

INTRODUCTION TO SPINAL CORD INJURIES AND DISORDERS

FSARN REHABILITATION NURSING REVIEW COURSE 2025

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TRAUMATIC SPINAL CORD DISORDERS

Direct Traumatic Injury

- Stab Injury to spinal cord
- Gunshot to spinal cord

Excessive Movement

- Acceleration
- Deceleration
- Deformation

Directional Forces

- Flexion, Hyperflexion
- Extension, Hyperextension
- Rotational
- Lateral Bending
- Vertical Compression
- Distraction

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 torso or 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

NON- TRAUMATIC SPINAL CORD DISORDERS

Tumors

- Cancer vs Benign

Infections

- Osteomyelitis
- Abscess

Vascular interruptions

- AVMs

Cord Ischemia (rare)

- Decompression sickness
- Clamping of aorta

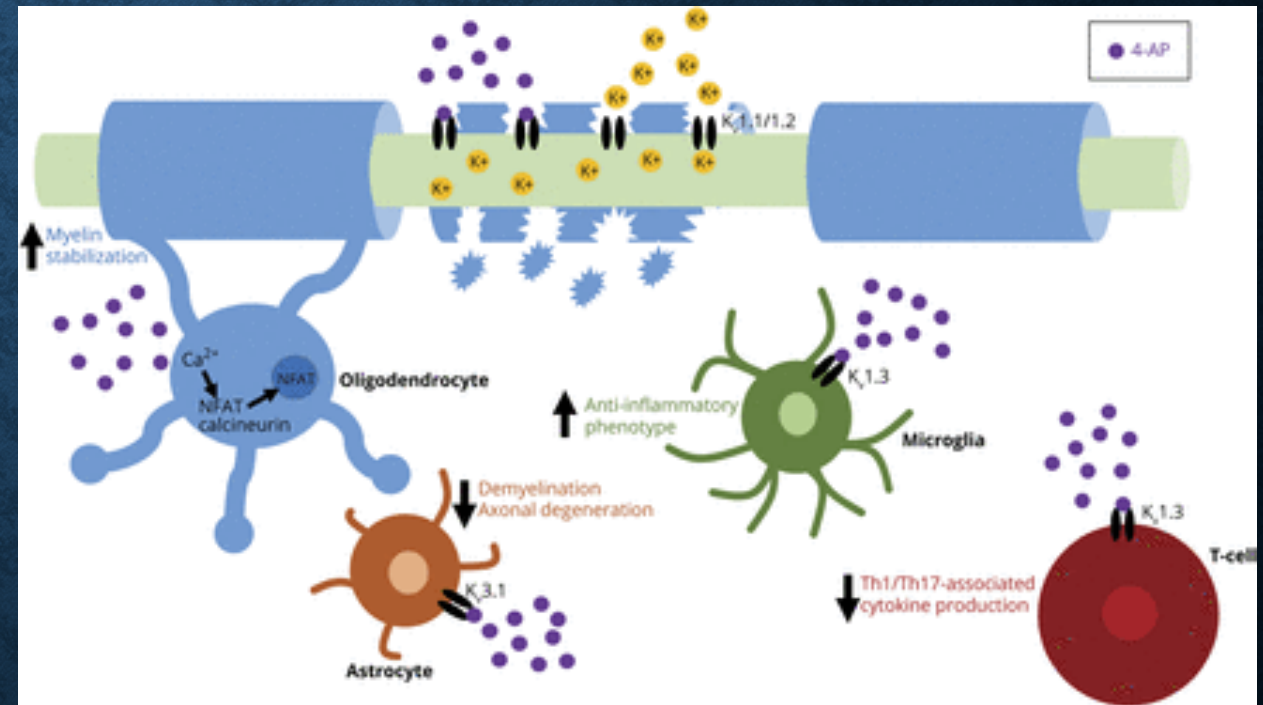
Congenital anomalies

DEMYELINATION DISORDERS OF SPINE

Guillain-Barre Syndrome

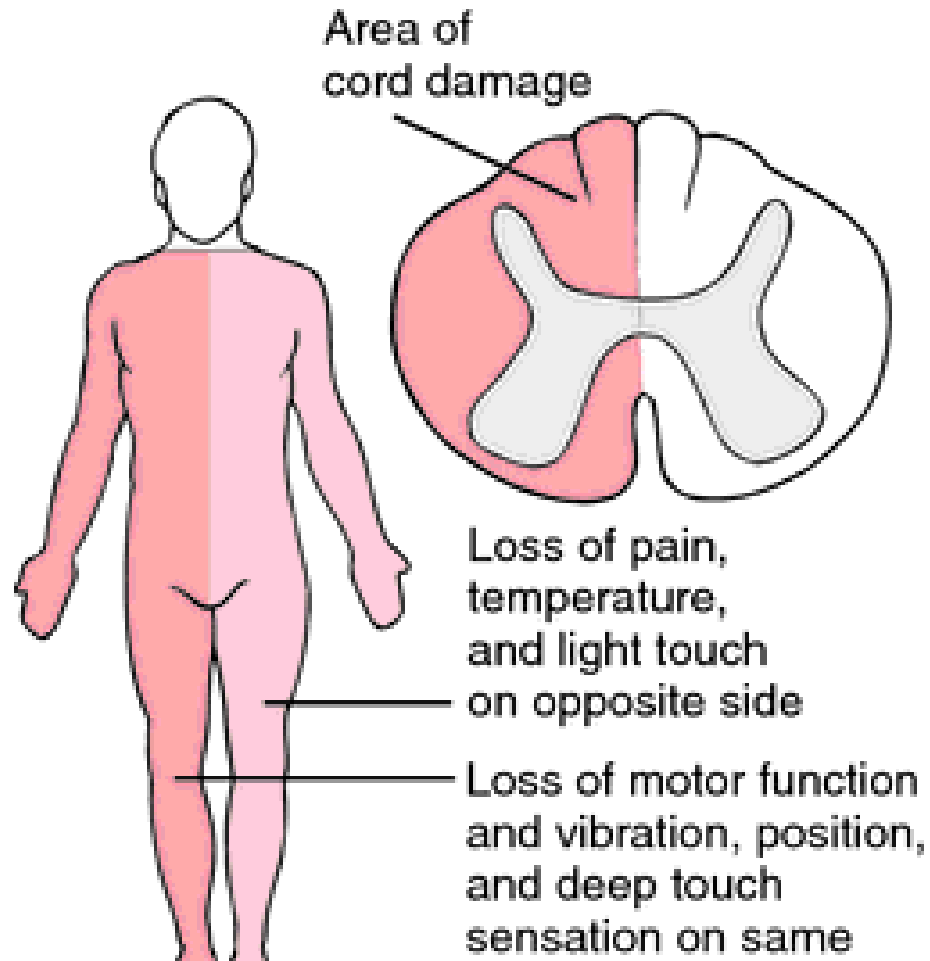
Multiple Sclerosis (MS)

Amyotrophic Lateral Sclerosis (ALS)



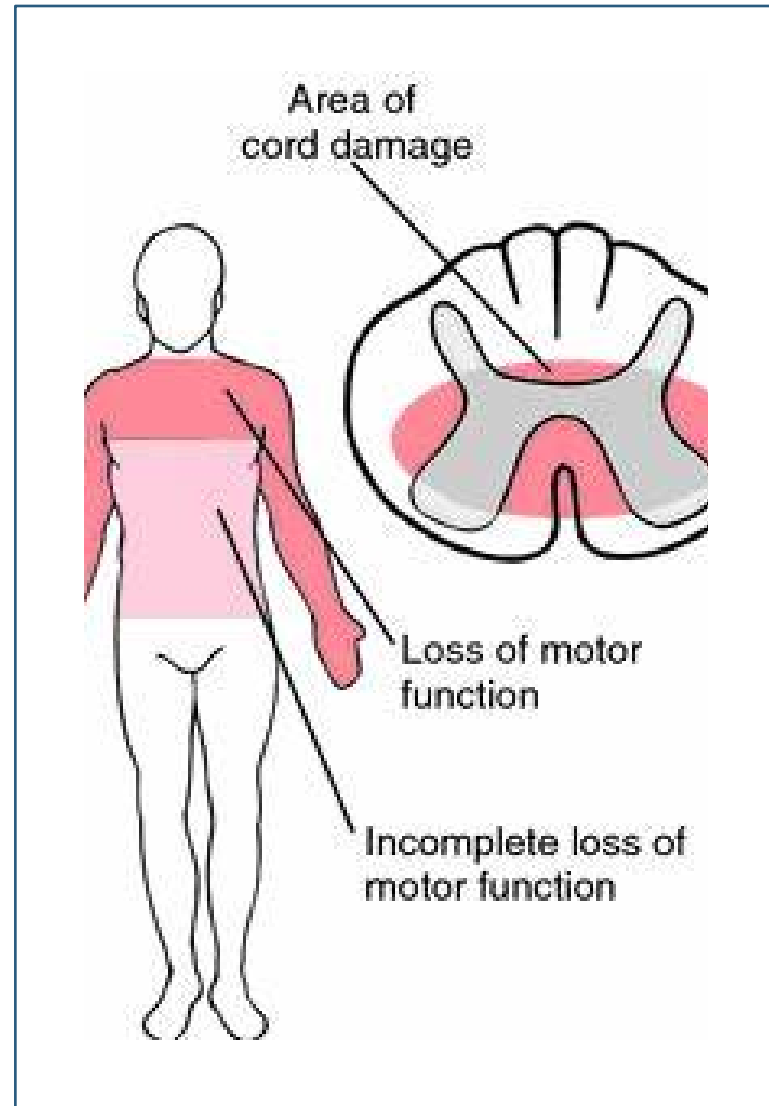
BROWN-SEQUARD SYNDROME

- **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**



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



SPINAL CORD INJURIES AND DISORDERS SYSTEM OF CARE

- 42,000 SCI injured eligible for VA care
- 26,000 received care or services in 2008
- 13,000 received SCI/D care
- The 25 VA SCI centers are at the following locations:

- Long Beach, CA;
- Palo Alto ,CA;
- San Diego, CA
- Denver, Co
- Miami ,Fl
- Tampa, FL;
- Augusta, GA;
- Hines, IL;
- West Roxbury, MS;
- Minneapolis, MN;
- St. Louis, MO;
- East Orange, NJ;
- Albuquerque, NM;
- Bronx, NY;
- Syracuse, NY;
- Cleveland, OH;
- San Juan, PR;
- Memphis, TN;
- Dallas, Houston, Tx;
- San Antonio, TX;
- Hampton, VA;
- Richmond, VA;
- Seattle, WA;
- Milwaukee, WI.

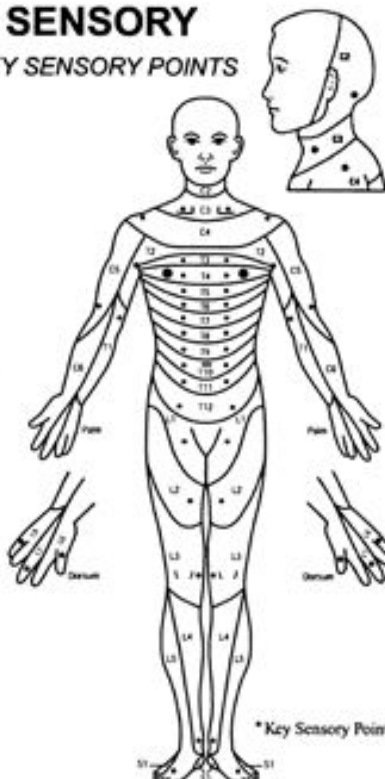


SCI CLASSIFICATION SYSTEMS

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



STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

MOTOR		LIGHT TOUCH		PIN PRICK		SENSORY	
KEY MUSCLES		R L		R L		KEY SENSORY POINTS	
C2	☐	C2	☐	C2	☐		
C3	☐	C3	☐	C3	☐		
C4	☐	C4	☐	C4	☐		
C5	☐	C5	☐	C5	☐		
C6	☐	C6	☐	C6	☐		
C7	☐	C7	☐	C7	☐		
C8	☐	C8	☐	C8	☐		
T1	☐	T1	☐	T1	☐		
T2	☐	T2	☐	T2	☐		
T3	☐	T3	☐	T3	☐		
T4	☐	T4	☐	T4	☐		
T5	☐	T5	☐	T5	☐		
T6	☐	T6	☐	T6	☐		
T7	☐	T7	☐	T7	☐		
T8	☐	T8	☐	T8	☐		
T9	☐	T9	☐	T9	☐		
T10	☐	T10	☐	T10	☐		
T11	☐	T11	☐	T11	☐		
T12	☐	T12	☐	T12	☐		
L1	☐	L1	☐	L1	☐		
L2	☐	L2	☐	L2	☐		
L3	☐	L3	☐	L3	☐		
L4	☐	L4	☐	L4	☐		
L5	☐	L5	☐	L5	☐		
S1	☐	S1	☐	S1	☐		
S2	☐	S2	☐	S2	☐		
S3	☐	S3	☐	S3	☐		
S4-5	☐	S4-5	☐	S4-5	☐		

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
NT = not testable

0 = absent
1 = impaired
2 = normal
NT = not testable

TOTALS ☐ + ☐ = ☐ **MOTOR SCORE**
(MAXIMUM) (50) (50) (100)

TOTALS ☐ + ☐ = ☐ **PIN PRICK SCORE** (max: 112)
(MAXIMUM) (56) (56) (56) (56)

☐ + ☐ = ☐ **LIGHT TOUCH SCORE** (max: 112)
(MAXIMUM) (56) (56) (56) (56)

☐ Voluntary anal contraction (Yes/No)

NEUROLOGICAL LEVEL <small>The most caudal segment with normal function</small>	SENSORY	R	L	COMPLETE OR INCOMPLETE? ☐ <small>Incomplete = Any sensory or motor function in S4-S5</small>	ZONE OF PARTIAL PRESERVATION <small>Caudal extent of partially innervated segments</small>	SENSORY	R	L
	MOTOR	☐	☐			MOTOR	☐	☐
ASIA IMPAIRMENT SCALE					☐			

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.

LEVEL OF INJURY AND EXPECTATIONS

Upper motor neuron (UMN) injury

Lesions above T12-L1
Injury is to the spinal cord

Loss of control over all reflexes below the level of injury

Spastic paralysis

C1-
C3

Limited movement of head and neck

Breathing: Depends on a ventilator for breathing.

Communication: Talking is sometimes difficult, very limited or impossible. If ability to talk is limited, communication can be accomplished independently with a mouth stick and assistive technologies like a computer for speech or typing. Effective verbal communication allows the individual with SCI to direct caregivers in daily activities, like bathing, dressing, personal hygiene, transferring, and bladder and bowel management.

Daily tasks: Assistive technology allows for independence in tasks such as turning pages, using a telephone and operating lights and appliances.

Mobility: Can operate an electric wheelchair by using a head control, mouth stick, or chin control. A power tilt wheelchair for independent pressure relief.



C3-C4

Usually has head and neck control. Individuals at C4 level may shrug their shoulders.

Breathing: May initially require a ventilator for breathing; usually adjusts to breathing full-time without ventilator assistance.

Communication: Normal.

Daily tasks: With specialized equipment, some may have limited independence in feeding and independently operate an adjustable bed with an adapted controller.



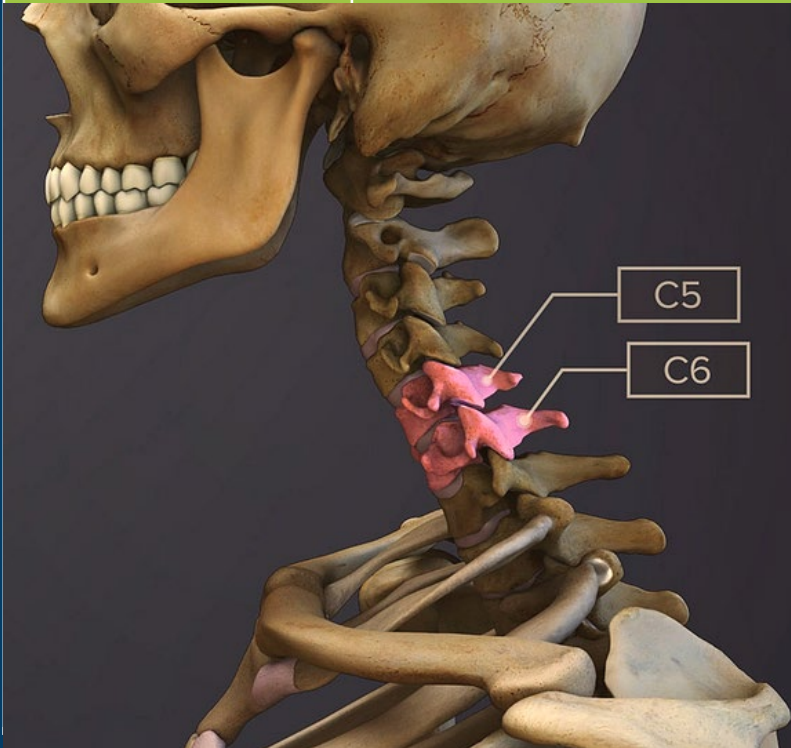
C5

Typically, has head and neck control, can shrug shoulder and has shoulder control. Can bend his/her elbows and turn palms face up.

Daily tasks: Independent with eating, drinking, face washing, brushing of teeth, face shaving and hair care after assistance in setting up specialized equipment.

Health care: Can manage their own health care by doing self-assist coughs and pressure reliefs by leaning forward or side -to-side.

Mobility: May have strength to push a manual wheelchair for short distances over smooth surface. A power wheelchair with hand controls is typically used for daily activities. Driving may be possible after being evaluated by a qualified professional to determine special equipment needs.



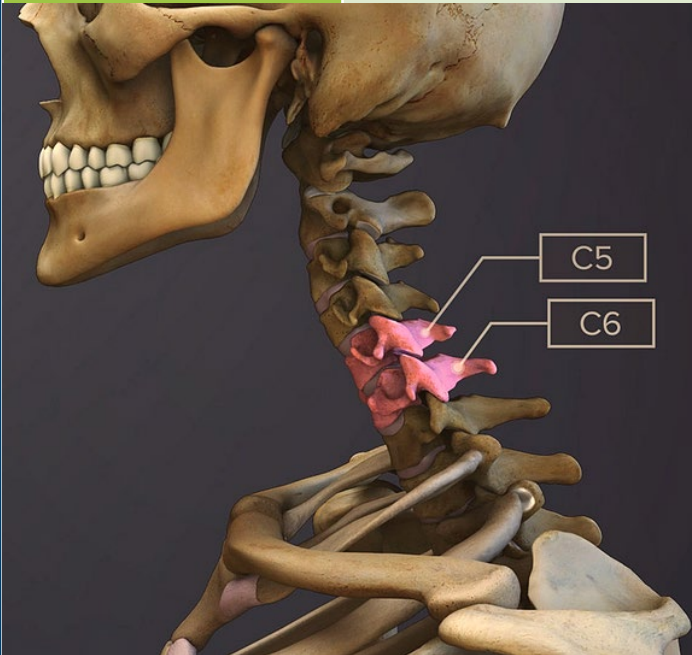
C6

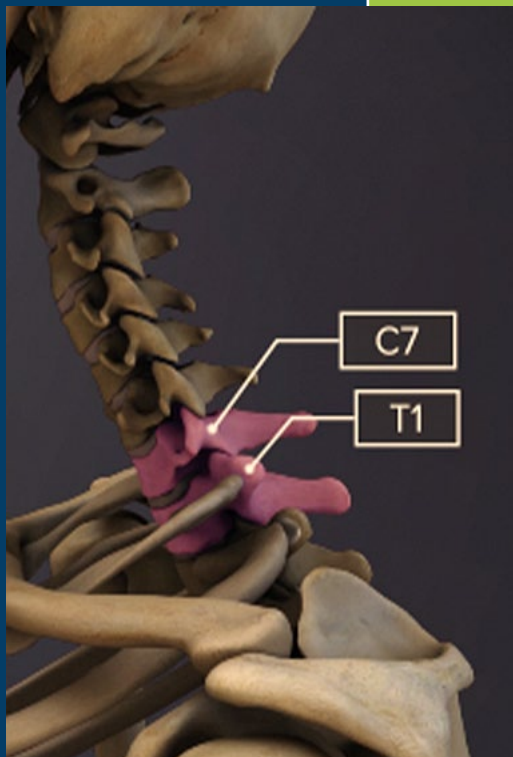
Has movement in head, neck, shoulders, arms and wrists. Can shrug shoulders, bend elbows, turn palms up and down and extend wrists.

Daily tasks: With help of some specialized equipment, can perform with greater ease and independence, daily tasks of feeding, bathing, grooming, personal hygiene and dressing. May independently perform light housekeeping duties.

Health care: Can independently do pressure reliefs, skin checks and turn in bed.

Mobility: Some individuals can independently do transfers but often require a sliding board. Can use a manual wheelchair for daily activities but may use power wheelchair for greater ease of independence.





C7

Has similar movement as an individual with C6, with added ability to straighten his/her elbows.

Daily tasks: Able to perform household duties. Need fewer adaptive aids in independent living.

Health care: Able to do wheelchair pushups for pressure reliefs.

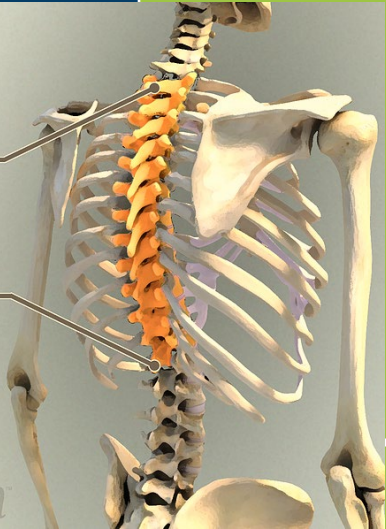
Mobility: Daily use of manual wheelchair. Can transfer with greater ease.

C8-T1

Has added strength and precision of fingers that result in limited or natural hand function.

Daily tasks: Can live independently without assistive devices in feeding, bathing, grooming, oral and facial hygiene, dressing, bladder management and bowel management.

Mobility: Uses manual wheelchair. Can transfer independently.

	T2-T6	Has normal motor function in head, neck, shoulders, arms, hands and fingers. Has increased use of rib and chest muscles, or trunk control.	<p>Daily tasks: Should be totally independent with all activities.</p> <p>Mobility: A few individuals are capable of limited walking with extensive bracing. This requires extremely high energy and puts stress on the upper body, offering no functional advantage. Can lead to damage of upper joints.</p>
<p>Spine</p>  <p>T1</p> <p>T12</p> <p><i>Shealth</i></p>			
	T7-T12	Has added motor function from increased abdominal control.	<p>Daily tasks: Able to perform unsupported seated activities.</p> <p>Mobility: Same as above.</p> <p>Health care: Has improved cough effectiveness.</p>

L1-L5

**Has additional
return of motor
movement in the
hips and knees.**

**Mobility: Walking can be a viable function, with the help
of specialized leg and ankle braces.
Lower levels walk with greater ease with the help of
assistive devices.**



Lower motor neuron (LMN) injury

Lesions below T12-L1

**Injury is to the conus medularis and cauda
equina**

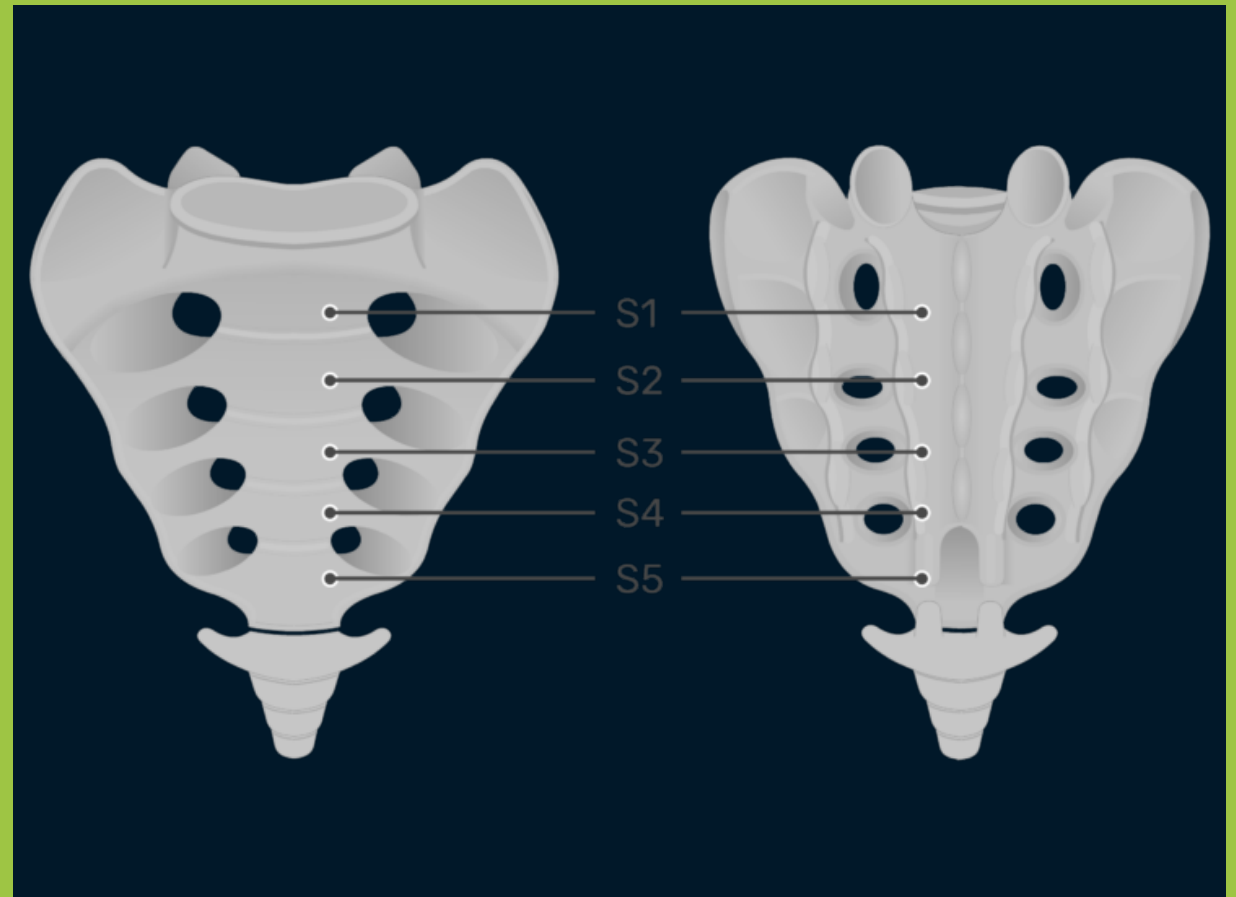
Loss of reflex arc

Flaccid paralysis

S1-S5

Depending on level of injury, there are various degrees of return of voluntary bladder, bowel and sexual functions.

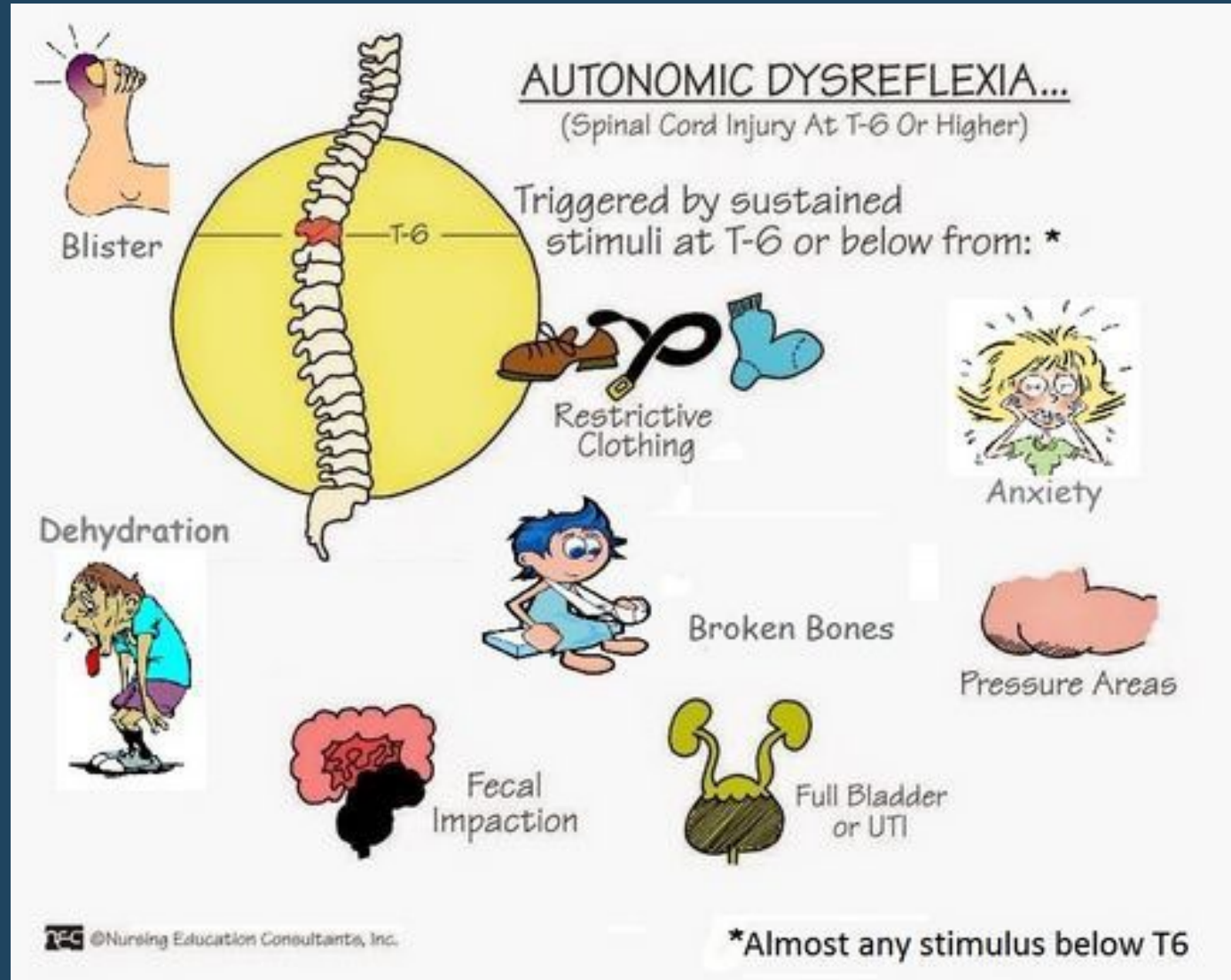
Mobility: Increased ability to walk with fewer or no supportive devices.



THE DANGERS OF AUTONOMIC DYSREFLEXIA

Causes:

- Distended bladder
- Urological procedures or infection/ stones
- Distended bowel
- Pressure ulcers
- Ingrown nails
- Fractures
- Deep Vein Thrombosis (DVT)
- Gynecological procedures/ pregnancy/delivery
- Restrictive clothing/shoes



AUTONOMIC DYSREFLEXIA

Signs/symptoms:

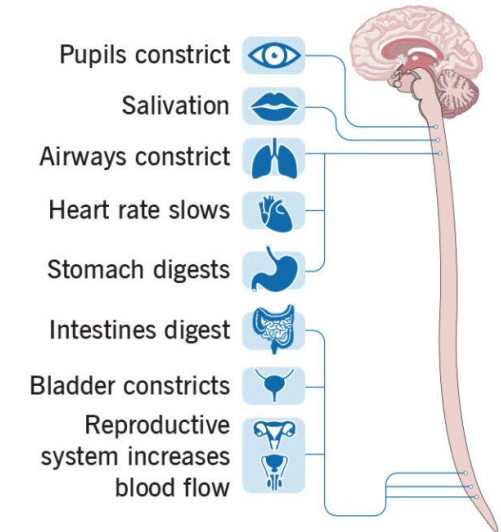
- Blood pressure 20-40 mmHg above baseline with bradycardia
- flushing,
- perspiration,
- piloerection (goosebumps) above injury level,
- nasal congestion,
- blurred vision/dots in vision

Treatment:

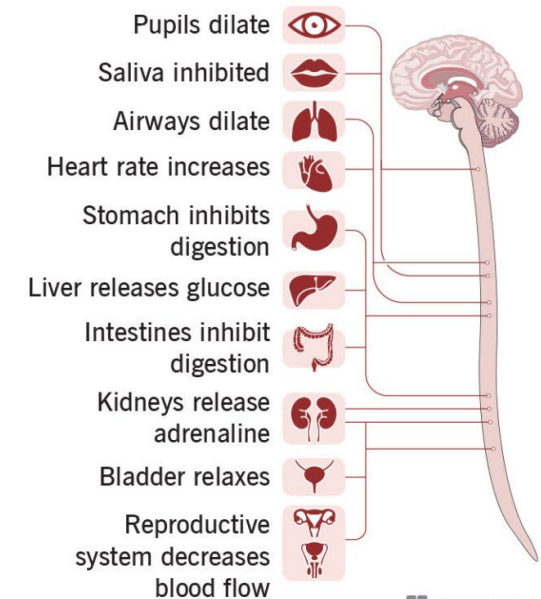
- Remove noxious stimuli
 - Bladder and bowel most common
- Untreated can result in stroke or coma or death
- Preventable with proper bladder and bowel management

Autonomic Nervous System

Parasympathetic Division



Sympathetic Division



SCI: PHYSICAL ASSESSMENT

▶ **Neurological**

- ▶ Cognitive, motor, sensory status, reflexes, cranial nerves, signs/symptoms of changes in function, pain and abnormal sensations

▶ **Respiratory**

- ▶ Breath sounds, airway patency, O2 sat, diaphragm function, sputum and aspiration, pulmonary emboli

▶ **Cardiovascular**

- ▶ Blood pressure, pulse, HR, rhythm, edema, DVT, orthostatic hypotension

▶ **Nutritional**

- ▶ Weight, hydration, dietary intake, CBC, electrolytes, albumin and prealbumin

SCI: PHYSICAL ASSESSMENT

▶ **Elimination**

- ▶ Abdominal tenderness/distention/masses, bowel sounds, premorbid/current bowel patterns, urine characteristics and amount

▶ **Musculoskeletal**

- ▶ Swelling, spasticity, ROM, tone, contractures, orthopedic injuries, HO

▶ **Integumentary**

- ▶ Skin breakdown: assessment, prevention

▶ **Psychosocial**

- ▶ Family support, coping, adjustment, potential responses to fear/anxiety, suicidal ideation, emotional state, behaviors of denial/anger/depression

▶ **Sexual**

- ▶ Physical capabilities, significant other/spouse, birth control practices, sexually transmitted diseases

SCI: INTERVENTIONS

▶ **Planning: setting goals should focus on**

- ▶ Ability not disability
- ▶ Should be directed toward helping the individual attain and maintain maximum independence
- ▶ Should include the patient and family

▶ **Interventions:**

- ▶ Spinal stability, preservation of life
 - ▶ Log rolling, no twisting
 - ▶ Surgery
 - ▶ Orthotics
 - ▶ Collars, TLSO, LSO
 - ▶ Usually worn for 3 months post surgery or post injury

▶ **Prevention of complications**

- ▶ Infections, psychiatric disorders, pressure sores, cardiovascular problems

SCI: INTERVENTIONS

- ▶ Interventions determined by team including patient and family
- ▶ Teaching patient and family
 - ▶ Problem solving, adaptive devices, safe and effective performance of skills
 - ▶ Learning new skills while maintaining newly learned skills
- ▶ Therapeutic relationship: rapport, trust
- ▶ Provide safe environment for verbalizing feelings without judgment
- ▶ Answer questions, find answers, don't take away hope
- ▶ Meet physical as well as emotional and psychosocial needs
- ▶ Promote a good self concept and body image
- ▶ Involve the team including the patient and family

SCI: INTERVENTIONS

▶ Common concerns of individuals with SCI:

- ▶ Walking
- ▶ Sexual function
- ▶ Pain
- ▶ Bowel and bladder
- ▶ Finances
- ▶ Loss of independence
- ▶ anxiety

▶ Common concerns of family caregivers:

- ▶ Negative attitudes toward SCI
- ▶ Feelings of guilt
- ▶ Frustration over lack of appreciation
- ▶ Loss of alone time
- ▶ Feeling overwhelmed
- ▶ Setting boundaries in the relationship of caregiving

SCI: SYSTEM MANIFESTATIONS

▶ **Cardiovascular**

- ▶ Hypotension and vasodilation decreases cardiac output
 - ▶ Orthostatic hypotension – problem getting blood from lower extremities back to heart
 - ▶ Vasodilation – loss of sympathetically induced vasoconstriction, pulling blood in abdomen and lower extremities
- ▶ Bradycardia caused by unopposed vagal tone
- ▶ Impaired temperature regulation (poikilothermia) due to inability to sweat or shiver below injury
- ▶ Cardiac dysrhythmias (in first few weeks especially severe injuries)
- ▶ Blood clots (3x higher)

SCI: DISCHARGE PLANNING

- It's never too early
 - Preadmission through rehabilitation
 - Collaborative process
 - Identify caregivers
 - Return demonstration
 - Prevention of secondary complications
 - Discharge destination
 - Home evaluation
 - Durable Medical Equipment (DME)
 - Funding/Transportation

RESOURCES/LINKS:

- ▶ [Atlanta Brain and Spinal Cord Injury Rehabilitation | Shepherd Center](#)
- ▶ [The Christopher & Dana Reeve Foundation | Paralysis Foundation](#)
[\(christopherreeve.org\)](http://christopherreeve.org)
- ▶ [Home \(pva.org\)](#)
- ▶ [Spinal Cord Injury Rehabilitation | SCI Physical Therapy Center](#)
[\(craighospital.org\)](http://craighospital.org)
- ▶ [Spinal Cord Injuries and Disorders System of Care Home \(va.gov\)](#)

TERMS TO REMEMBER

- Tetraplegia: C 1- 8, most common levels of injury for cervical area are C-5, C-6, C-7
- Paraplegia: T-1 and below, most common levels of injury for thoracic/lumbar areas are L-1, L-2
- Complete - No motor or sensation in lowest sacral segment
- Incomplete - Partial loss of motor or sensation including lowest sacral segment

- Upper Motor Neuron Injury- Lesions above T12-L1
 - Injury is to the spinal cord
 - Loss of control over all reflexes below the level of injury
 - Spastic paralysis, Reflexes intact- Spasticity
- Lower Motor Neuron Injury- Lesions below T12-L1
 - Injury is to the conus medularis and cauda equina
 - Loss of reflex arc
 - Flaccid paralysis, No reflexes – Flaccid