of cases. Despite advances in trauma care, **no standardized diagnostic or treatment guidelines** exist for NCSFs. Variability in imaging interpretation, institutional practices, and timing of intervention contribute to inconsistent outcomes. As trauma survival rates increase, these injuries are becoming more frequently recognized, underscoring the need for evidence-based frameworks to guide care.

Objective and Significance

Primary Objective: Evaluate how **injury region** (cervical, thoracic, lumbar) and **injury severity** influence treatment outcomes in adults with traumatic NCSFs.

Knowledge Gap

Noncontiguous spinal fractures lack **standardized management guidelines**, and most research focuses on single-level injuries. This study identifies how **injury region, severity, and treatment** influence outcomes to guide **data-driven, standardized protocols** and improve care for this complex trauma population.

Hypothesized Results

Patients with **multilevel or thoracic involvement** are expected to have **longer hospital stays, greater ICU use, and higher complication rates**, including pneumonia and readmission. In contrast, **early operative management** is anticipated to result in **shorter hospitalizations, fewer complications, and higher discharge-to-home rates**. Delayed diagnosis of secondary fractures is likely to worsen outcomes, reinforcing the importance of **early imaging, timely stabilization, and standardized treatment protocols** for improving recovery in **noncontiguous spinal fracture** patients.

Methods

Design: Retrospective cohort study of adults with noncontiguous spinal fractures treated at **UMC New Orleans (2016–2024)**.

Population: Blunt trauma patients ≥ 18 yrs with fractures separated by ≥ 3 intact vertebrae.

Variables:

- Demographics:** age, sex, insurance type
- Injury:** region, severity, mechanism
- Treatment:** operative vs non-operative
- Outcomes:** ICU/hospital stay, pneumonia, readmission, discharge

Analysis: Associations between **injury pattern, treatment, and outcomes** analyzed via **multivariable ANCOVA & logistic regression (SAS 9.4)**.

Sample Size: Power analysis estimates **≈ 654 patients** needed to detect outcome differences.

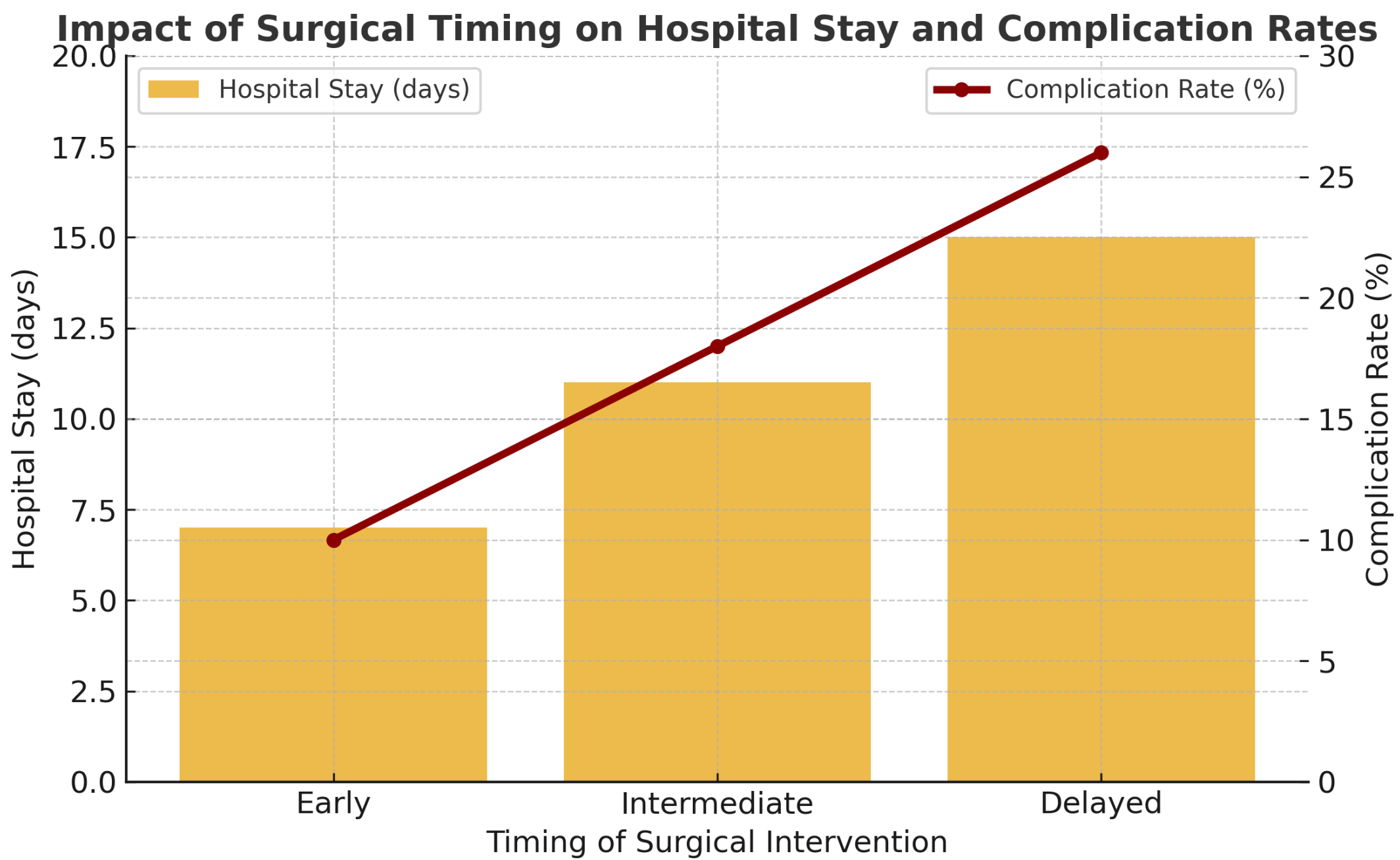
Literature

Patients with **multilevel or thoracic involvement** are expected to experience **longer hospitalizations, greater ICU utilization, and higher complication rates**, including pneumonia and readmission. In contrast, those managed **operatively**, particularly with **early fixation and stabilization**, are anticipated to have **shorter stays, fewer pulmonary complications, and higher discharge-to-home rates**. These patterns align with prior studies demonstrating that timely surgical management and improved imaging sensitivity contribute to reduced morbidity and enhanced neurological outcomes.

Delayed diagnosis of secondary injuries—reported in up to **28%** of cases—is likely to correlate with worse recovery trajectories. Overall, the results are expected to emphasize the importance of **standardized imaging and treatment protocols, early surgical decision-making, and multidisciplinary coordination** to improve outcomes for patients with **noncontiguous spinal fractures**.

Figure 1. *Impact of Surgical Timing on Hospital Stay and Complication Rates.*

Delayed fixation is anticipated to increase hospital length of stay and postoperative complications, while early intervention may improve recovery and discharge outcomes. Trends are from prior literature emphasizing early stabilization and multidisciplinary management in spinal trauma (Schoenfeld et al., 2019; Quinones et al., 2024; Scott et al., 2024).



Discussion and Limitations

This study aims to address the lack of **standardized management** for **noncontiguous spinal fractures** by identifying factors influencing outcomes across injury regions and treatment types. Anticipated findings are expected to highlight the benefits of **early operative stabilization** and **comprehensive imaging** in reducing complications and hospital stays. However, the **retrospective design** limits causal inference, and the **single-center setting** may reduce generalizability. Additional limitations include the absence of **long-term functional outcomes** and potential variability in surgeon decision-making. Despite these constraints, the study provides a crucial step toward developing **evidence-based care algorithms** for this rare and complex injury pattern.

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