PUSHING a Simple Task—Accomplished

There's more to good wheeling than meets the eye. You don't just get in and go!

by Kendra Betz, MSPT, ATP

At first glance, pushing a manual wheelchair appears quite simple. Almost anyone can figure out how a wheelchair works. There is an obvious space to sit, a place for your feet, and a large wheel on each side. Even a young child will rapidly figure out that if you push those wheels, the chair will move.

However, most people who use manual wheelchairs agree there is some skill involved. In addition to pushing forward to get from point A to point B, specific techniques are used for turning, maneuvering in tight spaces, crossing thresholds, and positioning the chair just right for reaching and transfers. Many accomplished wheelchair users have achieved advanced mobility skills where they can quickly pop a "wheelie" and move around, which is helpful for getting up and down curbs, descending inclines, and maneuvering over terrain.

While there is likely consensus that these advanced skills require training and practice, typically little attention is paid to the basic task of moving the wheelchair forward on all four wheels—that simple act of "getting from point A to point B." Even the most experienced wheelchair users don't give much thought to how they actually move their chairs, just as able-bodied people don't think about how they walk.

In hospital settings, where people sometimes learn to use a wheelchair for the first time, often little attention is paid to "how" they push the chair; the focus is on the basic achievement of moving it down the hall. However, we have learned there very well may be a better way to push a wheelchair.

Why Does It Matter?

Interest in how people push wheelchairs stems from the fact that upper-limb (arm and hand) pain and injury in manual-wheelchair users is a problem. Research studies report that 31–73% of wheelchair users have shoulder pain.[1-6] Wrist and hand pain is also common, with 49–73% having carpal tunnel syndrome (CTS).[1,7-9] Pushing a wheelchair has been specifically identified as a contributing factor to this common problem. Since upper-limb compromise creates many challenges for people

Wheelchair: —or Skill?

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who rely on their arms for everything, specific attempts have been made to address this issue.

One project that addresses pain and injury in wheelchair users is "Preservation of Upper Limb Function Following Spinal Cord Injury: A Clinical Practice Guideline for Healthcare Professionals," a guideline published in 2005 by the Consortium of Spinal Cord Medicine. With administrative and financial support from the Paralyzed Veterans of America (PVA; visit www.pva.org), this clinical practice guideline (CPG) was written by 10 expert panel members and reviewed by 38 additional experts. Several CPG recommendations specifically relate to wheelchair pushing, including:

- Use long, smooth strokes that limit high forces on the handrim
- Minimize frequency of repetitive upper-limb tasks
- Minimize forces required to complete upper-limb tasks

Research indicates that the way people push their wheelchairs is related to pain and injury in the wrist and shoulder. Specifically, pushing with short, overly repetitive strokes and/or high or ineffective forces increases the risk for upper-limb problems.

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Education and Training

So, based on reports that different ways of pushing wheelchairs impacts potential pain and injury, it makes sense for people to learn how to push properly. The CPG identifies the three key areas specifically related to wheelchair pushing (noted above). You may wonder, "So, how do I do that?" Following are a few suggestions:

Figure 1

Figure 2

Using smooth, long strokes is one part of proper pushing. Start with your arm back a bit so your hand is behind your body (Figure 1), keep your hand on the pushrim until it is past your body, and don't let go until your elbow is nearly straight (Figure 2).

Apply smooth long strokes: Think about where you initially contact the pushrim and where you let it go. To apply a long push, start with your arm back a bit so your hand is behind your body when you first touch the pushrim. Keep your hand on the pushrim until it is past your body, and don't let go until your elbow is nearly straight. (See Figures 1 and 2 for start and finish positions.) It is important that you avoid gripping the pushrim tightly.

Minimize frequency: When you use smooth long strokes, you move a greater distance for each stroke than if you used jerky, short ones. After you release the pushrim, allow the chair to continue rolling or "coast" until it begins to slow down before you start your next push. (You might be surprised how far it rolls before you need to push again.) The combination of long strokes and coasting allows you to decrease the number of times you push the wheel to move the same distance.

Minimize forces: Avoid "banging" the pushrim with strong, burst-like pushes. When moving forward on a level surface, pushing hard with short, frequent contact on the pushrim does not usually result in moving faster to get from point A to point B. The force you apply to the pushrim should be directed in line with the pushrim to move the chair forward. When you push down or inward, you apply "wasted" forces that do not move the chair forward and may actually slow you down.

These three suggestions relate to what to do while your hand is on the pushrim. So, what do you do with your hand after you let go of the pushrim while you are coasting?

Research findings support that letting your hand naturally drift down between the pushrim and the wheel axle is best. This is referred to as a semicircular propulsion pattern (Figure 3). It is important to avoid dragging your hand on the pushrim as you are getting ready for the next push, because this actually slows the wheelchair.

How do you know if your attempts at improved pushing are working? As with any experiment, measurement is necessary to gauge results. A physical or occupational therapist skilled in wheelchair-propulsion evaluation can help. He or she will watch how you currently push and take measurements to determine

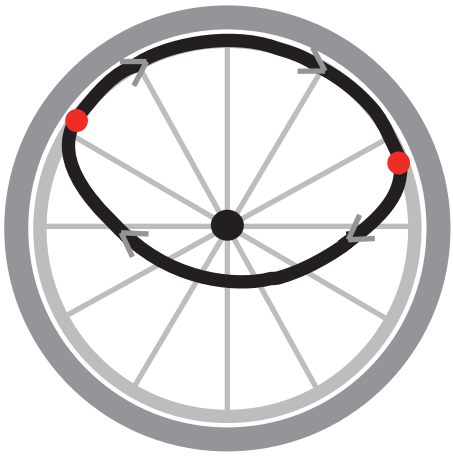

Figure 3

Figure 3. After you release the pushrim and are coasting, let your hand drift down between the pushrim and the wheel axle. This is called a "semicircular propulsion pattern."

Figure 4

Figure 4. The SmartWheel measurement device mounts to most manual wheelchairs to collect and report propulsion information.

potential areas for improvement. Based on these measurements, the therapist can provide education and training to modify how you push.

After practice, the same measurements are repeated to determine if improvement has been achieved. For example, if initially you are pushing with a short stroke measured as 50° of contact on the pushrim, and after education and practice you are pushing with a longer stroke of 90°, an improvement in push length has been achieved.

Measurement of symptoms is also highly valuable. If existing pain decreases with modified push techniques, a positive outcome has been accomplished.

Measurement of pushing is not as easy as it sounds. When evaluating push length, it is nearly impossible to take measurements while the wheelchair is moving. While frequency can be measured by counting the number of times you push the wheel over a set distance or time, keeping an accurate count of something that occurs about once per second is a challenge. The measurement of forces applied to the pushrim creates a unique challenge unless an instrumented wheelchair-propulsion measurement device is used. Due to the challenges identified with measuring wheelchair propulsion, a unique automated device, the SmartWheel®, was developed and is now available for clinical use.

Even the most experienced wheelchair users don't give much thought to how they actually move their chairs.

The SmartWheel is a measurement device that mounts to most manual wheelchairs and communicates with a computer via Wi-Fi technology to collect and report propulsion information (Figure 4). While you are pushing your chair, the SmartWheel gathers information about push length and frequency, forces applied to the pushrim, speed, and many other factors.

During the SmartWheel test session, a real-time graphical display gives a visual picture that represents each push (Figure 5). This display can

Figure 5. During SmartWheel test sessions, a real-time graphical display provides visual pictures of each push.

Figure 5

be replayed after the test session is complete; all the collected information is saved on the computer and available for review later.

A therapist using the SmartWheel can complete an initial SW session, provide education about improved pushing, and then complete a second SW session to determine if any changes or improvements have occurred. In addition to its use as an evaluation tool, the SmartWheel can be a training device. It is not something you would use on your own or take home. (For more information on the SmartWheel, visit www.3rivers.com.)

Your wheelchair plays a major role in how you push. It is extremely important that you use a good chair that is set up properly. Several research-supported recommendations about wheelchair selection and setup are included in the CPG.

Full-time and/or long-term wheelchair users should use a chair that is very lightweight, yet durable for long-term use. It should be carefully selected and custom configured to meet your unique preferences and needs, including postural support. Good posture is important for wheelchair pushing because a "neutral" or normal sitting posture allows you to push efficiently.

The rear wheel must also be addressed to optimize propulsion. To allow a long, smooth push, it should be positioned as far forward as possible without causing your chair to be "tippy" backward. A number of research studies indicate that a forward rear wheel is beneficial.[10-14] In the vertical, or "up and down" dimension, the rear wheel should be positioned so that when your hand is at the top of the pushrim, your elbow is bent between 100° and 120°,[15-16] which correlates with your middle finger at the center of the axle (Figure 6). It is also important that the

Figure 6. Numerous research studies indicate a forward rear-wheel is beneficial. When your hand is at the top of the pushrim, your elbow is bent, correlating to your middle finger being at the axle's center.

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wheels be positioned as close to your body as possible. The pushrim is a component of the rear wheel that should also be considered. Pushrims with an ergonomic design encourage a neutral wrist and hand position that may decrease the risk of CTS.

Education Programs

Two programs currently underway specifically address manual-wheelchair propulsion education:

■ VA Program Evaluation System for the SmartWheel

The VA Spinal Cord Injury (SCI) Program, in conjunction with the VA Prosthetics and Sensory Aids Service, is evaluating the use of the SmartWheel in clinical settings as a tool to improve the way veterans with SCI push their wheelchairs. Thirteen VA SCI regional centers are participating in this Quality Improvement project. The program is specifically targeted toward patient education with a focus on wheelchair propulsion relative to push length, frequency, forces, and speed. (For more information, contact Kendra.Betz@va.gov.)

■ PVA Education Foundation Grant Supporting Education Seminar for Upper Limb Preservation

A full day seminar, "Saving it for Later…Upper Limb Preservation for Manual Wheelchair Users," provides clinician education for practical implementation of the CPG with a focus on manual-wheelchair propulsion. Didactic education and hands-on lab practice are incorporated. The seminar will take place at seven locations in 2007 and 2008. (For more information, see the full-page ad in this issue or visit www.3rivers.com.)

Summary & Conclusion

While the task of pushing a manual wheelchair may at first appear simple, it is clearly an accomplished skill that requires education, training, and practice. Specific techniques that include long smooth pushes, reduced frequency, and minimized forces are likely to reduce the risk of upper-limb pain and injury. The SmartWheel is an automated measurement device that can be used for evaluation and training. Wheelchair selection and configuration are important for optimal push techniques. Education programs are currently underway with a specific focus on improving how people push wheelchairs. Wheelchair users and clinicians should seek out resources and opportunities to gain an improved understanding of how to push a wheelchair. ■