CRRN Review - Spinal Cord Injuries and Disorders

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Objectives

After this presentation you will be able to:

- Name all the Spinal Cord Injury Syndromes
- Describe the difference between Complete and Incomplete Spinal Cord Injury
- Explain how ASIA Scale is used
- Identify the difference between Spinal Cord Injury and Demyelination Disorders
- Describe Incidence and Demographics
  - Traumatic Injury
  - Disease Disorders

What is a Spinal Cord Injury

Spinal Cord Injuries (SCI) occurs when a traumatic event results in damage to cells within the spinal cord or severs the nerve tracts that relay signals up and down the spinal cord.

When cord tissue is compromised, so are the messages that are relayed between the brain and the other parts of the body. the functions of the body located above the point of injury will continue to work with no loss of function, while the areas of the body located below the point of injury will be impaired.

Impairment can include the following:

- Motor deficit
- Sensory deficit
- Breathing difficulty
- Bowel and/or bladder dysfunction

Spinal Cord Injury Basics

- Communication is blocked
  - Motor
  - Sensory
  - Reflex
- Higher the Injury, the more loss of function the patient will experience.
- Each person's recovery is different

Description	Diagram	Examples
Hyperextension Excessive posterior movement of head or neck		Face into windshield in MVC Elderly person falling to the floor Football tackler Dive into shallow water
Hyperflexion Excessive anterior movement of head onto chest		Rider thrown off of horse or motorcycle Dive into shallow water
Compression Weight of head or pelvis driven into stationary neck or torso		Dive into shallow water Fall of greater than 10 to 20 feet onto head or legs
Rotation Excessive rotation of the torsoor head and neck, moving one side of the spinal column against the other		Rollover MVC Motorcycle accident
Lateral Stress Direct lateral force on spinal column, typically shearing one level of cord from another		"T-bone" MVC Fall
Distraction Excessive stretching of column and cord		Hanging Child inappropriately wearing shoulder belt around neck Snowmobile or motorcycle under rope or wire

Spinal Cord Injuries

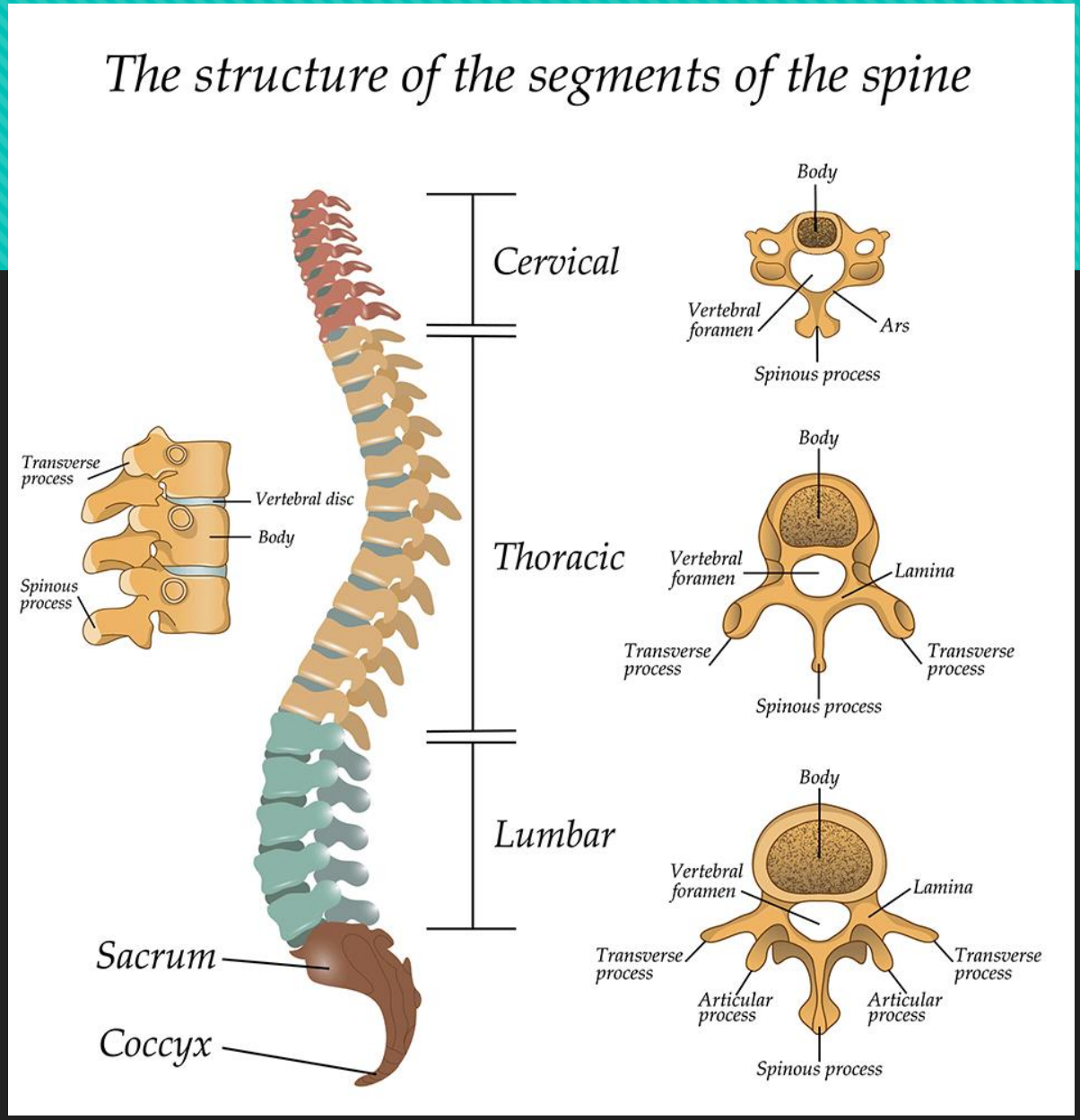
- Forces
  - Direct traumatic injury
    - stab or gunshot directly to the spine
  - Excessive Movement
    - acceleration
    - deceleration
    - deformation
- Directional Forces
  - flexion, hyperflexion
  - extension, hyperextension
  - rotational
  - lateral bending
  - vertical compression
  - distraction

Effects of SCI

- Loss of movement
- Loss of sensation
- Loss of bowel and/or bladder control
- Exaggerated reflex actions or spasms
- Change in sexual function, sexual sensitivity and fertility
- Pain or intense stinging sensations

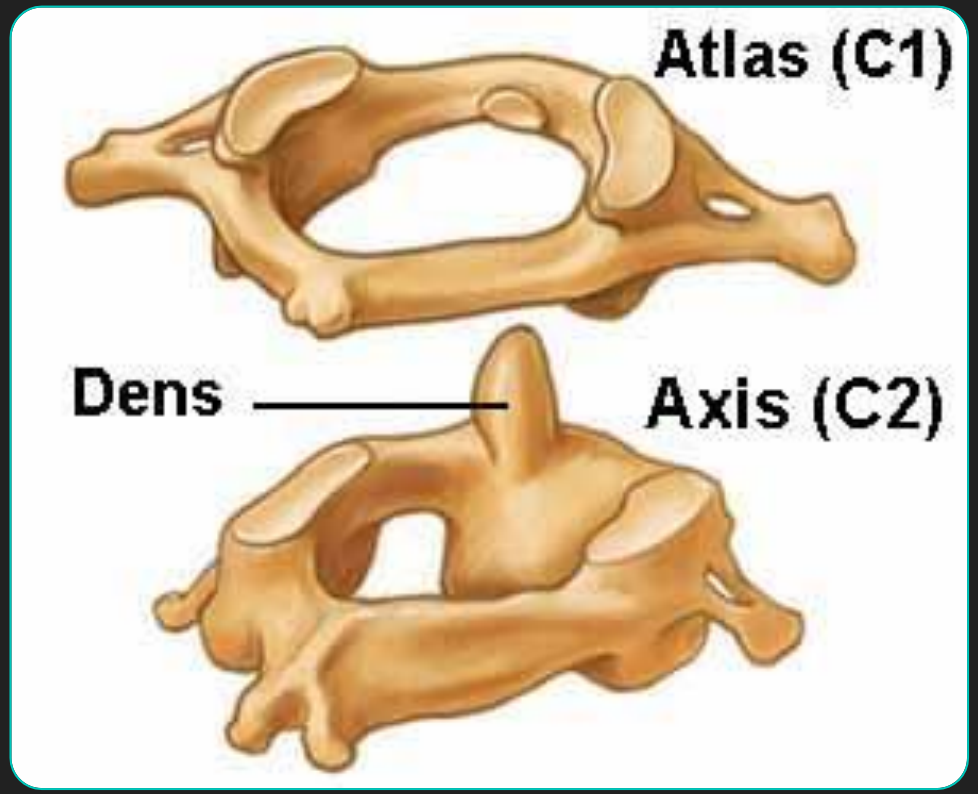
Anatomy & Physiology

- Spinal Column
  - Cervical (C 1-7)
  - Thoracic (T 1-12)
  - Lumbar (L1-5)
  - Sacral (S1-5 fused in adults)
  - Coccygeal (4 fused)



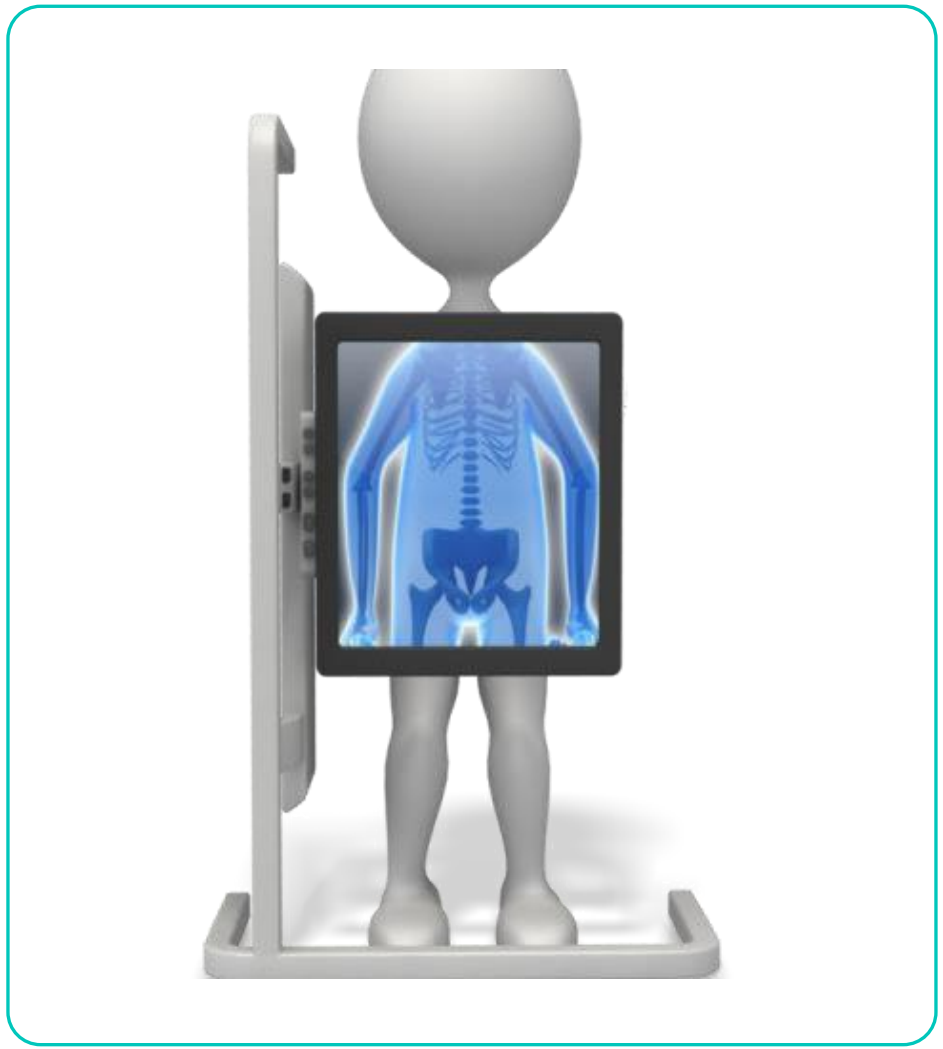
Atlas & Axis

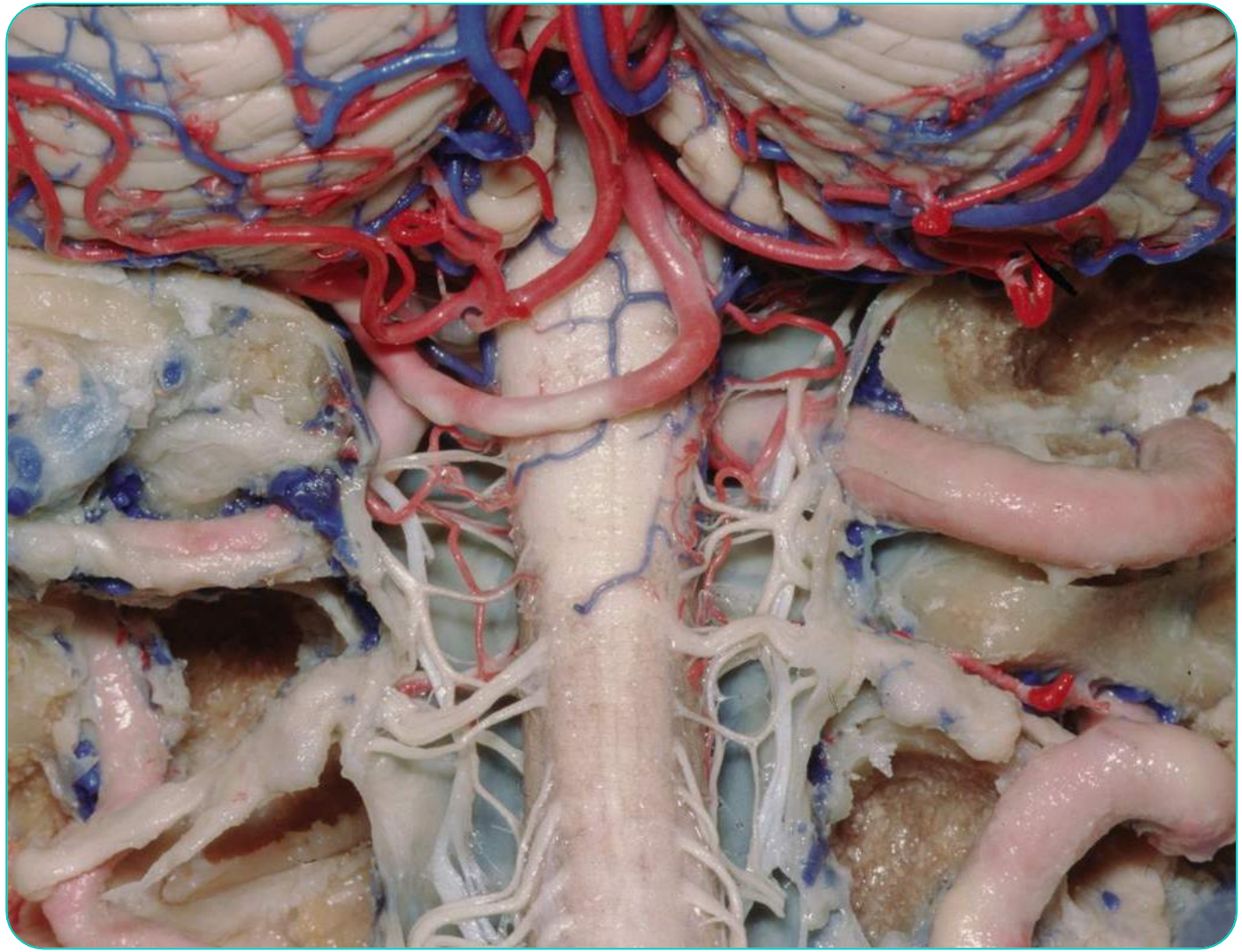
- Atlas (C-1)
  - Supports the "globe" (head)
  - Ring-like structure permits rotation of head
- Axis (C-2)
  - Forms pivot C1 rotates on
    - Allows flexion and extension of head
    - Instant death



What is the Spinal Cord?

The spinal cord is part of the central nervous system. It is a bundle of nerves that passes through the bones of the vertebrae down the back. It sends sensations to the brain from the body and returns motor commands to the various parts of the body. The spinal cord has a primary role in reflexes and in the autonomic nervous system.





Spinal Cord

- Elongated, cylindrical continuation of the medulla oblongata
- Insertion: cranial border of atlas
- Terminate: lower level of first lumbar vertebra (L1)
- Average Length in adult: 45 cm
- Average Weight in adult: 30 gm

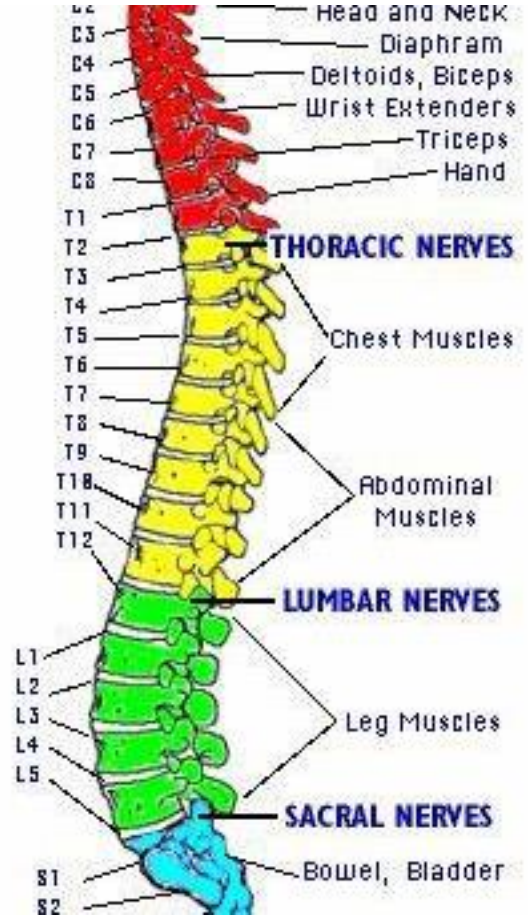
Spinal Cord

- Surrounded by 3 meninges:
  - Dura mater (outer layer) to S2
    - Epidural space
    - Subdural space
  - Arachnoid mater to S2
    - Subarachnoid space holds 75ml CSF to protect cord
  - Pia Mater
    - Vascular
    - Closely adheres to cord

Spinal Column

The spinal column is made up primarily of vertebrae, discs, and the spinal cord. The spinal column is separated into 5 specific functional areas.

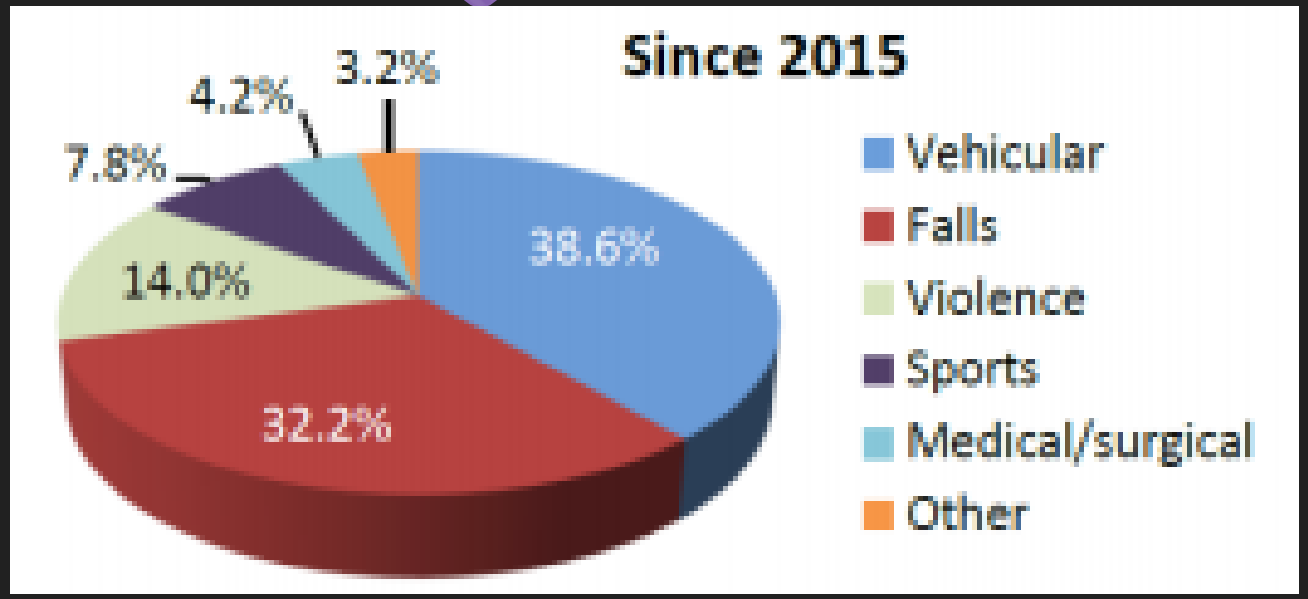
- Cervical / C 1-7
- Thoracic / T 1 - 12
- Lumbar / L 1 - 5
- Sacral/ S1-5
- Coccyx 4 fused

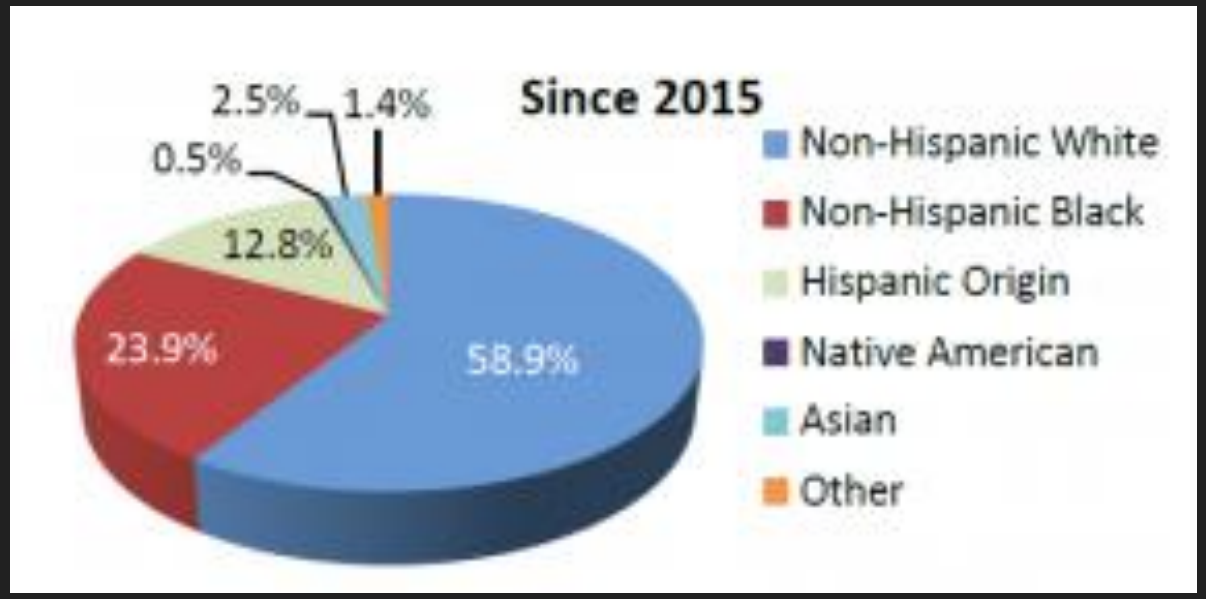


Nomenclature of SCI

- Old terminology
  - Para – Turkish for "piece"
  - Quadri – Latin for "four"
  - Plegia – Greek for "stroke" or "to strike"
- Correct Terminology
  - Hemi – Greek for "Half"
  - Tetra – Greek for "Four"

Incidence and Demographics





SCI Incidence

- SCI costs yearly $9.7 billion (CDC, 2008)
- Pressure sores to SCI patients alone cost $1.4 billion (CDC, 2008)
- Mortality is highest in first year after injury

Age	42.6 (Average)
Gender	Male 80.7%
Ethnicity	Caucasian 67%
Residence	At Home 88%
Causes Of Death	Pneumonia, Pulmonary Embolism (PE), Septicemia
Classification	47% Tetra; 52% Hemi
Life Expectancy	Slightly Below

Non-trauma Spinal Cord Disorders

Tumors

- Cancer vs Benign

Infections

- Osteomyelitis
- Abscess

Vascular interruptions

- AVMs

Cord Ischemia (rare)

- Decompression sickness
- Clamping of aorta

Congenital anomalies

Spinal Column

The level of injury is very helpful in predicting what parts of the body might be affected by paralysis and loss of function. Remember that in incomplete injuries there will be some variation in these prognoses.

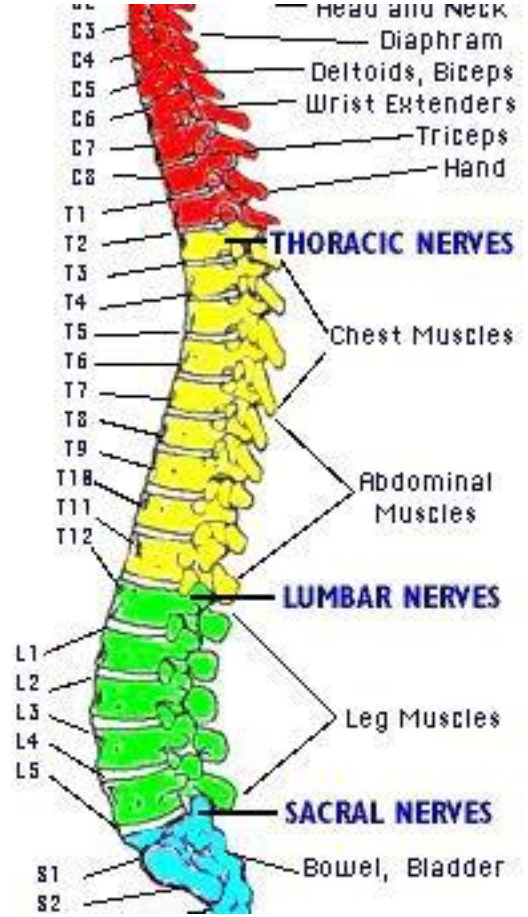
Neck: Cervical (neck) injuries usually result in quadriplegia.

C-1 to C-4: These very high injuries (C-1, C-2) can result in a loss of many involuntary functions including the ability to breathe, necessitating breathing aids such as mechanical ventilators or diaphragmatic pacemakers.

C-5: C-5 injuries often result in shoulder and biceps control, but no control at the wrist or hand. C-6: C-6 injuries generally yield wrist control, but no hand function.

C-7 and T-1: Individuals with C-7 and T-1 injuries can straighten their arms but still may have dexterity problems with the hand and fingers. Injuries at the thoracic level and below result in paraplegia, with the hands not affected.

T-1 to T-8: At T-1 to T-8 there is most often control of the hands, but poor trunk control as the result of lack of abdominal muscle control. T-9-T12: Lower T-injuries (T-9 to T-12) allow good truck control and good abdominal muscle control. Sitting balance is very good. Lumbar and Sacral injuries yield decreasing control of the hip flexors and legs.



Pathophysiology: Types of Spinal Cord Injury

Complete

- Total disruption of the cord
- Complete loss motor & sensory function below level of injury

Incomplete

- Some preservation of motor or sensory functions below level of lesion

Complete Injury

- Complete spinal cord injuries result in complete paraplegia or complete tetraplegia.
- Complete tetraplegia is characterized by the loss of hand and arm movement as well. Some tetraplegics require ventilator systems in order to breathe. Depending upon the location of the injury, some tetraplegics may have some arm and hand movement present.
- Complete paraplegia is described as permanent loss of motor and nerve function at T1 level or below, resulting in loss of sensation and movement in the legs, bowel, bladder, and sexual region. Arms and hands retain normal function

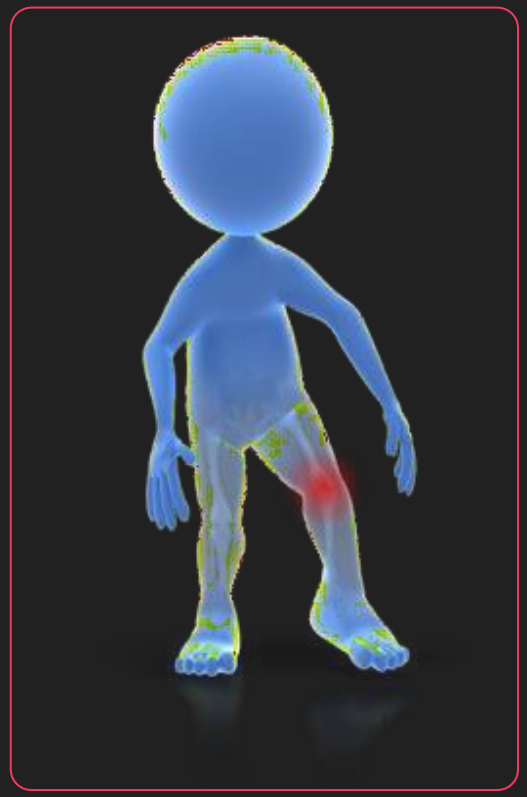
Incomplete Spinal Cord Injury

- Incomplete spinal injuries can result in some sensation but little or no movement, or in some movement but little or no sensation. The effects of incomplete lesions depend upon the area of the cord (front, back, side, etc.) affected. The part of the cord damaged depends on the forces involved in the injury.
- Incomplete spinal injuries fall under five different classifications.

Types of Incomplete SCI

- **Anterior Cord Syndrome:** is when the damage is towards the front of the spinal cord
- **Central Cord Syndrome**: is when the damage is in the center of the spinal cord.
- **Posterior Cord Syndrome**: is when the damage is towards the back of the spinal cord.
- **Brown-Séquard Syndrome:** is when damage is towards one side of the spinal cord.
- **Cauda Equina lesion:** The Cauda Equina is the mass of nerves which fan out of the spinal cord at between the first and second Lumbar region of the spine.
- **Conus Medullaris Syndrome**: Injury results in motor and sensory loss in the lower extremities as well as dysfunction in bladder and bowler control

Anterior Cord Syndrome



- Anterior spinal cord syndrome is usually seen as a result of compression of the artery that runs along the front of the spinal cord. Patients with anterior spinal cord syndrome usually have complete loss of strength below the level of injury. In Anterior Cord Syndrome, there is sparing of the dorsal column. The patient therefore exhibits greater motor loss in the legs than arms.
- Symptoms:
  - Voluntary movement deficits
  - Pain
  - Loss of temperature sensation

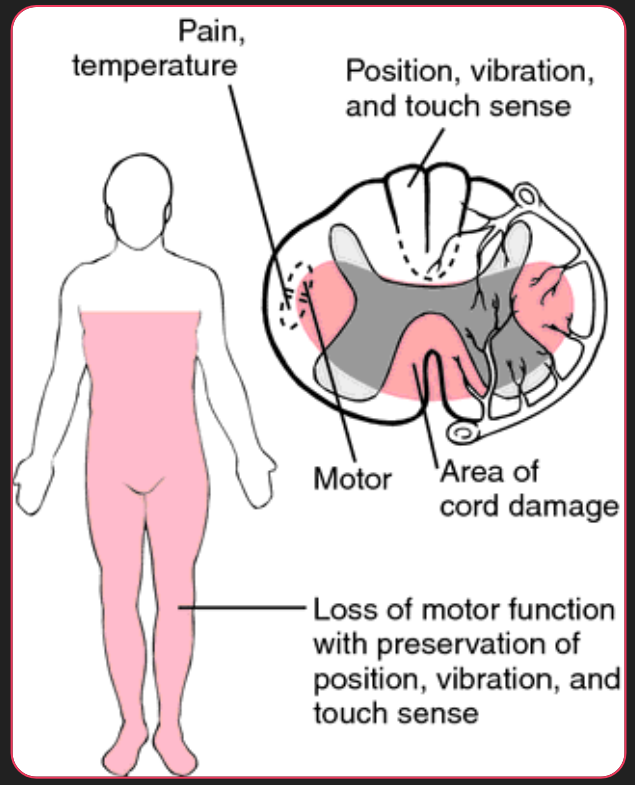
Anterior Cord Syndrome

- The prognosis is usually good if the recovery is evident and progressive in the patient during first 24 hours. However, if there are no signs of sacral sensibility to pinprick or temperature are present after 24 hours, then the prognosis for functional recovery can be said to be poor.
- There is no standard course of treatment or cure for anterior cord syndrome. Drug therapy, surgery, and rest are often part of the treatment program.

Posterior Cord Syndrome

- Posterior cord syndrome is when the damage is towards the back of the spinal cord. This type of injury may leave the person with good muscle power, pain and temperature sensation however they may have trouble in coordinating movement of their limbs. They are also able to detect touch that has significant pressure.
- Patients with this type of injury will exhibit deficits in the ability to walk, even though sensation and muscle control are intact.

Central Cord Syndrome



- Lesion almost exclusively in cervical region
- Greater sensory loss/weakness in upper limbs than lower
- Characterized by microscopic hemorrhage & edema in central gray matter
- Etiology
  - Hyperflexion w/spondylosis or stenosis
  - Elderly
    - Fall
    - MVC
  - Focused nursing considerations
    - Motor & sensory changes to include sacral sparing
    - Bowel, bladder & sexual function
    - Supportive care to loss of hand and arm function
    - Safety/Prevention of injuries due to inability to guard with upper extremities in a fall

Central Cord Syndrome

- Central Cord Syndrome (CCS) is an incomplete injury to the cervical cord resulting in more extensive motor weakness in the upper extremities than the lower extremities.
- CCS occurs typically in patients with hyperextension injuries where the spinal cord is squeezed or pinched between anterior cervical spondylotic bone spurs and the posterior intra-spinal canal ligament.
- This typically results in the loss of function in the arms, but some leg movement may be preserved. There may also be some control over the bowel and bladder preserved.

Central Cord Syndrome

- Central cord syndrome is the most common form of incomplete spinal cord injury.
- This syndrome is associated with damage to the large nerve fibers that carry information directly from the cerebral cortex to the spinal cord. These nerves are particularly important for hand and arm function.
- Symptoms may include :
  - Paralysis or loss of fine control of movements in the arms
  - and hands
  - Less impairment of leg movements
  - Sensory loss below the site of the injury
  - Loss of bladder control may also occur
  - Painful sensations such as tingling, burning, or dull ache.

Central Cord Syndrome

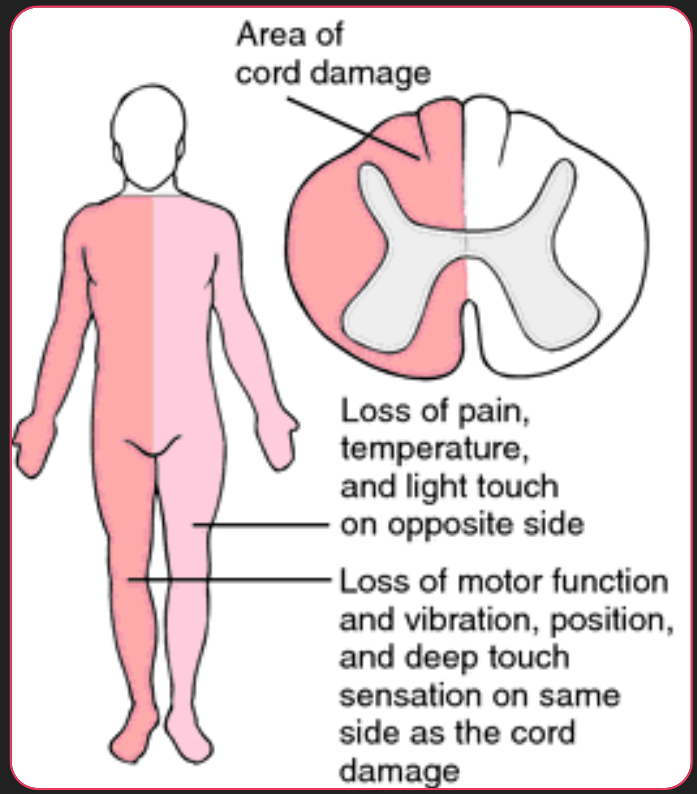
- There is no cure for central cord syndrome although some people recover near-normal function. There is no standard course of treatment. Acute surgical intervention is not usually necessary unless there is significant cord compression.
- Nonsurgical treatment consists of immobilization of the neck with a cervical orthosis, steroids unless contraindicated, and rehabilitation with physical and occupational therapy.
- Many patients with CCS make spontaneous recovery of motor function while others experience considerable recovery in the first six weeks post injury.

Central Cord Syndrome Prognosis

- The prognosis for central cord syndrome varies, but most people whose syndrome is caused by trauma have some recovery of neurological function.
- The prognosis for CCS in younger patients is favorable. Within a short time, most younger patients recover and regain the ability to ambulate and perform daily living activities.
- However, in elderly patients the prognosis is not as favorable, with or without surgical intervention.

Brown-Sequard Syndrome

- Ipsilateral proprioceptive motor loss
- Contralateral loss of sensitivity to pain/temperature
- Etiology:
  - Penetrating injury to one half cord
    - GSW
    - Knife
    - Sharp objects
  - Focused Nursing Considerations
    - Motor & sensory deficits below injury
    - Bowel, bladder & sexual functions
    - Ambulation & functional recovery possible



Brown-Séquard Syndrome

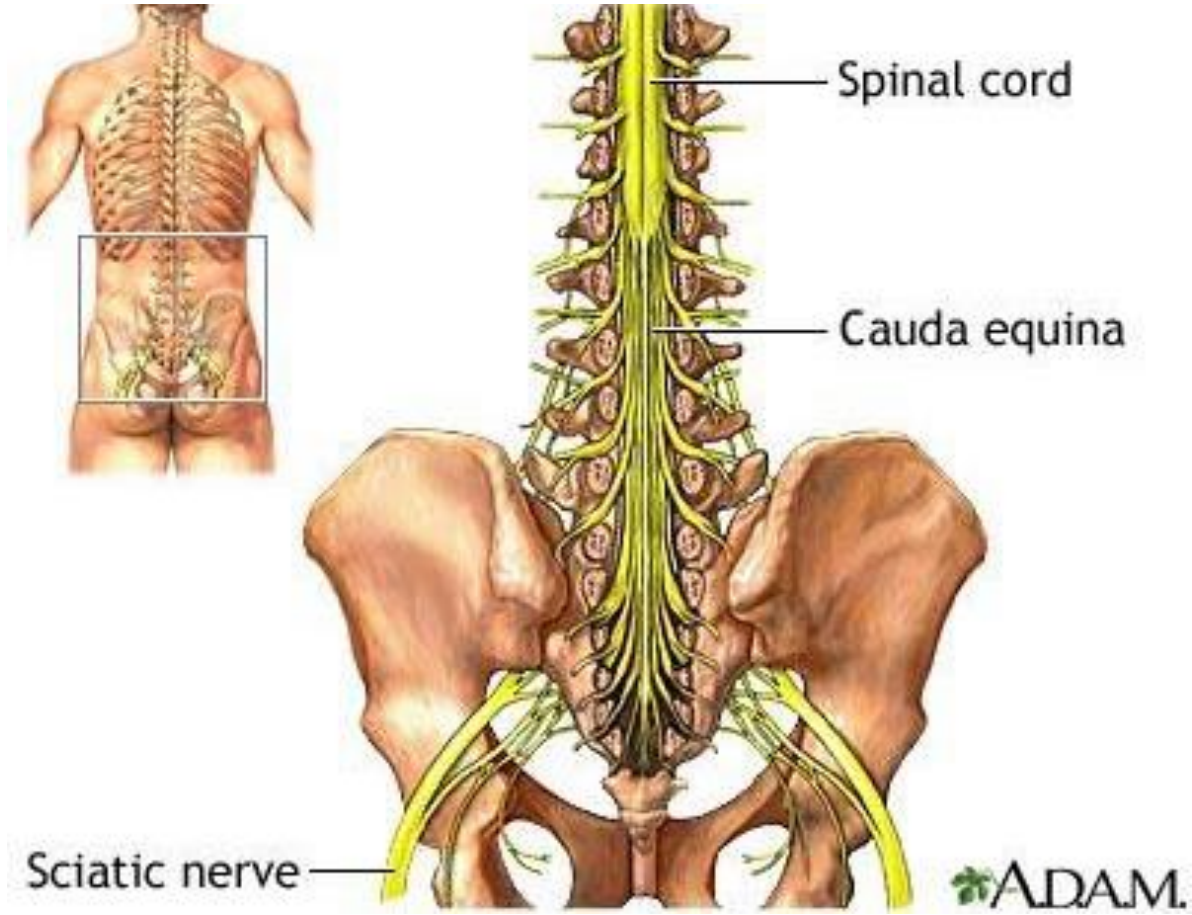
- Brown-Séquard syndrome is when damage is towards one side of the spinal cord. This results in impaired or loss of movement to the injured side, but pain and temperature sensation may be preserved. The opposite side of injury will have normal movement, but pain and temperature sensation will be impaired or lost.
- This damage, most often results from physical trauma, and results in a contralateral (opposite side of the body) loss of sensation and temperature and ipsilateral (same side of the body) paralysis or extreme weakness

Brown-Séquard Syndrome

- Although trauma is the most common cause of Brown Séquard Syndrome , other causes exist. Other etiologies include a mass effect from a tumor, an infection, tuberculosis, multiple sclerosis, and iatrogenic causes.
- The patient may have loss of bowel and bladder function. Additionally, the patient will experience spasticity due to the upper motor neuron lesions.
- Brown Séquard Syndrome has a good prognosis doing better than most incomplete spinal cord injuries. Between 75% to 90% of patients regain motor function with the ability to ambulate.
- Generally, treatment for individuals with BSS focuses on the underlying cause of the disorder. Early treatment with high- dose steroids may be beneficial in many cases. Other treatment is symptomatic and supportive.

Cauda Equina Syndrome

- The Cauda Equina is the mass of nerves which fan out of the spinal cord at between the first and second Lumbar region of the spine.
- Cauda Equina syndrome is caused by significant narrowing of the spinal canal that compresses the nerve roots below the level of the spinal cord.



Cauda Equina Syndrome Causes

- Cauda Equina syndrome is caused by the compression of nerves in the lumbar spine and a narrowing of the spinal canal. This pressure on the spinal nerves can occur from several underlying causes, including:
  - Any spinal condition that may compress the nerves in the lower back
  - Inflammatory conditions of the spine
  - Infections in the spinal canal
  - Spinal tumors that can put pressure on the nerves in the lower spine
  - Injury that penetrates the lower back
  - Trauma to the lumbar spine

Cauda Equina Signs and Symptoms

- Symptoms of cauda equina syndrome include:
- Numbness in the groin or area of contact if sitting on a saddle
- Bowel and bladder disturbances
- Lower extremity muscle weakness and loss of sensations
- Reduced or absent lower extremity reflexes
- Low back pain

Cauda Equina Treatment

- Medical treatment options are useful depending on the underlying cause of the cauda equina syndrome.
- Anti-inflammatory agents and corticosteroids can be effective in people with inflammatory processes
- People with cauda equina syndrome caused by an infection should receive appropriate antibiotic therapy.
- People with spinal tumors should be evaluated for chemotherapy and radiation therapy.
- In most cases, treatment with medications alone is not indicated because of a need for emergent release of the nerve compression (surgical decompression) of the spinal canal.

Conus Medullaris Syndrome

- The conus medullaris is the end of the spinal cord, which is located in the lower back. Nerves that pass through the conus medullaris control the bladder, bowel, genitals and the legs.
- Conus medullaris syndrome is a collection of signs and symptoms associated with injury to the conus medullaris.
- A person with conus medullaris syndrome has symptoms that occur when the nerves in the conus medullaris malfunction. Conus medullaris syndrome usually occurs because of compression of this lower portion of the spinal cord.

Conus Medullaris Signs and Symptoms

- Symptoms of conus medullaris syndrome include:
  - Low back pain
  - Difficulty walking
  - Leg weakness
  - Leg and foot numbness
  - Numbness in the groin or inner thighs
  - Loss of bladder control
  - Rectal Incontinence
  - Impotence

Conus Medullaris Syndrome Treatment

- Treatment for conus medullaris syndrome differs based on the underlying cause.
- If the conus medullaris Syndrome is due to compression by a tumor or hematoma, removing the object causing the compression will ease the symptoms.
- If Infection is causing the conus medullaris to swell it may be treated with antibiotics.
- Congenital problems are most likely to be addressed through surgery.

Demyelination Disorders of Spine

Guillain-Barre Syndrome

Multiple Sclerosis (MS)

Amyotropic Lateral Sclerosis (ALS)

Guillain–Barré Syndrome

- Guillain-Barré syndrome is a disorder in which the body's immune system attacks part of the peripheral nervous system. The exact cause of Guillain-Barre syndrome is unknown, but it is often preceded by an infectious illness such as a respiratory infection or the stomach flu.
- No one yet knows why GBS strikes some people and not others. Nor does anyone know exactly what sets the disease in motion. What scientists do know is that the body’s immune system begins to attack the body itself, causing an autoimmune disease

Guillain–Barré Syndrome

- The first symptoms of GBS include varying degrees of weakness or tingling sensations in the legs. The weakness and abnormal sensations may spread to the arms and upper body.
- Guillain Barre Syndrome is a life-threatening disorder. Unfortunately, without prompt proper medical treatment many people lose their lives.
- In these cases, the disorder is life threatening - potentially interfering with breathing and, at times, with blood pressure or heart rate and is considered a medical emergency. Bladder dysfunction and constipation may occur.

Guillain–Barré Syndrome

Early signs of Guillain Barre Syndrome

- Nausea, vomiting
- Loss of appetite,
- Stomach pain,
- Migraines,
- Low grade fevers and chills
- Constant exhaustion, tiredness
- Pain in the back of head

Guillain–Barré Syndrome

There is no known cure for Guillain-Barre syndrome (GBS). However, there are therapies that lessen the severity of the illness and accelerate the recovery in most people. There are also a number of ways to treat the complications of the disease.

Plasmapheresis: To reduce the severity and duration of the Guillain-Barré episode

Immunoglobulin: In high-dose immunoglobulin therapy, doctors give intravenous injections of the proteins that, in small quantities, the immune system uses naturally to attack invading organisms.

The most critical part of the treatment consists of keeping the patient's body functioning during recovery of the nervous system. This can sometimes require placing the patient on a ventilator, a heart monitor, or other machines that assist body function.

Guillain–Barré Syndrome Prognosis

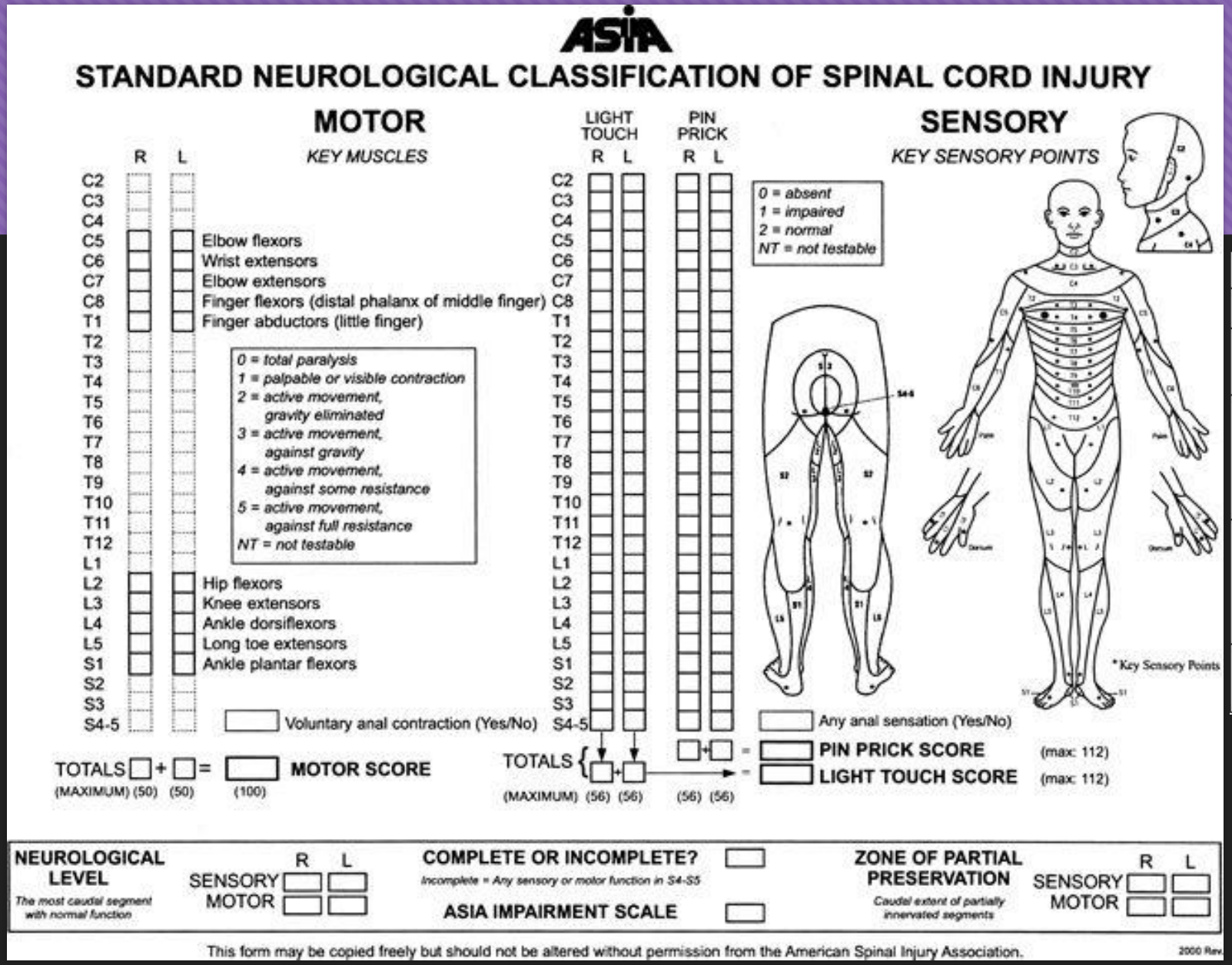
- Guillain-Barré syndrome can be a devastating disorder because of its sudden and unexpected onset.
- The recovery period may be as little as a few weeks or as long as a few years. About 30 percent of those with Guillain-Barré still have a residual weakness after 3 years.

SCI Classification Systems

- Neurological Assessment
  - Motor function
  - Sensation
  - Reflex Activity
- Uses
  - Baseline neurological level of impairment
  - Develop realistic physiologic and functional goals

ASIA Impairment Scale

- The American Spinal Cord Injury Association (ASIA) defined an international classification based on neurological responses, touch, pinprick and strength of ten key muscles on each side of the body (shoulder, elbow, wrist, etc.)
- Traumatic spinal cord injury is classified into five categories by the American Spinal Cord Injury Classification System



ASIA Grade	Type of Injury	Definition of type of Injury
Grade A	Complete	No motor or sensory function
Grade B	Incomplete	Sensory but not motor function is preserved below the level of injury
Grade C	Incomplete	Motor function is preserved, but majority of key muscles below the neurological level have a muscle grade < 3
Grade D	Incomplete	Motor function is preserved, but the majority of key muscles below the neurological level have a muscle grade > 3
Grade E	Normal	Motor and sensory functions are normal.

ASIA Scale

MUSCLE GRADING

0 total paralysis

1 palpable or visible contraction

2 active movement, full range of motion, gravity eliminated

3 active movement, full range of motion, against gravity

4 active movement, full range of motion, against gravity and provides some resistance

5 active movement, full range of motion, against gravity and provides normal resistance

5* muscle able to exert, in examiner's judgement, sufficient resistance to be considered normal if identifiable inhibiting factors were not present

NT not testable. Patient unable to reliably exert effort or muscle unavailable for testing due to factors such as immobilization, pain on effort or contracture.

ASIA IMPAIRMENT SCALE

☐ A = **Complete**: No motor or sensory function is preserved in the sacral segments S4-S5.

☐ B = **Incomplete:** Sensory but not motor function is 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 below the neurological level have a muscle grade of 3 or more.

☐ E = **Normal:** Motor and sensory function are normal.

CLINICAL SYNDROMES (OPTIONAL)

☐ Central Cord
☐ Brown-Sequard
☐ Anterior Cord
☐ Conus Medullaris
☐ Cauda Equina

STEPS IN CLASSIFICATION

The following order is recommended in determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
2. Determine motor levels for right and left sides.
   Note: In regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level.
3. Determine the single neurological level.
   This is the lowest segment where motor and sensory function is normal on both sides, and is the most cephalad of the sensory and motor levels determined in steps 1 and 2.
4. Determine whether the injury is Complete or Incomplete (sacral sparing).
   If voluntary anal contraction = **No** *AND all S4-5 sensory scores* = **0** *AND any anal sensation* = **No**, *then injury is COMPLETE. Otherwise injury is incomplete.*
5. Determine ASIA Impairment Scale (AIS) Grade:

Is injury Complete? If **YES**, AIS=A Record ZPP (For ZPP record lowest dermatome or myotome on each side with some (non-zero score) preservation)

NO ↓

Is injury motor incomplete? If **NO**, AIS=B (Yes=voluntary anal contraction OR motor function more than three levels below the motor level on a given side.)

YES ↓

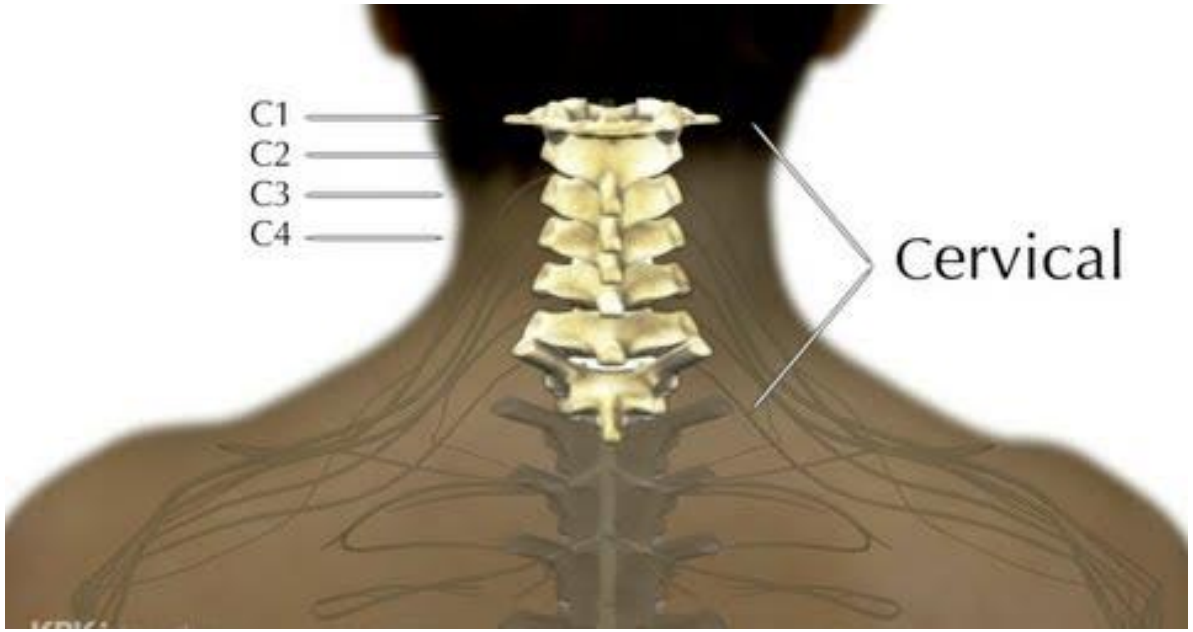
Are at least half of the key muscles below the (single) neurological level graded 3 or better?

NO ↓ AIS=C

YES ↓ AIS=D

If sensation and motor function is normal in all segments, AIS=E
Note: AIS E is used in follow up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.

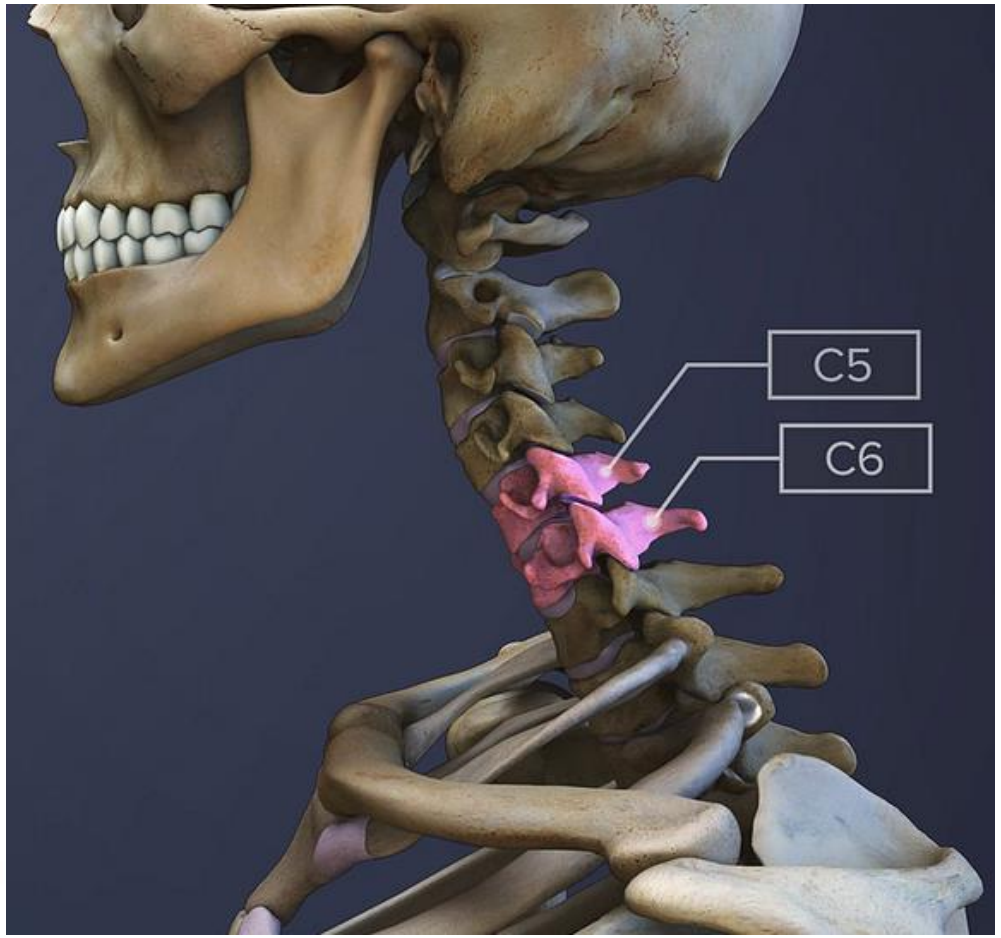
Recap:
Level of Injury and Expectations

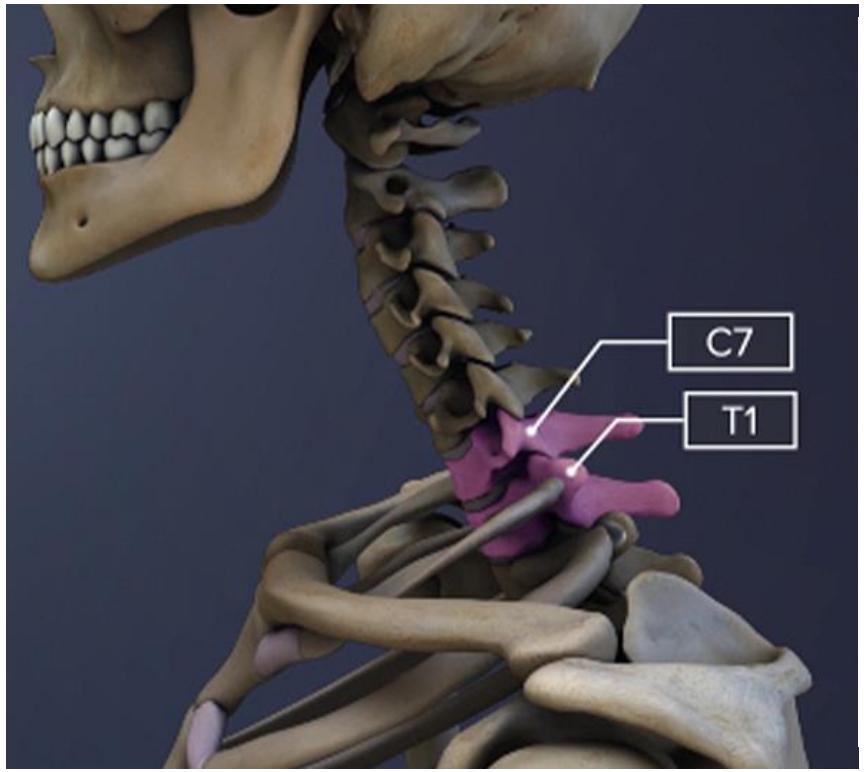


High-Cervical Nerves (C1 – C4)

- Most severe of the spinal cord injury levels
- Paralysis in arms, hands, trunk and legs
- Patient may not be able to breathe on his or her own, cough, or control bowel or bladder movements.
- Ability to speak is sometimes impaired or reduced.
- When all four limbs are affected, this is called tetraplegia or quadriplegia.
- Requires complete assistance with activities of daily living, such as eating, dressing, bathing, and getting in or out of bed
- May be able to use powered wheelchairs with special controls to move around on their own
- Will not be able to drive a car on their own
- Requires 24-hour-a-day personal care

- C5 injury
  - Person can raise his or her arms and bend elbows.
  - Likely to have some or total paralysis of wrists, hands, trunk and legs
  - Can speak and use diaphragm, but breathing will be weakened
  - Will need assistance with most activities of daily living, but once in a power wheelchair, can move from one place to another independently
- C6 injury
  - Nerves affect wrist extension.
  - Paralysis in hands, trunk and legs, typically
  - Should be able to bend wrists back
  - Can speak and use diaphragm, but breathing will be weakened
  - Can move in and out of wheelchair and bed with assistive equipment
  - May also be able to drive an adapted vehicle
  - Little or no voluntary control of bowel or bladder, but may be able to manage on their own with special equipment





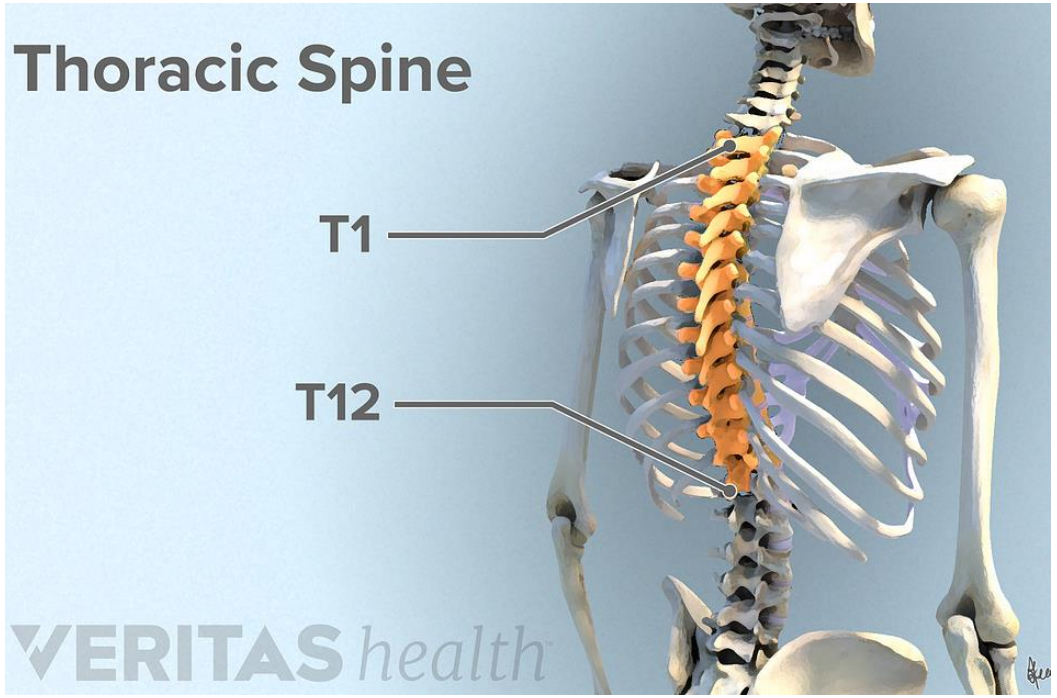
- C7 injury
  - Nerves control elbow extension and some finger extension.
  - Most can straighten their arm and have normal movement of their shoulders.
  - Can do most activities of daily living by themselves, but may need assistance with more difficult tasks
  - May also be able to drive an adapted vehicle
  - Little or no voluntary control of bowel or bladder, but may be able to manage on their own with special equipment
- C8 injury
  - Nerves control some hand movement.
  - Should be able to grasp and release objects
  - Can do most activities of daily living by themselves, but may need assistance with more difficult tasks
  - May also be able to drive an adapted vehicle
  - Little or no voluntary control of bowel or bladder, but may be able to manage on their own with special equipment

Thoracic Nerves (T1 – T5)

- Corresponding nerves affect muscles, upper chest, mid-back and abdominal muscles.
- Arm and hand function is usually normal.
- Injuries usually affect the trunk and legs(also known as paraplegia).
- Most likely use a manual wheelchair
- Can learn to drive a modified car
- Can stand in a standing frame, while others may walk with braces

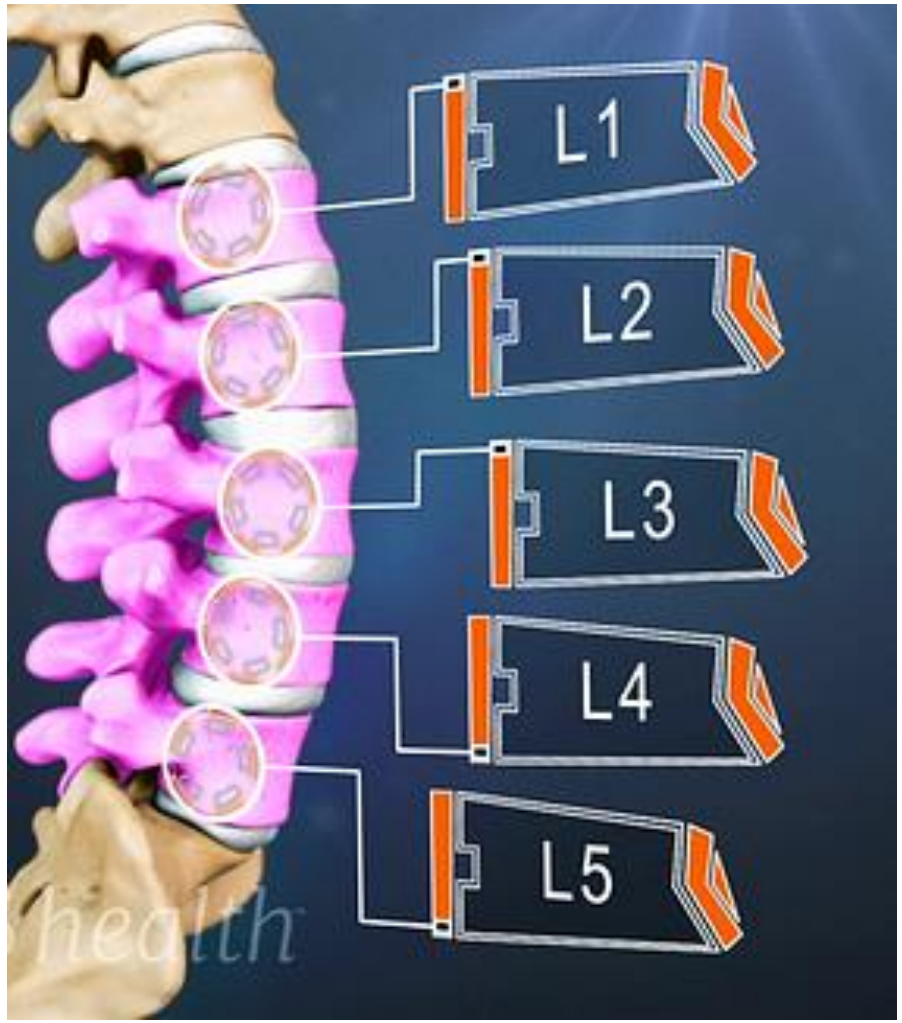
Thoracic Nerves (T6 – T12)

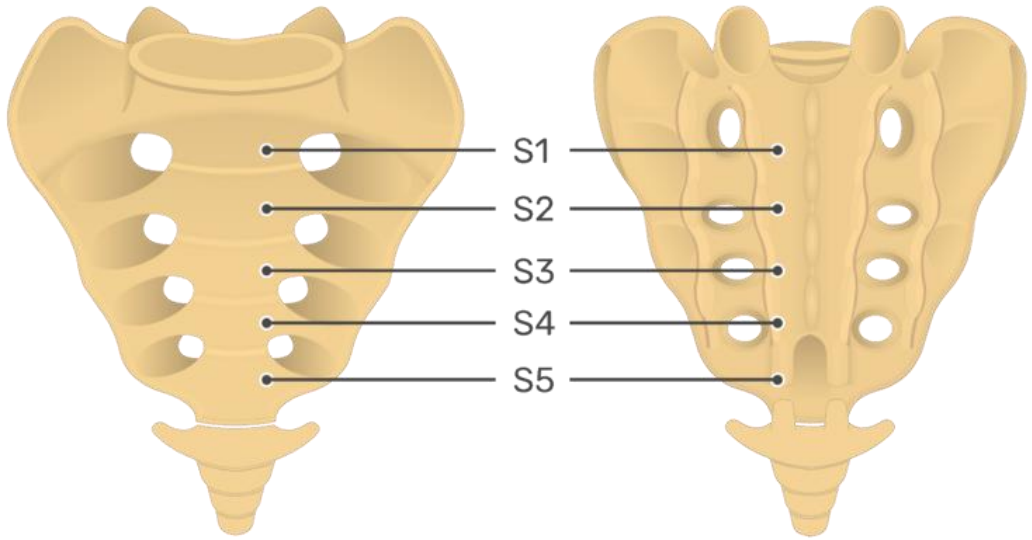
- Nerves affect muscles of the trunk (abdominal and back muscles) depending on the level of injury.
- Usually results in paraplegia
- Normal upper-body movement
- Fair to good ability to control and balance trunk while in the seated position
- Should be able to cough productively (if abdominal muscles are intact)
- Little or no voluntary control of bowel or bladder but can manage on their own with special equipment
- Most likely use a manual wheelchair
- Can learn to drive a modified car
- Some can stand in a standing frame, while others may walk with braces.



Lumbar Nerves (L1 – L5)

- Injuries generally result in some loss of function in the hips and legs.
- Little or no voluntary control of bowel or bladder, but can manage on their own with special equipment
- Depending on strength in the legs, may need a wheelchair and may also walk with braces



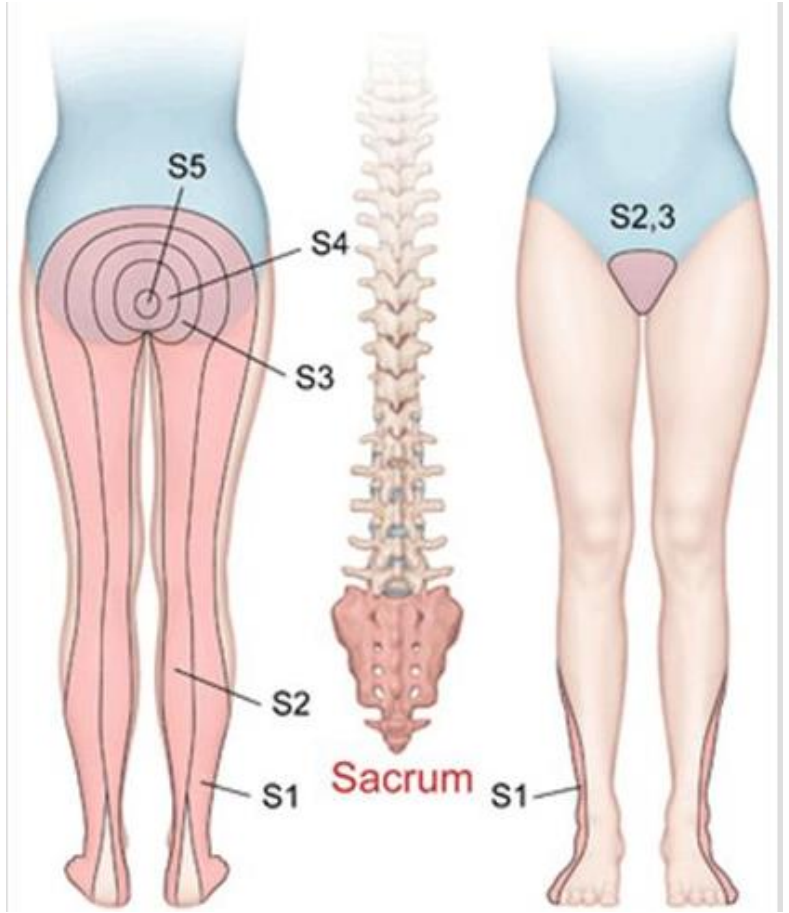


Sacral Nerves (S1 – S5)

- Injuries generally result in some loss of functionin the hips and legs.
- Little or no voluntary control of bowel or bladder, but can manage on their own with special equipment
- Most likely will be able to walk

Sacral Sparing

- Used to help diagnose whether a person's spinal cord injury is complete or incomplete.
- With complete spinal cord injuries, all sensory and motor functions below the level of injury are affected because signals from the brain cannot travel past the spinal lesion.
- With an incomplete SCI, some neuronal connections remain, allowing information to be communicated past the level of injury. This results in a greater possibility of functional recovery.



The Dangers of Autonomic Dysreflexia