THE VALIDITY OF THORACOLUMBAR INJURY CLASSIFICATION AND BIOMECHANICAL APPROACH IN THE CLINICAL OUTCOME OF OPERATIVE AND NON-OPERATIVE TREATMENTS

Caitlyn J. Smith M3/PSF, Fassil B. Mesfin MD, PhD, FACS, FAANS

Department of Orthopaedic Surgery, University of Missouri School of Medicine, Columbia, MO 65212, USA

Introduction

- In the United States, the incidence of thoracolumbar injures is approximately 15,000 per year due to high-energy trauma resulting mainly from a motor vehicle accident in younger patients
- Most commonly, thoracolumbar (TL) injuries occur at the T10 to L2 level, which is the most common site afflicted by trauma
- Numerous classification systems for thoracolumbar spine injuries have established
- Currently, there is no universal acceptance of a classification system for thoracolumbar spine injuries that facilitates proper communication between treating physicians and helps to standardize approaches to treatment.

Objective

This study aims to assess the validity of utilizing the biomechanical approach using finite element analysis in TLICS classification by addressing the "gray zone" decision discrepancy of thoracolumbar spinal injuries

Methods

- A systematic literature review of spine trauma was performed using Medline and PubMed databases following the PRISMA guidelines
- Finite element computational biomechanical models were constructed in the LS-DYNA software program.

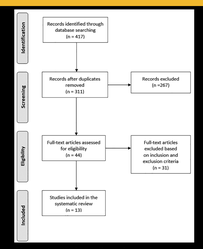


Figure 1. PRISMA flowchart showing record review and study inclusion.

Injury Category	Point Value
Injury morphology	
Compression	1
Burst	2
Translation or rotation	3
Distraction	4
PLC status	
Intact	0
Injury suspected or indeterminate	2
Injured	3
Neurologic status	
Intact	0
Nerve root involvement	2
Spinal cord or conus medullaris injury	
Incomplete	3
Complete	2
Cauda equina syndrome	3

Table 1. The TLICS with its subcategories and scoring.

TLICS Score	Treatment Recommendation
0–3	Nonsurgical
4	Nonsurgical or surgical
≥5	Surgical

Table 2. TLICS treatment guidelines for spine injury

Score of **3 or lower** indicates **nonsurgical** approach with brace immobilization and active patient mobilization.

Score of **4** indicates an "grey zone" where surgical or nonsurgical intervention may be equally appropriate.

Score of **5 or higher** warrants **surgical** intervention with deformity correction, neurological decompression if necessary, and stabilization.

CASE: 37-year-old male restrained driver involved in a high-speed motor vehicle accident

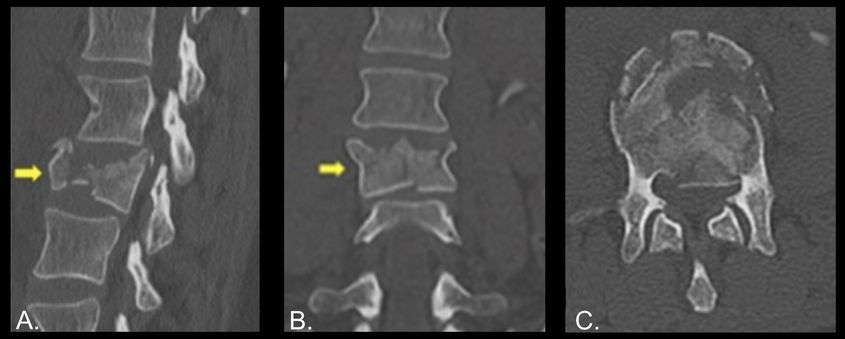


Figure 2. CT of the lumbar spine. A) Sagittal view, burst fracture at L3 vertebrae. B) Coronal view, loss of vertebral height. C) Axial view, retropulsion into spinal canal.

Morphology: L3 burst fracture with **retropulsion.** There is loss of vertebral body height on the sagittal view with moderate narrowing of the spinal canal; **2 points.**

PLC integrity: CT features of **PLC pathology indeterminate** but suspected PLC involvement; **2 points**

Neuro deficits: None; **0 points**

TLICS SCORE: 4 POINTS

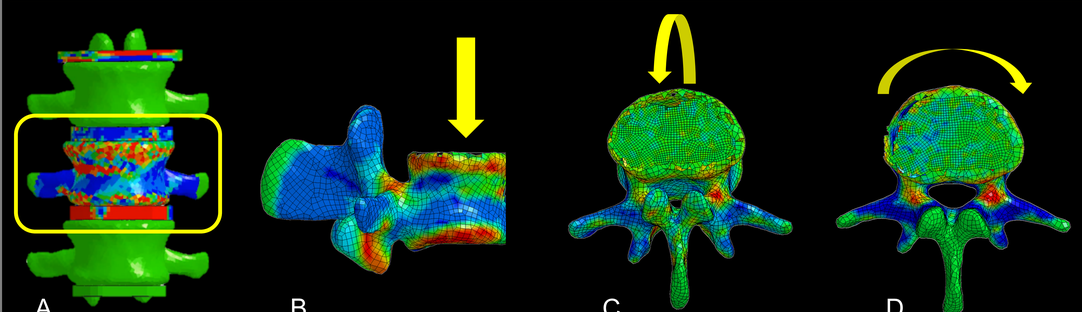
Treated surgically with percutaneous instrumentation owing to concerns of instability.

Results

TLICS (N = 55)			
	1-3 points	4 points or "grey zone"	> 5 points
Neurological Deficit (N = 18)	-	-	18
Neurological Function Intact (N = 37)	-	-	37
Incomplete Spinal Cord Injury (N = 14)	-	-	14
AO System			
Neurological Deficit (N = 18)	-	-	18
Neurological Function Intact (N = 37)	18	-	19
Incomplete Spinal Cord Injury (N = 14)	-	8	6

Table 3. Comparison of thoracolumbar injury scores of patients with an unstable burst fracture. (Yuksel et al., 2018). Abbreviations: Thoracolumbar Injury Classification and Severity Scale (TLICS), Arbeitsgemeinschaft für Osteosynthesefragen System (AO System).

Finite Element Computational Biomechanics: Lumbar Burst Fracture



FE Modeling: Lumbar burst fracture analyzed under all loading conditions and each separate loading condition to evaluate the biomechanical stress of the vertebral column and damaged vertebrae.

Figure 3: A) **d**amaged model. B) axial compression. C) flexion and extension. D) lateral bending.

Discussion

- TLICS is a reliable classification system in the management of single-column fractures treated conservatively, and 3-column injuries (flexion/extension distraction injuries and fracture-dislocations) treated with surgical stabilization
- Compared to the AO recommendations, TLICS may be more reliable in guiding the surgical management of unstable thoracolumbar burst fractures without neurological deficits, as the AO system had recommended conservative treatment in patients with unstable burst fractures
- Inclusion of MRI in the evaluation of the PLC changed the final TLICS score leading to a decrease in the agreement between the suggested and actual treatment
- Among the three finite element analysis studies, limited data have been published on the PLC status when an injury is suspected or indeterminate
- The TLICS system does not consider factors such as segmental kyphosis, loss of vertebral height, degree of canal compromise for guiding surgical treatment

Conclusion

- Special attention to enhancing the TLICS classification system by eliminating the gray zone of a TLICS score of 4 is necessary
- Biomedical computational modeling may be utilized on the thoracolumbar spine to enhance the current TLICS classification by standardizing treatment among treating physicians
- The FE method provides significant advantages by providing a post-treatment assessment for spine injuries, such as TLBF, and where there are such individual variations, allowing cause-effect relationships to be isolated and fully explored

Acknowledgments

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