Walking After Spinal Cord Injury

This factsheet describes the factors that help to determine or predict whether a person with an SCI may walk again. It gives an overview of the different categories of walking ability. Finally, it talks about treatments to improve walking ability.

Introduction

After a spinal cord injury (SCI), people often ask whether they will be able to walk again. Whether a person will be able to walk after an SCI depends on many factors. This factsheet describes the factors that make walking more likely after SCI and the treatments that can help improve walking ability. It also discusses assistive devices (such as canes, walkers, or crutches) and braces that can help with walking after an SCI, as well as robotic exoskeletons for walking.

While walking is often a goal for people after an SCI, it is important to keep in mind that focusing only on walking can take time away from learning to use a wheelchair and other skills that people may need for a full and active life.[1] Most people who have some ability to walk after an SCI continue to use a wheelchair for some of their activities. They may use a wheelchair to get around outdoors and for long distances. Wheelchairs help many people with SCI to move around in places where it may be too slow or difficult to walk. A physical therapist (PT) or physiatrist can examine a person's strength, balance, and ability to feel and estimate whether walking may or may not be a practical goal for them. When walking is a practical goal, it can take a long time to relearn this skill as it challenges both physical and mental capabilities.

What Makes Walking So Difficult After SCI?

Walking is a complicated activity. When someone walks, signals from the brain travel down the spinal cord to activate the specific muscles needed for walking. Walking requires muscle strength, balance, coordination, sensation, joint movement, and a lot of energy. Because of these factors, the distance someone with SCI can walk may be limited. Soon after an SCI, it can be hard to know how much strength a person will get back. This makes it hard to predict how well (or how far) the person will be able to walk, or whether they will be able to walk at all. People with more strength in their legs are more likely to walk again than people with less strength in their leg muscles.

For people with paraplegia—SCI that causes weakness in the muscles of the trunk and legs—having strength in the muscles that lift the thigh (hip flexors) and the muscles that straighten the knee (knee extensors) makes it more likely they will be able to walk.[2]

For people with tetraplegia—SCI that causes weakness and decreased feeling in the arms/hands, trunk, and legs—it can be hard to predict future ability to walk.

The Model Systems Knowledge Translation Center works with Spinal Cord Injury Model System (SCIMS) centers to provide free research-based rehabilitation resources for people living with spinal cord injury (See https://msktc.org/sci for more information). This factsheet has been approved by experts from the SCIMS centers.

This is because weakness and decreased ability to feel can affect balance and arm/hand weakness may make it difficult to use assistive devices that help substitute for leg and trunk weakness.

While leg muscle strength can help predict whether a person will walk again after an SCI, this may not apply to people with an SCI below level T11 (mid to lower back region). People with SCI below T11 have a good chance of walking with assistive devices and braces because their SCI does not affect their trunk and arm muscles.

Safety

Falls during walking can be dangerous for people with SCI. Their bones may be more fragile than those of people without an SCI. If a person with an SCI can walk, then they should use the assistive devices and braces recommended for them. Individuals walking after SCI must stay alert to their surroundings and potential hazards, as different environments and rough terrain can pose unique challenges. Learning strategies to prevent and recover from falls are a top priority during walking, whether in daily life or therapy.

Variation in Walking Ability

Walking after an SCI can look different for everyone. How someone moves can also change depending on the distance or the environment. Some people may walk for therapy or exercise. This includes walking short distances using braces and assistive devices and may require the help of another person. These individuals use a wheelchair most of the time. Others may use a mix and walking and wheeling based on factors like time of day, their surroundings, fatigue, or pain. Some individuals can walk inside and outside the home using assistive devices such as canes, walkers, or braces. A smaller number may walk independently without any assistive devices, although they may still face limits in how far or how fast they can go.[3]

Predicting Walking at 1 Year After SCI

Data from the SCI Model Systems published in 2024 show that of people with SCI who completed their inpatient rehabilitation at an SCI Model System center, about one in three could walk one street block outside and four in 10 could walk 150 feet at 1 year after injury.[4] Whether someone will walk again after an SCI often depends on the severity of the injury. Severity means how much feeling (sensation) and muscle control (strength) is lost below the level of injury. This is sometimes described using the term “completeness.” (To learn more, see *Understanding Spinal Cord Injury: Part 1—The Body Before and After Injury* at https://msktc.org/sci/factsheets/understanding-spinal-cord-injury-part-1-body-and-after-injury.) The number of people with SCI who can walk tends to go down over time, especially several years after the injury.[4]

Usually, people who are younger and who have more strength and sensation early after their injury are more likely to walk again. However, it is hard to make accurate predictions. It is also important to know that different research studies define walking in different ways—such as walking a short distance, walking with help, or simply reporting whether someone walks or not. These definitions may not always match how someone actually moves and gets around in their daily life.

There are tools that help predict walking ability after SCI.[5-8] These tools often use information like a person’s age and their strength and sensation in the legs shortly after the injury. One tool uses completeness early after injury (within 2 weeks of injury) to predict walking at 1 year.[5] The table that follows shows the percentage of people in each injury completeness group who were walking at least 30 feet (10 meters) indoors by 1 year after their SCI.[5]

Initial completeness	% of people walking at 1 year
No sensation and no strength in the muscles below the level of injury	8%
Sensation but no strength in the muscles below the level of injury	38%
Sensation and more than half of the muscles below the injury are very weak	62%
Sensation and more than half of the muscles below the injury are reasonably strong	97%

It is important to remember that recovery after spinal cord injury is an ongoing process and can continue for a lifetime, but most studies only measure progress during the first year after injury.

What Treatments May Help Improve Walking Ability?

For people with SCI who can move their legs, training and exercises that strengthen the leg muscles and help with joint range of motion can sometimes improve the ability to walk. While strength and sensation are used to help predict the ability to walk, sufficient range of motion of the hips, knees, and ankles are also essential. For people whose leg muscles are strong enough to make walking a practical goal, there are two types of training that can help improve walking ability: gait training and locomotor training. The sections that follow describe these types of training.

Gait Training

Gait training is practicing walking with assistive devices or braces as needed. Assistive devices and/or braces can improve balance and stability, protect the leg joints, and make walking safer. Gait training helps people learn to use assistive devices in an efficient and safe way. It also helps to improve their balance and the timing and coordination of their steps. It helps them learn how to walk on different types of surfaces, such as tile, carpet, curbs and stairs, gravel, and grass.

Locomotor Training

Locomotor training involves practicing walking movements over and over again. The goal is to gain skill and speed with the leg movements needed for stepping. This training also seeks to improve balance and increase endurance for walking longer distances. Locomotor training can involve walking on a treadmill or walking on the floor (referred to as “overground”). Some therapy settings use a body weight support system. This is a harness and lift system that provides partial support for the weight of your body during locomotor training. Providing this support makes walking easier. As a result, people can get more practice with walking. Use of a body weight support system also helps with balance and fall prevention. Depending on the setting, people may use the body weight support system for training on a treadmill, overground, or both.

- **Treadmill-based locomotor training.** Locomotor training may start on a treadmill at a slow speed. The therapist may help a person move their legs during stepping. Some settings use a robotic exoskeleton to help move the legs while walking on the treadmill. Treadmill-based locomotor training often uses a body weight support (BWS) system as described above, or it can take place in a pool.

- **Overground locomotor training.** When a person with an SCI has enough leg strength to walk over ground, locomotor training can be performed overground. Overground training lets people practice their walking and balancing in the real world. Some therapy settings may initially combine this training with a BWS system.

What Devices May Help Improve Walking Ability?

For a person who can walk after an SCI, a PT helps determine the best assistive devices and/or braces. This is based on their leg strength, balance, and grip strength.

Assistive Devices

People with SCI may use many different assistive devices for gait training, including:

- **Walkers with or without wheels on the front legs.** Arm supports can be added for people with weakness in their hands.
- **Forearm crutches.** These are crutches with a cuff that goes around the forearm. They are also known as Lofstrand crutches.
- **Quad canes.** These are canes with four tips at the bottom.
- **Straight canes.** These are canes with a single tip at the bottom.

Braces

Braces may have many benefits. They may protect joints that lack strong muscle support. They can also keep joints in the proper position when a person puts weight on them during walking. They can also reduce the risk of falling by helping to keep the knees straight and the foot and toes up during stepping. They may also increase walking speed and distance. Braces are also known as “orthoses” or “orthotics.”

Braces may be plastic, metal, plastic and metal, or carbon fiber. They may be pre-made (“off-the shelf,”) or custom made to fit a person by an orthotist (a professional that makes and fits braces and splints) or physical/occupational therapist. People may wear them on one side only, or on both sides, and they may be for activity, at rest, or all of the time.

Common Types of Braces

People use different types of braces based on which leg muscles are weak. If the strength in each leg is different, then a person may need a different type of brace on each leg. People with SCI who have some ability to walk may use these types of braces:

- **Ankle foot orthoses (AFOs).** AFOs support the ankle and foot. They help lift the front of the foot off the ground during walking and support the ankle. Some are rigid and others can bend when taking a step with the opposite leg and in standing.
- **Knee ankle foot orthoses (KAFOs).** KAFOs support the knee, ankle, and foot. They help keep the knee from buckling during walking.
- **Hip knee ankle foot orthoses (HKAFOs).** HKAFOs support the lower trunk and all the joints of the leg. In general, people use HKAFOs for walking as exercise because they are tiring to use for long distances.

Electrical Stimulation

Electrical stimulation helps to activate muscles during walking. A common problem for people with SCI who can walk is “foot drop.” Foot drop is difficulty lifting the front of the foot, which results in the toes dragging on the ground. While AFOs can prevent foot drop, stimulation devices can activate the muscles that lift the front of the foot. Outside of the therapy setting, these foot drop stimulators are the most common type of stimulation used for walking. Newer stimulation devices allow for stimulation of not only the ankle but also the muscles of the hip and knee joints.

Robotic Exoskeletons

There is great interest in the use of robotic exoskeletons to help people with SCI walk. Right now, people mostly use exoskeletons in the therapy setting. However, they are becoming more common in the home and community as insurance coverage is available on a limited basis. Most of the exoskeletons that are currently available require the people who use them to also use assistive devices, such as crutches. In addition, people who use them must have a companion walk with them to assist with balance and in case of a fall. But some of the exoskeletons that are currently available or in development are self-balancing; that means that people do not need to use assistive devices. Most of the current exoskeletons can only walk over level ground, but some can walk up ramps and stairs. Exoskeleton technology continues to advance.

Summary

After an SCI, walking again is a goal for many people. With enough range of motion in their hips and legs, and the more strength and sensation that someone has in their legs, the more likely they are to walk. There are many types of training and devices available to help people reach this goal. Compared with walking, using a wheelchair can often be a safer and more efficient way to get around. Even for people with some walking ability, it may take time before their walking is strong or steady enough to use for daily activities or getting around in the community. During this time, using a wheelchair can help them stay active, safe, and independent. One should also think about the risk of falling. People with an SCI should work with a team that includes physical therapy and physiatry to help decide if walking is a practical goal.

Additional Resources

Understanding SCI | MSKTC: https://msktc.org/sci/sci-topics/understanding-sci

Exercise After Spinal Cord Injury (SCI) | MSKTC: https://msktc.org/sci/factsheets/exercise-after-spinal-cord-injury

Functional Electrical Stimulation (FES) for SCI | MSKTC: https://msktc.org/sci/factsheets/functional-electrical-stimulation-fes-sci

Strategies to Maintain Bone Health with SCI | MSKTC: https://msktc.org/sci/factsheets/bone-loss-after-spinal-cord-injury

Exoskeletal-Assisted Walking | MSKTC: https://msktc.org/sci/sci-topics/exoskeletal-assisted-walking

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Additional Reference

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Authorship

Walking After Spinal Cord Injury was developed by Edelle Field-Fote, PT, PhD; Kelly Thatcher, DPT, NCS; Jeanne Zanca, MPT, PhD; and Lynn Worobey, DPT, PhD, in collaboration with the Model Systems Knowledge Translation Center (MSKTC).

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