Carolinas Rehabilitation

Introduction to Spinal Cord Injury

This self-directed learning module contains information you are expected to know in order to provide a safe environment for our patients who have a spinal cord injury, our guests, and you.

Carolinas Rehabilitation

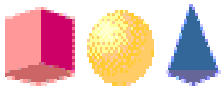
Target Audience: Support Staff working with individuals with Spinal Cord Injuries

Recommended for: Support staff whose specialty is another population besides Spinal Cord Injury

---

Contents

Introduction to Spinal Cord Injury



INSTRUCTIONS

The material in this module is an introduction to important general information. After completing this module, contact your supervisor to obtain additional information specific to your department.

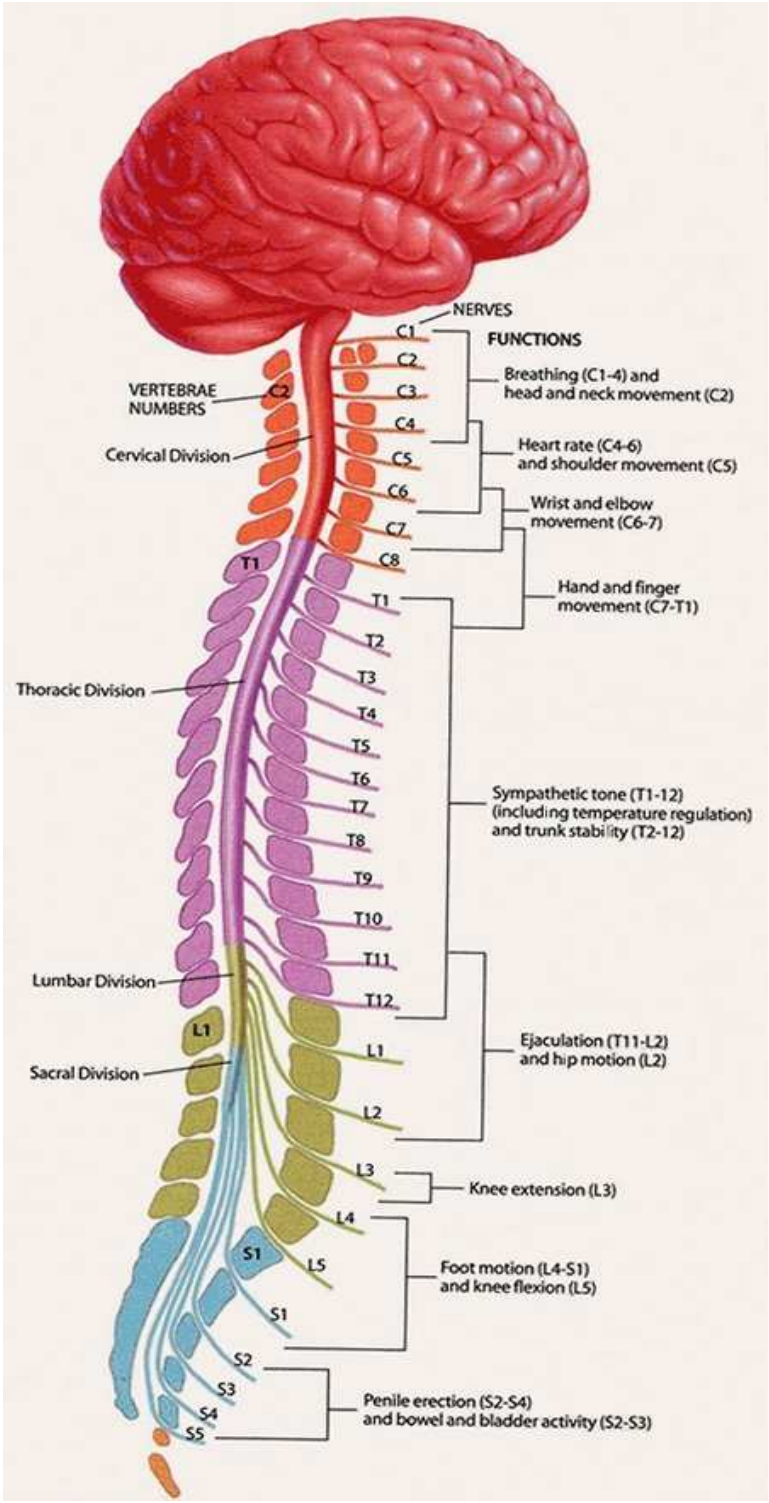
- Read this module.
- If you have any questions about the material, ask your supervisor.
- Complete the online post test for this module.
- The **JOB AID** on page 12 may be customized to fit your department and then used as a quick reference guide.
- Completion of this module will be recorded under My Learning in PeopleLink.

Learning Objectives

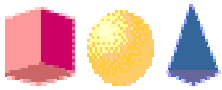
When you finish this module, you will be able to:

- Describe the main parts and functions of the spinal cord.
- Understand the AIS categories of spinal cord injury.
- Identify medical complications associated with a spinal cord injury and appropriate interventions.
- Identify community resources for individuals with spinal cord injury

Introduction to Spinal Cord Injury



Introduction to Spinal Cord Injury



I. Parts of the Spinal Cord

A. Cervical Spine is comprised of 7 vertebral levels. Spinal nerves exiting at this level control the following key muscle groups: C3 – the Diaphragm, C4 – Shoulder Abduction, C5 – Elbow Flexors, C6 – Wrist Extensors, C7 – Elbow Extensors, C8 – Finger Flexors. They carry sensory information for the upper chest and upper extremities. Injuries at this level are considered upper motor neuron (UMN). UMNs originate in the brain and travel through the spinal cord to communicate with the spinal (peripheral) nerves that ultimately communicate with target muscles .Individuals with an injury to this area are diagnosed with **tetraplegia**.

B. Thoracic Spine is comprised of 12 vertebral levels. Spinal nerves exiting at this level control the sensation and muscles in the trunk (back and abdominals). They assist with balance and proper respiration. T4 is approximately at height of the nipples. The true spinal cord typically ends at the T10 level and injuries above this level are considered UMN in nature. T10 is approximately at the height of the umbilicus. Immediately below this spinal level the cord becomes the Conus Medularis which is comprised of a combination of upper and lower motor neurons (LMN). LMNs are the spinal nerves that receive information from the UMNs and communicate directly with target muscles. The Conus Medularis is followed by the Cauda Equina (horse's tail) a collection of spinal nerves only. Injuries at this level are considered LMN in nature. Autonomic nervous system ganglions for the sympathetic nervous system also reside in this area. Individuals with an injury to the thoracic spine or below are diagnosed with **paraplegia**.

C. Lumbar Spine is comprised of 5 vertebral levels. Spinal nerves exiting here control the following key muscles groups: L2 – Hip Flexors, L3 – Knee Extensors, L4 Ankle Dorsiflexors, L5 Long Toe Extensors. They carry sensory information for the front of the leg. Nerves in this area also contribute to bowel, bladder and sexual function. Some of the autonomic nervous system ganglions for the parasympathetic nervous system reside in this area. Injuries at this level would be LMN in nature.

D. Sacral Spine is comprised of 5 fused vertebrae. Nerves exiting here contribute to bowel, bladder and sexual function. They carry sensory information for the foot, back of the leg and perianal area. Injuries in this area would be LMN in nature.

E. Coccyx is comprised of 3 vertebrae. No specific spinal nerves are associated with this region. Injuries in this area are not typically associated with neurologic changes.

Introduction to Spinal Cord Injury

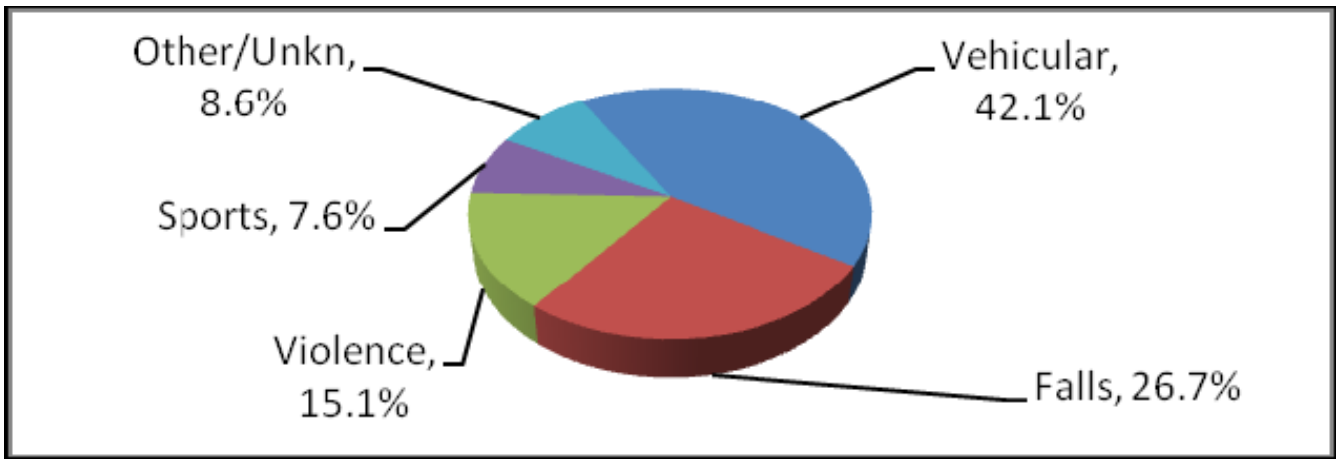
II. Types of Spinal Cord Injury:

A. Traumatic spinal injury (TSCI) occurs when damage is a result of an external force. These injuries can be caused by:

- Motor vehicle accidents
- Falls
- Assault
- Sports

B. Non-traumatic spinal injury (NTSI) may be caused by:

- Infection
- Tumor
- Vascular compromise (spinal stroke, abdominal aortic aneurysm)
- Narrowing of the spinal canal (stenosis) due to arthritic changes in the spine



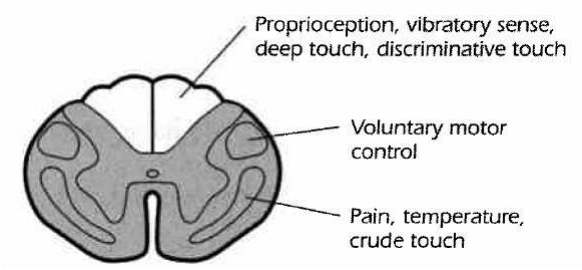
C. ASIA Impairment Scores

a. **AIS A** – Complete Injury – no sensory or motor function preserved below level of injury and in the lowest sacral segments (S4-5) (No volitional anal contraction or sensation in S2-3. An individual can have a "Zone of Partial Preservation" below the level of injury and still have a complete injury)
b. **AIS B** – Motor Complete and Sensory Incomplete Injury - sensory but not motor function preserved below level of injury and in lowest sacral segments
c. **AIS C** – Incomplete Injury – motor function preserved below the neurological level, and *more than half* of key muscle groups below level have a muscle grade *less than 3*

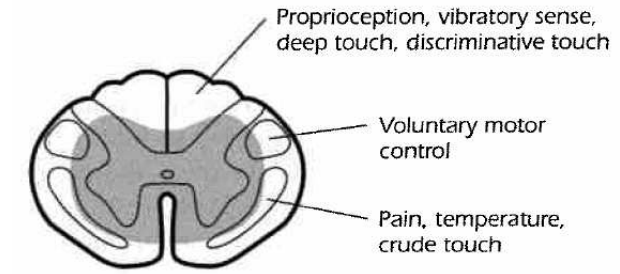
d. **AIS D** – motor function preserved below the neurological level, and *at least half* of key muscle groups below level have a muscle grade *greater than or equal to 3*.
e. **AIS E** – Incomplete Injury – normal sensation and motor function below the level of injury

D. Types of Incomplete Injury

a. **Anterior Cord Injury** – Often due to vascular compromise of the spinal cord. Impairs ability to tell where involved limbs are in space. Depending on extent of damage often leads to muscle weakness at and below the level of injury.

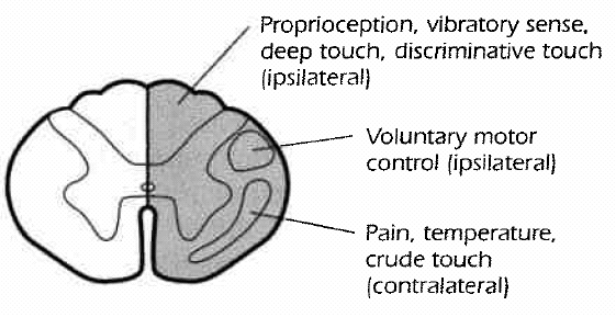


b. **Central Cord Injury** – Often due to hyperextension of the cervical spine (often following a fall). Especially frequent in individuals that have premorbid spinal canal narrowing from arthritic changes. Arms are usually more impaired than legs following this type of injury.



c. **Brown Sequard Injury** – Often due to blunt trauma. The ipsilateral (same) side of the body below the level of injury will have greater strength than sensation. The contralateral (opposite) side of the body below the level of injury will have greater sensation than strength.

Introduction to Spinal Cord Injury

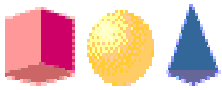


I. Medical Issues to be Aware of Following Spinal Cord Injury:

a. **Orthostatic Hypotension** – Following a spinal cord injury individuals will typically have a blood pressure lower than pre-injury and will initially have greater difficulty compensating for changes in upright positioning. If symptoms of orthostasis occur (lightheadedness, lethargy, syncope) Ted hose, ace wraps donned in a figure 8 configuration, and abdominal binder frequently assist in elevating pressure. Adequate hydration and gradual mobilization into upright position also help to minimize symptoms. Medication can also be utilized to assist with blood pressure management if this is a consistent problem despite the above interventions.

b. **Pneumonia** - Following a spinal cord injury individuals will have a diminished respiratory capacity and cough strength (the closer to the cervical spine the injury, the greater the deficit). This paired with decreased mobility increases the risk of fluid accumulation in the lungs. Encouraging individuals to change positions in bed, increase time in upright position, regularly use incentive spirometer and maintain adequate hydration to keep secretions thin will minimize this complication. In addition, each patient should be taught to direct or perform an assisted cough to improve effectiveness of airway clearance.

c. **Deep vein Thromboses (DVTs)** – Following a spinal cord injury individuals are frequently less mobile than needed for optimal venous blood flow return to the heart. The risks of immobility are magnified due to the lack of or reduced voluntary muscle contractions in the large muscles of the lower body. Use of Ted hose and sequential compression devices will assist with improving venous return. Adequate hydration and use of blood thinning medications will also help to minimize the risk for



developing DVTs. Careful attention to signs of asymmetrical swelling in either arms or legs is strongly encouraged since following a spinal injury an individual may not experience physical discomfort due to impaired sensation.

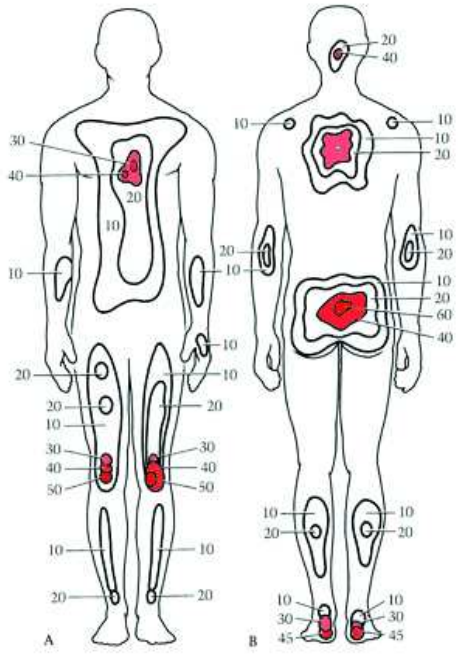
d. **Pulmonary Emboli (PEs)** – If signs of a DVT are not detected in time, a clot can become displaced and travel to the lungs where it can become life threatening. This frequently results in necessary transfer to an acute care facility.

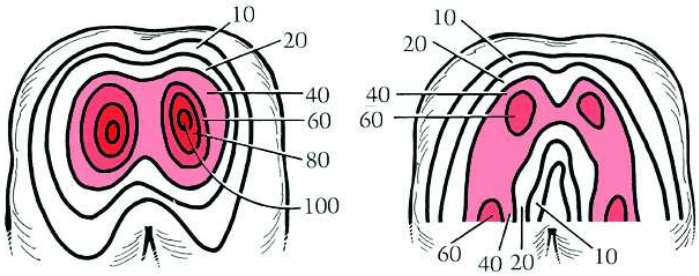
e. **Autonomic Dysreflexia** – An over activity of the autonomic nervous system causing an abrupt onset of excessively high blood pressure that occurs in individuals with injuries at or above the level of T6. It affects anywhere from 43-90% of individuals with SCI but does not usually occur until > 2 months post injury due to spinal “shock”. Symptoms of Autonomic Dysreflexia may include a sudden “pounding” headache, goose bumps, sudden and profuse sweating, flushing in face and neck, visual changes and severe hypertension (typical BP after SCI ranges from 80-90/50-60, with dysreflexia it can reach 300/160).

   Treatment includes moving the person into an upright position (if lying down) to immediately lower the blood pressure. Then look for things that can trigger an autonomic response. The most frequent problem occurs in the bladder (76-85%). Check for distention, UTI, catheter problems. The second most frequent contributing factor is with the bowel (<20%). Check for distention or hemorrhoids. Skin issues contribute to a lesser degree (<5%). Check for pressure, tight clothing, ingrown toenails, and wounds/injuries.

f. **Pressure Sores** - Following a spinal cord injury, individuals are at a higher risk for developing a pressure sore due to both impaired mobility and altered sensation in weight bearing surfaces.

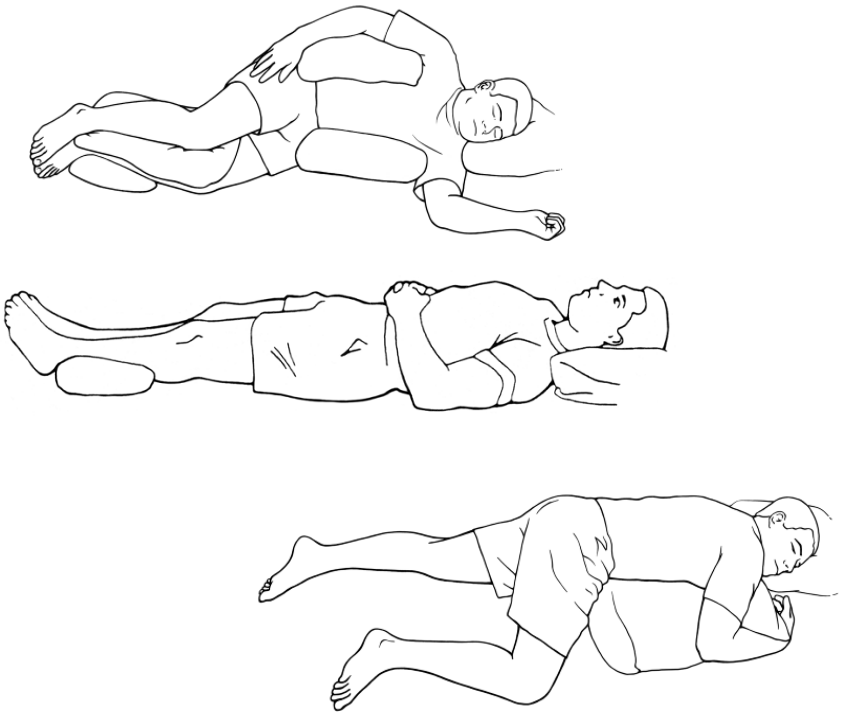
Introduction to Spinal Cord Injury





Individuals should perform an approved pressure relief (forward lean, lateral lean, press up, or tilt back to at least 65 degrees) every 30 minutes and hold for at least 2 minutes when sitting upright for adequate return of blood flow the area at risk.

Individuals should initially change position every two hours when in bed.

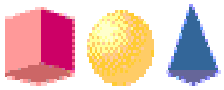


Individuals should be using an approved pressure compensating cushion when sitting up on any surface (especially in wheelchair) and should be maintaining a diet with adequate protein.

The seating clinic are CR-Main (704-355-4325) offers pressure mapping services that can provide patients with biofeedback on optimal pressure reliefs and positioning that can be ordered by the doctor to help optimize wound healing or compliance/understanding of pressure.

g. **Osteoporosis**- Following a spinal cord injury, all individuals are at higher risk for developing osteoporosis. It is especially problematic to the femur (upper leg bone) just above the knee. Care should be taken when assisting individuals that have been injured for a few years when moving their legs (especially when twisting upper leg such as when crossing ankle over opposite knee i.e. during dressing) or when putting weight through the lower body (use of tilt table or standing frame).

h. **Heterotopic Ossification** – Sometimes following an injury to the central nervous system (brain or spinal cord) the body forms bone in soft tissues



which normally do not have it. It occurs in 20-25% of individuals that have had a spinal cord injury. It always occurs below level of injury. The hip is involved most frequently (70-97%), followed by the knee, elbow, shoulder, hand and spine. Treatment is limited. Care should be taken with stretching by avoiding aggressive movements to minimize trauma to the area which may exacerbate the extra bone growth, but maintain available range of motion as able. Once the bone growth has stabilized, surgical removal is one option if needed to restore functional range of motion.

IV. Community Resources

As an individual recovers from a spinal cord injury, access to community resources is very helpful. You as a healthcare professional may require additional resources to best manage your patient's care. The individual and their family or caregiver will need resources as well. There are many agencies and resources within each community that can help meet the needs of individuals with a spinal cord injury.
Some services are not available in all areas. The resources at Carolinas Rehabilitation can be accessed by referring to the Carolinas Rehabilitation Telephone Directory.

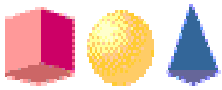
In addition to the community resources utilized by patients with other rehabilitation diagnoses that you currently treat, the following spinal cord injury specific sites will be helpful in accessing additional information:

A. Spinal Cord Injury Support Groups

Information for North Carolina groups is available through the North Carolina Spinal Cord Injury Association at (919) 350-4172 or www.ncscia.org

B. NC and SC Assistive Technology Programs

These state agencies offer the opportunity to test various adaptive equipment increase independence in communication, leisure/recreational participation, employment, or computer use.
North Carolina Website: www.ncatp.org
South Carolina Website: www.sc.edu/scatp/



B. Paralyzed Veterans Association

A national organization that provides, among other services, a wealth of information including free downloadable booklets written for both healthcare professionals and individuals with spinal cord injury and their families. Topics available include (but are not limited to): functional outcomes (listed by level of injury), treatment for pressure ulcers, preservation of UE function, bladder management, sexuality, respiratory management, depression, acute care management and autonomic dysreflexia. www.pva.org

C. American Spinal Injury Association (ASIA)

A membership based organization promoting research and education related to the treatment of spinal cord injury. It provides free forms for the motor and sensory classification of level of spinal injury. Quality e-learning resources are available for a fee. www.asia-spinalinjury.org

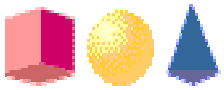
D. Christopher Reeve Foundation

An organization committed to providing education and resources to individuals dealing with a spinal cord injury. Among other services, they provide quality of life grants, resources and facts/figures related to SCI. www.christopherreeve.org

E. United Spinal Organization

A national non profit membership organization whose mission is to improve the quality of life of all Americans living with spinal cord injuries and disorders (SCI/D), including multiple sclerosis, spina bifida, Lou Gehrig's Disease (ALS), and post polio. www.unitedspinal.org

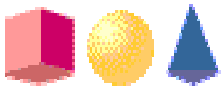
Introduction to Spinal Cord Injury



JOB AID

- The cervical spine innervates the muscles of the upper extremity and diaphragm. Injuries here result in tetraplegia.
- The thoracic spine predominantly innervates the muscles of the trunk. Injuries here result in paraplegia.
- The lumbar and sacral spine predominantly innervates the muscles of the lower extremity, bowel and bladder. Injuries here often result in LMN or flaccid paralysis.
- ASIA Impairment Scores classify injuries by the degree of preserved motor and sensory function and are divided into A, B, C and D where A is the most severe impairment and D is the least.
- Incomplete injuries (AISA B, C and D) can vary in their presentation based on where in the spinal cord the damage has occurred.
- Medical issues following a spinal cord injury are often typical of those faced by any other rehabilitation diagnosis with limited mobility but are exacerbated by the corresponding loss of sensation and pain perception.
- Autonomic Dysreflexia can be life threatening due to the sudden elevation in blood pressure. Check bladder, bowel and skin for any issue requiring attention and maintain an upright position to assist with lowering blood pressure.
- Pressure relief must be performed every 30 minutes for 2 minutes while in a seated position and every 2 hours when in bed.
- There are many online resources available specifically to provide information regarding spinal cord injury. Some of them provide valuable resources free of charge to both healthcare workers and survivors of spinal injury.

Introduction to Spinal Cord Injury



References:

- www.pva.org
- www.asia-spinalinjury.org
- www.christopherreeve.org
- Dunn, K. (2004) Identification and management of autonomic dysreflexia in the emergency department. Topics in Emergency Medicine, 26(3), 256-259
- Regan MA. Et al. A systematic Review of Therapeutic Interventions for Pressure Ulcers after Spinal Cord Injury. *Arch Phys Med Rehabil*. 2009:90:213-231.
- Coggrave MJ. Rose LS. A specialist seating assessment clinic: changing pressure relief practice. *Spinal Cord*. 2003:41:692-695
- Consortium for Spinal Cord Medicine. Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury: A clinical practice guideline for health care professionals. 2000. 1-62.

Introduction to Spinal Cord Injury

Posttest

Name: _____

Date: _____

Circle the correct answer.

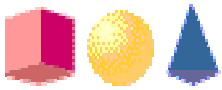
1. An injury to the cervical spine would result in which of the following deficits?
    a. Impaired respiratory ability
    b. Arm and hand weakness
    c. Impaired bowel and bladder function
    d. All of the above

2. Your patient presents with good upper body strength but cannot move his/her legs and cannot use the bathroom on his/her own. Sitting balance and trunk strength are very good. The most likely level of injury is where?
    a. Cervical spine
    b. Upper thoracic spine
    c. Lower thoracic spine or Lumbar spine
    d. Sacral or coccyx spine

3. Your patient has motor function preserved below their neurological level of injury and more than half of key muscle groups below that level have a muscle grade less than 3. Their injury is…
    a. AIS A
    b. AIS B
    c. AIS C
    d. AIS D

4. Your patient's arms are weaker than his/her legs. They most likely have which type of injury?
    a. Central Cord
    b. Anterior Cord
    c. Brown Sequard
    d. None of the above

5. Your patient is complaining of a sudden, severe headache and is sweating profusely. He/she may be experiencing which medical complication?
    a. Orthostasis
    b. Pulmonary embolism
    c. Autonomic dysreflexia



d. Heterotopic ossification

6. Your patient has heterotopic ossification in his/her hip. Which treatment approach is correct?
   a. Avoid all movement in that joint until the heterotopic ossification heals
   b. Stretch the joint gently but avoid aggressive movements
   c. Stretch the joint aggressively to achieve maximal range of motion
   d. Put a cast on the joint to protect the developing bone.

7. Pressure relief should be performed …
   a. Every 30 minutes for 2 minutes when sitting up in a chair
   b. Every 2 hours for 2 minutes when sitting up in a chair
   c. Every 2 hours when lying in bed
   d. A and C
   e. B and C

8. Which of the agencies below provide information to both healthcare workers and survivors of spinal cord injury?
   a. The Christopher Reeve Foundation
   b. The Paralyzed Veterans Association
   c. United Spinal Organization
   d. All of the above