WHAT'S NEW? AN OVERVIEW OF THE LATEST AND GREATEST POWER WHEELCHAIR DRIVING METHODS (PART 1)

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Many people with physical disabilities have limited mobility and require some form of mobility device to improve independence and function. For clients who are unable to self-propel any type of manual wheelchair efficiently, power mobility should be considered. Most clients who use a power wheelchair are able to successfully drive with a joystick. When a standard joystick is too difficult to use - often due to decreased motor control, abnormal muscle tone, decreased strength, or paralysis – alternative driving methods can be explored.

Driving methods are categorized into Proportional (or Analog) and Non-Proportional (or Digital). Proportional control typically provides 360 degrees of directional control as well as speed control by moving further from a starting point. The most common type of Proportional control is a joystick. Digital control uses switches, discreet directional control, and does not typically provide speed control via how the switch is activated.

Proportional Driving Methods

Proportional control driving methods are typically explored first, as these provide both full directional and speed control. Proportional control can be difficult for some clients. Joystick control requires grading of the force and distance of movement, which is particularly difficult for clients with increased muscle tone or movement disorders. The client must also have adequate movement and motor control to use a joystick. Sometimes, an alternate placement of the joystick can optimize control. A standard joystick requires approximately 250 grams of force to move from center and sustain. Mini proportional joysticks are available which only require 10 – 50 grams of force, as well as reduced travel distance. These often work well for clients with reduced active range of motion and strength, but who still have good fine motor skills. These mini joysticks may be placed at a finger or thumb and are often mounted at the chin. For the client who can use a chin joystick, reducing the required force and travel can decrease risk of repetitive stress injuries at the jaw and cervical area.

Non-Proportional Driving Methods

Fair Upper Extremity Control

For the client who cannot use any type of proportional control, but who has fair upper extremity control, individual mechanical switches can be placed on a tray surface. Clients in this category include people with cerebral palsy, traumatic brain injury, multiple sclerosis, and muscular dystrophy. Typically, 4 switches are used for Forward, Left, Right and Reverse or Reset. Reset redefines what the Forward, Left and Right directional switches control by changing the mode of operation of the wheelchair, providing control of Reverse, Speeds, power seating, IR transmission, Mouse emulation and Interfaced external AT devices. The client must be able to move their hands horizontally and vertically to move up and over the switch surface.

If the client does not have controlled vertical movements (which is the more difficult directional movement for clients with increased tone), proximity switches can be placed under the tray surface. Proximity switches are capacitive switches and are activated by items which are conductive. The switch can be activated by certain items on the tray within the activation area, including beverages or a cat. The switches will not be activated by non-conductive items, such as a book. The switches must be protected from moisture. Typically, an array of 4 switches are used. Place switches at a distance apart and in a pattern that matches the client's abilities. Provide a tactile cue on the tray surface so the client knows where the activation area is located, even when looking forward to drive (i.e. Velcro). The activation distance is adjustable and is a "bubble" around the switch. If the activation area is too large, the switches may activate one another or be activated by the top of the client's thighs.

Good Fine Motor Control, Limited Activation Travel and Force

For the client who cannot use any type of joystick, but who has good fine motor control and limited activation travel and force, a Touch Pad or Fiberoptic switches may be used. Clients in this category include people with amyotrophic lateral sclerosis, spinal muscular atrophy, and Duchene muscular dystrophy. Touch pads provide proportional control. The client must have adequate movement of a finger or thumb to move within a 360 circle for full available directional control. The farther the finger or thumb moves from center, the faster the wheelchair moves. A client with this control may be able to use a mini proportional joystick. Another option no longer available in the United States is the VIC Touchless finger joystick which requires similar movements.

If the client has insufficient active travel and force to use a Touch Pad, Fiberoptic switches provide a non- proportional driving method which captures very small movements and requires no activation force. Place switches at a distance apart and in a pattern that matches the client's abilities. The client should be able to feel the tip of the fiberoptic switch or mount to determine location. The activation distance is a straight line from the end of the switch and is adjustable. Match this to the client's available movement, which is typically quite small. Fiberoptics can be placed at the angle required by the client. These can be placed facing directly upwards or parallel to the floor, allowing the fingers to be moved while curled over the edge of a handpad or tray in a flexed position. The switch cables are fragile and need to be well-protected. Switches can be mounted in a tray, handpad of armtrough or in a hollow gooseneck mount. To provide postural support and facilitate a very small movement, support of the forearm, wrist and hand is required.

Good Head Control, Limited Extremity Control

Some clients have little control of their upper and lower extremities, yet good head control. Clients in this category include people with high level spinal cord injuries, amyotrophic lateral sclerosis, cerebral palsy, and multiple sclerosis. These clients may be able to use a proportional head driving method, such as Magitek or a Proportional Head Control (RIM). This client may also be able to use a Head Array, particularly if head control is only fair.

Magitek is a sensor typically mounted at the top of the head on a headset. Movement of the head is translated into movement of the power wheelchair. The client must be able to consistently bring their head to upright to stop movement of power wheelchair. Programming is required to allow power seating control through left and right directional control only.

The Proportional Head Control (RIM) is a posterior head pad attached to a joystick behind the head. Moving the head rearward moves the power wheelchair Forward. The client must sustain pressure against back pad to sustain Forward. This can lead to increased tone in some clients or require excessive muscle strength for others. Increased tone can impact the client's ability to stop. This driving method is difficult to use with tilt or recline as the head pad moves posteriorly. A strategy to access Reverse is required.

Despite not providing proportional control, head arrays may provide better driving control for some clients in this category. Clients with only fair head control can often use the Head Array, as well, including people with cerebral palsy, traumatic brain injury, and high level spinal cord injuries. Typically, a Head Array is comprised of 3 to 5 proximity switches in a tri-pad head rest. The pad behind the head is for Forward directional control. Various style head supports can be used. A Reverse strategy is required. This may be accomplished through an external switch to toggle Forward and Reverse, a quick hit on the rear pad, a Reset switch or Standby. Options vary by base electronics.

The Permobil Total Control head array allows a combination of mechanical and proximity switches. This has 2 proximities in the rear pad to better capture diagonals.
The Switch It Dual Pro has 3 options: 1. Proximities only, 2. Mechanical only - increased force on switch increases speed, 3. Proximities and Mechanical – proximities respond immediately and mechanicals allow increased speed with increased force. The speed for each switch/direction can be

changed on the control panel on the rear of the head array. Increased force can lead to increased tone and difficulty stopping, as well as increased fatigue.
The ASL Atom offers a user switch which plugs into the head array. Pressing the user switch turns off the head array (signaled by a double beep), allowing the client to rest on the head support without driving, changing modes, or powering off the chair. If the user switch is held down for a longer amount of time (signaled by a long beep), a directional command from the head array can now send a wireless switch signal to an AT device (no interfacing component or cable required). Auditory feedback is optional when a directional switch is activated.
The Stealth Products i-Drive head array allows mechanical and proximity switches to be combined. Each switch is assigned using i-Drive programming, which also provides other customizable options.

Good Oral Motor Control, Little Head or Extremity Control
Sip ‘n Puff requires good intra-oral pressure control, which requires good lip closure and a competent soft palate. This driving method is commonly used with clients who have a high level spinal cord injury. Latch is used to sustain Forward movement without sustaining a hard puff and is typically turned on by a second Hard Puff and turned off with a Hard Sip. Consider a fiberoptic “kill switch” if the client will use latch.
4 pressure control: Hard Puff (forward), soft puff (right), hard sip (reverse), soft sip (left). Various strategies for changing speed which vary by base electronics.
2 pressure control (Q-Logic): 2 puffs (forward), 1 puff (right), 2 sips (reverse), 1 sip (left).
Stage control (i-Drive): Stage 1 only controls Forward and Reverse and is not latched. A softer puff moves the chair forward slowly (i.e. creeping up to a table). Stage 2 (entered via a Hard Puff) provides 4 pressure control with Latch option.

Limited Oral Motor Control, Limited Head Control
The Sip n Puff Head Array combo combines features of traditional sip n puff and a standard head array. Any puff is Forward, any sip is Reverse and the head array controls Left and Right. This may be appropriate for a client who cannot discriminate between hard and soft pneumatic commands, but has some head movement. Potential candidates include clients with multiple sclerosis, traumatic brain injury, spinal cord injury, and cerebral palsy.

Adequate Motor Control at 4 Body Sites
Any 4 mechanical and/or electrical switches can be combined for Forward, Left, Right and Reverse or Reset. An optimal switch placement is where the client has small, isolated, repeatable and sustained ability to activate and release a switch. Switches vary in size and force requirements. i-Drive is the only system which allows any mechanical and electrical switches to be combined. Clients who may require a combination of 4 switches at multiple body sites include people with cerebral palsy, traumatic brain injury, amyotrophic lateral sclerosis, spinal muscular atrophy, and muscular dystrophy.

Adequate Motor Control at 3 Body Sites
If the client only has 3 body sites with adequate control, 3 mechanical and/or electrical switches can be used for Forward, Left and Right. Reverse or Reset can be added later or consider Standby, as needed. Clients who may require a combination of 3 switches at multiple body sites include people with cerebral palsy, traumatic brain injury, amyotrophic lateral sclerosis, and spinal muscular atrophy.

Adequate Motor Control at 2 Body Sites
Clients who have adequate motor control at only 2 specific body sites include people with cerebral palsy, traumatic brain injury, amyotrophic lateral sclerosis, and spinal muscular atrophy. Two mechanical and/or electrical switches can be used to emulate 4 directions.
Q-Logic 2 switch control:

> Switch #1: 2 switch activations, second sustained (Forward), 1 sustained switch activation (Left), double click (Reset)
> Switch #2: 2 switch activations, second sustained (Reverse), 1 sustained switch activation (right)

i-Drive Link:

Sustained activation of both switches simultaneously (Forward) Sustained activation of Switch #1 (Left)
Sustained activation of Switch #2 (Right)
Double click of Switch #1 (*Reset)

ASL 2 switch Fiberoptic array (can only be used with fiberoptic switches):
Sustained activation of both switches simultaneously (Forward)
Sustained activation of Switch #1 (Left)
Sustained activation of Switch #2 (Right)

ASL Single Switch Scanner with Dual Switch Step Scan
Switch #1: each activation moves through driving direction choices (Forward, Left, Right and Reverse)
Switch #2: sustained activation moves the power wheelchair in the selected direction

Adequate Motor Control at 1 Body Site

Clients who have adequate motor control at only 1 specific body site include people with cerebral palsy, traumatic brain injury, amyotrophic lateral sclerosis, and spinal muscular atrophy. Use of 1 switch for driving requires Single Switch Scanning. An external scanner (ASL) or the base electronics display shows the directional scan. Specific options vary by base electronics. The first switch activation starts the scan and a second sustained activation moves the power wheelchair in the highlighted direction. Both directions and Reset can be scanned.

A wide variety of power wheelchair driving methods are available to meet individual client needs. Each driving method includes specific features to further match specific client parameters. It is important to be familiar with each driving method in order to help clients with physical limitations achieve functional and independent mobility.

Speaker Bio:

Michelle is an occupational therapist with 30 years of experience and has been in private practice, Access to Independence, for 10 years. She is a well-respected lecturer, both nationally and internationally and has authored 6 book chapters and over 200 articles. She is the editor of Fundamentals in Assistive Technology, 4th ed. and Clinical Editor of NRRTS Directions magazine. Michelle is on the teaching faculty of RESNA. Michelle is a member of the Clinician Task Force. Michelle is a certified ATP, certified SMS and is a Senior Disability Analyst of the ABDA.