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A New Classification of Thoracolumbar Injuries

The Importance of Injury Morphology, the Integrity of the Posterior Ligamentous Complex, and Neurologic Status

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Study Design. A new proposed classification system for thoracolumbar (TL) spine injuries, including injury severity assessment, designed to assist in clinical management.

Objective. To devise a practical, yet comprehensive, classification system for TL injuries that assists in clinical decision-making in terms of the need for operative *versus* nonoperative care and surgical treatment approach in unstable injury patterns.

Summary of Background Data. The most appropriate classification of traumatic TL spine injuries remains controversial. Systems currently in use can be cumbersome and difficult to apply. None of the published classification schemata is constructed to aid with decisions in clinical management.

Methods. Clinical spine trauma specialists from a variety of institutions around the world were canvassed with respect to information they deemed pivotal in the communication of TL spine trauma and the clinical decision-making process. Traditional injury patterns were reviewed and reconsidered in light of these essential characteristics. An initial validation process to determine the reliability and validity of an earlier version of this system was also undertaken.

Results. A new classification system called the Thoracolumbar Injury Classification and Severity Score (TLICS) was devised based on three injury characteristics: 1) morphology of injury determined by radiographic appearance, 2) integrity of the posterior ligamentous complex, and 3) neurologic status of the patient. A composite injury severity score was calculated from these characteristics stratifying patients into surgical and nonsurgical treatment groups. Finally, a methodology was developed to determine the optimum operative approach for surgical injury patterns.

Conclusions. Although there will always be limitations to any cataloging system, the TLICS reflects accepted features cited in the literature important in predicting spinal stability, future deformity, and progressive neurologic compromise. This classification system is intended to be easy to apply and to facilitate clinical decision-making as a practical alternative to cumbersome classification systems already in use. The TLICS may improve communication between spine trauma physicians and the education of residents and fellows. Further studies are underway to determine the reliability and validity of this tool.

Key words: spine trauma, thoracolumbar fractures, classification, clinical pathways. **Spine 2005;30:2325–2333**

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Despite a sizable amount of literature on the issue, the classification and treatment of thoracolumbar spine fractures remain controversial. Although several classification systems for thoracolumbar injuries have been described and promoted since Böhler's sentinel classification in 1929, none has gained universal acceptance.[1–12] This lack of acceptance appears to be due, in part, to the difficulty of applying certain systems in clinical practice and the lack of validity and reproducibility of the more popular classifications as shown in recent studies.[13] Furthermore, the majority of these schemes ignore the degree of force impact at the time of injury or the precise morphology of injury and are largely ineffectual at predicting the outcome of a given fracture pattern.

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In essence, they strive to serve only as descriptors and not predictors.

In a review article written approximately 20 years ago, Bucholz and Gill[14] identified the limitations of existing spinal thoracolumbar trauma classification systems, stating that thoracolumbar fracture classifications did not accurately reflect the dynamic mechanics of the injury and failed to include neurologic assessment as part of the systems.[14] Surprisingly, despite huge advances in imaging and surgical techniques for treating fractures, these limitations have not been resolved. Currently available classifications are limited by a number of fundamental problems. The majority of systems are so complex as to limit their utility in routine clinical practice. Second, many classification systems fail to include certain anatomic or physiologic factors important to clinical decision-making such as the status of the posterior ligamentous structures or the neurologic status of the patient. And third, most classification schemes do not help to suggest treatment, taking into account the modern diagnostic and therapeutic techniques available. Instead, the interpretation of the majority of thoracolumbar fracture classification systems relies on anecdotal surgeon experience, retrospective reconstruction of the mechanism of injury, and nonvalidated predictors of spinal deformity and neurologic compromise.

A clinically relevant classification system should not only take into account the natural history of an injury pattern but should also predict outcome in a variety of treatment alternatives. Ideally, such a system should provide a universal language to describe spinal injuries and should guide clinical decision-making. This system must be easy to remember and use in clinical practice and should provide a platform for prospective research on spinal injuries. The system must be able to stratify injury severity and suggest the prognosis of a given injury. The purpose of this paper is to present a novel and clinically useful classification system for thoracolumbar spinal injuries that satisfies these criteria.

■ Methods

A review of the English and non-English literature was performed on the topic of thoracolumbar spine trauma, classification, and treatment. Selected articles were chosen for further review based on their level of medical evidence, soundness of their methodology, and popular acceptance among the spinal care community. The data obtained were then reviewed and discussed at several meetings and through telephone conferencing by a total of 40 surgical spine experts from 15 level I trauma institutions in the United States, Canada, Australia, Germany, Mexico, France, Sweden, India, and the Netherlands. Major limitations were tabulated from each of these systems. In addition, the experts were polled for characteristics of thoracolumbar spine trauma thought to be pivotal in clinical judgment and decision-making for present-day standard of care treatment. Existing deficiencies were combined with these critical indicators to provide a framework for a new functional thoracolumbar trauma classification system. By unanimous agreement, the classification system was constrained to include: 1) a description of the major morphometric features of the thoracolumbar injury, 2) an analysis of injury severity, 3) an assessment of both mechanical and neurologic aspects of an injury, 4) reproducibility, 5) usefulness in prospective research settings, and 6) flexibility to evolve through future clinical studies.

After consensus was reached with respect to the structure of the new classification system, two preliminary validation surveys were sent out to members of one single institution (71 cases) and to the Spine Trauma Study Group (56 cases) to better understand the reliability and validity of the chosen features of the new classification system. Minor changes were made to reflect perceived deficiencies such as substituting the morphology of injury for mechanism of injury and modifying the scoring paradigm. The classification system was then applied to a common series of clinical situations discussed among all of the investigators to ensure the elimination of any remaining apparent limitations.

■ Results

Three major variables were identified as critical to clinical decision-making in thoracolumbar trauma: 1) the morphology of injury as determined by reviewing the pattern of disruption on available imaging studies, 2) the integrity of the posterior ligamentous complex (PLC), and 3) the neurologic status of the patient. These three injury characteristics were thought to be largely independent predictors of clinical outcome. Within each of the three categories, subgroups were identified and arranged from least to most significant. The three major components of the Thoracolumbar Injury Classification and Severity Score and their subgroups are described as follows:

Morphology: Fracture Pattern

Fracture pattern (Table 1) can be conveniently summarized by one of three morphologic descriptors similar to that described in the AO thoracolumbar injury classification: 1) compression, 2) translation/rotation, and 3) distraction (Figure 1)[9]. Injury morphology is determined by careful review of radiographic studies to determine the pattern of anatomic disruption. In most cases, this requires integration of information from plain radiographs, CT imaging, and MRI. Included in the description of the injury morphology is the spinal level of involvement.

Table 1. Injury Morphometries

Compression
Axial compression, axial burst
Flexion compression, flexion burst, flexion compression or burst with distraction of posterior elements
Lateral compression, lateral burst
Lateral burst
Translation/rotation
Translation/rotation
Unilateral or bilateral facet dislocation
Translation/rotation compression or burst
Unilateral or bilateral facet dislocation compression or burst
Distraction
Flexion distraction, flexion distraction compression or burst
Extension distraction

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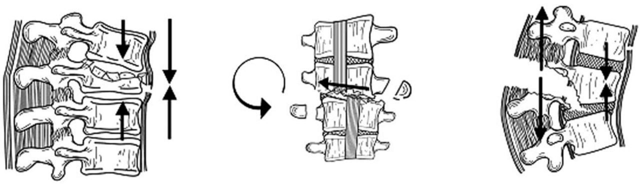


a b c

Figure 1. The three major morphologic descriptors in the Thoracolumbar Injury Classification and Severity Score include compression, translation/rotation, and distraction. These are determined from a combination of plain film, CT images, and MRI. **a,** Compression. In this description, the vertebral body buckles under load to produce a compression or burst fracture. **b,** Translation/rotation. The vertebral column is subjected to shear or torsional forces that cause the rostral part of the spinal column to translate or rotate with respect to the caudal part. **c,** Distraction. The rostral spinal column becomes separated from the caudal segment because of distractive forces. Combinations of these morphologic patterns may occur.

Compression. A compressive description is assigned when the vertebral body fails under axial loading. In its less severe form, this is represented by a simple compression fracture with buckling of the anterior wall of the vertebrae and accentuated kyphosis. In its more severe form, the posterior cortex of the vertebral body fails between the pedicles with various degrees of retropulsion (burst fracture; Figure 2, available for viewing online through ArticlePlus only). Occasionally, lateral angulation is apparent through the fracture site on an anteroposterior (AP) radiograph, conveying an extra degree of instability. Injury description is made more specific with a simple modifier to describe the appearance of the compression deformity. This may include the prefixes axial, flexion, or lateral (Figure 3).

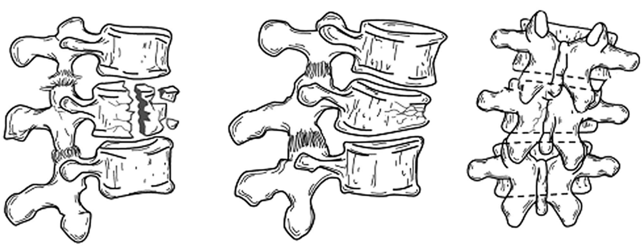
Rotation/Translation. Torsional and shear forces are primarily responsible for spinal column failure in rotation or translation. Anatomically, the thoracolumbar spine is configured to move in flexion and extension but to resist significant rotation and translation. Hence, failure from torsion and/or shear requires considerably more destruction of normal anatomy and imparts considerably more instability than failure from compression.[9] Rotational injuries are recognized by horizontal separation of the spinous processes or acutely altered alignment of the pedicles above and below the level of the injury on an AP film. Axial CT sequences also demonstrate a shift in the midline sagittal plane across the injury site. Sagittal CT reconstructions provide the detail necessary to look for a facet jump or fracture. Translation is most easily recognized on a lateral radiograph or sagittal CT reconstruction. The term dislocation can be interchanged for translation/rotation if the facet joint(s) are intact but dislocated (Figure 4, available for viewing online through ArticlePlus only).

Distraction. A distraction morphology is surmised when one part of the spinal column is separated from the other leaving a space in between. This can occur through disruption of anterior and posterior ligaments, through anterior and posterior bony elements, or a combination of both. The key element in identifying this morphology is that the rostral component of the spinal column becomes disconnected from its caudal component. These are often very unstable injuries, as by definition, the spinal column is disrupted circumferentially. Angulation is frequently seen in the sagittal and/or coronal planes across the fracture site. In the distraction description, the prefixes extension or flexion are used and can be combined with compression or burst descriptors as a postfix as necessary (Figure 5).

For more complex fracture patterns, failure of the spinal column is best described using a combination of the three primary morphologies. For example, in a severe distraction injury, it is possible to have a compression and a translation component (Figure 6, available for viewing online through ArticlePlus only). This injury pattern would best be described as a distraction translation compression injury. Alternatively, in a rotational injury, a burst fracture may be present (rotation burst fracture).

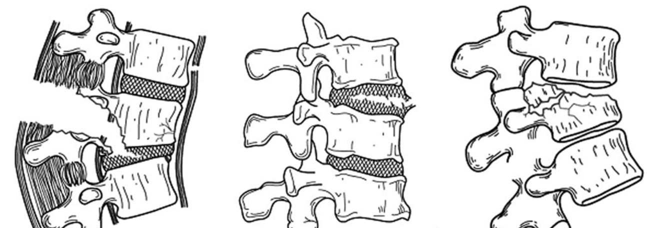
Integrity of the PLC

The PLC includes the supraspinous ligament, interspinous ligament, ligamentum flavum, and the facet joint capsules. The importance of this complex in protecting the spine against excessive flexion, rotation, translation, and distraction has appropriately earned it the name "posterior tension band." Its importance to fracture classification and treatment algorithms is further under-



a b c

Figure 3. For compression injuries, a series of prefixes may be used to more precisely describe the injury morphology, such as (**a**) axial, (**b**) flexion, or (**c**) lateral.



a b c

Figure 5. Distraction injuries are divided into various subtypes by the prefix: (**a**) flexion or (**b**) extension. A postfix descriptor may include (**c**) compression or burst.

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scored in that, once disrupted, this ligamentous complex generally requires surgical intervention because of its poor healing ability. Integrity of the PLC is categorized as intact, indeterminate, or disrupted. This assessment can be made from plain film, CT, and MR images. It is typically indicated by splaying of the spinous processes (widening of the interspinous space), diastasis of the facet joints, and facet perch or subluxation. Other more indirect 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. For example, a palpable gap between the spinous processes may be evidence that the PLC is disrupted.

Neurologic Status

Neurologic function is a very important indicator of the severity of spinal column injury. The spinal cord and cauda equina are well protected in their bony armor; neurologic injury attests to the severity of the spinal column injury. In addition, incomplete neurologic injury is generally accepted as an indication for surgical decompression. Because neurologic status plays such an important role in patient assessment and surgical decision-making, it comprises one of the three main injury characteristics in this classification algorithm. The neurologic status is described in increasing order of urgency as: neurologically intact, nerve root injury, complete (motor and sensory) spinal cord, and incomplete (motor or sensory) spinal cord or cauda equina injury. The incomplete spinal cord injuries are considered American Spinal Injury Association (ASIA) B, C, and D, while the complete injuries are considered ASIA A.

With an understanding of the three major categories specific for an injury, the injury can now be adequately classified. For example, an injury may be described as a flexion burst fracture in a neurologically intact patient with a disrupted PLC.

Injury Severity Score

A comprehensive Injury Severity Score is calculated from the injury characteristics to assist in determining treatment. Each of the subgroups in the three main injury categories has a numerical value associated with it. As the injury is sequentially classified into these subgroups, the values are added across the three main injury categories to provide a comprehensive severity score. One to four points (1 point = least severe; 4 points = most severe) are assigned to reflect the degree of injury severity and the potential impact on mechanical or neurologic stability. In the presence of multiple contiguous or noncontiguous injuries, only the most severely involved level is scored.

Morphology. A compression fracture is assigned 1 point. If there is a burst component, an additional point (1) is assigned. A translational/rotational mechanism is assigned 3 points. Distraction injuries are assigned 4 points. Only one morphologic subgroup (compression-compression or burst, translation/rotation, or distraction) is scored (the highest one) when multiple morphologic features are present (Table 2). For example, in a compression burst injury with distraction of the posterior elements, only distraction would be scored because it has the highest value. If an injury morphology is unclear, such as with the description distraction when disruption of the PLC is indeterminate, it (distraction) is not listed under the morphology section and therefore not scored. An injury morphology can only be listed if it is clearly thought to be present.

Integrity of the PLC. An intact posterior soft tissue component is assigned 0 points (Table 3). Indeterminate disruption is assigned 2 points, while definite disruption is assigned 3 points.

Neurologic Status. A patient with an intact neurologic examination is assigned no points, while a patient with a nerve root injury is given 2 points (Table 4). Motor and sensory complete spinal cord injuries are assigned a score of 2 points, while incomplete sensory or motor spinal cord injury or cauda equina injuries are assigned 3 points.

Examples to Illustrate the Application of the TLICS

Compression Fracture. A neurologically intact patient with a compression fracture would be assigned 1 point for the fracture pattern. No points are assigned for an intact neurologic status and PLC. The final score is 1 and would therefore fall into the nonoperative category (Figure 7).

Table 2. Injury Morphology

Type	Qualifiers	Points
Compression		1
	Burst	1
Translational/rotational		3
Distraction		4

Table 3. Integrity of Posterior Ligamentous Complex

PLC disrupted in tension, rotation, or translation	Points
Intact	0
Suspected/indeterminate	2
Injured	3

Table 4. Neurologic Status

Involvement	Qualifiers	Points
Intact		0
Nerve root		2
Cord, conus medullaris	Complete	2
	Incomplete	3
Cauda equina		3

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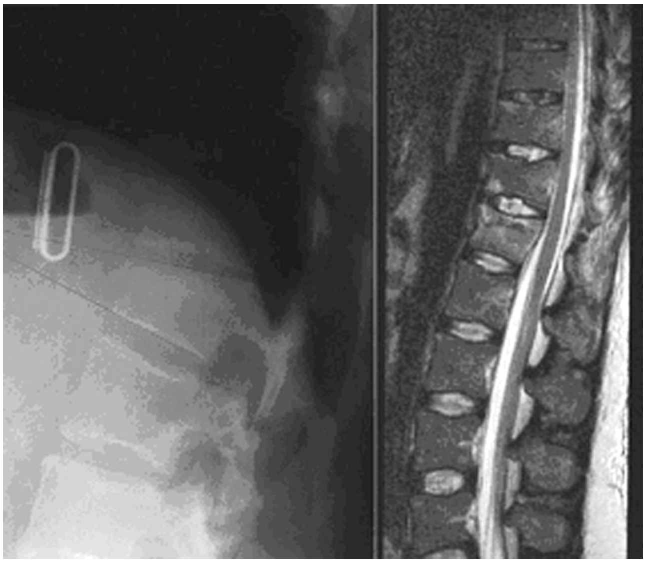

Figure 7. A neurologically intact patient (0 points) with a flexion compression fracture (1 point) and no posterior ligamentous injury (0 points). Total points = 1.

Burst Fracture. A neurologically intact patient (neurologic status, 0 points) with an axial burst fracture (fracture pattern, 2 points), with an intact PLC (0 points) is assigned a total of two points (Figure 8, available for viewing online through ArticlePlus only). This, too, should be treated nonoperatively.

Burst Fracture with Disrupted PLC. A flexion burst fracture (2 points) in a patient who is neurologically complete (2 points), with loss of the integrity of the PLC (3 points) receives a total of 7 points, and would be considered a surgical candidate (Figure 9).

Translational/Rotational Injury. In instances of complex fracture patterns involving more than one major morphologic category (*e.g.*, translation and compression [burst]), only the highest category is scored. For example, a patient with a translation (3 points) and lateral burst (2 points) injury (only translation is scored), a complete spinal cord injury (2 points), and disruption of the posterior ligaments (3 points) would be given a score of 8 (Figure 10, available for viewing online through ArticlePlus only). This is a surgical candidate.

Figure 9. A flexion burst fracture (2 points) in a patient who is neurologically complete (2 points), with loss of the integrity of the posterior ligamentous complex (3 points) receives a total of 7 points.

A comprehensive severity score of 3 or less suggests a nonoperative injury, while a score of 5 or more suggests that surgical intervention may be considered. Injuries assigned a total score of 4 might be handled conservatively or surgically. The final classification according to the TLICS system combines the descriptors of injury morphometry, neurologic condition, and integrity of the posterior ligaments with the injury severity score. In the case of the patient shown in Figure 10, this would be classified as a "translational, lateral compression burst injury with a complete spinal cord injury and disruption of the posterior ligamentous complex," with a TLICS of 8.

Surgical Approach

The TLICS guides not only the need for surgery but the surgical approach as well. Many variables affect a surgeon's decision about the best surgical approach to perform, but the two most important considerations are reflected in the last two components of the classification scheme: integrity of the PLC and neurologic status. The general principles are: 1) an incomplete neurologic injury generally requires an anterior procedure if neural compression from the anterior spinal elements is present following attempts at postural or open reduction; 2) PLC disruption generally requires a posterior procedure; and 3) a combined incomplete neurologic injury and PLC disruption generally requires a combined anterior and posterior procedure. These principles are largely independent of the mechanism of injury and serve to help clarify surgical priorities. Additional combinations of injury patterns and the favored approaches are summarized in Table 5.

Qualifiers. While the preceding classification system objectifies thoracolumbar fracture patterns and helps to direct management, a variety of other clinical consider-

Table 5. Suggested Surgical Approach

	Posterior Ligamentous Complex	
Neurologic Status	Intact	Disrupted
Intact	Posterior approach	Posterior approach
Root injury	Posterior approach	Posterior approach
Incomplete SCI or cauda equina	Anterior approach	Combined approach
Complete SCI or cauda equina	Posterior (anterior)* approach	Posterior (combined)* approach

*Aggressive decompression in ASIA A patients is practiced in many institutions to optimize any potential for neurologic recovery, reconstruct the vertebral support column, restore CSF flow to prevent syringomyelia, and allow for short-segment fixation.

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ations can significantly influence treatment and therefore need to be considered before blindly acting on a comprehensive injury severity score. These clinical qualifiers have a variable influence depending on many different factors but can often cause an otherwise nonsurgical patient to become surgical and *vice versa* irrespective of any type of numerical classification. They can be local in nature such as extreme kyphosis or collapse,[13] lateral fracture angulation, open fractures, overlying burns, multiple adjacent rib fractures, or inability to brace. Remote comorbidities can also influence treatment such as a sternum fracture, severe closed head injury, limb amputation, and multisystem trauma. Finally, systemic considerations also play a role in clinical decision-making such as rheumatoid arthritis, ankylosing spondylitis, osteoporosis, obesity, patient age, and even general health. The influence these qualifiers play in guiding management decisions cannot be objectified but must be considered in weighing the benefits of various forms of treatment for the patient as a whole. In the same context, the principles of surgical approach cannot be substituted for a surgeon's experience with a given approach as it is conceded that various approaches may be used successfully to treat injuries to the thoracolumbar spinal column. There is no treatment algorithm that can supersede a surgeon's intuition in prioritizing and integrating a multitude of complex clinical and biomechanical issues.

Discussion

There are nearly a dozen different thoracolumbar injury classifications that have attempted to objectify fracture patterns and prognosis.[1–5,7–9,12,15–17] The shear number of classification schemes attests to the difficulty experts have experienced in coming to some type of agreement about how to best represent these injuries. The resulting confusion has plagued not only spinal surgeons but has clouded education of physician colleagues, clinical and research fellows, residents, and medical students. The need for a clinically relevant and useful classification system is as real today as it was almost six decades ago.

Defining Instability

The continuing effort to classify thoracolumbar spinal fractures reflects the contemporary difficulties encountered in defining or predicting the stability of these injuries. Presumed spinal instability following trauma has been traditionally based on an assessment of routine plain radiographs, computerized tomography, and magnetic resonance imaging. These studies capture only an isolated moment in time, providing a static perspective of the injury, not necessarily correlating with dynamic deformation occurring at the time of incident. Biomechanical engineers and clinicians alike have been constrained to these limitations in developing a universally accepted definition of stability. Nicoll defined spinal stability as the absence of deformity or neurologic deficit increasing over time.[1] Similarly, Kelly and Whitesides called a spine unstable if progressive deformity resulted in increasing neurologic compromise.[4] Perhaps White and Panjabi devised the most comprehensive definition:

"Clinical instability is defined as a loss in the ability of the spine under physiologic loads to maintain relationships between vertebrae in such a way that there is neither damage nor subsequent irritation to the spinal cord or nerve roots. In addition there is no development of incapacitating deformity or pain due to structural changes.[18]"

From the failure of these reflections and others like them to provide a working model of instability, it becomes intuitive that a more meaningful categorization might reflect different categories of instability rather than degrees of instability. Our panel has defined these categories to include:

- Immediate mechanical stability (suggested by the morphology of injury)
- Long-term stability (indicated by integrity of the PLC)
- Neurologic stability (indicated by the presence or absence of a deficit)

It is our opinion that, when considered together, these independent variables allow a much more practical and clinically relevant assessment of injury severity. This, in turn, more appropriately reflects instability when compared with more traditional measures of angulation and translation.

Validity and Reliability

One of the main purposes of a classification system is to create a language common to those who treat thoracolumbar spinal trauma, thereby promoting efficient and reliable communication. This requires a minimum degree of intraobserver and interobserver reliability as the system is used. These types of reliability have been problematic in fracture classification systems in general. A classification system is based on a presumption that there exist common underlying characteristics within the subsets of a domain. In the case of a spinal fracture classification system, it is presumed that the interaction of various forces with the spinal column creates some basic repetitive injury patterns. The difficulty lies in the interaction of innumerable variables that go on to produce a traumatic lesion. A classification scheme has to presuppose an "all or none result" for some of these interactions. It must also compress available information into reproducible categories without loss of information content (*i.e.*, an "algorithmic compression process"). Such a process inevitably leads to two pitfalls: 1) either there is a loss of information content in favor of simplicity and thus higher reproducibility, or 2) there is a loss of simplicity and reproducibility in favor of higher informational content.

Two of the most commonly used thoracolumbar fracture classifications of the last decade are the Denis and AO classifications. Despite widespread dissemination and adoption of these systems, the authors failed to follow up by systematically establishing their validity. As a

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result, the algorithms have not been modified or improved. Studies later performed by independent groups have gone on to raise serious concerns about the reliability and reproducibility of these classification methods. Blauth *et al*[19] conducted a multicenter study to assess the interobserver reliability of the AO classification system using the imaging studies of 14 fractures of the lumbar spine. Plain radiographs and CT scans were reviewed by 22 institutions experienced with spinal trauma. The mean interobserver agreement for the 14 cases was 67% (range, 41%–91%) when only just the three main categories (A, B, C) were used to classify the spinal injuries. The corresponding interobserver kappa coefficient was 0.33, indicating only fair reliability. The reliability coefficient decreased by increasing the number of injury categories. Oner[20] studied the reproducibility of the Denis and AO schemes using plain radiographs, CT, and MRI in 53 patients. They found fair reproducibility (kappa = 0.34) with CT scans when describing the fracture using the main AO fracture categories. Using MRI, reproducibility reached only moderate levels (kappa = 0.42). Subclassification of Type A (groups) injuries yielded higher kappa values corresponding to substantial agreement. Intraobserver kappa values were moderate.

Interobserver and intraobserver agreement has been found to be better with the Denis classification (CT scan, major fracture type-kappa: 0.60; CT scan, entire classification system 0.45, MRI major fracture type: 0.52; MRI entire classification system 0.39). However, the variance was much higher because of difficulties of finding proper categories for some injury patterns.

Thus, the AO scheme preserves informational content by providing categories for all kinds of possible injury patterns. This has inevitably caused a degree of complexity to the scheme making its day-to-day use impractical. On the other hand, the Denis classification simplified fracture classification to the extent that many fracture patterns were not recognized. These popular thoracolumbar trauma schemes serve to exemplify the recognized limitations of classification systems at either end of the spectrum. Construction of the TLICS system was undertaken with these limitations in mind. Three simple injury morphometries can be combined in the classification of an injury to reflect multiple injury patterns. A complicated fracture does not have to be constrained to one category. Intuitively within the TLICS system, combinations of injury morphologies represent more severe injuries. Nonetheless, it remains imperative that the score be further validated, the interobserver and intraobserver reliability be established, and that further modifications be made if necessary so as to avoid the same mistakes as the more established classification systems.

A preliminary scoring system by Vaccaro *et al*[21] described an earlier version of the scoring mechanism referred to as the Thoracolumbar Injury Severity Score (TLISS). This system focused on injury mechanism rather than morphometry. Following the dissemination of validation surveys, it became apparent that surgeons at all levels of training disagreed frequently on proposed injury mechanisms and felt more comfortable describing injury appearance (morphometry). This led to the modification of the scoring system as presented here as the TLICS system.

Treatment Algorithms

All classification systems are based on image pattern recognition. However, pattern recognition does not necessarily lead to a better understanding of prognosis. A classification system becomes useful if it helps predict outcome more accurately than random chance. Only by

Figure 11. A patient with a L1 axial burst fracture. It is a compression injury (1 point) with burst component (1 point). The patient is neurologically intact (0 points). Although edema is noted in the posterior ligamentous complex, no rotation, translation, or distraction is noted (0 points). The point total is 2; therefore, the recommendation is nonoperative therapy. If the patient had an incomplete neurologic deficit (3 points), the point total would be 5 points and the treatment recommendation would be surgery.

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Figure 12. A T12 flexion burst fracture in a patient with an incomplete spinal cord injury. Compression injury (1 point) with burst component (1 point), definite injury to PLC (3 points), and incomplete spinal cord injury (3 points) gives 8 total points; thus, the treatment recommendation is surgery.

linking observed outcomes to recognized patterns can the prognostic significance of the patterns become appreciated. Hence, a practical spine trauma classification scheme should not only provide a mental construct or model of a complex biomechanical system but should also be instructive as to the severity of injury and possible clinical consequences. This information should allow reasonable estimations of the outcome of different treatment methods. Simple recognition of specific injury patterns is not meaningful if it cannot be used as a tool for outcome prediction.

The TLICS draws from a large breadth of clinical experience and applies anticipated outcomes to recognized fracture patterns through its numerical weighting system. It accommodates an injury with a severe morphology, a disrupted PLC, and a compromised neurologic picture, and translates it to a high-risk clinical situation most likely requiring combined anterior and posterior surgical intervention. None of the classification systems published to date has integrated treatment algorithms for the care of patients with thoracolumbar injuries. The previous TLISS system was developed and tested by listing all potential thoracolumbar injury patterns and then assigning point values to injured structures. The scoring outcomes were then reviewed to see if specific values correlated with best treatment options. This score was then validated several times to see if the scoring system was reliable and reproducible (Figures 11–14; figure 13 is available for viewing online through ArticlePlus only). The results of this validation process led to the final TLICS.

Figure 14. A flexion distraction injury (4 points) at T12–L1 in a patient with an ASIA A spinal cord injury (2 points) and a definite injury to the PCL (3 points). The point total = 9; thus, the treatment recommendation is surgery.

■ Conclusion

Controversy remains in the area of thoracolumbar trauma diagnosis, treatment, and management. We think that a simpler classification system, which takes into effect factors relevant to decision-making, is needed. In this article, we suggest a new system that we think clinicians and researchers alike will find useful. Because our system is based on carefully chosen, objective clinical indicators linked to patient outcome, it should facilitate communication about injuries and help in making treatment decisions. Ultimately, this system may prove useful as a research tool to compare various treatment strategies for thoracolumbar trauma. Finally, because injury severity is weighted by a point system, the TLICS system is amenable to modification if factors not yet understood come to light.

The Thoracolumbar Injury Classification and Severity Score describes not only the morphology of thoracolumbar spinal trauma but also serves to rank the degree of instability. By including components of neurologic status and posterior ligamentous integrity, the clinician is forced to consider additional facets of instability and severity. The numerical scores generated by this process help the treating physician more appropriately weigh their relative contribution in the assessment of the spinal injury. As a direct result, the classification scheme and injury severity score can be used to guide clinical man-

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agement and surgical approach. Further validation and estimation of reliability will help objectively define how the TLICS will perform in everyday practice.

■ Key Points

- The Thoracolumbar Injury Classification and Severity Score is designed to depict the features important in predicting spinal stability, future deformity, and progressive neurologic compromise, and thereby facilitate appropriate treatment recommendations.
- The composite injury severity score derived from this classification system assigns between 1 and 4 points to three critical components of an injury. Fractures with 3 points or less are considered nonoperative cases. Fractures with scores of 4 points can be considered for nonoperative or operative intervention. Fractures with 5 or greater points are considered surgical cases.
- In operative candidates, features of this classification system, such as posterior ligamentous integrity and the neurologic status of the patient, serve to direct the optimal surgical approach.

Black White *black & white images*

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