126 Classification of Cervical, Thoracic, and Lumbar Spine Injuries

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SUMMARY OF KEY POINTS

- Systems of describing spinal column injuries have historically focused on fracture classification and morphology. With advancements in our understanding of spinal biomechanics, modern classification systems have arisen that emphasize injury mechanisms as well as clinical evaluations.
- The Thoracolumbar Injury Classification and Severity Score (TLICS) factors the presence of a neurologic deficit, fracture morphology, and integrity of the posterior ligamentous complex to assess the need for surgical stabilization of a thoracolumbar injury.
- The new AOSpine Thoracolumbar Spine Injury Classification System is based on evaluating three basic parameters: morphologic classification of the fracture, neurologic status, and patient-specific modifiers. This classification adds clinical aspects, which can better guide fracture management when combined with a severity score in the future.
- The subaxial injury classification, also known as the subaxial cervical spine injury classification system, is much like the TLICS based on injury morphology, discoligamentous complex injury, and the neurologic status of the patient.

Spinal cord injury (SCI) frequently leads to devastating neurologic deficits and disability with an estimated United States prevalence in 2013 of approximately 273,000 persons, with some studies estimating the prevalence to be as high as 332,000 persons.[1] Hence, there has been great interest and effort to define and optimize classifications of spine injuries to facilitate communication, achieve optimal treatment, and maximize neurologic recovery.

The spine community has had a long inherent tradition in the use of classification systems. This chapter discusses spinal cord injury classification systems including the thoracolumbar and cervical spine injury classification schemes.

SPINAL CORD INJURY CLASSIFICATION SYSTEMS

In 1969 in the journal *Paraplegia*, Frankel and colleagues attempted to define spinal cord injuries (Table 126-1).[2] In this review that took place over a 19-year period, Frankel examined and grouped 682 spinal cord injury patients into five categories. Patients were categorized from the most severe injury or complete spinal cord/cauda injury (Frankel A) to the least severe injury or patients with only a brief, transient deficit (neurologically intact patient, Frankel E). This was the basis for future SCI classifications.

The need to further classify and define injury types in patients became more apparent with the initiation of treatments to improve neurologic recovery with spinal cord injury trials. In 1978, Bracken and colleagues[3] used a modified Frankel scale in an in-depth review of spinal cord injury. They used the Bracken scale with a five-scale motor examination and seven-scale sensory examination. This classification system did not gain widespread use, as there was the elimination of a bowel and bladder examination.

ASIA Classification

In 1982, the American Spinal Injury Association (ASIA) expanded on the Frankel scale[4] with the implementation of a 0-5 motor scale of 10 predefined motor groups, which represented specific motor root distributions. This ASIA scoring system was in use for roughly a decade until 1992, when ASIA in association with the International Medical Society of Paraplegia (now the international Spinal Cord Society) further included the use of the functional impaired measurement (FIM) scale.[5] Thus, in the updated 1996 version, the modified ASIA classification included the ASIA impairment scale, ASIA motor scale, ASIA sensory score, and FIM outcome scale. Further revisions of the standards were completed in 2000 and 2010. Figure 126-1 shows the revised 2013 edition.

SPINAL INJURY CLASSIFICATION SYSTEMS

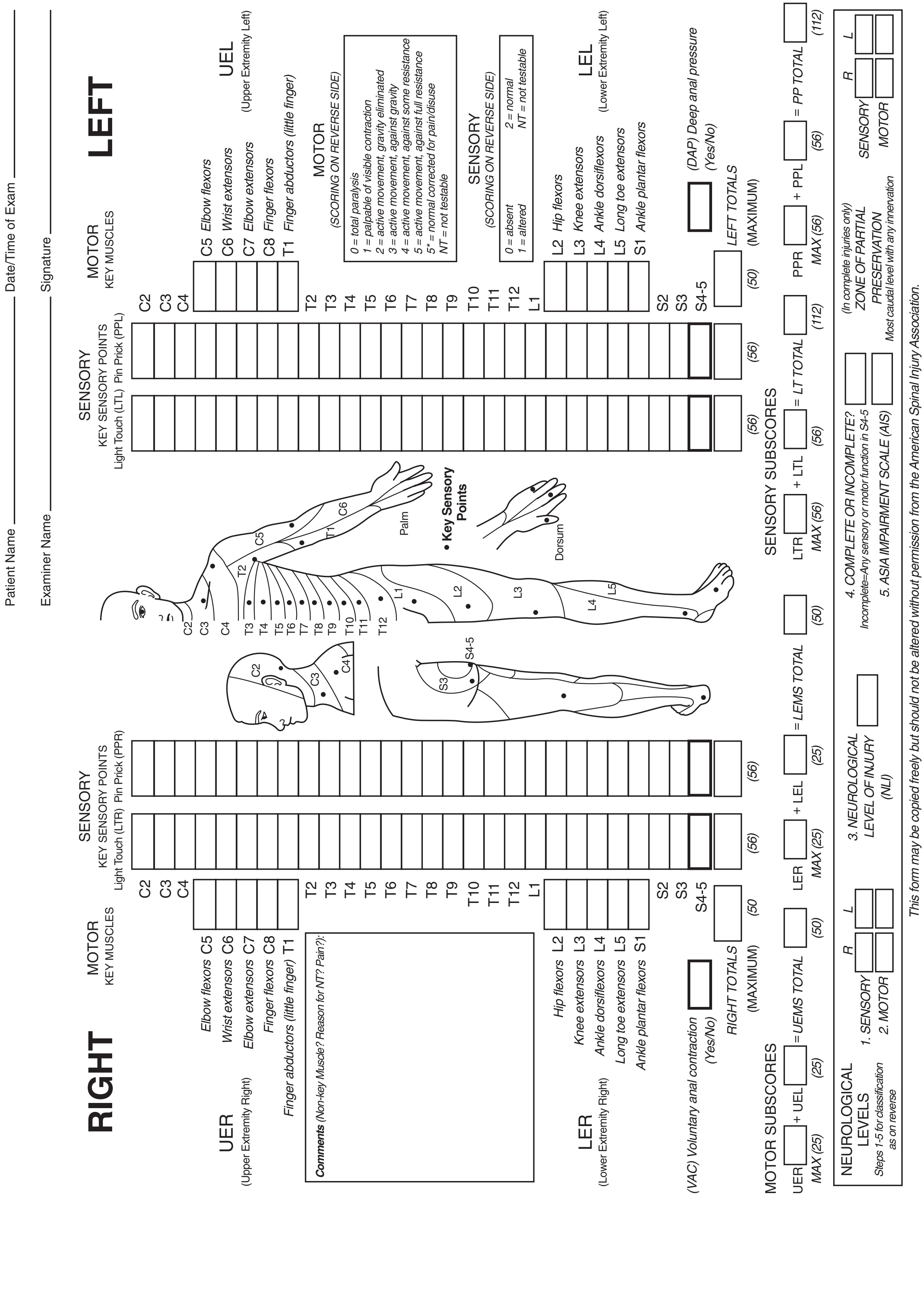
To be helpful for clinicians, patients, and society, classification systems need to have a uniform method of description in such that they allow for direction of treatment. Moreover, they should be reproducible, usable, accurate, and comprehensive.

Thoracolumbar Classification

Of all the classification systems developed for the spine, thoracolumbar fractures have been the most studied. Original systems arose out of the ability to describe fracture morphology. Physicians at this time were struggling to understand what constituted to instability, thus requiring surgery. As such, Watson-Jones in 1943 emphasized the concept of "instability" and presented the first morphologic classification of thoracolumbar injuries. In this manuscript, he reviewed 252 patient radiographs.[6] He identified seven discrete types of fractures, which are the fracture types we commonly describe today such as wedge fractures (compression fractures), comminuted fractures (burst fractures), and fractures dislocations. However, a setback of pure morphologic classification schemes is that they do not take into account the clinical presentation.

In 1949, Nicoll expanded the thoracolumbar classification system in an attempt to find a "stable" versus "unstable" thoracolumbar injury.[7] In this review of 152 coalminers' radiographs for which Nicoll provided primary care, he initially described the importance of the posterior longitudinal ligament such that he was able to define fractures as either stable or unstable based on the fact that the posterior ligamentous complex was intact. Intact posterior ligamentous complexes were deemed to be stable fractures.

In the 1960s through the 1980s, further modification occurred to thoracolumbar classification based on arbitrary


Patient Name ______ Date/Time of Exam ______
Examiner Name ______ Signature ______

RIGHT

MOTOR KEY MUSCLES		SENSORY KEY SENSORY POINTS Light Touch (LTR)	Pin Prick (PPR)
	C2		
	C3		
	C4		
UER (Upper Extremity Right) Elbow flexors C5			
Wrist extensors C6			
Elbow extensors C7			
Finger flexors C8			
Finger abductors (little finger) T1			
	T2		
	T3		
	T4		
	T5		
	T6		
	T7		
	T8		
	T9		
	T10		
	T11		
	T12		
	L1		
LER (Lower Extremity Right) Hip flexors L2			
Knee extensors L3			
Ankle dorsiflexors L4			
Long toe extensors L5			
Ankle plantar flexors S1			
	S2		
	S3		
(VAC) Voluntary anal contraction (Yes/No)	S4-5		
RIGHT TOTALS (MAXIMUM)	(50	(56)	(56)

Comments (Non-key Muscle? Reason for NT? Pain?):

MOTOR SUBSCORES
UER ___ + UEL ___ = UEMS TOTAL ___ MAX (25) (25) (50)
LER ___ + LEL ___ = LEMS TOTAL ___ MAX (25) (25) (50)

LEFT

MOTOR KEY MUSCLES		SENSORY KEY SENSORY POINTS Light Touch (LTL)	Pin Prick (PPL)
C2			
C3			
C4			
C5 Elbow flexors			
C6 Wrist extensors			
C7 Elbow extensors			
C8 Finger flexors			
T1 Finger abductors (little finger) UEL (Upper Extremity Left)			
T2			
T3			
T4			
T5			
T6			
T7			
T8			
T9			
T10			
T11			
T12			
L1			
L2 Hip flexors			
L3 Knee extensors			
L4 Ankle dorsiflexors			
L5 Long toe extensors			
S1 Ankle plantar flexors LEL (Lower Extremity Left)			
S2			
S3			
S4-5 (DAP) Deep anal pressure (Yes/No)			
LEFT TOTALS (MAXIMUM)	(50)	(56)	(56)

MOTOR (SCORING ON REVERSE SIDE)
0 = total paralysis
1 = palpable of visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
5* = normal corrected for pain/disuse
NT = not testable

SENSORY (SCORING ON REVERSE SIDE)
0 = absent
1 = altered
2 = normal
NT = not testable

SENSORY SUBSCORES
LTR ___ + LTL ___ = LT TOTAL ___ MAX (56) (56) (112)
PPR ___ + PPL ___ = PP TOTAL ___ MAX (56) (56) (112)

NEUROLOGICAL LEVELS
Steps 1-5 for classification as on reverse
1. SENSORY R ___ L ___
2. MOTOR R ___ L ___
3. NEUROLOGICAL LEVEL OF INJURY (NLI) ___
4. COMPLETE OR INCOMPLETE? ___
Incomplete=Any sensory or motor function in S4-5
5. ASIA IMPAIRMENT SCALE (AIS) ___
ZONE OF PARTIAL PRESERVATION (In complete injuries only)
Most caudal level with any innervation
SENSORY R ___ L ___
MOTOR R ___ L ___

This form may be copied freely but should not be altered without permission from the American Spinal Injury Association.

Figure 126-1. American Spinal Injury Association (ASIA) classification of the patient after recovery, performed according to the International Standards for Neurological Classification. Revised in 2013.

TABLE 126-1 Frankel's Classification

Type A	Complete spinal cord/cauda injury
Type B	Only sensation present
Type C	Motor present, but useless
Type D	Motor useful
Type E	Neurologically intact

TABLE 126-2 Thoracolumbar Injury Classification and Severity Score (TLICS)

Morphology	
No abnormality	0
Compression	1
+ Burst fracture	2
Rotation/translation	3
Distraction	4
Posterior Ligamentous Complex	
Intact	0
Suspected/indeterminate	2
Injured	3
Neurologic Status	
Intact	0
Root injury	2
Complete cord/conus medullaris injury	2
Incomplete cord/conus medullaris injury	3
Cauda equina	3

Adapted from Vaccaro AR, Lehman RA Jr, Hurlbert RJ, et al: A new classification of thoracolumbar injuries: the importance of injury morphology, the integrity of the posterior ligamentous complex, and neurologic status. Spine *30:2325–2333, 2005.*

TABLE 126-3 Severity Score

Management	Score
Nonoperative	< 4
Consider for operative or nonoperative intervention	= 4
Operative	> 4

Adapted from Vaccaro AR, Lehman RA Jr, Hurlbert RJ, et al: A new classification of thoracolumbar injuries: the importance of injury morphology, the integrity of the posterior ligamentous complex, and neurologic status. Spine *30:2325–2333, 2005.*

compartmentalization of the spine. In 1970, Holdsworth[8] divided the thoracolumbar junction as "a two-column structure": the anterior column consisting of the vertebral body and intervertebral disc, and the posterior column consisting of facet joints and the posterior ligamentous complex. The stability was based on the ability of these columns to retain loads.

However, there was a failure in this modeling, and numerous fractures that were defined as unstable were, in fact, stable fractures. For example, unstable burst fractures were falsely categorized as stable. Therefore, numerous authors devised a "three-column" theory and a number of classification schemes.[9-12] Of these classification schemes, the Denis classification became the most widely adopted due to the rise in use of computed tomography (CT).[11] Denis astutely recognized modern technology and adapted the CT scanner to define fracture morphology and aid his classification scheme. In the Denis classification, the spine is subdivided into an anterior, middle, and posterior column. The anterior column was defined as the anterior vertebral body, anterior annulus fibrosus, and anterior longitudinal ligament. The middle column consists of the posterior wall of the vertebral body, posterior annulus fibrosus, and posterior longitudinal ligament (PLL). The posterior column consists of everything posterior to the PLL, including the pedicles, lamina, facet joints, and spinous process. Denis categorized four distinct fracture types: compression fractures, burst fractures, fracture-dislocations, and seatbelt injuries. The Denis classification scheme recognized the importance of the middle column, in that fractures with violation of the posterior vertebral body wall would be defined as burst type fractures.

Unfortunately, there has been much misunderstanding about this classification system and its interpretation in clinical practice. For example, the Denis classification does not state that a fracture is unstable with a three-column violation requiring surgical treatment. Several prospective randomized studies have shown that these fractures are stable and can be treated quite well with nonoperative therapy.

In 1994, McCormack and colleagues published an important paper documenting the significance of "anterior column support."[13] In this classification scheme, they determined fractures on a 1- to 9-point scale known also as the "Load Sharing Score." Fractures were defined as more severely injured if they had more comminuted fractures and a wider dispersion of the fractures' displacement as well as the ability to correct kyphosis. Thus the patients had an unstable spine if they had not anterior column support as shown by the severely dispersed fracture fragments as well as the spine could be easily manipulated surgically (showing no support structures).

In 1994, Magerl and colleagues, through the AOSpine (Arbeitsgemeinschaft für Osteosynthesefragen Spine) Society, developed the thoracolumbar mechanism classification.[14] This comprehensive classification was developed after a review of 1445 cases. It is based on the mechanism and the direction of internal forces. There are three broad classification schemes: type A refers to compression type injuries, type B refers to distraction type injuries, and type C refers to rotational injuries. These are all based on increasing severity. The unfortunate issue with this classification scheme is that there are 53 separate subtype injury patterns, making the overall system confusing and the interrated variability less than ideal. In fact, Oner and coworkers, in an interview of 53 patients using CT and magnetic resonance imaging (MRI), noted that the interobserver reliability for the AO classification was 0.28 with MRIs and 0.31 with CT scans, whereas the Denis classification was 0.6 for CT scans and 0.52 for MRIs.[15]

Due to the lack of cohesiveness, prognostic ability, and comprehensiveness of the aforementioned classifications of the thoracolumbar spine,[16] Vaccaro and colleagues, in association with the Spine Trauma Study Group, developed the Thoracolumbar Injury Classification and Severity Score (TLICS).[17] This classification system was developed on the numerous merits of previous classifications, specifically the importance of the injury morphology, neurologic status, and the integrity of the posterior ligamentous complex (Table 126-2). Based on these three separate areas, each fracture is given and rated points to determine whether it is operative or nonoperative (Table 126-3). However, there is a predefined "gray zone," such as severity score 4, which permits surgeons to use individual clinical judgment to determine surgical options. Another major drawback is that the TLICS is based on MRI for evaluating the integrity of the posterior ligamentous complex, suggesting that its specificity can be as low as 50%.[18]

In 2013, Vaccaro and associates, in cooperation with the AOSpine Spinal Cord Injury and Trauma Knowledge Forum, further expanded the TLICS system and proposed a new thoracolumbar classification system, known as the AOSpine Thoracolumbar Spine Injury Classification System (Table 126-4).[19] This classification system was validated using a diverse international consensus process by independently classifying it twice by group members. The new AOSpine classification system is based on the evaluation of three basic parameters:

TABLE 126-4 AOSpine Thoracolumbar Spine Injury Classification System

Parameter	Example/Explanation
1. Morphologic Classification of the Fracture	
Type A (Compression)	
A0: No injury/process fracture	No vertebral fracture or insignificant fractures of the spinous/transverse processes
A1: Wedge/impaction	Wedge compression or impaction fracture; involves a single endplate without involvement of the posterior vertebral wall
A2: Split/pincer type	Split- or pincer-type fracture; involves both end plates without involvement of the posterior vertebral wall
A3: Incomplete burst	Involves single end plate as well as the posterior vertebral wall
A4: Complete burst	Involves both end plates as well as the posterior vertebral wall
Type B (Tension Band Disruption)	
B1: Posterior transosseous disruption	Transosseous disruption of the posterior tension "chance fracture," which affects a single vertebral level
B2: Posterior ligamentous disruption	Ligamentous disruption of the posterior tension band +/– osseous involvement; affects an intervertebral level
B3: Anterior ligamentous disruption	Disruption of the anterior longitudinal ligament, causing hyperextension injury; intact posterior tension band
Type C (Displacement/Translation)	
C	Translation beyond the physiologic range in any plane
2. Neurologic Status	
N0	Neurologically intact
N1	Transient neurologic deficit, resolved
N2	Symptoms or signs of radiculopathy
N3	Incomplete spinal cord injury or cauda equina injury
N4	Complete spinal cord injury
NX	Cannot be examined (e.g., head injury)
3. Clinical Modifiers	
M1: Indeterminate injury to the tension band	MRI cannot identify ligamentous disruption
M2: Patient-specific comorbidity	Ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, osteopenia/porosis, and other conditions

Adapted from Vaccaro AR, Oner C, Kepler CK, et al: AOSpine thoracolumbar spine injury classification system: fracture description, neurological status, and key modifiers. Spine *38:2028–2037, 2013.*

morphologic classification of the fracture, neurologic status, and clinical modifiers. The morphologic classification is based on three main injury patterns: type A, compression (Fig. 126-2); type B, tension band disruption (Fig. 126-3); and type C, displacement/translation (Fig. 126-4) injuries. Nine subtypes were proposed (five in the A group, three in the B group, and one in the C group). In addition, clinical modifiers address indeterminate injuries and patient-specific comorbidities such as ankylosing spondylitis and diffuse idiopathic skeletal hyperostosis.

Unlike the TLICS, the updated AOSpine classification is based on CT scan, an imaging tool widely available at trauma centers worldwide. This classification adds clinical aspects that can better guide fracture management when combined with a severity score in the future. However, clinical validation requires large prospective observational studies.

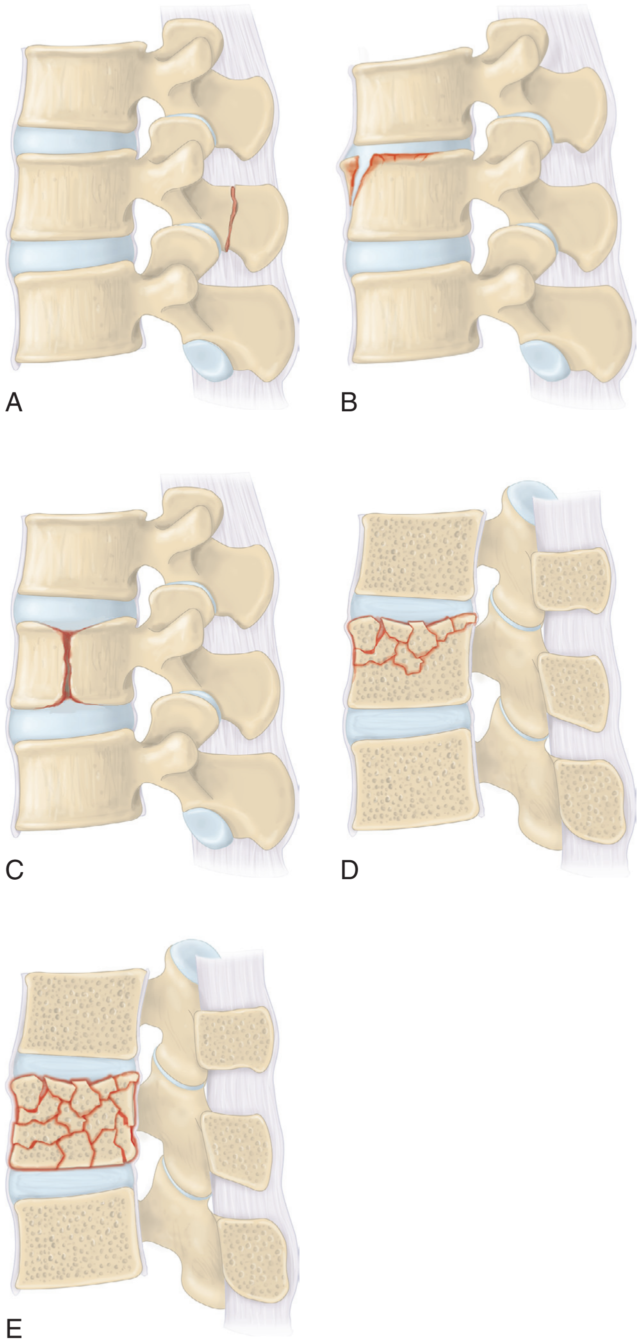


Figure 126-2. Type A Injuries: Compression injuries. **A,** A0: No vertebral fracture or clinically insignificant fractures of the spinous or transverse processes. **B,** A1: Wedge compression or impaction fracture with a single end plate fracture. **C,** A2: Split- or pincer-type fracture involving both end plates. **D,** A3: Involves a single end plate as well the posterior vertebral wall. **E,** A4: Involves both end plates as well as the posterior vertebral wall.

CERVICAL SPINE INJURY CLASSIFICATIONS

The cervical spine classification system also suffers from the difficulties associated with the thoracolumbar and spinal cord injury classifications. In addition, in the cervical spine it is difficult to define a dynamic process through static images. Furthermore, it is difficult to define exactly what "stability" consists of. The cervical spine region, unlike the

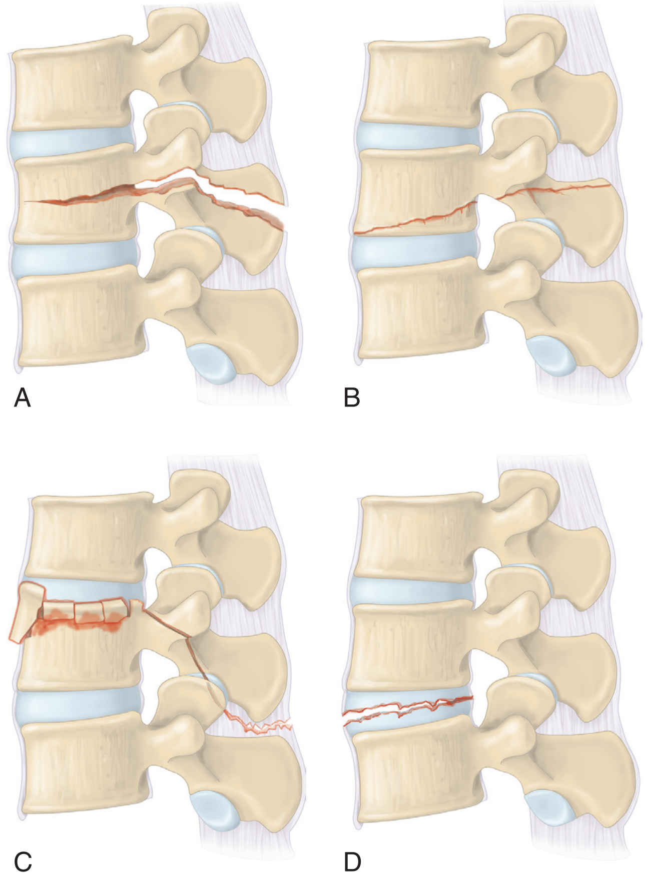


Figure 126-3. Type B Injuries: Tension band injuries. **A,** B1: Transosseous disruption of the posterior tension "chance" fracture. **B,** B2: Ligamentous disruption of the posterior tension band, with or without osseous involvement. **C,** B3: Disruption of the anterior longitudinal ligament, causing hyperextension injury. Intact posterior tension band.

thoracolumbar region, is distinct in that the upper and lower cervical spine has different injury patterns and mechanisms.

In the cervical spine classification system, supracervical injuries are defined as fractures just close to and occurring at the occipital C1-2 region. The first fracture classification would be an occipital cervical dislocation. This is defined as a rupture typically of the ligamentous complex between the occipital and C1 ligaments. Unfortunately, due to the high kinetic energy required for this ligamentous disruption, and the high cervical location of the pathology, this injury often results in a devastating neurologic injury. In the cervical spine injury guidelines, it was noticed that the Harris rule of 12 mm of the basion-dental interval is the most sensitive methodology for detecting these injuries.[20] However, this method is not reliable in children younger than 13 years old due to variable age of dens complete ossification and fusion. Pang and associates[21] noted that in the pediatric population these injuries are probably identified by noting discrepancies in the distance from the clivus to the tip of the dens.

Fractures of the axis are much more commonly encountered in practice. These are typically classified as type I to type III.[22] Type I fractures are rare, involving the upper portion of the dens, and are considered to be an avulsion of the alar ligament. The true stability of these fractures has yet to be defined due to their rarity. Type II fractures consist of the lower half of the fraction and have a high pseudarthrosis rate. This is because the fracture line is through the base of the dens and

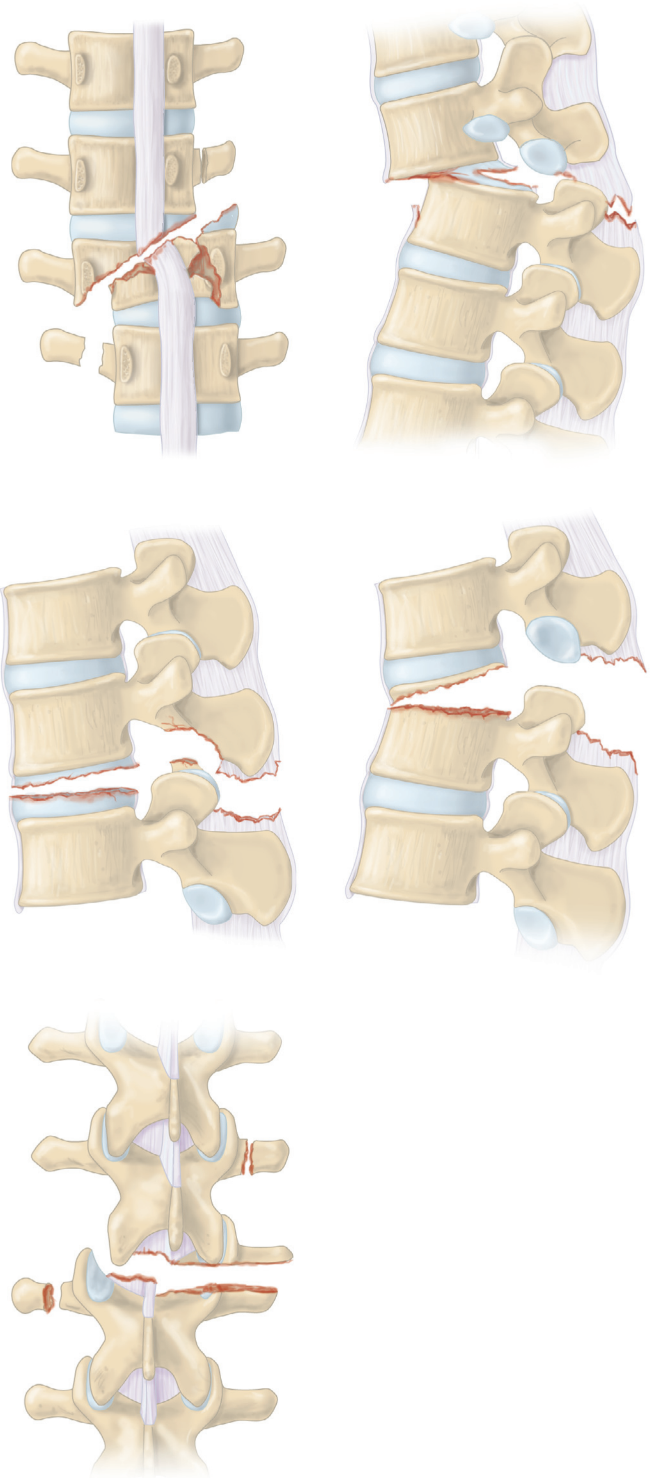


Figure 126-4. Type C Injuries: Displacement/translational injury. Displacement of the cranial and caudal parts of the spinal column in any plane.

has poor blood supply. A second type IIA classification was defined by Hadley, a subclass known as the Hadley type IIA odontoid fracture.[23] This was noted to constitute approximately 3% of all type II fractures and consist of a comminuted fracture with free-fracture fragments at the anterior or posterior aspect of the odontoid. Unfortunately, this also had a high rate of pseudarthrosis.[23]

Presently, there is a large discrepancy regarding the optimal treatment for type II odontoid fractures, particularly in the elderly population. There has been a large amount of literature suggesting that early surgical treatment may be more beneficial than nonoperative therapy. Vaccaro and coworkers[24] conducted a multicenter prospective study where geriatric patients were treated either surgically (n = 101) or nonsurgically (n = 58). The surgical group had significantly better outcomes in addition to lower mortality rates compared to the nonsurgical group.

Type III odontoid fractures are actually not true odontoid fractures. They are fractures through the base of the C2 body and can be distinguished from type II fractures in that the fracture line will proceed into the facet joint. However, unlike type II fractures, these have an exceptional rate of fusion believed to be due to the greater surface area of the fracture as well as the fact that this type of odontoid fractures occurs along a cancellous bone interface with a great blood supply. Thus, the majority of these fractures can be optimally treated with immobilization with a cervical orthosis.

C2 spondylolisthesis, also referred to as a hangman's fracture, has also undergone numerous classification systems. The two most commonly known are by Effendi[25] and Francis.[26] Under this classification, type I fractures are nondisplaced, type II fractures have 3 to 5 mm of anterior subluxation with less than 10 degrees of angulation, type IIA typical fractures have greater than 10 degrees of angulation, and type III fractures have a C2-3 dislocation. This treatment algorithm has evolved and aids physicians in their management, where type I and type II fractures are typically maintained in a collar. Type IIA fractures that have the need for hyperextension and axial rotation are managed in a halo vest immobilization. Type III fracture dislocations require surgical realignment and fixation.

The subaxial cervical spine and its classification is also quite complex and has undergone numerous modifications and alterations, being either descriptor or mechanistic in structure. Numerous renditions have been written by several authors including Jefferson,[27] Crutchfield,[28] Schneider,[29] Whitley and Forsyth,[30] and Holdsworth.[8] These evolved into the Allen and Ferguson classification system, which is a mechanistic cervical classification system based on static plain radiographs. It notes seven distinct categories and is based on the position of the spine and the dominant loading force, and it has 24 given classifiers.[31]

Unfortunately, with the aforementioned classification systems, the question of stability remains, and these classifications have significant variability. One of the most widely referenced stability criteria for cervical spine injury is based on the White-Panjabi instability score (Table 126-5).[32] This system was based on cadaver models and some of the criteria used have not been employed clinically. One example is the "stretch test." When using this nomenclature, a translation of greater than 3.5 mm or a rotation greater than 11 degrees indicates instability.

To develop a quantitative system defining cervical spine injuries, Moore and colleagues[33] devised the cervical spine injury severity score to classify lower cervical spine injuries. In this 20-point system, the cervical spine was defined at four discrete columns. Each patient's degree of instability was given a value of 0 to 20, where 0 to 7.5 was nonoperative and 14 to 20 was considered operative. This system was based on the column theory developed by Louis.[34] In this classification, the anterior column consisted of the disc, body, and ligament, and there were two sets of posterior lateral pillars consisting of the lateral mass, facet, and capsules. Moore and coworkers went on to define the posterior osseous ligament complex as a fourth pillar. This system was noted to have excellent inter- and intraobserver variability.[33]

TABLE 126-5 Checklist of Clinical Instability in the Middle and Lower Cervical Spine

Element	Point Value
Ventral elements destroyed or unable to function	2
Dorsal elements destroyed or unable to function	2
Positive stretch test	2
Radiographic criteria	4
A. Flexion-extension x-rays	
1. Sagittal plane translation > 3.5 mm or 20%	2
2. Sagittal plane rotation > 20 degrees	2
OR	
B. Resting x-rays	
1. Sagittal plane displacement > 3.5 mm or 20%	2
2. Relative sagittal plane angulation > 11 degrees	2
Abnormal disc narrowing	1
Developmentally narrow spinal canal	1
1. Sagittal diameter < 13 mm	
OR	
2. Pavlov's ratio < 0.8	
Spinal cord damage	2
Nerve root damage	1
Dangerous loading anticipated	1

A total of 5 points or more equals instability.
Pavlov's ratio: the width of a given vertebral body on the lateral cervical spine radiograph divided by the corresponding space allowed for the cord at the same level.

White AA, Panjabi MM: Clinical biomechanics of the spine, ed 2, Philadelphia, 1990, Lippincott.

TABLE 126-6 Subaxial Injury Classification (SLIC) System

Morphology	
No abnormality	0
Compression	1
+ Burst fracture	+1 = 2
Distraction	3
Rotation/translation	4
Discoligamentous Complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurologic Status	
Intact	0
Root injury	1
Complete cord injury	2
Incomplete cord injury	3
Continuous cord compression (in setting of neurodeficit)	+1

Adapted from Vaccaro AR, Hulbert RJ, Patel AA, et al: The subaxial cervical spine injury classification system: a novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex. Spine *32:2365–2374, 2007.*

The most recent classification scheme was developed by the Spine Trauma Study Group. This format consists of a subaxial cervical spine injury classification system also referred to as a subaxial injury classification (SLIC) system.[35] Much like the TLICS and AOSpine thoracolumbar systems, this method is based on injury morphology, disco-ligamentous complex injury, and the neurologic status of the patient (Table 126-6). The treatment decision is based on the Severity Scale (Table 126-7).

CONCLUSIONS

Spinal cord injury is frequently associated with devastating neurologic deficits and disability. Hence, several classification systems have described spinal column injuries and historically

TABLE 126-7 Subaxial Injury Classification (SLIC) Severity Scale

Management	Score
Nonoperative	< 4
Consider for operative or nonoperative intervention	= 4
Operative	> 4

Adapted from Vaccaro AR, Hulbert RJ, Patel AA, et al: The subaxial cervical spine injury classification system: a novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex. Spine *32:2365–2374, 2007.*

focused on fracture classification and morphology, and more recently on injury mechanisms and clinical evaluation. Although these classifications are associated with significant variability, the most acceptable thoracolumbar and cervical injury classification systems are the TLICS and the SLIC, respectively.

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