

A review of the TLICS system: a novel, user-friendly thoracolumbar trauma classification system

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The classification and treatment of thoracolumbar injuries remain controversial. The Spine Trauma Study Group (STSG) has developed a classification system that has prognostic significance and helps guide treatment decisions. It is based on three aspects: morphology of the injury, integrity of the posterior ligamentous complex, and neurological status of the patient. A severity score is used in conjunction with the classification system to help guide treatment decisions. This classification system has been shown to have good inter- and intra-observer reliability.

The current lack of a standardized protocol for treatment of thoracolumbar injuries stems, in part, from the lack of a universally accepted, appropriate classification system. Such a classification system should be simple and comprehensive, and incorporate reliable information for determination of the best treatment. Moreover, such a system should be prognostic of functional and radiographic outcomes, and should have good inter- and intra-observer reliability. A common classification system should facilitate communication between clinicians, encourage meaningful multi-center research, and generate a standardized approach to the treatment of thoracolumbar injuries.

Existing classification systems

Despite significant efforts to appropriately classify thoracolumbar injuries (Holdsworth 1963,

Denis 1983, Magerl et al. 1994, McCormack et al. 1994), previous classification systems have had inherent shortcomings that have limited their use in the clinical setting. Recent studies have raised concerns regarding the reliability of both the Denis and the AO systems, two of the more commonly referenced classification systems (Blauth et al. 1999, Wood et al. 2005). The authors have found that both systems have moderate inter- and intra-observer reliability, which become reduced with use of the more complex subtypes within each system (9 subtypes in the AO system and 16 in the Denis system). These findings support the notion that increased complexity of the classification system often leads to less reliability in the clinical setting.

The TLICS classification system

Since its inception in 2002, the Spine Trauma Study Group (STSG) has invested considerable energy in developing a comprehensive classification system for injuries of the thoracolumbar spine, called the Thoraco-Lumbar Injury Classification and Severity (TLICS) scale. Members of the STSG identified the following three “primary axes” that are independently important and complementary to the others in the overall analysis and management of fracture patterns: (1) injury morphology, (2) integrity of the posterior ligamentous complex (PLC), and (3) neurological status (Vaccaro et al. 2006a). The three primary axes are further divided into a limited number of easily recognizable sub-

groups, further defining a particular injury from least to most significant (Vaccaro et al. 2005a).

Morphology. The morphology of thoracolumbar injury is determined from a combination of radiographs, CT scans, and MRI using one of 3 morphological categories: (1) compression, (2) translation/rotation, or (3) distraction. In a compression pattern, the vertebral body fails under an axial load. Less severe injuries involve only the anterior portion of the vertebral body. Increased forces can lead to involvement of the posterior vertebral body with a varying degree of retropulsion of the posterior vertebral wall into the canal (i.e. burst fracture). Rotation or translation injuries result from shear or torsional forces on the spine. Rotational instability is best demonstrated by horizontal rotation of the spinous processes and pedicles, visible on the anteroposterior radiograph and the axial CT images. Anterior-posterior translational instability is usually apparent on the lateral radiograph and sagittal CT reconstructions, whereas medial-lateral translational instability is usually apparent on the anteroposterior radiograph and coronal CT reconstructions. Distraction of the spinal column can occur through the anterior and posterior ligaments, the anterior or posterior bony elements, or a combination of both. Distraction results in a circumferential separation of the spinal column and is thus an unstable injury. A distraction injury can occur in flexion or extension, can lead to angulation across the fracture site, and can be associated with a compression- or burst-type pattern of injury to the vertebral body. Combinations of the above morphologies should be identified. It is the more severe component of the morphology that is used when determining appropriate treatment.

Integrity of the posterior ligamentous complex. The PLC of the spinal column is comprised of left and right facet capsules, ligament flavum, and interspinous and supraspinous ligaments. Collectively, this complex contributes to spinal stability, serving as the “posterior tension band” of the spinal column. Because of its poor healing capability, disruption of the PLC alone may necessitate surgical stabilization. In thoracolumbar trauma, the PLC can be categorized as: (1) intact, (2) disrupted, or (3) indeterminate. Injury to the PLC can be identified on the radiographs and CT scan as splaying of the spinous process and diastasis of the facet joints.

Assignment of point values in the TLICS system

	Point value
Injury morphology	
Compression	1
Burst component	1
Translation rotation	3
Distraction	4
PLC integrity	
Intact	0
Indeterminate	2
Disrupted	3
Neurological status	
Intact	0
Nerve root injury	2
Complete	2
Incomplete (cord or cauda equina)	3

The T2 weighted sagittal MRI images are helpful in identifying injury of the PLC (Lee et al. 2000).

Neurological status. Neurological status is an important consideration when making treatment decisions and forecasting clinic outcome. It can be categorized as follows, in increasing order of severity: intact, nerve root injury, cauda equina injury, incomplete spinal cord injury, or complete spinal cord injury. In terms of the grading system of the American Spinal Injury Association (ASIA) for neurological injury, complete neurological deficits are those defined by ASIA A criteria, while incomplete deficits are those defined by ASIA B, C, or D criteria.

TLICS score

The TLICS severity score is based on the principles of the TLICS system described above (Vaccaro et al. 2005 a). Specific point values are assigned to each of the subgroups in the three main categories (i.e. morphology of injury, integrity of the PLC, and neurological status). Lesser point values are assigned to the less severe or less urgent injuries and greater point values are assigned to more severe or more urgent injuries. In general, severity is used to gauge the extent of injury to the bony and ligamentous elements of the spine. Urgency, on the other hand, has a temporal component and is used to gauge the need for the injury to be treated surgically (Table).

Morphology. The 3 main morphological categories each have an assigned point value. A compres-

sion pattern with a burst component represents a subset of the compression pattern, and—because it represents a more severe injury pattern—has a greater point value. Combinations of the three main morphological categories should be documented. It is the point value of the most severe component of the morphology that is used when calculating the injury severity score. Point assignment for morphology includes: compression fractures (1 point), compression with a burst component (2 points), translation/rotation injuries (3 points), and distraction injuries (4 points) (Table).

Integrity of the PLC. As with morphology, the 3 main categories regarding the PLC (i.e. intact, indeterminate, and disrupted) are each assigned a point value. Injuries with an intact PLC are assigned zero points, injuries in which the integrity of the PLC is indeterminate are assigned 2 points, and injuries in which the PLC is disrupted are assigned 3 points (Table).

Neurological status. Of the 5 main categories indicating the neurological status of the patient (i.e. intact, nerve root injury, cauda equina injury, incomplete spinal cord injury, and complete spinal cord injury), each is assigned a point value according to the following system: neurologically intact (0 points), nerve root injury (2 points), complete neurological deficit (2 points), incomplete spinal cord injury or cauda equina deficit (3 points, as these are the most clinically urgent scenarios with respect to intervention strategies) (Table).

Surgical decision making using the TLICS system

The TLICS system has proven helpful in guiding surgical treatment (Vaccaro et al. 2005). Sub-scores for the 3 categories are summed to yield a total severity score. In general, patients with a total score of ≤ 3 can be treated nonoperatively, depending on the type of injury. In contrast, patients with a total score of ≥ 5 usually require surgical treatment. Patients with a total score of 4 are in an intermediate zone where either operative or nonoperative treatment might be equally appropriate. In such cases the nature of the injury, the patient's wishes, the individual surgeon's preferences, and the co-morbidities of the patient are all taken into consideration.

The TLICS system is also helpful in guiding the surgical approach. The two most important

categories to consider when planning the surgical approach are integrity of the PLC and neurologic status. Patients who have an incomplete neurological deficit with compression from the anterior direction most often require an anterior approach. Because of the poor healing capability of the PLC, patients with an incompetent PLC require posterior stabilization. Patients with both a neurological deficit and an incompetent PLC usually require a combined anterior and posterior approach. Although one aim of this protocol for surgical treatment is to decompress neural elements in the presence of neurological deficit, the need to do so remains a matter of debate. In a systematic review of the literature, Boerger et al. (2000) failed to find evidence that surgical decompression of burst fractures improves neurological outcome.

Certain clinical qualifiers may alter what is considered appropriate treatment (Vaccaro et al. 2006b). Characteristics of the fracture itself, including excessive angulation in the coronal plane, may affect the treatment decision. In addition, systemic conditions and overall medical health must be considered when planning treatment. It is not practical to include all of these clinical qualifiers in the classification system and severity score. They should, however, be taken into consideration and used—along with the information provided by the classification and severity score—to guide treatment. A complete algorithm for the TLICS system is shown in Figure 1. Specific cases that demonstrate the use of the TLICS system can be found in Figures 2, 3, and 4.

Validation of the TLICS system

The reliability and the validity of the TLICS system have been extensively investigated. Since the introduction of the Thoracolumbar Injury Severity Score (TLISS) in 2005, this classification scheme has undergone changes and updates as dictated by the scrutiny and review of the STSG. The original description of the TLISS by Vaccaro et al. (2005b) included the following three major components: (1) the mechanism of injury, (2) the integrity of the posterior ligamentous complex, and (3) the patient's neurological status. Subsequent research showed, however, that mechanism of injury may not be as reliable as injury morphology in classifying thoracolumbar injuries (Harrop et al. 2006, Vaccaro et

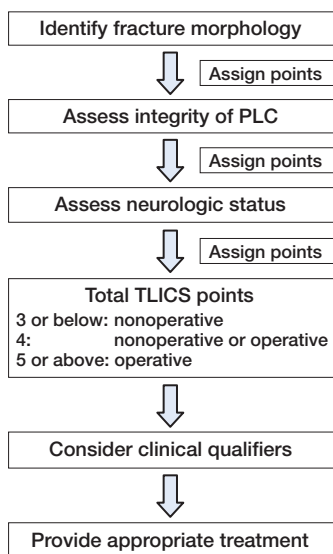


Figure 1. The TLICS algorithm.

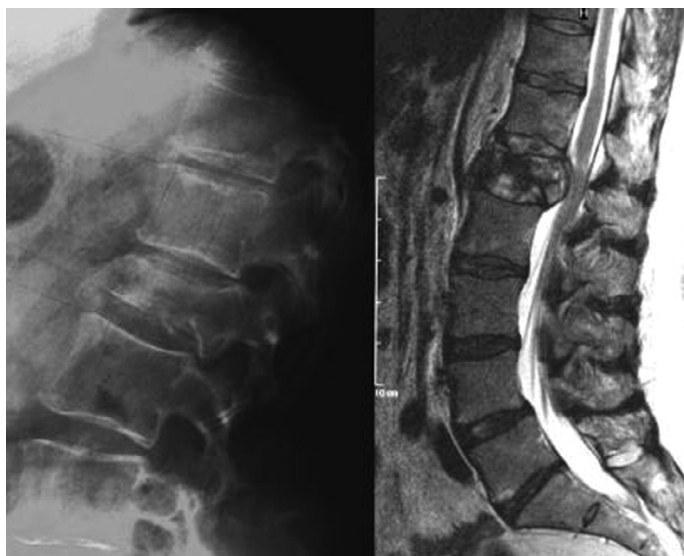


Figure 2. A neurologically intact patient (0 points) with an L1 burst fracture (2 points) and an intact posterior ligamentous complex (0 points). Thus, the total TLICS score is 2. The TLICS system treatment recommendation is therefore non-operative treatment. This patient was treated in a thoracolumbosacral orthosis.

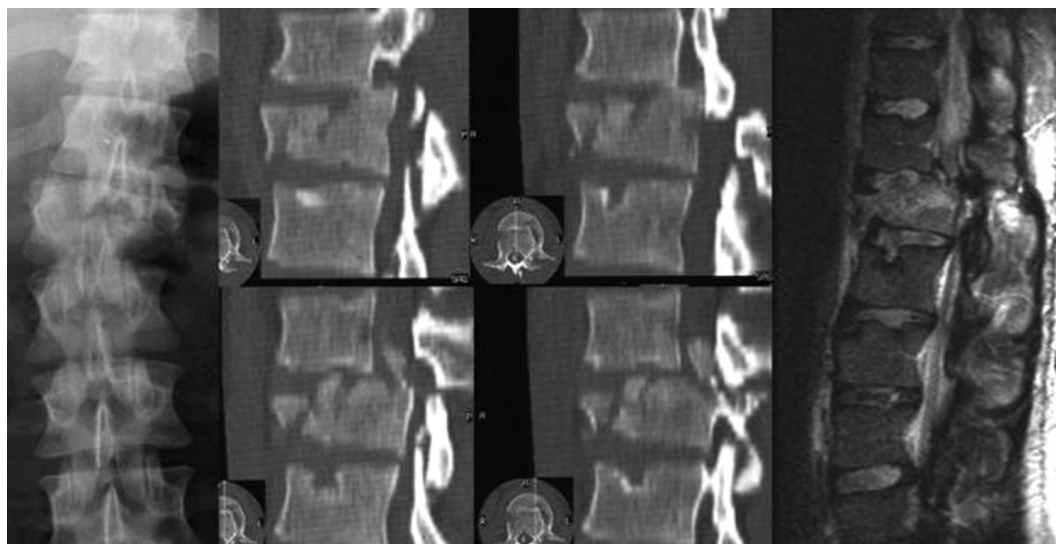


Figure 3. A patient with a translation and compression injury morphometry who has a complete spinal cord injury. The TLICS system classifies this as an L1 translation (3 points), lateral compression burst injury (not counted because only the most severe of the major categories is counted) with a complete spinal cord injury (2 points) and disruption of the posterior ligamentous complex (3 points). The total TLICS score is 8. This is obviously a severe and unstable injury, as indicated by the severity score. The TLICS system treatment recommendation is operative treatment.

al. 2006b). The STSG called for either more strict definitions of what constitutes the various mechanisms of injury or a change in this major category of the TLISS system. Subsequently, a study was performed that surveyed 22 leading spine surgeons

from 20 level-I trauma centers around the world in order to define the major characteristics of thoracolumbar injuries that influence their treatment decisions (Vaccaro et al. 2006a). All agreed that the 3 most important characteristics of a thoracolumbar

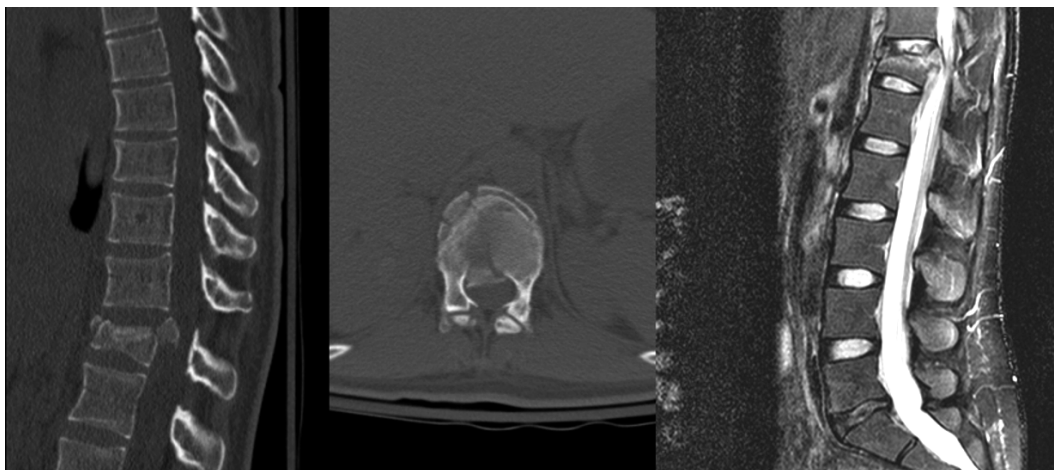


Figure 4. (Above) A patient with a burst fracture (2 points) of T12 following a motor vehicle accident. This patient was neurologically intact (0 points). On imaging, the status of the PLC was indeterminate (2 points). The total TLICS score is 4 points. According to the TLICS system, this injury could be treated nonoperatively or operatively. Nonoperative treatment with a TLSO brace was initially attempted. At her one-month follow-up appointment however, the patient was complaining of some lower extremity weakness and urinary incontinence and was noted to have increased kyphosis at the level of the fracture.



The patient was then taken to the operating room for a T12 corpectomy, with placement of an expandable cage (XPand, Globus Medical, Audubon, Pennsylvania) and fixation of T11 to L1 with a plate-rod system (Gateway, Globus Medical, Audubon, Pennsylvania). Local autograft from the corpectomy was placed within the cage.

injury are: (1) injury morphology, (2) integrity of the PLC, and (3) neurological status of the patient. Findings from the studies listed above prompted the STSG to modify the scoring system to include injury morphology in place of injury mechanism as one of the three “primary axes”. The name was changed to TLICS, which has been described in detail above and is the subject of this review.

Additional studies have been performed to validate the STSG thoracolumbar injury classification paradigm. Rampersaud et al. (2006) performed a multi-center reliability study to assess the agreement between orthopedic spine surgeons and neu-

rosurgeons in classifying thoracolumbar injuries according to the TLISS scheme. This study supported the notion that the TLISS establishes a consensus-based algorithm for treating thoracolumbar injuries. In the first prospective validation of the system, Patel et al. (2007) studied two groups of consecutive patients with acute thoracolumbar injuries. Their goal was to evaluate time-dependent changes in inter-observer reliability. The inter-observer reliability showed substantial improvement at the second assessment, suggesting that the classification system can be taught effectively and incorporated into daily practice. Whang et al. (2007)

compared the reliability and validity of the TLICS and TLISS schemes to determine the importance of injury mechanism and injury morphology for the identification and treatment of thoracolumbar injuries. Inter-rater reliability for all scores and subscores (i.e. mechanism/morphology, status of the posterior ligaments, total score, and recommended management) were within the range of moderate to substantial reproducibility. Construct validity was excellent for both systems. What is currently lacking in the literature is a multi-center prospective analysis with large numbers of patients, comparing the TLICS system to previous classification systems such as the AO or Denis system.

In summary, the TLICS system classifies injuries based on three pivotal characteristics of a thoracolumbar injury as defined by an international panel of spinal trauma specialists: morphology of the injury, integrity of the posterior ligamentous complex, and neurological status of the patient. A severity score is used in conjunction with the classification system to help guide treatment decisions. In almost all cases, spine traumatologists who use the system agree with the treatment recommendations set forth by the TLICS scheme. Prospective, multi-center studies that will provide more information about the reliability and validity of this classification system are under way.

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