

Adapted Driving

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Key points

- After spinal cord injury (SCI), many people are still able to drive.
- In order to return to driving, an in-depth driving assessment needs to be conducted by a driving rehabilitation specialist or occupational therapist.
- There are many different types of modifications that can be made to a vehicle based on your needs and limitations.

Why is driving after SCI beneficial?

Being able to drive is an important skill that is helpful for day-to-day activities. Research has shown that being able to drive is related to many benefits, such as:

- Improved happiness with life
- Decreased depression
- Increased access to health vehicle services in the community
- Increased engagement in daily activities, such as running errands
- A greater sense of independence



In addition, research has found that driving is associated with being able to work post-SCI. After SCI, one of the biggest barriers to working is a lack of transportation. Being able to drive on your own can address this issue, and promote working.

How do I know if I can drive?

Many people can still drive after SCI. One study noted that many people with a C4 injury or below are able to independently drive. Although a formal driving assessment is often required before you are able to drive, some positive signs that you will be able to drive again include:

- Stable SCI – there are no changes to your function
- You don't need narcotics to control your pain
- Good vision/corrected vision
- Controlled muscle spasms
- Ability to transfer on and off a toilet

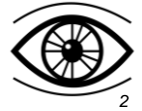
Research also shows that tetraplegics are able to drive as well as able-bodied individuals but have slower reaction times. Nonetheless, many people with SCI are able to drive.

What does a driving assessment look like?

Before getting on the road again, a formal driving assessment is often done by an occupational therapist or a driving rehabilitation specialist. During these assessments, the specialist will go over your medical history, driving history, and goals for driving. In addition, they will evaluate many aspects of your health and functioning, which include the following:

Vision

The specialist will assess if you are seeing things correctly with a vision test.



Physical abilities

Many aspects of your physical abilities will be assessed, including:

- The strength and amount of movement in your limbs for controlling the vehicle
- How much are you able to rotate your head and neck to check for vehicles
- How quickly you are able to react to other vehicles, pedestrians, and other objects on the road (i.e., your reaction time)
- Balance, which is used for getting in and out of the vehicle and being able to sit still while making turns
- Hand-eye coordination



Cognition

Driving requires a lot of focus. Some tests will be done to evaluate how well and fast your brain is working. Some of these include:

- Memory, which can influence remembering the rules of the road and navigating the road
- Visual processing, or how fast you understand and interpret what you see happening on the road
- Visual spatial abilities, or being able to identify where things are on the road and judging their distance
- Visual perception, or your brain's ability to make sense of what you see
- Attention, which is required for paying attention to the road
- Judgement and decision making, which are used in cases of knowing when to go/stop, when to switch lanes, etc.



Mood/behaviours

Mood and behaviours may also be evaluated during an assessment. Some traits may be red flags for driving, including being overly anxious on the road, being impulsive, and being highly irritable.



How will I learn to drive?

After you find out what kind of equipment you need to adapt your vehicle, you must learn to use it to drive in a safe manner. Driver rehab provides training and supervised practice using your newly modified vehicle. Some topics that may be covered in driver rehab include:

- How to use your adaptive driving equipment or perform different driving techniques
- Cognitive strategies to address issues with memory, attention, etc.
- Visual strategies to address perception, sight, etc.
- Anxiety management
- A reintroduction to the driving environment

Often, you will need to participate in driver rehab sessions until you are able to demonstrate proficiency with using your vehicle modifications under typical driving conditions. In some areas of the world, a road test may be required to get your full license.

What kind of vehicle can I drive?

Many vehicles can be adapted for driving after SCI. However, the ideal vehicle for you is dependent on your wants and needs. For example, paraplegics tend to transfer into the driver seat of the vehicle, while among tetraplegics, half will transfer to the driver's seat and half will drive in their wheelchair. If you are driving in your wheelchair, you will need a larger vehicle to accommodate the wheelchair. However, if you are transferring into the vehicle seat, you might want a vehicle that is closer to the ground for an easier transfer and wheelchair loading. Larger vehicles like trucks and SUVs may require extra equipment to help with transfers and wheelchair loading.

One study has looked at the measurements of various vehicles. In regards to the height between the ground and the driver seat, they found that the average height is:

- 22 inches for a sedan
- 28 inches for a mid-height vehicle (vans, small-medium SUVs)
- 36 inches for a high-profile vehicle (large truck or SUV)



Various types of vehicles including a mini-van (A), a sedan (B), and a truck (C).^{6,7,8}

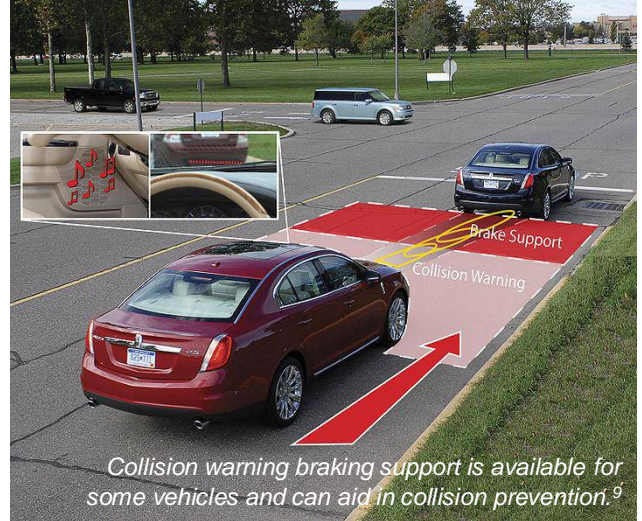
This study also found that the average difference in height between the driver's seat and wheelchair seat is 3.7 inches, and ranged from -3.5 inches to 16 inches. This means that for some vehicles, the wheelchair seat may be above the vehicle seat, while in others, they can be up to 16 inches below the vehicle seat. Your ability to transfer is a consideration in what kind of vehicle to buy. Other considerations include how much space you want in your vehicle, where you will be driving your vehicle, and how/where you will be storing your wheelchair if you plan on transferring into the driver seat of the vehicle.

What kinds of adaptations are available for my vehicle?

A vehicle can be adapted in many ways with the use of adaptive driving equipment, or technology used to make your vehicle more accessible. In general, driving is broken into 4 parts:

- 1) transferring in and out of the vehicle
- 2) loading your wheelchair
- 3) using primary controls (steering, accelerating, braking)
- 4) using secondary controls (e.g., controlling the windshield, signals, radio)

In addition, there are various safety features that can be added to the vehicle to help you drive if you have any limitations. Some driver rehabilitation centers will also complete a vehicle modification assessment. During this assessment, a driving specialist will help you select the equipment to get you and your wheelchair into the vehicle safely.



Transferring in and out of the vehicle

When getting in and out of your vehicle, the first consideration is whether you are able to transfer into the driver seat, or if you will stay in your wheelchair. Although it is possible to drive from your wheelchair, some additional considerations include:

- the original driver seat in the vehicle has been designed to withstand a vehicle crash, and is in an optimal position to be used with the air bag and seatbelt
- the seatbelt may not fit ideally when in your wheelchair due to the design of a wheelchair



Transferring from a manual wheelchair into the driver seat and manually loading the wheelchair

There are many ways to get into your vehicle from a wheelchair. The following is a general overview of the steps.

1. Transfer into the seat. This can be done using a transfer board, hanging onto a grab bar/handle, or placing a hand on the seat. Some people choose to transfer by placing their right leg into the vehicle before transferring, or they keep both their legs outside of the vehicle.



2. Decide where you will place your wheelchair: in the front passenger seat, or the back seats. Those with weaker shoulder muscles should consider loading their wheelchair into the front seats.
3. Remove the wheels from the wheelchair. This is commonly done by pressing the center button in the middle of the wheel. Place the tires in the vehicle.
4. Some people remove the cushion and the side guard from the wheelchair. Place these in the vehicle.
5. Load the wheelchair frame into the vehicle. Reclining the front seat can help you get the frame over your body and into the vehicle.



Driving from the driver seat

If you have difficulties with transferring or loading your wheelchair there are many adaptations that can be used. Swivel seats are seats that turn and come out of the vehicle, giving you more space to transfer in. Alternatively, a transfer seat can be used. A transfer seat can move up or down in height, can turn, and can be moved in the vehicle for more space. This is done by placing the original driver seat on top of a motorized plate. However, it is important to note that swivel seats are only compatible with some SUV's, trucks, and minivans, and transfer seats are only compatible with minivans or full sized vans. If you only need a bit of assistance getting in and out of a vehicle, additional grab bars can be installed into a vehicle.



Swivel-style car seats can come out of the car or turn inside of the car.^{13,14}

Driving from your wheelchair

If it is decided that it is best for you to drive from your wheelchair, you will need a wheelchair accessible vehicle. To have enough height for a wheelchair to enter, the vehicle is raised up and the floor is lowered. A ramp is then installed. It may come out from the floor or fold out. Once in your vehicle, it is important to make sure that your wheelchair is stiff enough to provide a stable driving platform, and will not move when you are driving.



Wheelchair tie downs should be used to secure the wheelchair when driving.¹⁶

Your wheelchair will also need to be secured in place while driving. This can be done with a manual locking system and the help of another person. There are also automated docking systems which anchors your wheelchair without the help of another person. These systems have an additional piece that connects to your wheelchair. The part on your wheelchair clicks

into the docking system on the floor of your vehicle. Automated docking systems are controlled electronically. A button installed in your vehicle releases the docking system lock. The part that attaches to your wheelchair weighs 10-19 lbs, and is permanently attached to your wheelchair. Many people using a manual wheelchair have a hard time managing the extra weight on the wheelchair, so this system is usually used with power wheelchairs.

Primary Controls (steering, braking, acceleration)

To help with steering and driving, different handles can be added onto the steering wheel. A spinner knob can be added to make it easier to control the steering wheel. For people with no hand function, a tri-pin add on may be helpful. A tri-pin handle consists of one larger straight



A spinner knob can be used to increase control when driving.¹⁷



Rods can be connected to the accelerator and brakes to allow for hand control driving.¹⁸

prong, and two smaller straight prongs. The larger prong sits in your hand, and your wrist sits between the two smaller prongs.

This allows you to use your shoulder and elbow muscles to steer.

To accelerate and brake, rods are connected to the pedals, and the rod is connected to a handle beside the steering wheel. The handle is pushed forward to brake. Different motions, including depressing, rocking, pulling, or twisting can be used to control the gas. These hand controls are not removable, but the pedals remain in place so an able-bodied person can drive. The vehicle can be shared!

With the advancement of technology, there electronic-based steering adaptations. Some of these technologies include:

- Power-controlled levers and rods for accelerating/braking: similar to mechanical rods and levers, but with a motor built in to make the movement easier
- Reduced effort steering: modifications made to the vehicle to reduce the strength required to turn the steering wheel
- Using joysticks or other electronic wheels to drive the vehicle: a modification can be made to the vehicle so that it is controlled by a computer. The vehicle is then driven with a wheel or joystick that is connected to the computer.

Secondary Controls (windshield wipers, turn signals, etc)

Secondary controls are used to interact with other drivers on the road (such as signaling and using the horn), and to manage the vehicle (e.g., use the windshield wipers, changing the transmission gear, starting the vehicle, managing the heating/air conditioning etc). A lot of these functions can be adapted so that they are controlled with the push of a button. For example, buttons can be placed on the head rest so that they can be pressed with the head, or on the door so that it can be pressed with the elbow. Buttons can activate a single function, or can be used to trigger several functions. The multiple buttons can be programmed to the function of your desire, and can be connected to the steering wheel or other location that is convenient to you. These adaptations come in a variety of set-ups, and will require customization to your needs.



Secondary controls on a button system.¹⁹

What are some considerations when using and buying an adapted vehicle?

Funding considerations

There are often costs associated with the various parts of getting back on the road. In general, fees are required for the initial driving assessment, rehabilitation both in a clinic setting and on the road, and for adaptive equipment. In Canada, there is often no funding for these costs; this is often paid out of pocket unless you have an injury claim or other funding source. As a result, funding can be a big barrier to returning to driving. For more information on the related fees, contact your local driving rehabilitation center for.



Considerations when looking to buy a vehicle to adapt

When looking to buy a vehicle to adapt after your injury, some things to consider include:

Transfer abilities

What are your transfer abilities? Will you be staying in your wheelchair to drive or will you transfer to the driver seat? If you are able to transfer, how easy is it for you to transfer to a higher surface? Do you need a ramp to get in and out of the vehicle?

Wheelchair storage

If you are planning on transferring out of your wheelchair, where will you store it? In the front seat or back?

Adaptive equipment required

Does the equipment you need only fit in a certain type of vehicle, such as a van? Can the vehicle accommodate the hand controls you need?

Passengers

If you plan on driving others, will there be enough space for passengers in the vehicle once it has been adapted?

Parking

Will the vehicle fit in the parking space you have?

Some driver rehabilitation centers will also complete a vehicle modification assessment. This assessment will help you select the equipment you need to get you and your wheelchair into the vehicle safely. There is usually a fee for a vehicle modification assessment.

Considerations when driving an adapted vehicle

Two studies interviewed people with disabilities who drove adapted vehicles. Some challenges that were identified by the drivers included:

Pain

Pain was experienced in the wrists when driving long distances, especially with a twist accelerator. Shoulder pain was also reported after driving for a long time. You may want to consider what position your arms are in, what movements are used, and if you can do this over a long period of time.

Trunk strength

Having a weak core resulted in some drivers needing to slow down or brace themselves when driving at high speeds or on winding roads. People with a higher spinal cord injury level often need extra trunk support, as they are unable to use their arms for support when hand controls are being used.

Fatigue

Driving can be tiring in comparison to driving able-bodied, as more focus is required for driving an adapted vehicle.

Accessibility of the environment

Some drivers found that the location they drove to was inaccessible, and they were unable to get out of their vehicle. For example, some garages had a step to get out of them, had a steep hill to the entrance, or if there is not enough space to open a ramp.

The bottom line

After an SCI, many people continue to drive with the use of adaptive driving equipment. There are many modifications that can be made to a vehicle to suit your needs and enable you to drive again. However, prior to hitting the road, you will need to be evaluated by a driving rehabilitation specialist or occupational therapist. This evaluation will help the clinician understand your needs and limitations, and help them determine the best adaptations for you. Although getting back to driving may be a lengthy process, it can be beneficial for your sense of independence, and partaking in activities that you want to do again.

For a list of included studies, please see the [Reference List](#). For a review of what we mean by “strong”, “moderate”, and “weak” evidence, refer to the [SCIRE Community Evidence Ratings](#).

References

Full reference list available from: <https://community.scireproject.com/topic/adapted-driving/#references>

Glossary terms available from: <https://community.scireproject.com/topics/glossary/>

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