

Power Wheelchair Alternative Drive Controls in Spinal Cord Injury

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Fact Sheet

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When a person with a spinal cord injury is unable to use a standard joystick on a power wheelchair, an alternative drive control and location is required. Depending on the person's level of injury and musculature that remains innervated, the more common locations of alternative drive control input devices include the head, neck, face, eyes, and tongue.

A **proportional drive control** allows the wheelchair's speed/direction to mirror the force/direction applied to the input device by the user, most often through a joystick. Proportional drive control options include¹:

- **Standard Joystick:** able to move in any direction at any speed. It is often the most intuitive device for adults with injuries at C5 and below. Joysticks are commonly located on either left or right arm rest but can be altered for location in midline if spasticity or contracture limits neutral shoulder/elbow alignment.
- **Alternative Joystick** (often set at the user's chin): joysticks vary in size and require less force and deflection to activate the joystick.¹

A **non-proportional drive control** uses commands to turn on/off various functions such as direction (forward, back, left, or right) of the wheelchair. Speed is predetermined and not variable to the strength of the command provided. Non-proportional drive controls include^{1,2}:

- Sip-and-Puff
- Head Array
- Head Array/Sip-and-Puff Combo

Non-proportional drive controls can be either momentary or latched. A momentary control is on only when the switch is being activated. A latched control remains active until the switch is pushed again or for a certain predetermined time.^{1,2}

Common alternative drive control types following SCI:

Chin control: utilizes a small alternative joystick located at the chin to operate the wheelchair. This joystick can be placed at the chin with two options; a neck collar that rests on the person's chest or on a swing away bar connected to the chair.³

Considerations of a chin control include:

- **Advantages:** the joystick remains aligned at the person's chin as position changes occur, such as recline, so the person does not lose access to their joystick, proportional control of wheelchair
- **Disadvantages:** The device sits in front of the person's face which may be a deterrent for some users, facial hair may interfere with accuracy of the device, may require position adjustments throughout the day from caregivers.

Sip-and-Puff: uses a straw device located in front of the user's mouth to provide a series of commands via different forces of "puffs" (positive pressure) and "sips" (negative pressure) to negotiate the wheelchair in four directions.⁴ Considerations of the sip-and-puff drive include:

- Advantages: device moves with the person through position changes or spasticity, easy for caregivers to adjust the position of the straw, cost effective
- Disadvantages: the device sits in front of the person's face which may be a deterrent, communication while using sip-and-puff device is limited until a latch (timed feature) can be used while driving, multiple breath commands may cause respiratory fatigue, requires maintenance for hygiene

Head Array: utilizes a series of commands for steering via pads of wheelchair headrest to drive in the corresponding direction. A head array may use mechanical switches that require physical contact to activate or electronic switches that use proximity sensors and are activated with movements towards the switch.^{1,3,4} Considerations for the head array drive include:

- Advantages: device does not sit in front of user's face which may be more aesthetically pleasing to the person, intuitive to drive
- Disadvantages: requires proper positioning throughout the day to adequately access the head array. As the person reclines the back rest, the user may slide down and lose contact with the head array. Significant spasticity or uneven terrain may cause unintentional changes of head/trunk position.

Additional input devices:

- Switches are commonly used with above mentioned devices. They are used to change position/drive modes and turn chair on/off. Switches can come in several designs including toggle, button, proximity, and leaf switch. These switches can be mounted anywhere that the user can access.²

Other considerations

When selecting an alternative drive control type and location, some questions to consider include:

1. What is the endurance of the musculature at the site location chosen, for example neck or chin, to use throughout the entire day?
2. What is the cognitive ability of the person and will it affect complexity of the drive control chosen?
3. What electronic devices will the person interface with in their home environment using their alternative drive control? The alternative drive control selection can affect the person's efficiency and accuracy with their paired devices and may affect their selection in a type of drive control.

References:

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