

Spinal Cord Injury - Draft

Also called SCI, Quadriplegia, Paraplegia, Tetraplegia

Description of the Disability

A spinal cord injury is an injury to the major bundle of nerves that runs through the boney spinal column. Several factors affect the specific consequences of an SCI for each person, including how high up in the spinal column the injury happened, whether all or part of the spinal cord is damaged, and whether the nerves are pinched or severed. Many things can cause the initial injury, including infection, tumors, and traumas (automobile crashes, diving accidents, falls, etc.), but traumas are the most common. Damage caused by infection or secondary swelling and bruising will often improve with treatment or time, but damage from traumatic injuries is usually permanent. Traumatic injuries to the spinal cord can cause bruising, partial or complete tearing, and pinching of the spinal cord. These can cause a reduction or lack of sensation, voluntary control, and organ function below the level of the injury.

There are two kinds of significant injuries, or “lesions,” of the spinal cord - complete and incomplete. A **Complete Spinal Cord Lesion** is a broken or crushed place in the spinal cord nerve bundle that severs all of the nerves in the cord. Because nerves serving different parts of the body exit the spinal cord in sequence, each just slightly higher than the body part it serves, the higher the injury, the more parts of the body are affected "downstream." After a complete lesion, there is no feeling or voluntary movement below the place of the lesion. An **Incomplete Spinal Cord Lesion** happens when the spinal cord is damaged but not completely broken or crushed. After an incomplete lesion, the person usually still has some feeling and voluntary control of the body below the place of the lesion. The specific effects of an incomplete lesion are different from person to person because some nerve pathways passing through the site of the injury may be not be damaged while others are. In general, higher spinal cord injuries (cervical injuries) tend to be complete lesions and lower injuries (lumbar injuries) tend to be incomplete. Sometimes an injury that seemed to be complete right after the accident can turn out to be incomplete later when the swelling inside the spinal cord goes down.

In addition to the physical act of tearing involved with a lesion, swelling of the spinal cord right after the injury can also contribute to the nerve damage. The swelling and a decrease in blood pressure can starve the nearby nerve cells, causing a gap in the nerve circuit. Afterwards, scar tissue can form around the gap. The swelling and scarring can sometimes double the area of the original injury, increasing the severity of an incomplete lesion. For this reason, emergency medical staff try to reduce the swelling as soon as possible after a person experiences a spinal cord injury.

Quadriplegia (also called **Tetraplegia**) involves an injury high on the spine that causes the loss of some or all feeling and movement in a person’s arms and legs and everything in between. The person often has some use of their arms and may have limited use of their fingers.

Paraplegia involves an SCI farther down on the spine that causes the loss of some or all of the feeling and movement in a person's waist and legs. A person with paraplegia may or may not

have problems with “trunk control” – the ability to hold their upper body steady, lean forward and back, etc. Some individuals with paraplegia may be able to stand or even walk short distances.

For a person with an SCI, limited feeling and movement in part of the body can mean several things. The person may have complete feeling and control of, for example, the outside/top of their arms, but not the inside/bottom and hands. They may be able to move their fingers in a general way, but not have fine motor control. They may be able to feel and move some fingers and not others. If the person has limited control of their leg, they may be able to raise their leg but not press down with it. Or they may have control and feeling in one leg but not the other. There are many variations and the consequences for each person are unique.

Anatomy of the Spine and the numbering of SCIs

The spine, or “vertebral column”, is a stack of many ring- or collar-shaped bones called vertebrae sitting on top of each other. These vertebrae support the body and wrap protectively around the spinal cord. The spinal cord is a bundle of nerves that runs down the column through a hole in the middle of each vertebra. Motor and sensory nerves branch off at different parts of the body and carry signals between the brain and different parts of the body controlling feeling and movement.

Physicians group the 33 vertebrae into five types depending on their height: 8 cervical (at the top), 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal (at the bottom below the pelvis). Physicians letter and number these vertebrae for reference, starting at the top. So vertebrae C1 – C8 are the cervical vertebrae, T1 – T12 are the thoracic vertebrae, L1 – L5 are the lumbar, etc. Physicians then describe an SCI’s location by the code of the vertebrae where the injury happened. For example, a C5-6 injury is high up in the spine, while an L2 injury is much lower.

Because nerves serving different parts of the body exit the spinal cord sequentially just slightly higher than the body part they serve, the higher the injury, the more parts of the body are affected downstream. Injuries that are very high up on the spine cause the most problems because they affect breathing. Injuries slightly lower on the spine will cause problems with both upper and lower parts of the body, including organ function. Injuries lower on the spine only cause problems with the lower part of the body. So a complete C3 injury will probably mean the person will have quadriplegia and need a ventilator to help them breathe. A complete C5-6 injury will probably mean the person has quadriplegia but has limited use of his or her arms. A complete T7-8 injury will mean the person has paraplegia.

Related Medical Complications

Skin Care. Damage to the spinal cord means the loss of the ability to detect heat, cold, and pressure in parts of the body. Besides not being able to feel these things, it is difficult for someone with an SCI to shift their body easily to relieve potential pressure or temperature problems. This can lead to “**pressure sores**” or “**decubitus ulcers**” - places where some of the skin has died because the pressure of sitting or laying on it for a long period blocked the blood flow. The skin will grow back if the blood gets to it, but until then there is a hole, or ulcer, there

and it can get infected. This can become a very serious problem and may make the person miss work. It may even lead to the need for reconstructive surgery. It is important for the person to spend time out of the wheelchair, to shift positions (either on their own or with help), and to check regularly for sores.

Spasticity. Many people with SCI experience muscle spasticity (muscle twitches or spasms) below the level of the injury. Although the nerve connections to the brain are blocked, there are still reflex arcs that operate inside the lower spinal cord, like the arc that makes you kick when the doctor taps your knee. Some of these reflex arcs would normally be mediated by overriding signals from the brain, but after an SCI they can sometimes set up cycles of involuntary muscle twitches or spasms. Some spasticity can be good because it helps keep the muscles toned even if the person does not have voluntary control over them. But too much spasticity can cause problems with transferring between seats, beds, or vehicles, and can increase the likelihood of falling. They can also be embarrassing for the person and, in extreme cases, actually push the person out of their wheelchair or bed. A few people report that they are uncomfortable, too, almost like an itching or tingling. Some people take medications such as Baclofen to help control spasticity (see drug entry on Anti-spasticity Drugs).

Bowel and Bladder Functioning. For most people with an SCI, the injury will affect their bowel and bladder functioning. Depending on the level of injury, the person may not be able to reflexively empty his or her bowels and bladder. They may either wear a catheter or adult diapers or they may require assistance with a management program to manually empty the bowel and bladder. Vocationally, it is important to know that these management programs are necessary and take time. If the person needs assistance, they need to make sure they have reliable personal care assistants.

A person with an SCI is especially vulnerable to infections in the genitourinary system. Without the ability to feel when the bladder is full or empty, the person will not automatically know when to urinate or when the bladder is completely emptied after urination. If the bladder is not completely emptied, the remaining urine can become a growth medium for bacteria, leading to a bladder infection. Improper cleaning of a catheter can also introduce bacteria into the system. In addition, immediately after an SCI there is often an increase in calcium in the blood from adjustments in bone metabolism (see Bone Metabolism below), and the extra calcium builds up in the urine, which can lead to the formation of kidney stones. In the past these problems could be fatal. Today proper care and prevention make them more manageable.

Autonomic Dysreflexia. This is an abnormal and dramatic increase in blood pressure. It can happen to anyone with an SCI higher than T7. Your body has a number of "autonomic" nerve functions that control things over which you do not have voluntary control, such as heartbeat, body temperature, and blood pressure. In people with an SCI, the autonomic nervous system's control of the blood pressure sometimes gets abnormally stimulated and gets out of control. It usually happens because of a "noxious stimuli" – something that would have been painful to the person if they could feel it. These stimuli can include an overfull bladder, a urinary infection, an infected or impacted bowel, pressure sores, very tight clothing, menstrual cramps, acute abdominal conditions such as peritonitis or an ulcer, severe sunburn, scalding, and other situations. If the blood pressure is not brought under control, it can lead to a stroke or death.

Usually removal or treatment of the stimulus will correct the situation, but sometimes it takes medication. Symptoms of Autonomic Dysreflexia include:

- Intense, pounding headache
- Flushed face
- Sweating and red blotches on the skin above the level of injury
- Clamminess and goosebumps below the level of injury
- Nausea
- Slow heartbeat (less than 60 beats per minute)

It is important that coworkers understand this is a serious medical situation that must be handled immediately.

Respiratory Infections. A person with a cervical (neck) SCI or a high thoracic SCI may have problems breathing and clearing their lungs by coughing. The problems may or may not cause constant, daily difficulty, but they can make the person vulnerable to respiratory infections. If the person is not able to cough hard enough to clear their lungs, mucus can accumulate in the lungs, providing a home for bacteria to grow. Most people with an SCI learn how to deal with these problems before they leave the hospital, but it is important for others to be aware of the risk. Many people with SCIs take antibiotics regularly to help prevent respiratory infections and bladder infection.

Bone Metabolism. Most people lose bone mass (osteoporosis) soon after experiencing an SCI. This increases their risk for broken bones. Some people with an SCI also experience **Heterotopic Ossification (HO)** - a build up of bone in the soft tissues of joints. HO can cause pain and limited range of motion, leading to problems dressing, eating, working, etc.

Chronic Pain. Many people with an SCI experience chronic pain in the affected areas, even when they have lost all touch sensation in those areas. Researchers do not know a lot about why this pain happens and it may be related to the phantom limb pain of amputees. For some people the pain decreases over time, but for others it does not. For more information, see the entries on Chronic Pain and on Amputations.

Sexual Issues. Although not directly related to vocational issues, it is important to realize that people with SCI still feel sexual urges and pleasure, and still engage in sexual activity. It is entirely possible for a woman with an SCI to become pregnant or for a man with an SCI to become a father.

Psychosocial Issues. The psychosocial aspects of SCI are complex, vary from individual to individual, and do not necessarily relate to the level of injury. For example, someone with a low SCI (thoracic or lumbar) may or may not have more difficulty adjusting than someone with a high SCI (cervical). Adjustment and grieving over the changes in ones life have less to do with the level or type of injury than with the person's outlook and interpretation of the experience. In

addition to the initial adjustments to injury, a person must continually make adjustments throughout their life, so they may periodically re-experience the grieving process.

Not surprisingly, people with an SCI are more likely than others to experience depression afterwards as they deal with all the medical, functional, and social changes in their life. There is often a normal, healthy process of grieving over the changes in their lifestyle as the person adjusts. Family members may also grieve over the changes. However, in some cases the person may need professional help to move past the grief and depression. In addition, someone with an SCI may occasionally need help facing additional adjustments throughout the rest of his or her life.

Possible Coexisting Conditions

- Traumatic Brain Injury (TBI) (may not be diagnosed in the urgency of treating the SCI)
- Substance abuse

Incidence Statistics

- Between 250,000 and 400,000 people in the U.S. have spinal cord injuries
- There are 10,000 new injuries each year
- 89% of people experiencing an SCI are able to return home after rehabilitation
- People between the ages of 16 and 30 have the highest SCI injury rate. This age group accounts for around 60% of all SCIs.
- There has been an increase in incidence of SCI among people age 60 years or older
- 82% of people who experience SCI are male
- Motor vehicle accidents cause almost 50% of spinal cord injuries
- 52% of injuries are at the cervical level
- Fewer people are experiencing complete quadriplegia than in the past and more are experiencing incomplete paraplegia.
- 34% of people with paraplegia have jobs, 24% of people with quadriplegia have jobs
- 57% of people who acquire an SCI are employed at time of injury
- Compared to other successfully employed VR clients, people with SCI tend to be older at the time of application and at the time of closure, spend longer in service, and need more expensive services.
- Persons with paraplegia or an incomplete SCI are more likely to find employment post-injury than those with quadriplegia.
- Persons with an SCI are slightly less likely to get married than the rest of the population, and slightly more likely to divorce if they do marry or were married before the injury.

- The average length of inpatient rehabilitation after an SCI is 52 days. After inpatient rehabilitation, about 24% of people enter outpatient rehabilitation.

Common Treatments, Medications, and Side Effects

A person will often make functional improvements for at least six months following the initial spinal cord injury. There is controversy over how much improvement a person may show after six months. Functional issues remaining a year after the injury are probably permanent, but this is an area of ongoing research.

During this initial recovery period, the person will usually get training in managing the different aspects of their post-injury life – bladder and bowel management, decubitus ulcer prevention, diet restrictions, adaptive driving, transfers (bed to wheelchair, wheelchair to care)etc. Discharge planning often involves plans for home modification, connection with community supports groups, and other resources including VR. Some physical rehabilitation programs have independent living units in which the person can practice self-care skills before they go home.

Possible Functional Issues

As with all disabilities, functional issues are different from person to person. Even injuries at the same level may have completely different consequences for different people.

- No walking, use of wheelchair
- Limited or no use of arms
- Difficulty breathing, susceptibility to respiratory problems
- Reduced endurance
- Chronic pain
- Difficulty regulating body temperature in warm or cold environments
- Reduced or limited coordination
- Need for assistance with activities of daily living, including bowel and bladder functions
- Difficulty "transferring": moving oneself from one "seat" (wheelchair, car seat, toilet, bed) to another
- Reduced strength
- Increased fatigue when moving from place to place around town
- Reduced trunk control, posture
- Limited ability to stand or walk is possible
- Learning and problem-solving skills usually not affected
- Social skills usually not affected

- Driving may or may not be a challenge

Initial Interview Considerations

Initial Questions

- How medically stable is the person? Are there any recurring medical issues causing problems?
- When was the last time the person had problems with decubitus ulcers? How common are ulcers for them? (gets at medical stability and ability to manage activities of daily living)
- How stable is their personal attendant situation? How often do they have to change attendants?
- How often, if at all, do they drive a vehicle themselves?
- How tiring is it for the person to travel around town? Do they enjoy it?
- How easily do they get tired in general? Would working all day be a challenge?
- How has the SCI affected their ability to work?
- What accommodations have turned out to be particularly helpful?
- How much use of the upper extremities does the person have?
- How long, if at all, can the person stand or walk?
- What specific tasks cause problems for the person?
- What does the person do on a typical weekend? (gets at other interests, abilities)
- How difficult is writing for the person?
- How difficult is using a computer for the person? How familiar are they with computers?
- How much difficulty do they have handling changes in air temperature?
- How much difficulty do they have with transfers (moving from the wheelchair to a car, to a chair, etc.)?

Initial Observations

- How is the person's posture and trunk control?
- How well can the person write to fill out or sign forms?
- Is their wheelchair in good repair? Does it need to be upgraded?
- Does anyone accompany the individual to the interview? With what types of things does the companion help? Are there things that the companion does that could be done by the client with the right accommodations?

Interview Accommodations (if any)

- Make sure the interview location is physically accessible

- Have someone available to help the person fill out forms if they would like assistance
- If you have a respiratory infection or cold, be sure to call the person ahead of time and warn them. Respiratory infections can be serious challenges for someone with an SCI. Give them the opportunity to reschedule.

Possible Accommodations and Assistive Technology

- A personal care assistant at work to assist with grooming, toileting, eating
- A service animal to assist with some office activities
- Flexible scheduling (may be needed if the person uses public transportation, among other reasons)

Work station accommodations:

- Desk raised on blocks to accommodate wheelchair
- Forms and files in locations the person can easily reach
- Frequently used supplies on shelves that the person can reach
- Mechanical page turners and book holders
- Writing aids
- Office machines that can be operated from a seated position
- Adaptive phones, including features like voice activation, large buttons, automatic dialing, and headsets
- Alternative access features for computers, including speech recognition, trackballs, keyguards, alternative keyboards, mouth sticks
- Furniture and equipment arranged so the person can easily maneuver the area
- Walkways with proper access (at least 36" for one-way traffic, 60" for two-way traffic, and 32" for doors)
- Accessible restroom facilities
- Carpet pile less than ½ inch
- Changes in floor level indicated by a visual and texture change
- Doors with easy-to-grasp
- Emergency/rescue procedures in place

Career Planning Issues

- It is very important that the person is able to manage his or her medical needs, personal assistance needs, transportation needs, and other issues. These skills and supports must be in place if the person is going to have a successful career. Examination of the person's medical history may give a sense of his or her medical stability. If something is recurring regularly, such as pressure sores or bladder infections, the person may need extra training or support to stabilize the situation.
- Because most people with SCI acquire their injury between the age of 16 and 30, many are entering the workforce for the first time. Those who have worked before their injury may have jobs based on physical skills they can no longer perform, leading them to feel a similar sense of entering the workforce for the first time.
- Accessibility and accommodations in the workplace and community will be a significant consideration. It may be useful to tell potential employers that more than half of the workplace accommodations for individuals with SCI cost less than \$500. In addition, there are tax incentives to help employers reach ADA compliance if major expenses are involved.
- Employers sometimes fear that accommodations for people using wheelchairs will be quite expensive. Information from the Job Accommodations Network indicates that over half of all accommodations cost less than \$500. Employers are not responsible for providing a personal care assistant, however, they may be responsible for certain accommodations which allow a person to take care of his personal needs. Each person obviously has different abilities and limitations; therefore, the following is only a sample of possible accommodations:

Emerging Issues

- Research into containing the damage that comes after the initial injury, inducing nerve regeneration in the spinal cord, and advancing technology and therapies to enhance remaining function

Additional Information Resources

- Job Accommodations Network: www.jan.wva.edu
- National Spinal Cord Injury Association: www.spinalcord.org
- Spinal Cord Injury Information Network: www.spinalcord.uab.edu
- Spinal Cord Injury Resource Center: www.spinalinjury.net