

# TRAUMATIC SPINAL CORD INJURIES: THE UNDERWRITING SIGNIFICANCE



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## Case Presentation

A 42-year-old male was involved in a cliff diving incident 6 years ago which resulted in a traumatic spinal cord injury at L1,2,3 and T4,5,6 levels causing paraplegia. He is fully employed as a software engineer. Medical records reveal the following:

- The proposed insured relies on a wheelchair.
- He is able to use the toilet regularly with normal bladder function and daily bowel movements.
- He has chronic pain and has been prescribed gabapentin, oxycodone and tramadol for pain management, which he only uses as needed.
- He has stable depression, post-traumatic stress disorder (PTSD) and anxiety, which are controlled with 50 mg Zoloft daily and 1 mg alprazolam as needed.

## Epidemiology of Traumatic Spinal Cord Injuries

One of the most catastrophic types of injury is traumatic spinal cord injury, which can result in varying degrees of paralysis, sensory loss, and bladder or bowel dysfunction. TSCI not only has a negative impact on one's health, but it also has a significant financial impact on the family and the individual. The most common causes of TSCI are accidents involving motor vehicles and falls. TSCI prevalence varies by location or country and it has risen steadily. The mean age of TSCI in developed countries ranges from 14.6 to 67.6 years, and in underdeveloped countries the average age varies from 29.5 to 46.0 years. Previous studies have revealed that the age of TSCI patients follows a bimodal distribution, with the first peak occurring between the ages of 15 and 29, and the second occurring after the age of 65. The number of incidents for males is much higher than the number of female patients, and the average age of TSCI patients has gradually risen over time.<sup>1</sup>

**Executive Summary** *Many people like to talk about how thrilling avocations are, while very few talk about the risks. Unfortunately, from an underwriting perspective, we must always think of these risks and the “what if” scenarios. In this article, we will highlight a case of traumatic spinal cord injury (TSCI) and discuss the epidemiology, pathophysiology, sequelae and prognosis of TSCI. Lastly, we will cover how to properly assess these risks while underwriting a file. Now let's dive in (with caution of course).*

## Pathophysiology of Traumatic Spinal Cord Injuries

TSCIs occur when there is excessive blunt force or penetrating injury on the vertebral column, leading to damage of the spinal cord. Mechanisms of injury include transection, compression or contusion of the spinal cord. Compromise of the blood vessels supplying the cord can lead to ischemia and infarct of the spinal cord. Studies have suggested that acute spinal cord injury is a two-step process involving primary and secondary mechanisms:<sup>2</sup>

- The primary injury refers to the initial mechanical damage (such as direct compression, damage of cord and associated nerves and blood vessels by fractured and displaced bone fragments or disc material) after mechanical trauma.
- The secondary mechanism includes a cascade of biochemical and cellular processes, such as electrolyte abnormalities, formation of free radicals, vascular ischemia, edema, post-traumatic inflammatory reaction and cell death.

## Severity of Traumatic Spinal Cord Injuries

TSCI can present as a spectrum of clinical signs and syndromes, depending on severity. The widely used American Spinal Injury Association (ASIA) impairment scale classifies SCI based on whether the injury is complete, sensory incomplete, motor incomplete or normal.

## ASIA Impairment Scale

A	Complete	No motor or sensory function is preserved (i.e., grade 0), including the sacral segments S4-S5.
B	Incomplete	Sensory function preserved but motor function is not preserved below the neurological level and includes the sacral segments S4-S5.
C	Incomplete	Motor function is preserved below the neurological level and more than half of key muscles below the neurological level have a muscle grade less than 3.
D	Incomplete	Motor function is preserved below the neurological level, and at least half of key muscles have a muscle grade of 3 or more.
E	Normal	Motor and sensory function are normal (i.e., sensory grade 2/motor grade 5).

Source: Adapted from the American Spinal Injury Association and from Roberts TT.

On physical exam, sensory function is graded from 0 to 2, with 0 as absent, 1 as altered, and 2 as normal, while muscle function is graded on a scale of 0 to 5:<sup>3</sup>

- 0-Total paralysis.
- 1-Palpable or visible contraction.
- 2-Active movement, full range of motion (ROM) with gravity eliminated.
- 3-Active movement, full ROM against gravity.
- 4-Active movement, full ROM against gravity and moderate resistance.
- 5-Normal muscle function.

Spinal shock is the altered physiologic state immediately after a TSCI, which presents as a loss of spinal cord function below the level of the injury, with flaccid paralysis, anesthesia, loss of bowel and bladder control, and loss of reflex activity.<sup>4</sup> The ASIA grade after spinal shock has resolved is highly predictive of an individual's ability to walk at 1 year.<sup>5</sup> Patients with ASIA Grade A injury are highly unlikely to regain independent ambulation at 1 year post-injury,

in contrast to those with Grade D injuries who have a high (>97%) probability of walking independently at 1 year.

### Paralysis/Disability

There are several manifestations of paralysis that can result from a TSCI:<sup>6</sup>

- Quadriplegia/tetraplegia (affects both arms and both legs).
- Triplegia (three limbs are paralyzed).
- Paraplegia (affects both legs).
- Diplegia (paralysis of corresponding parts on both sides of body - typically affecting the legs more severely than the arms).
- Paraparesis (partially unable to move legs).
- Monoplegia/monoparesis (paralysis limited to a single limb - usually an arm).

These manifestations of paralysis can be further divided into clinical classifications as described in the following table:

Condition	Level	Classification
Complete Quadriplegia, Tetraplegia, Triplegia	C1-C4	Respirator-dependent
Complete Quadriplegia, Tetraplegia, Triplegia	C5-C8	Non-ambulatory, neurogenic bowel/bladder
Incomplete Quadriplegia, Tetraplegia, Triplegia	All	Ambulatory with aids, no respiratory support, intact bowel/bladder
Complete Paraplegia, Diplegia, Paraparesis	T1-12, L1-5	Wheelchair use, neurogenic bowel/bladder
Incomplete Paraplegia, Paraparesis	T1-12, L1-5	Ambulatory with aids, intact bowel/bladder
Monoplegia, Monoparesis	Any	One limb only, paralyzed
Neurogenic Bladder	No other cord involvement	Paralysis of urinary sphincter
Neurogenic Bowel	No other cord involvement	Paralysis of anal sphincter

## Complications

TSCIs have significant long-term sequelae, affecting almost every organ system. Complications that are most commonly encountered and have a significant impact on underwriting include:

- **Cardiovascular**
  - Coronary artery disease: In one study, CAD and MI were found in 11.7% and 6.7% of patients respectively,<sup>7</sup> which is slightly higher than the general population. This is thought to be due to the presence of risk factors (obesity, inactivity, dyslipidemia) and atypical presentations of myocardial ischemia.
  - Autonomic dysreflexia, a condition of uncontrolled sympathetic response in those with a TSCI at T6 or above, leading to a dramatic rise in blood pressure. Symptoms include headache, hypertension, flushing and sweating.<sup>8</sup>
- **Pulmonary**
  - Pneumonia due to poor respiratory function, particularly in cervical and high thoracic TSCI. The risk of pneumonia continues to be high throughout life, and is one of the leading causes of death in those with TSCI.<sup>9</sup>
  - DVT and PE from trauma and immobility, typically highest in the first year and with a significant decline seen in year 2.<sup>9</sup>
- **Genitourinary and Gastrointestinal**
  - Bladder dysfunction is frequently seen in TSCI, as control of the bladder involves a complex neural pathway involving the spinal cord. This can lead to urinary retention, urinary tract infections and renal insufficiency.
  - Bowel dysfunction can lead to constipation and fecal incontinence. While serious abdominal complications such as cholecystitis and pancreatitis are less common, acute abdominal emergencies are difficult to diagnose, as classic signs may not be present and can lead to high morbidity and mortality in those with TSCI. Approximately 10% of TSCI patients die of acute abdominal problems.<sup>10</sup>
- **Musculoskeletal and Skin**
  - Muscle spasticity, contractures and overuse injuries from repetitive motion (i.e., wheelchair-to-bed transfers) are frequently seen in this population. Pressure ulcers are common and can be a nidus for infection.
  - Osteoporosis below the level of the injury, as a result of neural factors and lack of use, was found to affect 61% of men in one study 15 years after their injury, with 34% experiencing a fracture.<sup>11</sup>
- **Psychiatric Complications and Chronic Pain**

- Depression and suicidality: Individuals with TSCI have a four to five times higher rate of suicide compared with age-matched population samples, with the highest rates in persons 25-54 years old.<sup>12</sup>
- Chronic pain syndromes are prevalent in this population, with one study showing an average prevalence of 65%, with around one-third rating their pain as severe.<sup>13</sup>

## Prognosis and Mortality Implications

The risk of death is highest in the first year after injury; however, after the first year, in a long-term follow-up of 886 patients over 50 years,<sup>14</sup> the life expectancy of those with TSCI was shorter than the general population—in fact, 92.3% of normal. This investigation listed the top 10 leading causes of death as:

1. Respiratory diseases
2. Urinary tract diseases
3. Ischemic/nonischemic heart disease
4. Cancer
5. Other
6. Injuries (including suicide)
7. Cerebrovascular diseases
8. Septicemia
9. GI diseases
10. Arteries/pulmonary circulation

Another long-term mortality study<sup>15</sup> of 401 patients with TSCI found that the overall standardized mortality ratio (SMR) was 1.85 times the general population. Complete TSCI has a higher mortality risk (SMR of 4.23) than incomplete TSCI, while those with cervical injuries had a much higher risk of death (up to 6.7 times higher in those with complete TSCI) than those who have thoracic/lumbosacral spine injuries.

## Case Resolution

Although the PI uses a wheelchair, his injury would be classified as incomplete paraplegia due to intact bowel and bladder function, and he would classify as Grade C on the ASIA impairment scale. To properly assess this risk, favorable and unfavorable factors should be reviewed.

Underwriting Assessment	
Favorable	Unfavorable
Incomplete paraplegia	Chronic pain
Normal bowel/bladder function	Depression/anxiety
Low-risk opioid use	Opioid and benzodiazepine use
Stable mental health	
Fully employed	

In this case, the favorable factors likely outweigh the unfavorable factors. The chronic pain and benzodiazepine use, along with incomplete paraplegia with no current evidence of severe associated complications, also weigh in the overall rating. With several favorable factors in this case, an offer in the moderate-to-high substandard range is supported.

## Notes

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*In the article "Will Multi-Cancer Early Detection Tests Soon Be a Reality?" of OTR March 2022 edition unfortunately there was a misleading statement. The statement that "with a specificity of the Galleri test of 99.5%, it can be interpreted that a positive test result is correct (i.e., cancer exists) in 99.5% of the time, or to put it differently, only 1 in 200 positive results are false-positive results" did not consider the clinical context, i.e., the prevalence of disease. Sensitivity and specificity alone do not provide the probability that a diagnostic test will also provide a correct diagnosis. Here the positive predictive value together with clinical validity and utility have to be taken into consideration, both being subject to ongoing studies.*