

# Understanding SCI & Functional Goals

Any damage to the spinal cord is a very complex injury. People who are injured are often confused when trying to understand what it means to be a person with a spinal cord injury (SCI). Will I be able to move my hands? Will I walk again? What can I do? Each injury is different and can affect the body in many different ways.

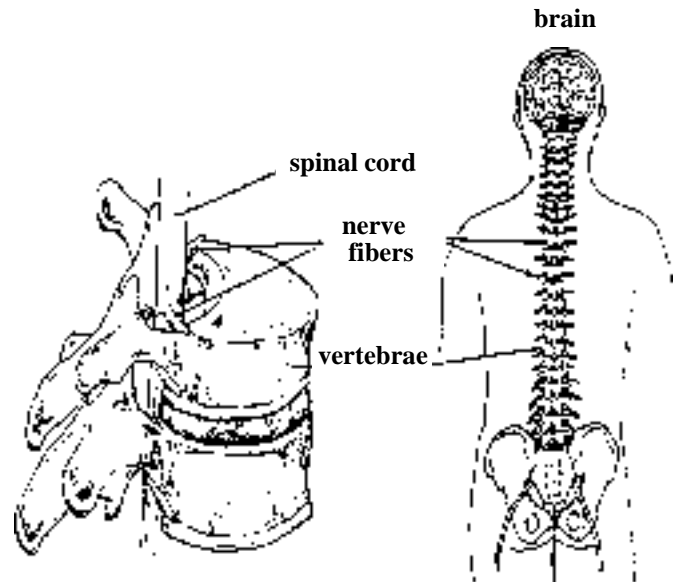
This is a brief summary of the changes that take place after a spinal cord injury. It tells how the spinal cord works and what some of the realistic expectations are for what a person should eventually be able to do following a spinal cord injury. Included is a chart of functional goals for specific levels of injury as well as additional information resources.

## THE NORMAL SPINAL CORD

The spinal cord is a part of your nervous system. It is the largest nerve in the body. Nerves are cord-like structures made up of many nerve fibers. The spinal cord has many spinal nerve fibers that carry messages between the brain and different parts of the body. The messages may tell a body part to move. Other nerve fibers send and receive messages of feeling or sensation back to the brain from the body, such as heat, cold, or pain. The body also has an autonomic nervous system. It controls the involuntary activities of the body; such as, blood pressure, body temperature, and sweating.

The nerve fibers that make up the communication systems of the body can be compared to a telephone system. The telephone cable (spinal cord) sends messages between the main office (the brain) and individual offices (parts of the body) over the telephone lines (nerve fibers). The spinal cord is the pathway that messages use to travel between the brain and the other parts of the body.

Figure A

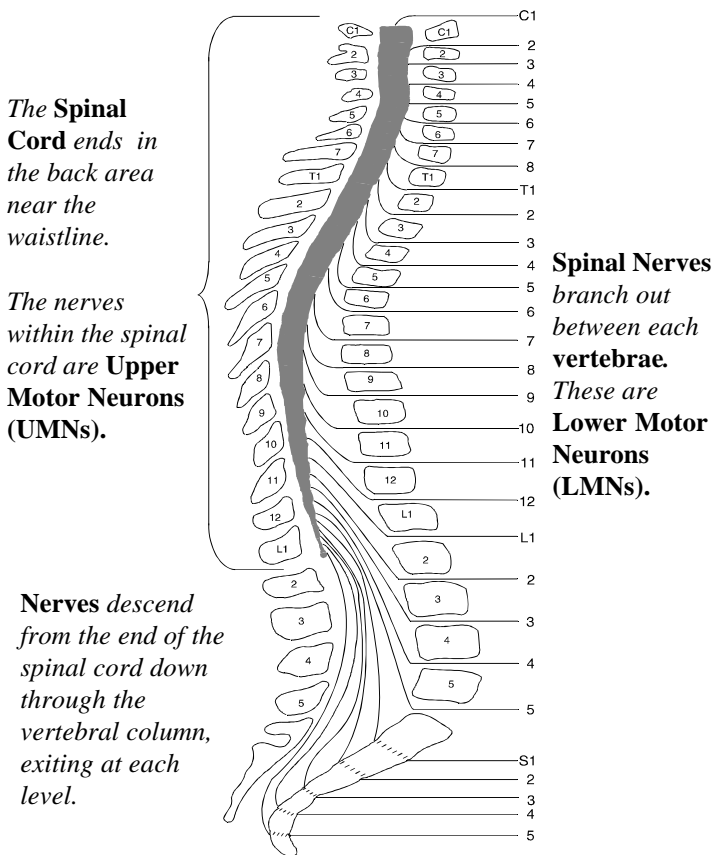


*The spinal cord goes through the center of the stacked vertebrae. These bones protect the spinal cord. The nerve fibers branch out from the spinal cord to other parts of the body.*

Because the spinal cord is such an important part of our nervous system, it is surrounded and protected by bones called vertebrae. The vertebrae, or backbones, are stacked on top of each other. This is called the vertebral column or the spinal column. The vertebral column is the number one support for the body. The spinal cord runs through the middle of the vertebrae [See Figure A].

The spinal cord is about 18 inches long. The cord extends from the base of the brain, down the middle of the back, to about the waist. The bundles of nerve fibers that make up the spinal cord itself are Upper Motor Neurons (UMNs). Spinal nerves that branch off the spinal cord up and down the neck and back are lower motor neurons (LMNs). These nerves exit between each vertebrae and go out to all parts of the body. At the end of the

**Figure B**



spinal cord, the lower spinal nerve fibers continue down through the spinal canal to the sacrum, or tailbone. [See Figure B]

The spinal column is divided into four sections. The top portion is the cervical area. It has eight cervical nerves and seven cervical vertebrae. Moving down the back, the next section is the thoracic area. It includes the chest area and has twelve thoracic vertebrae. The lower back section is the lumbar area and has five lumbar vertebrae. The bottom section has five sacral vertebrae and is the sacral area. The bones in the sacral section are actually fused together into one bone.[See Figure C]

**THE SPINAL CORD AFTER AN INJURY**

Damage to the spinal cord can occur from either a traumatic injury or from a disease to the vertebral column. In most spinal cord injuries, the backbone pinches the spinal cord, causing it to become bruised or swollen. Sometimes the injury may tear the spinal cord and/or its nerve fibers. An infection or a disease can result in similar damage.

After a spinal cord injury, all the nerves above the level of injury keep working like they always have. From the point of injury and below, the spinal cord nerves cannot send messages between the brain and parts of the body like they did before the injury.

The doctor examines the individual to understand what damage has been done to the spinal cord. An X-ray shows where the damage occurred to the vertebrae. The doctor does a “pin prick” test to see what feeling the person has all over his body (sensory level). The doctor also asks, “what parts of the body can you move?” and tests the strength of key muscle groups (motor level). These exams are important because they tell what nerves and muscles are working.

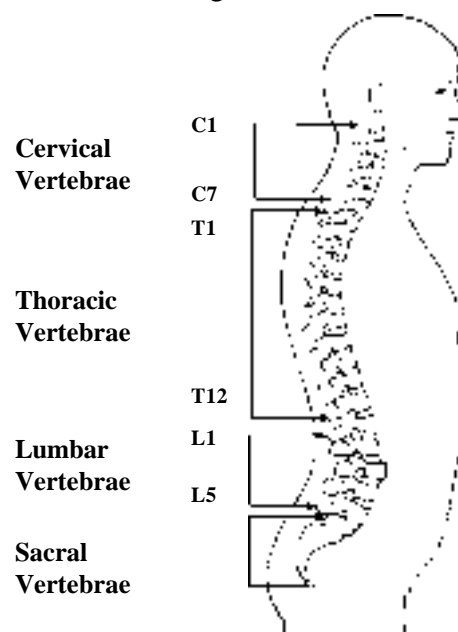
Each spinal cord injury is different. A person’s injury is described by its **level** and **type**.

**LEVEL OF INJURY**

The level of injury for a person with SCI is the lowest point on the spinal cord below which there is a decrease or absence of feeling (the sensory level) and/or movement (the motor level).

Tetraplegia [formerly called quadriplegia] generally describes the condition of a person with a

**Figure C**



*The vertebrae are numbered and named according to their location in the vertebral column.*

spinal cord injury that is at a level from C1 to T1. This individual can experience a loss of feeling and/or movement in their head, neck, shoulder, arms and/or upper chest.

Paraplegia is the general term describing the condition of a person who has lost feeling and/or is not able to move the lower parts of his/her body. The body parts that may be affected are the chest, stomach, hips, legs and feet. An individual with a level from T2 to S5 has paraplegia.

The higher the spinal cord injury is on the vertebral column, or the closer it is to the brain, the more effect it has on how the body moves and what one can feel. More movement, feeling and voluntary control of the body's systems are present with a lower level of injury. For example, a person with a C-5 level of injury has a decrease or loss of feeling and movement below the 5th cervical spinal cord segment. An injury at the T-8 level means the individual has a decrease or loss of feeling and movement below the eighth thoracic spinal cord segment. Someone with a T-8 level of injury would have more feeling and movement than someone with a C-5 level of injury.

## **COMPLETE OR INCOMPLETE INJURY**

The amount of feeling and movement that an individual has also depends on whether the injury is complete or incomplete. A complete injury means there is no motor or sensory function in the S4 or S5 area, or anal area. If there is evidence of any motor or sensory function in this area, one of three incomplete injury classifications is given.

Some people with an incomplete injury may have feeling, but little or no movement. Others may have movement and little or no feeling. Incomplete spinal injuries differ from one person to another because the amount of damage to each person's nerve fibers is different. This fact makes it impossible to accurately predict how much of an individual's sensory and motor function will return. There is a greater chance of return of some or all of a person's motor and sensory function if an individual is incomplete at the time of injury.

## **CHANGES AFTER THE INITIAL INJURY**

Sometimes the spinal cord is only bruised or swollen after the initial injury. As the swelling goes down, the nerves may begin to work again. There are no tests at this time to tell how many nerves, if any, will begin to work again or when this will occur. This makes it impossible for medical staff to guarantee how much or when function may return.

Some individuals have involuntary movements, such as twitching or shaking. These movements are called spasms. Spasms are not a sign of recovery. A spasm occurs when a wrong message from the nerve causes the muscle to move. The individual often can not control this movement.

In addition to movement and feeling, a spinal cord injury affects how other systems of the body work. An individual with SCI learns new ways to manage his/her bladder and bowel. His/her skin and lungs often need special care and attention to stay healthy. There may also be changes in sexual function.

## **FUNCTIONAL GOALS**

Functional goals are a realistic expectation of activities that a person with spinal cord injury eventually should be able to do with a particular level of injury. These goals are set during rehabilitation with the medical team. They help the individual with SCI learn new ways to manage his/her daily activities and stay healthy.

Achievement of functional goals can also be affected by other factors, such as an individual's body type and health related issues. By striving to reach these functional goals, the hope is to give individuals with SCI the opportunity to achieve **MAXIMUM INDEPENDENCE**.

The chart, "*Functional Goals for Specific Levels of Complete Injury*", shows the expected functional goals for a person with a complete injury at a particular level. Motor and sensory functions improve with lower levels of injury.

## Resources

Consortium for Spinal Cord Medicine. *Outcomes following traumatic spinal cord injury: Clinical practice guidelines for health-care professionals*. 1999. [Available on [www.pva.org/prof/9811cpgs/trauma.htm](http://www.pva.org/prof/9811cpgs/trauma.htm)].

Corbet B, Dobbs J, and Bonin B. *Spinal Network: The Total Wheelchair Book*, 3rd Ed. 1998. [Available from: Spinal Network, P.O. Box 8987, Malibu, CA 90265-8987. 800-543-4116  
Online: <http://www.newmobility.com/bookstore/>].

Hammond M, Umlauf R, Matteson B, and Perduto-Fulginiti S. *Yes, You Can! A Guide to Self-Care for Persons with Spinal Cord Injury*. 2<sup>nd</sup> Ed. Washington, DC: Paralyzed Veterans of America, 1993. [Cost: \$12 Order from PVA].

*International Standards for Neurological and Functional Classification of SCI*, Rev. 2000. [Available from: American Spinal Injury Association. Online: [http://www.asia-spinalinjury.org/publications/2001\\_Classif\\_worksheet.pdf](http://www.asia-spinalinjury.org/publications/2001_Classif_worksheet.pdf)].

*An Introduction to Spinal Cord Injury: Understanding the Changes*, 1998 Ed. [Available from: Paralyzed Veterans of America. Cost: First copy free, additional are \$1.50. Online: <http://www.pva.org/sci/98scigd/98scigd1.htm>].

Kirshblum SC and O'Connor KC. *Levels of spinal cord injury and predictors of neurologic recovery*. In: Kraft GH and Hammond MC, eds. **Physical Medicine and Rehabilitation Clinics of North America, Topics in Spinal Cord Injury Medicine**. Philadelphia: W.B. Saunders Co., 2000; 11(1):1-28.

*Learning about Spinal Cord Injury*. 1991. Booklet. Available from Medical RRTC on Secondary Conditions of SCI. [Cost: \$3 +s/h].

*"Locating Information About SCI" Spinal Cord Injury InfoSheet #1*. Level - Consumer. [Available from RRTC on Secondary Conditions of SCI. Online: <http://main.uab.edu/show.asp?durki=21479> or via FAX: 205-975-8376 / #101].

*Spinal Cord Injury: Facts and Figures at a Glance*. January 2000. National Spinal Cord Injury Statistical Center. Birmingham, AL. [Available at [www.spinalcord.uab.edu/show.asp?durki=21446](http://www.spinalcord.uab.edu/show.asp?durki=21446) ].

*Spinal Cord Injury Patient Education Manual*. 1998. [Available from Penn State Geisinger Rehabilitation Center, 500 University Dr., Hershey, PA. 17033 717-531-8521. Online: <http://www.collmed.psu.edu/sciweb/>].

*Take Control: Multimedia Guide to Spinal Cord Injury- Vol.1*. 1996. [CD-Rom programs Available from Arkansas Spinal Cord Commission, 1501 N University Ste 400, Little Rock, AR 72202, 501-296-1788, Email: [arksc@aol.com](mailto:arksc@aol.com) ].

### ORGANIZATIONS:

American Spinal Injury Association  
345 East Superior Ave, Rm 1436  
Chicago, IL 60611  
312-238-1242  
<http://www.asia-spinalinjury.org>

National Spinal Cord Injury Association (NSCIA)  
6701 Democracy Blvd, Ste 300  
Bethesda, MD 20817  
800-962-9629  
Email: [resource@spinalcord.org](mailto:resource@spinalcord.org)  
<http://www.spinalcord.org>

Paralyzed Veterans of America  
801 18<sup>th</sup> St NW, Washington, DC 20006  
800-424-8200  
Email: [info@pva.org](mailto:info@pva.org)  
<http://www.pva.org>

RRTC on Aging with Spinal Cord Injury  
Rancho Los Amigos Medical Center  
7601 E Imperial Hwy, 800 West Annex  
Downey, CA 90242-3456  
562-401-7402  
<http://www.agingwithsci.org>

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## Spinal Cord Injury - Functional Goals for Specific Levels of Complete Injury

Level	Abilities	Functional Goals
C1-C3	C3-limited movement of head and neck	<p><b>Breathing:</b> Depends on a ventilator for breathing.</p> <p><b>Communication:</b> 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 the person's daily activities, like bathing, dressing, personal hygiene, transferring as well as bladder and bowel management.</p> <p><b>Daily tasks:</b> Assistive technology allows for independence in tasks such as turning pages, using a telephone and operating lights and appliances.</p> <p><b>Mobility:</b> Can operate an electric wheelchair by using a head control, mouth stick, or chin control. A power tilt wheelchair also for independent pressure relief.</p>
C3-C4	Usually has head and neck control. Individuals at C4 level may shrug their shoulders.	<p><b>Breathing:</b> May initially require a ventilator for breathing, usually adjust to breathing full-time without ventilatory assistance.</p> <p><b>Communication:</b> Normal.</p> <p><b>Daily tasks:</b> With specialized equipment, some may have limited independence in feeding and independently operate an adjustable bed with an adapted controller.</p>
C5	Typically has head and neck control, can shrug shoulder and has shoulder control. Can bend his/her elbows and turn palms face up.	<p><b>Daily tasks:</b> Independence with eating, drinking, face washing, brushing of teeth, face shaving and hair care after assistance in setting up specialized equipment.</p> <p>Health care: Can manage their own health care by doing self-assist coughs and pressure reliefs by leaning forward or side -to-side.</p> <p><b>Mobility:</b> May have strength to push a manual wheelchair for short distances over smooth surfaces. A power wheelchair with hand controls is typically used for daily activities.</p> <p>Driving may be possible after being evaluated by a qualified professional to determine special equipment needs.</p>

Level	Abilities	Functional Goals
C6	Has movement in head, neck, shoulders, arms and wrists. Can shrug shoulders, bend elbows, turn palms up and down and extend wrists.	<p><b>Daily tasks:</b> 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.</p> <p><b>Health care:</b> Can independently do pressure reliefs, skin checks and turn in bed.</p> <p><b>Mobility:</b> 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.</p>
C7	Has similar movement as an individual with C6, with added ability to straighten his/her elbows.	<p><b>Daily tasks:</b> Able to perform household duties. Need fewer adaptive aids in independent living.</p> <p><b>Health care:</b> Able to do wheelchair pushups for pressure reliefs.</p> <p><b>Mobility:</b> Daily use of manual wheelchair. Can transfer with greater ease.</p>
C8-T1	Has added strength and precision of fingers that result in limited or natural hand function.	<p><b>Daily tasks:</b> Can live independently without assistive devices in feeding, bathing, grooming, oral and facial hygiene, dressing, bladder management and bowel management.</p> <p><b>Mobility:</b> Uses manual wheelchair. Can transfer independently.</p>
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><b>Daily tasks:</b> Should be totally independent with all activities.</p> <p><b>Mobility:</b> 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>
T7-T12	Has added motor function from increased abdominal control.	<p><b>Daily tasks:</b> Able to perform unsupported seated activities.</p> <p><b>Mobility:</b> Same as above.</p> <p><b>Health care:</b> Has improved cough effectiveness.</p>
L1-L5	Has additional return of motor movement in the hips and knees.	<p><b>Mobility:</b> 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.</p>
S1-S5	Depending on level of injury, there are various degrees of return of voluntary bladder, bowel and sexual functions.	<p><b>Mobility:</b> Increased ability to walk with fewer or no supportive devices.</p>