Thoracolumbar spine trauma classification: the Thoracolumbar Injury Classification and Severity Score system and case examples

Clinical article

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Object. The aim of this study was to review the Thoracolumbar Injury Classification and Severity Score (TLICS) and to demonstrate its application through a series of spine trauma cases.

Methods. The Spine Trauma Study Group collaborated to create and report the TLICS system. The TLICS system is reviewed and applied to 3 cases of thoracolumbar spine trauma.

Results. The TLICS system identifies 3 major injury characteristics to describe thoracolumbar spine injuries: injury morphology, posterior ligamentous complex integrity, and neurological status. In addition, minor injury characteristics such as injury level, confounding variables (such as ankylosing spondylitis), multiple injuries, and chest wall injuries are also identified. Each major characteristic is assigned a numerical score, weighted by severity of injury, which is then summed to yield the injury severity score. The TLICS system has demonstrated initial success and its use is increasing. Limitations of the TLICS system exist and, in some instances, have yet to be addressed. Despite these limitations, the severity score may provide a basis to judge spinal stability and the need for surgical intervention.

Conclusions. By addressing both the posterior ligamentous integrity and the patient’s neurological status, the TLICS system attempts to overcome the limitations of prior thoracolumbar classification systems. The TLICS system has demonstrated both validity and reliability and has also been shown to be readily learned and incorporated into clinical practice. (DOI: 10.3171/2008.12.SPINE08388)

KEY WORDS • injury classification • injury severity score • spinal cord injury • Thoracolumbar Injury Classification and Severity Score • thoracolumbar spine trauma

Injuries to the thoracic and lumbar spine account for > 50% of all spinal fractures and a large portion of acute spinal cord injuries.7 Given this frequency and the significant impact of these injuries, significant advancements have been made in the surgical treatment of thoracolumbar trauma. Despite the invention and continued evolution of spinal instrumentation and surgical techniques, medical decision-making in spine trauma remains controversial. Fracture treatment can vary widely, from bracing to invasive 360° fusions, based on geographical, institutional, or individual preferences with little scientific basis.

Abbreviations used in this paper: AO = Arbeitsgemeinschaft für Osteosynthesefragen; ASIA = American Spinal Injury Association; PLC = posterior ligamentous complex; TLICS = Thoracolumbar Injury Classification and Severity Score.

A number of classification systems have been developed in an attempt to better define thoracolumbar trauma and aid treatment decision-making. These systems are typically based on either anatomical structures (Denis Three-Column System) or on proposed mechanisms of injury (Ferguson and Allen, and the AO system).2,3,6 Overall, however, there is a paucity of strong data supporting the use of any of these systems. Additionally, there is currently no clear consensus regarding the optimal system for characterizing thoracolumbar fractures. An ideal system must be simple and reproducible based on commonly identified clinical and radiographic parameters. Current systems are either excessively convoluted, with an impractical number of variables, or are too simple, lacking sufficient detail to provide clinically relevant information. These limitations have yielded classification systems that are difficult to implement, have shown in-
sufficient validity and reproducibility, and have not been widely popular.\textsuperscript{1,5,8,16} The TLICS has been described and validated to address the shortcomings of the prior classification systems. The purpose of this paper is to review the TLICS system and to demonstrate its clinical application using 3 cases of thoracolumbar spine trauma.

\section*{Methods}

The TLICS, introduced by the Spine Trauma Study Group in 2005, was designed to provide a clear, reliable classification system that accounts for many of the shortcomings of prior systems.\textsuperscript{14} The system has demonstrated good to excellent inter- and intraobserver reliability and has also been shown to be easily taught, learned, and incorporated into clinical practice.\textsuperscript{11,12,14,15} The TLICS system assigns numerical values to each injury based on the categories of morphology of injury, integrity of the PLC, and neurological involvement (Table 1).

\subsection*{Injury Morphology}

Compression injuries are defined by a visible loss of height of the vertebral body or disruption through the vertebral endplate. This category includes traditional compression (anterior vertebral body) and burst (involvement of the posterior vertebral wall) fractures as well as sagittal or coronal plane fractures of the vertebral column in 2005, was designed to provide a clear, reliable classification system that accounts for many of the shortcomings of prior systems.\textsuperscript{14} The system has demonstrated good to excellent inter- and intraobserver reliability and has also been shown to be easily taught, learned, and incorporated into clinical practice.\textsuperscript{11,12,14,15} The TLICS system assigns numerical values to each injury based on the categories of morphology of injury, integrity of the PLC, and neurological involvement (Table 1).

\begin{table}[h]
\centering
\caption{Thoracolumbar injury classification and severity score scale}
\begin{tabular}{|l|l|}
\hline
Category & Points \\
\hline
injury morphology & \\
compression & 1 \\
burst & +1 \\
translational/rotational & 3 \\
distraction & 4 \\
neurological status & \\
intact & 0 \\
nerve root & 2 \\
cord conus medullaris & \\
incomplete & 3 \\
complete & 2 \\
cauda equina & 3 \\
PLC & \\
intact & 0 \\
jury suspected/indeterminate & 2 \\
injured & 3 \\
\hline
\end{tabular}
\end{table}

The rotation/translational injury is defined by horizontal displacement of one vertebral body with respect to another (Fig. 1A). It is typified by unilateral and bilateral dislocations, facet fracture dislocations, and bilateral pedicle or pars fractures with vertebral subluxation (traumatic spondylolisthesis).

The distraction injury pattern is readily identified by anatomical dissociation in the vertical axis. A representative example would be a hyperextension injury causing disruption of the anterior longitudinal ligament with subsequent widening of the anterior disc space. Posterior element fractures (facet, lamina, or spinous process) may also be present. Thoracolumbar kyphotic deformities of the spine, through a tensile failure of the posterior ligamentous restraints, represent another clinical example of the distraction morphology.

If more than 1 injury morphology is present, then the single injury morphology with the largest score is used. For example, a T11–12 distraction injury with a T-12 burst fracture would be classified as a distraction injury and assigned 4 points (Table 1); scores for the burst fracture morphology are not used. If multiple levels of involvement are present, each injury can be assessed independently. For example, an individual with a T-5 burst fracture (2 points) and a T-9 compression fracture (1 point) is assigned a different TLICS score for each injury.

\subsection*{Integrity of the PLC}

The PLC includes the supraspinous ligament, interspinous ligament, ligamentum flavum, and facet joint capsules. The importance of this complex in protecting the spine against excessive flexion, rotation, translation, and distraction has been well described.\textsuperscript{9,10} Furthermore, once disrupted, the ligamentous structures have poor healing ability and generally require surgical stabilization.

The integrity of the PLC is categorized as intact, indeterminate, or disrupted. This assessment can be made from plain radiographs, CT scans, and MR images.\textsuperscript{5} Disruption is typically indicated by splaying of the spinous processes (widening of the interspinous space), widening of the facet joints, empty facet joints, facet perch or subluxation, or dislocation of the spine. Other measures of posterior ligamentous disruption include vertebral body translation or rotation.

When the evidence of disruption is subtle, the integrity of the ligaments is labeled “indeterminate.” In some cases, clinical examination may be helpful in determining the status of the PLC as an obvious gap between the spinous processes indicates PLC disruption. Magnetic resonance images may show areas of high signal intensity on STIR or T2-weighted imaging suggesting PLC injury. However, MR imaging findings of the PLC have yet to be reproducibly proven to correlate with anatomical disruption.\textsuperscript{4} Therefore, unless CT scans or plain radiographs demonstrate clear disruption, MR imaging suggesting PLC injury may best classified as indeterminate.

\subsection*{Neurological Status}

The neurological status of the patient is often the most influential component of medical decision-making. Additionally, it can be inferred that neurological injury is a critical indicator of the degree of spinal column injury. In addition, incomplete neurological injury in the setting of neural compression is generally accepted as an indication for surgical decompression. The neurologi-
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neurologically intact, nerve root injury, complete (motor and sensory) spinal cord injury, and incomplete (motor or sensory) spinal cord or cauda equina injury. The incomplete spinal cord injuries are considered ASIA Grades B, C, or D, while the complete injuries are considered ASIA Grade A.

A numerical value is assigned for each injury subcategory dependent on the severity of injury. These individual scores are then summed to produce an injury severity score, which is, in turn, used to guide treatment (Table 1). A score of ≥ 5 (Cases 1 and 3, below) suggests operative treatment of the patient due to significant instability, whereas a score of ≤ 3 (Case 2) suggests nonoperative treatment; a patient with a score of 4 may be treated either operatively or conservatively. In the setting of multiple fractures, the injury with the greatest TLICS score is used to guide treatment.

Summary of Cases

Three cases of thoracolumbar trauma are presented to demonstrate use of the TLICS system and its ability to guide surgical decision-making.

Case 1

This patient (Fig. 1) was an 18-year-old female who sustained a fall from 10 ft after being thrown from a horse. She presented with an incomplete spinal cord injury (ASIA Grade B) with severe weakness in the lower extremities but maintained light touch and pinprick sensation in the perineal and perirectal region and the lower extremities.

TLICS Classification: T10–11 translational injury with a disrupted PLC and an incomplete spinal cord injury.

TLICS Score: Injury Morphology (Translation) = 3 points; PLC (Disrupted) = 3 points; Neurological Status (Incomplete) = 3 points; Total TLICS score = 9 points (operative treatment).

Case 2

This patient (Fig. 2) was a 42-year-old male involved in a high-speed motor vehicle collision who presented with back pain but no neurological deficits.

TLICS Classification: T1–2 burst fracture with an intact PLC and normal neurological examination results.

TLICS Score: Injury Morphology (Burst) = 2 points; PLC (Intact) = 0 points; Neurological Status (Intact) = 0 points; Total TLICS score = 2 points (nonoperative treatment).

Case 3

This patient (Fig. 3) was a 23-year-old male who presented after a 25-ft fall with subsequent back pain and lower-extremity weakness and numbness consistent with an incomplete cauda equina injury.

TLICS Classification: L1–2 burst fracture with indeterminate PLC injury and an incomplete cauda equina injury.

TLICS Score: Injury Morphology (Burst) = 2 points; PLC (Indeterminate/Suspected) = 2 points; Neurological
Treatment of thoracolumbar spinal trauma is based on a systematic evaluation of the clinical and radiographic information available on the patient at the time of assessment. Classification systems have been developed to help physicians categorize this information and synthesize a treatment strategy. Prior systems have been based on either injury to specific anatomical structures (Denis Three-Column System) or proposed mechanisms of injury (Ferguson and Allen, and the AO system). An inherent limitation of the latter system is that injuries are classified by inferring unknown injury patterns rather than by a description of known or presenting injury morphology. Not surprisingly, significant interobserver variability has been noted with mechanistic classifications. Blauth et al. demonstrated only fair ($\kappa = 0.33$) interobserver reliability of the AO system with 3 main categories (A, B, and C); as injury subtypes were included, reliability decreased significantly. Wood and colleagues and Oner et al. independently demonstrated fair interobserver reliability of the AO system and fair to good reliability of the Denis classification system.

The TLICS system has been designed to address these limitations. The TLICS system defines injuries according to injury morphology, integrity of the PLC, and neurological status of the patient. It is the first thoracolumbar system to use injury morphology combined with the neurological status of the patient and the critical importance of the posterior ligamentous structures in medical decision-making.

As such, the TLICS system has been designed to aid in medical decision-making by providing both diagnostic and prognostic information with a weighted injury severity score. Stable injury patterns (TLICS < 4) may be treated nonoperatively with brace immobilization and active patient mobilization. Unstable injury patterns (TLICS > 4) may be treated operatively with the guiding principles of deformity correction, neurological decompression if necessary, and spinal stabilization followed by active patient mobilization.

The TLICS system has shown good to excellent intra- and interobserver reliability in a number of countries, including with both orthopedic surgeons and neurosurgeons, and throughout a spectrum of spine treatment providers with varying levels of experience. The TLICS system has been tested in the setting of an academic trauma center, verifying that physicians in training (residents and fellows) can readily be taught and incorporate the TLICS system into patient care. Furthermore, use of the TLICS has yielded > 90% agreement in the management of thoracolumbar trauma across a number of providers.

Although the TLICS system has demonstrated success, there are inherent limitations. To date, many of the investigations into the TLICS system have been performed by individuals involved with its development. Whereas the system has demonstrated educational efficacy, a broader application of the system across multiple physicians and trauma centers may further validate or refute the TLICS system. Additionally, a prospective application of the TLICS system and severity score to the treatment of spinal injuries is needed to define any improvements in care and patient outcomes compared with conventional systems. Lastly, there are certain injury patterns that may be difficult to classify and score. The following case is an example of the limitations of the TLICS system.
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Fig. 3. Case 3. Images obtained in a 23-year-old male who presented after a 25-ft fall out of a tree with resulting back pain and an incomplete cauda equina injury. A: Sagittal CT scan demonstrates an L2 burst fracture. B: Axial CT scan showing the burst pattern at L2 with 90% canal stenosis. C: Sagittal T2-weighted MR image demonstrates compression of the cauda equina and possible signal change in the PLC.

Fig. 4. Images obtained in a 68-year-old male with ankylosing spondylitis who was involved in a ground-level fall and subsequently presented with back pain and normal neurological examination results. A: Sagittal CT scan demonstrates a T9–10 distraction injury with anterior, middle, and posterior column involvement (arrows). B: Sagittal STIR MR image demonstrates an increased signal at the level of the fracture but intact ligamentous structures. C: Sagittal T2-weighted MR image demonstrates no anatomical disruption of the PLC.
A 68-year-old male with ankylosing spondylitis presented with back pain and normal neurological examination results after a ground-level fall (Fig. 4). His TLICS classification was a T9–10 distraction injury with an intact PLC and normal neurological examination. His TLICS score was: Injury Morphology (Distraction) = 4 points, PLC (Intact) = 0 points, Neurological Status (Intact) = 0 points, and Total TLICS score = 4 points (operative or nonoperative treatment). This case example demonstrates a number of limitations. The patient’s bone injury is a distraction injury, but the PLC is anatomically intact. Although this patient’s fracture was not severe, others with greater fracture displacement or angulation would be classified using the same score. The TLICS system is not sensitive enough to define these differences, but instead includes ankylosing spondylitis and other confounding factors as additional descriptors. Although this system allows the ultimate treatment decision to be made by the treating physician, the TLICS may not provide a common language or suggest a standard treatment for this injury pattern.

Conclusions

This paper has demonstrated the application of the TLICS system, a significant improvement over current classification systems because it incorporates major clinical determinants for medical decision-making and prognosis. Future prospective studies with the TLICS will help to further define its role in the care of thoracolumbar spine trauma.

Disclosure

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References


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