POSITIONING AND SET-UP IN THE VEHICLE FOR DRIVERS WITH SPINAL CORD INJURY.

By Caroline Rule

Correct positioning in the vehicle can help to optimise the physical function of drivers who have limited body function as a result of a spinal cord injury. This can make the difference between having the physical ability to avoid an emergency situation, compared with finding that they are trapped and unable to escape as a result of not having the agility to manoeuvre their vehicle out of harm's way.

Paralysed trunk muscles result in poor balance in the vehicle, the severity of balance loss depends on the level of injury. This has a big impact on their ability to turn, particularly to the right, as both arms are raised onto the steering wheel and controls, and the momentum of the vehicle throws their body to the left. The impact of this can be clearly seen when working on the skidpan with drivers with weak balance. Their ability to manoeuvre through cones at speed or to do an emergency lane change is compromised by their body falling from side to side. When correctly positioned in relation to the steering wheel and by stabilising the pelvis and trunk, we have seen a large improvement in their performances and the speed at which they are able to tolerate major changes in direction without losing balance. This is very significant should they find themselves in a situation where they need to do an emergency lane change on the highway.

Most experienced drivers with spinal cord injuries have developed their own techniques of hooking an arm on the side of the seat or wedging their arm again the door in order to keep them stable. This is fine for general everyday driving, but should they need to respond to an emergency situation, they could find that the time taken to stabilise themselves in that moment was too long. Being correctly positioned from the moment they start driving is a safer option.

When driving with hand controls only one arm is available for steering and a lot more strength is required compared with driving with both arms on the steering wheel. Where the individual has a cervical injury and thus reduced strength in the arms and shoulders, being correctly positioned in relation to the steering wheel can make a big difference to the amount of strength that they can apply to the steering wheel, it also reduces shoulder fatigue when driving long distances.

PRINCIPLES OF POSITIONING IN THE VEHICLE

1. The strongest arm should be on the steering wheel.

Steering is the primary function and is more important than braking and acceleration. In an emergency situation, the choice of action is to steer the vehicle to safety, not just hit the brakes. Where there is a discrepancy in strength between the two sides, it is important that the strongest

arm is on the steering. There are greater design options for brake and accelerator to accommodate reduced muscle function but there are limited steering adaptations and these quickly become expensive.

Rehab Focus:
In rehabilitation, work on the functional strength required for steering i.e. shoulders between 45-90^{o} flexion, work on horizontal abduction and adduction combined with internal and external rotation.

2. The driver should sit slightly higher in relation to the steering wheel than an able body driver.

This decreases the strength needed in the shoulders by reducing the active range of shoulder flexion required to hold and turn the steering wheel.

3. **When driving with hand controls the driver should be positioned slightly closer to the steering wheel than drivers using their feet.**
This is particularly important if there is any weakness in the shoulder girdle. The flexed elbow also reduces the active range of movement required at the shoulder and it places the scapular in a stable position. This is particularly important when the driver is only using one hand for steering and it is restricted to the spinner position on the steering wheel.

If the driver is positioned too far from the steering, then when turning the shoulder is pulled away from the support of the seat which adds to the instability of an unstable trunk.

NB. Ensure a minimum distance of 30cm between breastbone and airbag.

General guideline: –

Top of the shoulders should be level with or higher than the top of the steering wheel.

Elbows flexion:

30° - 45° for normal strength shoulders

> 45° for weak shoulders

4. **Where there is a lack of trunk control, the pelvis and trunk need to be stabilised in order to provide proximal stability .**

Proximal stability = distal control

Stabilising the pelvis gives improved balance and allows greater transfer of strength though the shoulders to the steering wheel. The same ergonomic seating principles that are used in wheelchair seating where an angled seat base is used to stabilise the pelvis, can be used to great effect in the vehicle.

Bucket seats have an **angled base** with lateral supports on the seat as well as the backrest. These provide great stability, but unfortunately they make transfers a lot more difficult. These racing seats are designed to stabilise racing drivers in order to improve their performance, and show well designed trunk support without restricting shoulder mobility.

An 8 way electrically adjustable seat provides easy adjustments to allow a flat seat for transfers and an angled seat to provide pelvic stability when driving. These are available as standard or an optional extra on many new vehicles, and they should be strongly recommended for any person driving with poor balance.

Where electronic seating is not available, a **wedge cushion** can be used to get the same effect.

The **CG Lock** is designed to secure the pelvis using the standard seat belt. This is a simple lock that secures the pelvic strap of the seatbelt while still allowing the inertia real to function on the upper half of the seat belt allowing trunk movement. These are available through Shoprider (012 6531817).

Providing **lateral trunk supports** help to stabilize the trunk. Many luxury vehicles have these built into the bucket seats, but in some vehicles it is possible to build these into the seat after market, or an office chair lumber support insert can also work successfully. An **armrest** to support the elbow of the arm on the hand controls helps to limit fatigue and provides additional stability.

In extreme cases chest straps or H harnesses can be used to provide upper trunk stability. These are normally only used while learning to drive or for racing.

5. Position of the hand controls.

The hand control should be positioned close to the steering to allow a thumb grip on the steering wheel. This can assist the steering arm. They should also be positioned low in relation to the steering wheel, to keep shoulder flexion to a minimum while driving, so as to limit fatigue. The use of a cruise control is also very effective in limiting shoulder fatigue while driving with hand controls.

6. Steering grip and the use of spinners

Steering spinners or knobs are very helpful when driving one handed or for people with limited hand function. It gives the driver far greater control when manoeuvring the vehicle; however they also have a number of disadvantages. A survey carried out by Rolling Inspiration found that only 35% drivers using hand controls use spinners.

Advantages

- Manoeuvring much easier
- Better grip and control of steering – no palming
- No release of steering.
- Provides grip for quadriplegic hands.
- Licensing Department want everyone to use them.

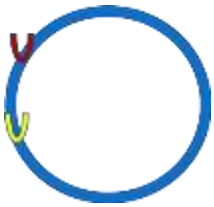
Disadvantages

- Limited to one position on steering wheel which results in strong and weak zones of steering.
- Gets in the way of loading wheelchair.
- Safety in event of accident.

The most common positions on the steering wheel for a spinner are as follows:

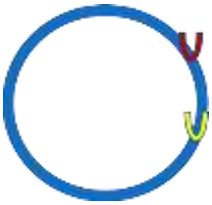
Left hand

- 10 o'clock
- 8 o'clock

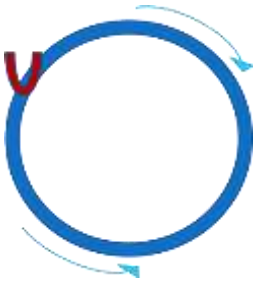


Right hand

- 2 o'clock
- 4 o'clock



Strong and weak steering zones are created as a result of not being able to move the hand into a different position on the wheel while turning it.
e.g. For a left hand driver, when moving between 12 to 2 turning clockwise or between 8 to 6 while turning in an anti-clockwise direction, they will find that these are 'weak zones'. The opposite applies for drivers who steer with their right hands.



Where the driver has shoulder weakness, they may find that when turning the steering wheel slowly, they can get stuck in the weak zones, creating a safety problem. It is preferable for them to move their hand back into their stronger zone where they can use their optimum strength to provide a positive steering action. Unfortunately the spinner does not allow the grip position to move as it is limited to one a single point.

Alternative grips on steering wheel:

Due to the weak and strong zones in the steering action, some people with shoulder weakness prefer to use different grips on the steering wheel instead of a spinner as this enables them to move their hands to different areas of the steering and always work in their strongest zones. A broader steering wheel with a non-slip surface allows the use of a tenodesis grip for steering.

7. Leg Positions:

Due to the lack of sensation and proprioceptive feedback it is essential that the legs are carefully positioned in order to avoid their feet sliding under the pedals as this can restrict the movement of the pedals which becomes a problem when the driver suddenly realises that the brakes don't work.
Drivers with long legs must ensure that their legs do not restrict the function of the controls.
Those who suffer from spasticity must position the feet in a position to prevent spasms. The position shown in the photo is effective for preventing spasms, however it results in poor limb position when driving long distances.
E.g. externally rotated hip and internally rotated ankle can result in increased risk of pressure sores and contractures of the ankle joint, and restricted blood circulation.
Regular changing of position must the taught when spending long periods in the vehicle as part of pressure care training.

Pedal Covers:

The use of a pedal cover over the accelerator pedal creates a safe position for the right leg. Automatic cars have a built in positioner for the left foot. The accelerator cover allows for safe and ergonomically correct positioning of legs.

Caution: Be aware of pressure areas on the heels when driving long distances. Again stress the importance of frequent changes in position when driving for extended periods.

Seat height and position:

The seating position in MPV's (Multi-Purpose Vehicles) where the seat is generally higher from the floor compared with sedan seats, creates space for a close to 90^{o} angle at the knee and ankles. This provides more even weight distribution on flat feet, reducing pressure areas, and keeps the feet well away from the pedals, removing the need for additional pedal covers. Due to the increased height of these seats, they are normally higher than the wheelchair and therefore require a strong transfer.

There is no single solution that works for every person. Each individual should be correctly positioned in the car according to their body height, proportions and strength. Every adjustment comes with a compromise – the art is in finding the right balance. Due to the enhancement in driving performance through correct positioning which results in the improved safety of the driver, these adaptations should be seen as an essential part of the OT's prescription when making recommendations on adaptations for drivers with disabilities.