In the last issue of the SCI newsletter, I reviewed research on the use of electrically or computer-controlled devices to improve arm and hand function, leg function and walking, and to improve strength of the torso muscles to improve balance, in those with paralysis due to spinal cord injury. This information is from a recent article published in “The Journal of Spinal Cord Medicine.” This will be a continuation of that article on the use of neuroprostheses for people with spinal cord injury.

**Bladder Neuroprostheses:**

Individuals with SCI who have incontinence between catheterizations or difficulty performing self catheterizations may benefit from these devices. For these to work, the bladder must be able to contract with reflex spasms due to firing of intact nerves from the lower part of the spinal cord to the bladder. This means that injury to the cord must be in the neck or upper thoracic spine, not in the low back area where injury of the cauda equina nerves would result in flaccid, rather than spastic, paralysis of the bladder.

There are two devices already commercially available in the U.S. that are approved for use in people with normal neurologic function who do not have spinal cord injury, to improve incontinence. These devices are being studied currently in those with spinal cord injury. The first device is the Medtronic Interstim (Minneapolis, MN). It involves surgically implanted wires over the sacral part of the spinal cord in the upper lumbar spine area. Used years after spinal cord injury showed no significant benefit, but in one study in which the device was implanted early, within the first few months after spinal cord injury, it did show significant benefits such as having less bladder spasms and less incontinence. The second device is the Uroplasty Urgent PC stimulator (Minnetonka, MN). In this system, wire electrodes are inserted near the tibial nerve in the foot. This nerve is stimulated weekly to activate sacral spinal nerve circuits which not only control foot sensation and muscle function, but also control bladder muscle function. Studies are in the planning stages for using this.
Neuroprosthetic Technology for People with Spinal Cord Injury

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device for people with spinal cord injury, so no results are available yet.

There is another device being used widely in Europe for people with spinal cord injury, but not yet commercially available in the U.S., called the Brindley Finetech sacral anterior root stimulator (Welwyn Garden City, UK). A surgically implanted pacemaker-like device is used to stimulate the urethral sphincter to prevent leakage of urine, then when the sphincter stimulation turns off, the bladder is stimulated, resulting in voiding of urine in spurts. Surgery to cut the sensation spinal nerves to the bladder is required with this device, to lessen unwanted spastic, reflexive contractions of the bladder and sphincter muscles, so they will activate only when the device stimulates those nerves, not on their own from muscles spasms. Many patients are not in favor of this device when offered, due to the requirement to cut and permanently damage the sensory nerves.

An alternative approach being studied in recent years is to electrically stimulate the incoming sensory nerves in the pelvis through wires near the urethra or genital area. This would not require nerves being cut. This technique has been found to result in bladder relaxation and improved continence. Most studies so far with this new technique have been done on animals with spinal cord injury, and human studies are just getting underway. The hope is that, within the next several years, researchers will be able to eliminate side effects and the need to permanently cut nerves, and will determine which of these methods is most beneficial for people with spastic paralysis of the bladder.

**Brain Electrical Stimulation to Restore Sensation:**

Tiny electrode wires implanted in the cerebral cortex (nerves on the surface of the brain) has been proposed as a method to restore a variety of sensory functions by activating nerve cells that would normally be responsive to a now disconnected sensory input. This is just in the planning stages for animal research so far, and studies have not yet been started in human subjects. Examples of possible applications include transmitting bladder distention signals, so a person could tell when the bladder was full and in need of catheterization. Another possible application would be to have wires in the tissues of the buttocks that detect excessive pressure when one is sitting, and transmitting those sensation signals to the brain so that pressure sores would be avoided. Also, if a person is using an electrically controlled limb movement system for ambulation or for improved arm and hand control, that limb system could convey information about position sensation and degree of movement to the brain electrodes, allowing the person to have more fine-tuned control of limb movement. This type of device has the potential to drive very high resolution sensory signals directly to the brain, but as animal research is just getting started with brain sensory stimulation, it is likely that it will be many years before this approach will be used regularly in humans.

**Conclusions:**

Neuroprosthetics hold great potential for restoring function and sensation for people with SCI. As research continues with these devices, improvement in effectiveness and ease of use will lead to devices becoming commercially available that meet the needs of the SCI population. Combining devices that give sensation feedback signals to the brain with devices that improve muscle function and control in muscles of the limbs and bladder are likely to result in intuitively controlled assistive devices that improve the lives of people with spinal cord injury.
FreeWheel Testimonial

By former St Luke’s patient

An accident in late March 2012 left me with an incomplete T-12 spinal cord injury, a severe humerus fracture, and paraplegia.

One devise that has made a huge contribution to my independence is a lite weight wheel chair attachment called a FreeWheel. This device attaches to the footrest of a “sport” wheelchair and allows the user to elevate the front castoring wheels about an inch off the ground and transforms the wheel chair into a trike. The result is an incredibly stable machine that allows a paraplegic user to go almost anywhere across a myriad of surfaces including: lawn turf, gravel, sand, snow, and light brush. The most useful benefit is the huge confidence improvement in traversing sidewalks. I lost count of the times I face planted myself on sidewalks because of a 3/4 inch up-heave at an expansion joint. Now I am able to look the other pedestrians in the eye instead of focusing on the sidewalk two feet ahead. Another benefit is a three to four fold increase in speed; on the level or downhill I can easily outpace most anybody walking. It is so nice to experience glide.

To see this gadget in action, check out www.gofreewheel.com. This device has enabled me to regain many of my former recreational pursuits. Last fall I accompanied my family and friends on an antelope hunt in Wyoming; an elk hunt in Idaho; and many deer hunts. I was able to push myself the entire length of the Hiawatha Trail (15 miles of gravel) near Lookout Pass. We even did a raft trip on the Salmon River.

A word of caution, there is one dangerous situation that a FreeWheel user must beware of. When you remove your FreeWheel, remember to slow down and watch out for pavement hazards. Those abrupt curb cuts and sidewalk expansion joints will bite you when you least expect and put you on your face faster than you can imagine.

Support Group

SCI support group: meets every 4th Wednesday from 1 - 2 p.m. Please check at front desk for room as location changes on occasion. SCI support group facilitates an opportunity to interact and network with peers living with spinal cord related injuries and deficits. Family and friends are always welcome.

FES Bike

Arms not getting you enough exercise? Use your legs to exercise your heart and improve cardiovascular fitness with the Community Functional Electrical Stimulation (FES) Bike Program.

Call St. Luke’s Outpatient Therapy at (509) 473-6869 for more information.

Participants will be assessed and trained, along with their caregiver. Training is by a physical therapist. In 5-10 visits participants will be able to perform independently.

Offered 2-3 days per week

$35 dollars per month
Upper Extremity Splinting Techniques
For Increased Function with Spinal Cord Injuries at the Cervical Levels C5-C7

By Emily Lunden, OTR/L

Bringing a spoon piled with ice cream to your lips while greatly anticipating the cool, creamy flavor invading your mouth... Gently drawing the cool metal blade of your razor across the five o'clock shadow while preparing for a night out on the town... Grasping the can of soda and bringing it to your mouth to refresh your mind and palette as you enjoy another summer’s evening... Making a list of all the places to visit during this summer’s vacation... All these activities demand some level of function from the hands. A spinal cord injury at the cervical level can impair the function of the hands making these activities challenging for an individual to complete independently. Through a variety of splinting techniques hand function can be improved for individuals with spinal cord damage at the cervical level of C5 to C7.

Upper extremity splints are used when patients have some ability to move their forearm and shoulder, but may struggle with controlling the wrist and fingers. Wrist and hand function depends on the level of injury and the degree to which the spinal cord was damaged. Individuals with spinal cord injury above the C5 (that is, C1-C4) level may not have enough arm strength to benefit from splinting depending on whether the injury was complete or incomplete. For this article, it will be assumed that the injuries levels discussed are complete spinal cord injuries.

A spinal cord injury at the C5 level will leave an individual with active, but possibly weak, deltoids and biceps but no muscle activation at the wrist or fingers. The deltoids and biceps allow the individual to bring their hand to their mouth for eating or even to the head to comb their hair. Since wrist and finger function absent make grabbing or holding an object unfeasible, a universal cuff (i.e. u-cuff) can be strapped to the palm of the hand to hold utensils. In some cases a splint may be needed to stabilize the wrist in a neutral position before the universal cuff can be used. Forks, spoons, razors, combs, toothbrushes, paintbrushes, and other utensils can be slipped into the cuff to increase independence with a myriad of everyday tasks.

If the level of injury is at the C6 level, an individual will be able to achieve wrist extension and therefore be able to utilize the tenodesis grasp pattern. The tenodesis grasp is natural closing of the fingers (the thumb meets the first finger) into the palm when the wrist is extended, or bent backwards, and the opening of the fingers when the wrist is dropped forward. Although this movement is present, it is often weak and may need to be supported with a tenodesis splint. Some tenodesis splints are simple and provide just enough support to enhance the natural movement of the hand while others may be more elaborate with moving parts to provide increased grip strength.

In Individuals who have sustained an injury at the C7 level the upper extremity hand function previously mentioned plus the triceps and long finger extensors, these muscles allow the individual to reach overhead or away from the body. Although arm function may be greater at this level, hand and finger function may still be limited. Activities, such as writing, may be possible
Upper Extremity Splinting Techniques

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but challenging for patients with a C7 injury. There are a number of splints or devices to assist with writing; however the Wanchick Writer splint is a reliable device for writing.

Although life after sustaining a cervical level spinal cord injury may be challenging, the enjoyment of many activities can still be achieved through the use of splinting techniques and tools. That cool taste of ice cream or a quick shave for a night out of the town can still be achieved independently through the use of a universal cuff. A refreshing sip of soda can be had through the use and mastery of a tenodesis splint. And that list of all the places to visit? Well, that’s where the Wanchick Writer would come in handy.

References:

SCI Study to be Done by St. Luke’s

St. Luke’s Rehabilitation Institute, in collaboration with WSU Spokane, recently received grant funding from the Craig H. Neilsen Foundation to conduct a study called, “Comparison of Two Psycho-educational Family Group Interventions for Persons with SCI and their Caregivers.” If your spinal cord injury occurred within the last three years, you may be eligible for this study, which will begin in September. If you are interested, please use the information at the end of this article to contact the research team.

Spinal cord injury (SCI) can result in difficult, long-term, life adjustments both for patients and their family members. This study will provide and test two different group treatments for SCI, one called Multi-family Group intervention and the other called SCI Active Education, to see if adjustment to the injury can be improved. The person with SCI and a close caregiver will be assigned at random to one program and will participate together with a group of 4-6 other couples to receive education and support about the specific challenges of living with SCI. The groups will be led by experienced clinicians from St. Luke’s and WSU who are skilled at helping families and patients in the process of rehabilitation for SCI. If effective, the researchers believe one or both of these programs may become an option for providing education, skills, and coping strategies to people with SCI and their close caregivers.

Both the Multi-family Group for SCI program and the SCI Active Education program will meet for 16 sessions across 9 months. The groups will meet at St. Luke’s approximately once every two weeks. The sessions will vary from 1 to 2 hours. You will also fill out several questionnaires on 3 occasions; this will take about 1½ hours each time. These questionnaires will measure such things as quality of life, health status, confidence and skill to self-manage SCI, emotional wellbeing, support you get from others, and coping. Participation is voluntary and you may choose to stop participating at any time. Refusing to participate will not affect your regular care at St. Luke’s.

You may benefit from the program by gaining a better understanding of SCI and learning how to manage it more effectively. Your participation also may benefit others with SCI and their caregivers in the future by helping the researchers find out what helps and does not help. You and your care partner will be paid up to $150 during the study as a thank you for your participation.

If you are interested in seeing if you qualify for this study, please contact St. Luke’s Senior Researcher, Dr. Douglas Weeks by phone at (509) 939-1316 or email him at WeeksDL@inhs.org. Dr. Weeks will answer any questions you may have.
Central Cord System/Personal Story

By Corey Morrow, OT

Joyce “Darlene” Dickmann was an active member in her community and family before a life-changing event disrupted her daily routine. Darlene fell and broke her neck at the first cervical vertebrae while in her home. As a result, Darlene was diagnosed with central cord syndrome.

Central cord syndrome refers to an incomplete spinal cord injury that primarily affects a patient’s arms and hands. Paralysis in the legs and gait instability is also possible but less severe with central cord syndrome as the injury compresses nerve fibers directly carrying signals to the upper extremities. Sensory loss and pain below the level of injury is common.

After a stint in acute care, Darlene was admitted to St. Luke’s Rehabilitation Institute to begin her road to recovery. Her first day at St. Luke’s, Darlene was unable to even sit up on her own. She underwent intensive therapy three hours a day between occupational and physical therapy. During this time, Darlene re-learned how to complete basic daily tasks like feeding herself, getting dressed, and brushing her teeth. In addition, Darlene utilized a specialized piece of equipment unique to St. Luke’s called the Lokomat®. This enabled Darlene to begin re-training her body how to walk again. After about eight weeks of rehabilitation, Darlene discharged to home with her family with a new sense of independence.

Darlene continues to participate in outpatient therapy to progress along her road to recovery. She is able to use only a walker while in the house and uses a power wheelchair to access her community. Darlene recently underwent a surgery to fuse the vertebral discs in her neck to increase stability and reduce the chances of further injury to her spinal cord in the future. Her passion for life and success post injury continues to be inspirational to new patients and therapists alike.

References