Management of Cervical Spine Trauma: Can a Prognostic Classification of Injury Determine Clinical Outcomes?

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- Subaxial injury classification • SLIC
- Discoligamentous complex • Neurologic injury
- Subaxial cervical spine

Cervical spine trauma remains one of the most common causes of morbidity in the United States with a significant financial burden on our society. For example, the estimated lifetime cost for a low tetraplegic injury (C5-C8) in a 25 year old will be more than $3 million.[1] Attempts to minimize the damage to the cervical spinal cord can result in very important improvements in the quality of life for these devastating injuries. Therefore, the goal of any surgeon is to appropriately identify those injuries that would benefit from surgical stabilization and decompression. Multiple classification systems have been developed by experts to assist others, and the purpose of any classification system is to provide insight into the injury pattern, severity, and prognosis. Unfortunately, traditional classification systems generally sought to describe the injury in great detail but overlooked the more important prognostic value of the neurologic status of patients. The Thoracolumbar Injury Classification System and subsequently the cervical spine with the Subaxial Injury Classification System (SLIC) have been developed to address the deficiencies of other classification schemes. With the introduction of these newer classification systems, the focus in spine trauma has moved to include injury pattern, severity, and neurologic status, thus, providing a better platform for clinicians to define treatment approaches and prognosis. The purpose of this article is to review the traditional and newer classification systems for the subaxial cervical spine and discuss the recent evidence to support the SLIC as a prognostic tool for spine surgeons.

TRADITIONAL CLASSIFICATION SYSTEMS

Sir Frank Holdsworth published the first detailed description of subaxial cervical spine trauma in 1970 based on his extensive experience in more than 1000 patients with quadriplegia/paraplegia and many more without spinal cord injury.[2] In his experience, specific fracture patterns were classified as either stable (simple wedge, burst, and extension injuries) or unstable (dislocations, rotational-fracture dislocations, and shear fractures), and patients were treated based on the injury morphology. During his vast experience, he

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also found that the posterior ligamentous complex was an important structure stabilizing the spine and used it to differentiate between the stable and unstable injuries. Although he dedicated a significant amount of energy into the management of neurologic injuries and how they relate to the patients' prognoses, he did not incorporate the neurologic status into his classification scheme. He undoubtedly managed patients based on their level of neurologic dysfunction but the classification system failed to reflect this, limiting the value of this scheme when generalized to the spine surgical community.

Allen and Ferguson[3] expanded the descriptive terms initiated by Holdsworth to include several other morphologic variables. In their classification system, the common fracture mechanisms were as follows: compression flexion, vertical compression, distractive flexion, compressive extension, distractive extension, and lateral flexion. They associated neurologic injury with the mechanism of injury and attempted to dictate a treatment plan based on the mechanism of injury. Although the mechanism of injury is associated with the neurologic injury, the mechanism was not predictive of final outcome and, therefore, not always useful in directing treatment. Harris and colleagues[4] modified this descriptive classification system to include the rotational vectors in 1986, but unfortunately the spotlight remained on injury morphology. Additionally, the mechanisms proposed were generally not validated biomechanically but were rather deduced on the bases of radiographic views. Some injuries fail to fit neatly into a specific category, perhaps because of complex or multidirectional force vectors that produced the spinal trauma.

The previous classifications systems focused on descriptive terminology and in doing so became cumbersome and less reliable. When evaluated by members of the Spine Trauma Study Group (STSG), there was only a 65% and 57% agreement among raters for the Ferguson/Allen and Harris classification systems, respectively.[5] The focus was firmly placed on injury morphology, with attempts to fit the fracture pattern into one of these previously determined categories. Frequently, fractures result from a mechanism that does not exactly correlate with one of the groups described by Harris, leaving ambiguity in the assessment of the injury.

SUBAXIAL INJURY CLASSIFICATION SYSTEM

In 2007, recognizing the difficulty with these traditional classification systems, the STSG sought to create a simple yet useful classification system for subaxial injuries in the cervical spine. The STSG recently derived a novel classification system for thoracolumbar injuries that was well received and easily adopted by the spine community.[6] They took the lessons learned from this previous classification system and incorporated them into the cervical spine, which created a paradigm shift in the thinking of cervical spine trauma. The focus was placed on neurologic injury and discoligamentous complex (DLC) in addition to the injury morphology. There are 6 variables that must be considered when describing a cervical spine injury:

1. Spinal level
2. Injury morphology (major category)
3. Bony injury description (ie, spinous process, lamina, lateral mass, superior facet, inferior facet, pedicle, transverse process, vertebral body)
4. Discoligamentous complex status (major category)
5. Neurologic status (major category)
6. Confounding variables (ie, diffused idiopathic hyperostosis, ankylosing spondylitis, osteoporosis, previous surgery, preexisting myelopathy/stenosis)

In this new classification system, the injury morphology, DLC, and neurologic injury are each evaluated separately and given a point value based on the level of severity (**Table 1**). Although each of these independent variables correlates with clinical outcome, the sum of the 3 values

Table 1
Subaxial Injury Classification System

Characteristic	Points
Injury morphology	
Compression	1
Burst	+1
Distraction	3
Translation/rotation	4
DLC	
Intact	0
Indeterminate	1
Disrupted	2
Neurologic status	
Intact	0
Root injury	1
Complete cord injury	2
Incomplete cord injury	3
Ongoing cord compression	+1