Andrew T. Dailey, MD[*]
Paul M. Arnold, MD[‡]
Paul A. Anderson, MD[§]
John H. Chi, MD, MPH[¶]
Sanjay S. Dhall, MD[‖]
Kurt M. Eichholz, MD[#]
James S. Harrop, MD[**]
Daniel J. Hoh, MD[‡‡]
Sheeraz Qureshi, MD, MBA[§§]
Craig H. Rabb, MD[¶¶]
P. B. Raksin, MD[‖‖]
Michael G. Kaiser, MD[##]
John E. O'Toole, MD, MS[***]

[*]Department of Neurosurgery, University of Utah, Salt Lake City, Utah; [‡]Department of Neurosurgery, University of Kansas School of Medicine, Kansas City, Kansas; [§]Department of Orthopedics and Rehabilitation, University of Wisconsin, Madison, Wisconsin; [¶]Department of Neurosurgery, Harvard Medical School, Brigham and Women's Hospital, Boston, Massachusetts; [‖]Department of Neurological Surgery, University of California, San Francisco, San Francisco, California; [#]St. Louis Minimally Invasive Spine Center, St. Louis, Missouri; [**]Departments of Neurological Surgery and Orthopedic Surgery, Thomas Jefferson University, Philadelphia, Pennsylvania; [‡‡]Lillian S. Wells Department of Neurological Surgery, University of Florida, Gainesville, Florida; [§§]Department of Orthopaedic Surgery, Weill Cornell Medical College, New York, New York; [¶¶]Department of Neurosurgery, University of Utah, Salt Lake City, Utah; [‖‖]Division of Neurosurgery, John H. Stroger, Jr Hospital of Cook County and Department of Neurological Surgery, Rush University Medical Center, Chicago, Illinois; [##]Department of Neurosurgery, Columbia University, New York, New York; [***]Department of Neurological Surgery, Rush University Medical Center, Chicago, Illinois

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Correspondence:
Andrew T. Dailey, MD,
Department of Neurosurgery,
University of Utah,
175 North Medical Drive East,
Salt Lake City, UT 84132.
E-mail: andrew.dailey@hsc.utah.edu

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Congress of Neurological Surgeons Systematic Review and Evidence-Based Guidelines on the Evaluation and Treatment of Patients With Thoracolumbar Spine Trauma: Classification of Injury

QUESTION 1: Are there classification systems for fractures of the thoracolumbar spine that have been shown to be internally valid and reliable (ie, do these instruments provide consistent information between different care providers)?

RECOMMENDATION 1: A classification scheme that uses readily available clinical data (eg, computed tomography scans with or without magnetic resonance imaging) to convey injury morphology, such as Thoracolumbar Injury Classification and Severity Scale or the AO Spine Thoracolumbar Spine Injury Classification System, should be used to improve characterization of traumatic thoracolumbar injuries and communication among treating physicians.

Strength of Recommendation: Grade B

QUESTION 2: In treating patients with thoracolumbar fractures, does employing a formally tested classification system for treatment decision-making affect clinical outcomes?

RECOMMENDATION 2: There is insufficient evidence to recommend a universal classification system or severity score that will readily guide treatment of all injury types and thereby affect outcomes.

Strength of Recommendation: Grade Insufficient

The full version of the guideline can be reviewed at: https://www.cns.org/guideline-chapters/congress-neurological-surgeons-systematic-review-evidence-based-guidelines/chapter_2.

KEY WORDS: Classification, Fracture, Thoracolumbar, Vertebrae

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Goals and Rationale

Classification systems should enhance communication between clinicians with varying degrees of experience about the severity of an injury or disease process, reliably guide treatment, and predict the outcome of various treatment options.[1-4] There are at least 12 different classification systems that have been used over the years.[5-18] Many classification systems have been developed for thoracolumbar trauma, but no single classification system has been universally accepted. Early attempts were prone to pattern recognition of fracture types, and therefore, the interobserver reliability was low. More recent attempts focus not only on description of the fracture but have also focused on prognosis and treatment. These systems have attempted to provide an injury severity score to help guide the clinician determine an acceptable treatment plan. In this guideline, the authors tried to determine (1) whether there are classification systems for fractures of the thoracolumbar spine that have

ABBREVIATIONS: AO, Arbeitsgemeinschaft fur Osteosynthesenfragen; **CNS,** Congress of Neurological Surgeons; **CT,** computed tomography; **LSC,** Load Sharing Classification; **PLC,** posterior ligamentous complex; **TLICS,** Thoracolumbar Injury Classification Scale; **TLISS,** Thoracolumbar Injury Severity Scale

been shown to be valid and reliable, and (2) when treating patients, whether employing a particular classification system affects clinical outcomes.

METHODS

Details of the systematic literature review are provided in the full text of this guideline (https://www.cns.org/guideline-chapters/congress-neurological-surgeons-systematic-review-evidence-based-guidelines/chapter_2) and in the methodology (https://www.cns.org/guideline-chapters/congress-neurological-surgeons-systematic-review-evidence-based-guidelines/chapter_1) article of this guideline series. The guidelines task force initiated a systematic review of the literature relevant to the diagnosis and treatment of patients with thoracolumbar trauma and a medical librarian implemented the literature search for the period from January 1, 1946, to March 31, 2015, using the National Library of Medicine PubMed database and the Cochrane Library. The literature search yielded 932 abstracts. Task force members reviewed all abstracts yielded from the literature search and identified the literature for full-text review and extraction, addressing the clinical questions, in accordance with the Literature Search Protocol.

RESULTS

The literature search yielded 932 abstracts of which 52 were selected for full-text review. Twenty articles assessed interobserver and/or intraobserver reliability of a classification system and were also selected for review in this guideline.[19-38]

DISCUSSION

Initial classification systems relied on plain radiographs and were not tested for reliability. With the advent of computed tomography (CT), advanced imaging could give a better anatomic image of a thoracolumbar injury and allow physicians to describe the injury with fine detail. Denis conceptually divided the spine into 3 columns with the integrity of the middle column having the most importance for stability with disruption leading to potential neurological instability. He described 4 major injury types with 16 subtypes. Magerl et al[14] described the Arbeitsgemeinschaft fur Osteosynthesenfragen (AO) Comprehensive Classification system from a retrospective review of 1445 thoracic and lumbar injuries showing 3 major injury patterns: type A-axial compression, type B-distraction of anterior and/or posterior elements, and type C-axial torque leading to anterior and posterior element disruption with rotation. When consecutive series of trauma patients are reviewed there is fair to moderate inter- and intraobserver reliability at the first level of classification, but the classification is much less reliable at the subtype and subdivision level, making the original AO Classification difficult to use in day to day practice.

More recently developed systems, including the Thoracolumbar Injury Classification and Severity Scale (TLICS/TLISS) or the AO Spine Thoracolumbar Spine Injury Classification System, focus not only on description of the fracture but also focus on prognosis and treatment, and these systems generally have higher interobserver and intraobserver reliability than prior classification systems. This was the first classification system to quantify the neurological status of the patient. If the point total was 5 or greater, the injury was deemed operable, and those injury patterns with only 3 points were thought capable of being treated nonsurgically.

Due to regional differences in the threshold for surgical intervention, and because of the often low reliability of discerning posterior ligamentous complex (PLC) injury and the wide variation in the availability of magnetic resonance imaging to help determine PLC injury,[35-37] the AO Spine Classification Group was tasked with the development of a morphologically based classification scheme that also paid attention to the critical determinant of neurological examination.[6,17] The resultant AO Spine Thoracolumbar Injury Classification System is a comprehensive yet simple scheme that appears on initial evaluation to have greater reproducibility and reliability than prior schemes. The wide availability and use of CT for evaluation of trauma patients is the basis for this scheme and uses the Magerl hierarchy of injury types with each successive type indicating ascending severity. Type A injuries are compression injuries with injury of the anterior elements and preservation of the posterior ligamentous complex.

Type B injuries are failure of the posterior or anterior tension band in distraction: B1 injuries are transosseous monosegmental failure of the posterior tension band; B2 are bony and/or ligamentous failure of the posterior tension band in conjunction with an A fracture of the vertebral body; and B3 injuries are hyperextension injuries through the disc space or bone as commonly seen in ankylosing spondylitis. There is some confusion because the first iteration of this new AO Classification System included these injuries under type C. However, for the purposes of this guideline, the authors will include them as type B as this is the classification that has been investigated for internal and external reliability.

Finally, type C injuries suffer disruption of all elements with displacement or dislocation of the cranial spinal elements relative to the caudal elements. There are no subtypes any longer for this injury pattern. In addition to the morphological classification, there is also a neurological grading component (N0 = intact, N1 = transient symptoms, N2 = radiculopathy, N3 = incomplete or cauda injury, and N4 = complete), and case-specific modifiers. Studies both within the original working groups and by independent researchers showing good to excellent inter- and intraobserver reliability with this new AO classification.

One classification system, the Load Sharing Classification (LSC), has helped guide treatment of burst fractures. Three characteristics were identified on CT: (1) comminution/involvement, (2) apposition of fragments, and (3) correction of kyphotic deformity in an attempt to determine if posterior short-segment instrumentation would fail in the setting of a burst fracture. Using this classification, a patient's CT pattern could be assigned a point total and a patient with a total of 7 to 9 points would be likely to benefit from both posterior and

anterior fixation, while fractures with >6 points could be treated by posterior short-segment fixation alone. The classification has been used outside the original group with good to excellent interobserver reliability. In addition, the original working group treated over 50 consecutive patients using this classification, without hardware failure, demonstrating the clinical efficacy of the LSC.

Future Research

These studies show that TLICS/TLISS cannot yet be adapted to predict management in all thoracolumbar trauma populations because there is still wide variation in treatment recommendations for physicians who treat these types of injuries. Further, prospective studies are necessary to validate the best treatment options for burst fractures that may be considered stable and have a TLICS score of 2 to 4. Prospective research is also lacking to demonstrate that the utilization of any classification system (compared to not using any system) in making treatment decisions results in superior clinical outcomes for patients with thoracolumbar spine injuries.

CONCLUSION

In summary, several classification systems for thoracolumbar trauma have been proposed over the last 100 yr. Some systems follow mechanistic descriptions of the fracture patterns, while others are considered morphological classification systems. However, all systems had limitations with some being overly comprehensive or inclusive, and therefore, difficult to learn and use, while other systems had fewer fracture types and subtypes, which left gaps that did not allow for descriptions of all fracture types. In addition, none of the classification systems went through a rigorous validation process, and therefore were often difficult to reproduce outside of the original working group that proposed the system.

In the last 10 yr, 2 classification systems have been proposed, TLICS and the AO Thoracolumbar Spine Injury Classification System. These have both undergone studies to measure internal and external reliability and were found to be inclusive and descriptive of most thoracolumbar fractures. Hopefully, more studies using these systems will become available to determine if these systems can accurately predict fracture treatment through specific treatment protocols. The authors recommend utilizing a thoracolumbar trauma classification scheme that uses readily available clinical data, such as the TLICS/TLISS or the AO Spine Thoracolumbar Spine Injury Classification System. However, there is insufficient evidence to recommend a universal classification system that can guide treatment and affect outcomes of these injuries.

Disclosures

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Potential Conflicts of Interest:

The task force members were required to report all possible conflicts of interest (COIs) prior to beginning work on the guideline, using the COI disclosure form of the AANS/CNS Joint Guidelines Committee, including potential COIs that are unrelated to the topic of the guideline. The CNS Guidelines Committee and Guideline Task Force Chairs reviewed the disclosures and either approved or disapproved the nomination. The CNS Guidelines Committee and Guideline Task Force Chairs are given latitude to approve nominations of Task Force members with possible conflicts and address this by restricting the writing and reviewing privileges of that person to topics unrelated to the possible COIs. The conflict of interest findings are provided in detail in the companion introduction and methods manuscript (https://www.cns.org/guideline-chapters/congress-neurological-surgeons-systematic-review-evidence-based-guidelines/chapter_1). The authors have the following potential conflicts of interest: Dr Anderson: Aesculap-Consultant, SI Bone-Stock shareholder, Spartec-Stock shareholder, Expanding Orthopedics-Stock shareholder, Titan Spine-Stock shareholder, RTI-Other, Stryker-Other, Lumbar Spine Research Society-Board officer position (President). Dr Arnold: Medtronic-Consultant, Sofamor Danek-Consultant, Spine Wave-Consultant, InVivo-Consultant, Stryker Spine-Consultant, Evoke Medical-Stock shareholder, Z-Plasty-Stock shareholder, AO Spine North America-Sponsored or reimbursed travel (for self only). Dr Chi: DePuy Spine-Consultant, K2M-Consultant. Dr Dailey: K2M-Grants/Research support/Consultant, Zimmer Biomet-Consultant, Medtronic-Consultant. Dr Dhall: Globus Medical-Honorarium, Depuy Spine-Honorarium. Dr Harrop: DePuy Spine-Consultant, Asterias-Other/Scientific advisor, Tejin-Other/Scientific advisor, Bioventus-Other/Scientific advisor, AO Spine-Board, trustee, or officer position. Dr O'Toole: Globus Medical-Consultant fee, RTI Surgical-Consultant, Theracell, Inc.-Stock shareholder.

Disclaimer of Liability

This clinical systematic review and evidence-based guideline was developed by a multidisciplinary physician volunteer task force and serves as an educational tool designed to provide an accurate review of the subject matter covered. These guidelines are disseminated with the understanding that the recommendations by the authors and consultants who have collaborated in their development are not meant to replace the individualized care and treatment advice from a patient's physician(s). If medical advice or assistance is required, the services of a competent physician should be sought. The proposals contained in these guidelines may not be suitable for use in all circumstances. The choice to implement any particular recommendation contained in these guidelines must be made by a managing physician in light of the situation in each particular patient and on the basis of existing resources.

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