MODIFIED TLICS SCORE (MTLICS) FOR DIAGNOSIS AND TREATMENT GUIDANCE IN THORACOLUMBAR SPINE INJURIES: A STUDY FROM PHU THO PROVINCIAL GENERAL HOSPITAL

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ABSTRACT

Introduction: This study aimed to evaluate the value of the modified Thoracolumbar Injury Classification and Severity Score (mTLICS) in diagnosing and guiding the treatment of thoracolumbar spine injuries at Phu Tho Provincial General Hospital. It also compared mTLICS with TLICS and TL AOSIS systems in predicting surgical and conservative treatment decisions. ***Subjects and Methods:*** A retrospective study was conducted on 41 patients with thoracolumbar spine injuries from January to April 2025. All patients underwent a 3.0 Tesla MRI. Their injuries were classified using TLICS, TL AOSIS and mTLICS. The classification results were compared with treatment decisions to assess sensitivity, specificity, and accuracy. ***Results:*** mTLICS showed superior diagnostic performance with 89% sensitivity, 100% specificity, and 93% accuracy (based on the second reader). Inter-rater agreement was moderate to substantial (Kappa = 0.708 for fracture morphology and 0.8 for posterior ligamentous injury). The mTLICS also highly correlated with surgical decision-making (r = 0.779 and 0.755). Notably, it achieved the highest area under the ROC curve (AUROC: 0.939–0.95), compared to TLICS (0.855–0.874) and TL AOSIS (0.802–0.843). At a cutoff score >3, mTLICS reached 92–100% sensitivity and 81.25% specificity. ***Conclusion:*** mTLICS is a reliable and accurate classification system for thoracolumbar injuries, offering better predictive value than TLICS and TL AOSIS. Its implementation may enhance decision-making and treatment outcomes, especially in provincial hospitals.

Keywords: *Thoracolumbar spine injury, mTLICS, injury classification, compression, MRI.*

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I. INTRODUCTION

Thoracolumbar spine injuries are among the most prevalent spinal traumas, accounting for up to 90% of all spinal injury cases [1]. The primary causes are traffic accidents and falls from height, which often result in significant neurological and functional impairments, adversely affecting patients' quality of life and placing a substantial burden on healthcare systems [1-3]. Accurate assessment of injury severity is essential for determining appropriate treatment strategies, minimizing neurological complications, and improving clinical outcomes [4].

To support clinical decision-making, several injury classification systems have been developed over the past decades, including the Denis classification (1983), AO Spine (1994), the Thoracolumbar Injury Classification and Severity Score (TLICS, 2005), and the Thoracolumbar AOSpine Injury Score (TL AOSIS, 2015). While these systems have made valuable contributions to injury evaluation and treatment planning, limitations persist. Notably, they do not

comprehensively assess posterior ligamentous complex (PLC) integrity, and some such as TLICS struggle to accurately classify the severity of vertebral body fractures, mainly compression and burst types [2-7]. To overcome these shortcomings, a Korean research group introduced the Modified Thoracolumbar Injury Classification and Severity Score (mTLICS) in 2016. The mTLICS system builds upon the original TLICS framework by incorporating magnetic resonance imaging (MRI) findings, offering a more detailed evaluation of PLC injuries and relevant anatomical changes. It also assigns additional points for vertebral body height loss greater than 50% or spinal canal stenosis exceeding 50%, improving its ability to identify cases requiring surgical intervention [8].

Multiple international studies have demonstrated that mTLICS provides higher diagnostic accuracy and predictive value than its predecessors, particularly in guiding treatment decisions [8,9]. However, its application in clinical practice in Vietnam especially at the provincial hospital level remains limited. There is a lack of research assessing the effectiveness of mTLICS in local settings. Therefore, this study evaluated the value of the mTLICS classification in diagnosing and guiding treatment and compared it with TLICS and TL AOSIS in the management of thoracolumbar spine injuries at Phu Tho Provincial General Hospital.

II. SUBJECT AND METHOD

2.1. Subject

2.1.1. Inclusion criteria:

All patients clinically diagnosed with thoracolumbar spine injury (T1-L5) who were indicated for 3.0 Tesla magnetic resonance imaging (MRI) at Phu Tho Provincial General Hospital between January 2025 and April 2025.

Patients with complete medical records, including relevant information such as age, gender, location and type of fracture, and factors related to clinical status and treatment.

2.1.2. Exclusion criteria:

Patients with MRI images of insufficient quality for assessment or images that cannot be adequately analyzed.

Patients with comorbidities affecting the assessment of clinical symptoms, such as sequelae of cerebrovascular accidents, neurological disorders, or other serious diseases (e.g., psychosis, bone tumours, bone tuberculosis).

Patients with severe concomitant injuries not involving the thoracolumbar spine.

Patients who did not consent to participate in the study or withdrew from the study during the implementation process.

2.2. Methods

Study Design: The study was designed using a cross-sectional descriptive retrospective method.

Sample Size: The study used a convenience, non-probability sample, including 41 patients.

Research Equipment: 3.0 Tesla Magnetic Resonance Imaging Machine (Siemens, Germany). Picture Archiving and Communication System (VR-PACS).

Research Procedures:

Clinical Examination: Patients will be clinically evaluated and diagnosed with thoracolumbar spine injury.

MRI Scan: Patients will undergo an MRI scan of the thoracolumbar spine using the 3.0 Tesla MRI system. Imaging will be performed with the following pulse sequences: T1W-sagittal, T2W-Dixon sagittal, T2W axial.

Classification Assessment: MRI results were independently evaluated by two experienced radiologists, who were blinded

to clinical and treatment data. Each case was classified using three systems:

+ TLICS (Thoracolumbar Injury Classification and Severity Score), evaluating injury mechanism, neurologic status, and fracture morphology [5,7].

+ TL AOSIS (Thoracolumbar AOSpine Injury Score), based on fracture morphology and neurologic status [4,6].

+ mTLICS (Modified TLICS), incorporating additional criteria including vertebral body height loss >50%, spinal canal stenosis >50%, and a refined PLC injury grading: Intact (0 points), Soft tissue edema (1 point), Bone marrow edema of facet/spinous process (2 points), Disruption of PLC (3 points) [8,9].

* Data Collection: Data on patient characteristics (age, sex, fracture location, morphology, neurologic status) will be collected and stored. Treatment decisions (conservative or surgical) will be recorded and compared with the classification results from the three systems.

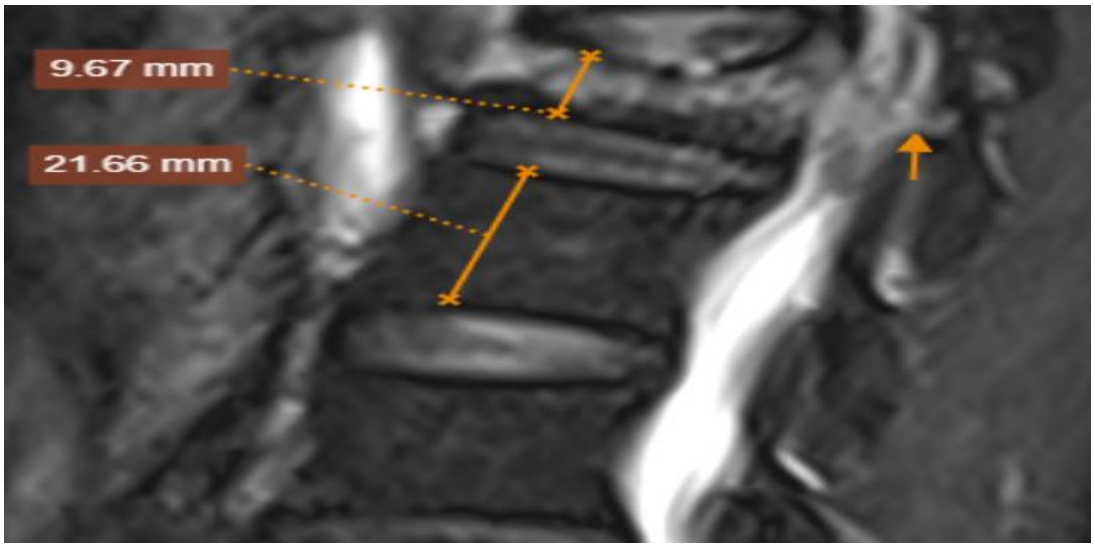

Figure 2: **MRI-Based L1 Injury Classification by TLICS, TL AOSIS, and mTLICS**

A 59-year-old female patient presented with low back pain following a domestic accident (Figure 1B, EMR: MR003375027). MRI showed a fracture of the L1 vertebral body with >50% height loss and a hyperintense lesion in the ligamentum flavum and facet joint (arrow). The AO-TLICS score for this injury was 3 (A3), the TLICS score was 4 (morphology: 2, neurologic status: 0, PLC: 2), and the mTLICS score was 5 (3, 0, 2). The patient underwent surgical fixation with internal screws.

Data collection, processing and analysis:

Comparison of Treatment Approaches: Classification results (AO-TLICS, TLICS, mTLICS) were compared with actual treatments to evaluate sensitivity, specificity, and accuracy.

Validity Assessment: Validity was tested by comparing recommended and actual treatments. Sensitivity, specificity, and accuracy were calculated for each system.

Statistical Analysis: Descriptive statistics summarized demographic and clinical data. Cohen's Kappa assessed inter-rater reliability. Chi-square and ANOVA tested differences between groups.

Software: Data were analyzed using SPSS v28.0. A p-value < 0.05 was considered statistically significant.

2.3. Ethical consideration

This study was approved by the Ethics Committee of Phu Tho Provincial General Hospital (Approval No. 2570/QD-BV, dated November 2, 2023). All patient information and medical records were kept confidential and used solely for research purposes

III. RESULT

Table 1: **Characteristics of patients with thoracolumbar spine injuries and treatment decisions**

Characteristic		Number of Patients (n)	Percentage (%)
Age		57.29 ± 16.44	
Gender	Male	17	41.5
	Female	24	58.5
Most Common Location	T12	9	22
	L1	17	41.5
	L2	7	17.1
Morphology	Compression Fracture	8	19.5
	Burst Fracture	27	65.9
	Rotation/Translation Fracture	0	0
	Distraction Fracture	6	14.6
Neurologic status	ASIA A	1	2.5
	ASIA C	8	19.5
	ASIA E	32	78
Treatment Decision	Conservative Treatment	16	39
	Surgical Treatment	25	61

A total of 41 patients (58.5% female, mean age 57.29 ± 16.44 years) were included in this study. The most common injury site was the L1 vertebra, which accounted for 41.5% of cases. Burst fractures were the most prevalent type of fracture (65.9%), and 78% of patients had no neurologic status deficits (ASIA E). Among the patients, 61% were treated surgically, while 39% received conservative management.

Table 2: **Inter-observer agreement for diagnostic performance**

Reader 2		Reader 1				Kappa value
Characteristic		Compression Fracture	Burst Fracture	Rotation/ Translation Fracture	Distraction Fracture	
Morphology	Compression Fracture	8	0	0	0	0,708
	Burst Fracture	2	25	0	0	
	Rotation/Translation Fracture	0	0	0	0	
	Distraction Fracture	0	0	1	5	
Posterior Ligament Injury		Yes		No		0,8
	Yes	24		1		
	No	3		13		

Both readers agreed on 8 cases of compression fractures and 25 cases of burst fractures, with discrepancies in 2 cases. For distraction fractures, 5 cases were agreed

upon, but 1 case had differing classifications: Reader 1 as distraction, Reader 2 as rotation/translation fracture. Despite the agreement (Kappa = 0.708), minor differences were noted between compression vs burst fractures and rotation/translation vs distraction fractures. Both readers agreed on 24 cases with injury and 13 without for PLC injury. Discrepancies occurred in 4 cases, with a Kappa of 0.8, indicating good reliability in PLC injury assessment.

Table 3: **Treatment Decisions for Thoracolumbar Spine Injuries Based on Reader Assessments**

Characteristic			Treatment Decision		Sensitivity (%)	Specificity (%)	Accuracy (%)
			Conservative (n)	Surgical (n)			
TLICS	Reader 1	Conservative	11	5	80	69	76
		Surgical	5	20			
	Reader 2	Conservative	11	4	81	73	78
		Surgical	5	21			
mTLICS	Reader 1	Conservative	13	2	88	87	88
		Surgical	3	23			
	Reader 2	Conservative	13	0	89	100	93
		Surgical	3	25			
TL AOSIS	Both Readers	Conservative	16	14	100	53,3	66
		Surgical	0	11			

The mTLICS system showed the highest specificity 100%, accuracy 93%, and sensitivity 89% (Reader 2) compared to other classifications, effectively identifying patients who do not require surgery and ensuring accurate conservative treatment decisions.

Table 4: Correlation Between Scores and Surgical Decisions Based on Reader Assessments

Characteristic	Surgical Treatment	Correlation Coefficient (r)	p
TLICS	Reader 1	0.65	<0.001
	Reader 2	0.612	<0.001
TL AOSIS	Reader 1	0.641	<0.001
	Reader 2	0.554	<0.001
mTLICS	Reader 1	0.779	<0.001
	Reader 2	0.755	<0.001

All classification systems showed a strong correlation with surgical treatment decisions, with mTLICS having the highest correlation coefficient (r = 0.779 for Reader 1 and r = 0.755 for Reader 2), indicating a strong agreement in predicting surgery based on this classification.

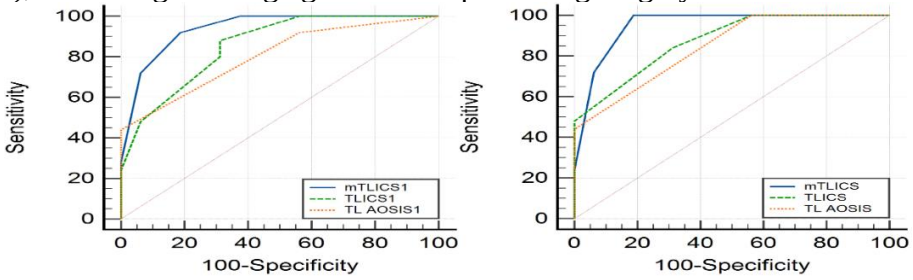

Figure3: **AUROC comparison of classification systems in surgical decisions based on reader assessments**

The mTLICS score showed an AUROC of 0.939-0.95 (95% CI: 0.817-0.99, p<0.001) with sensitivity (Se) of 92%-100% and specificity (Sp) of 81.25% at a cutoff >3. It outperformed TLICS and TL AOSIS in surgical decision-making (0.939-0.95 vs 0.855-0.874, 0.802-0.843). The difference was statistically significant when comparing mTLICS with TL AOSIS (p=0.0051-0.0199, z=2.394-2.801).

IV. DISCUSSION

Our study found that most thoracolumbar spine injury patients were female, with a mean age of 57.29 ± 16.44 years. This is consistent with the findings of Almigdad (2023) and Le Thien Bao (2024) [1,10], which noted a higher prevalence among older individuals and females due to age-related factors such as osteoporosis. The L1 vertebra was the most common fracture site (41.5%), with a predominance of burst fractures (65.9%) and neurologically intact patients (ASIA E - 78%).

The inter-observer agreement for thoracolumbar injury classification was substantial (Kappa = 0.708 for fracture morphology and 0.8 for posterior ligament complex injury), indicating good reliability of the mTLICS system, especially in evaluating factors critical to surgical decision-making such as PLC integrity. These findings align with Park (2016) [8], who emphasized mTLICS's effectiveness in assessing PLC injuries via MRI—a known limitation of prior systems like TLICS and TL AOSIS.

The mTLICS system demonstrated superior predictive performance, with a sensitivity of 89%, specificity of 100%, and accuracy of 93% (based on Reader 2). This is consistent with the study by Withrow (2025) [9], which reported mTLICS to have the highest sensitivity and specificity (96.3% and 95.3%, respectively), outperforming TLICS (81.3% and 95.3%) and TL AOSIS (92.6% and 92.7%). These results reaffirm the diagnostic power and clinical utility of mTLICS in distinguishing between conservative and surgical cases.

In our study, mTLICS showed the strongest correlation with actual surgical decisions (r = 0.779 for Reader 1 and r = 0.755 for Reader 2), surpassing TLICS (r = 0.65) and TL AOSIS (r = 0.641). These results are consistent with the findings of Park (2020) [7], who validated the clinical relevance of TLICS while also acknowledging its limitations in assessing vertebral body collapse and spinal canal compromise—areas where mTLICS demonstrates significant improvements by incorporating additional scoring for >50% vertebral height loss and >50% canal stenosis.

Furthermore, Nagi (2022) highlighted that MRI-based classification using TLICS could overlook critical factors in surgical decision-making. In contrast, mTLICS provides a more flexible and comprehensive framework by integrating radiological severity markers, enhancing its sensitivity and clinical applicability [2]. The ESTES recommendations (2023) also support early MRI evaluation and prompt surgical stabilization in thoracolumbar injuries, particularly in cases involving burst fractures or PLC injuries. mTLICS aligns well with these guidelines by offering a more detailed assessment of these conditions [4].

Despite these promising findings, the study has limitations: The small sample size and single-centre retrospective design limit

the generalizability of results. Moreover, treatment outcomes were not followed longitudinally, so it is unclear whether classification-based decisions resulted in better long-term functional outcomes. Future prospective, multicenter studies with larger cohorts and clinical follow-up are warranted further to validate the utility of mTLICS in routine clinical practice

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