spinal cord injury UPDATE

Department of Rehabilitation Medicine

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INSIDE:

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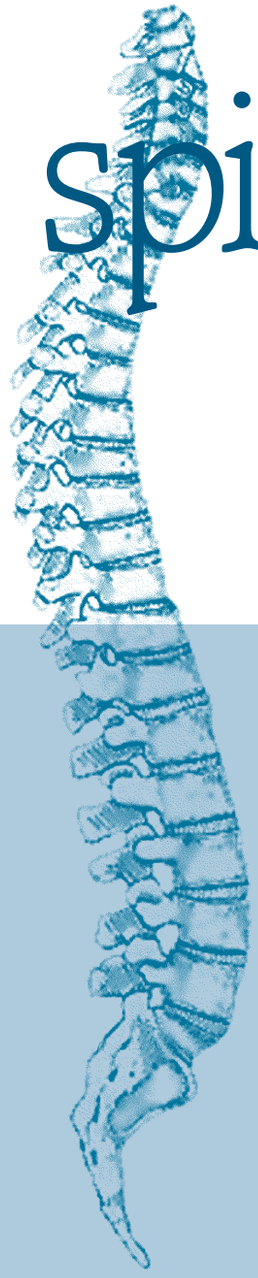


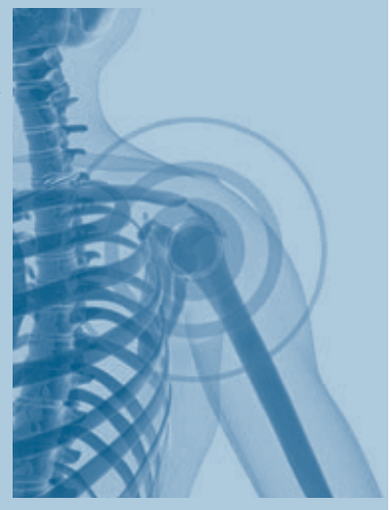
My Shoulder Hurts! My Wrist Aches!

Upper Limb Pain in Spinal Cord Injury

By Deborah Crane, MD, MPH, Assistant Professor, Rehabilitation Medicine, University of Washington

Pain and SCI

Pain is an unfortunate but common reality for people living with spinal cord injury (SCI). Persons with SCI may suffer with musculoskeletal pain (affecting the muscles, bones or joints), neuropathic ("nerve") pain, or both. Musculoskeletal pain is typically described as dull or achy, occurs above the level of injury, and is usually triggered by specific movements of a joint or body region. In contrast, neuropathic pain usually occurs at or below the level of injury, is often described as burning or stabbing, and does not have specific triggers.



Shoulder pain

People understandably worry about developing shoulder pain after SCI because it is such a common problem and can be so disabling. Surveys have found that it affects 30-60% of the SCI population. It is thought that using the arms for propelling a wheelchair or performing transfers over time leads to injuries and arthritic changes in the shoulders. Tears to the rotator cuff (tendons of the muscles that support the shoulder) are a common culprit, but other causes of shoulder pain after SCI include impingement (pinching of the tendons), arthritis (inflammation of the joint), biceps tendonitis (pain in the tendon that attaches the biceps muscle to the shoulder), and bursitis (inflammation of the bursa sac that cushions the joint). In addition, muscular shoulder pain may occur when a person is forced to use his or her shoulder muscles to maintain posture or has muscle imbalances due to the SCI.

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New remodel…new independence

Like many others who become paralyzed suddenly due to injury or disease, Larry Mohrman could no longer live in his house after sustaining a C-5 incomplete spinal cord injury in 2003. "It was a two-story home with the main living quarters on the top floor—not at all wheelchair accessible," he said. "A contractor friend told me remodeling it would be too expensive and suggested that I sell the house and buy another one later that could be remodeled more cheaply and easily."

Mohrman went to live in an adult family home after leaving rehab. He worked hard at regaining as much recovery as possible. After 2 ½ years was able to walk 200 feet with a walker, but still used a wheelchair for his primary mobility. He moved to an apartment where he was able to live independently.

In 2007, however, fate struck another blow: "A car hit me while I was in a crosswalk in my wheelchair. This caused further injury, and I can no longer stand, balance or walk due to spasticity. Now I use a power wheelchair fulltime."

After that he started looking for a house to buy—one that could be remodeled for maximum accessibility and independence. "I wanted a one-level, 2-3 bedroom, 1-2 bath house with a 1-car attached garage for storage and 2-car detached garage for his accessible van."

In June 2010 he found what he was looking for in southwest Seattle. "Although it was useless for a wheelchair user when I bought it, I could see the potential if it was done correctly, and the price was right," he said.

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Arm and hand pain

The shoulder is not the only upper limb joint at risk for injury. Elbow pain is present for 5-16% of those with SCI. It is commonly caused by tennis elbow, ulnar nerve injury, bursitis, and arthritis.

It is likely that more than 10% of persons with SCI have hand and wrist pain. Carpal tunnel syndrome (when increased pressure in the wrist puts pressure on the median nerve) is overwhelmingly the most common cause of pain in this region. The risk for developing carpal tunnel syndrome increases the longer a person has been living with SCI. Extreme wrist extension (bending the hand back)—a position often used when transferring or propelling a wheelchair—is the likely cause of carpal tunnel syndrome. Arthritis, ulnar nerve injuries, and tendinopathies (injuries or degenerative changes to tendons) also cause hand and wrist pain in the SCI population.

Back and neck pain

Many people with SCI also have back and neck pain. Depending on level of injury, this may be neuropathic or "nerve" pain, musculoskeletal pain, or both. After SCI, individuals may develop spine deformities that can cause pain, including scoliosis (curving of the spine) or kyphosis ("hump back"). Frequently, people with SCI complain of a "ring of fire" or "iron corset" around their shoulders or torso, which typically occurs at the level where their sensation changes from normal to abnormal. This can be very painful and, at times, very difficult to treat.

How can I avoid upper limb pain?

For those with relatively new SCIs hoping to prevent upper limb pain, there are some things you can do.

- Try to maintain a healthy body weight. As you gain weight, transferring and propelling your wheelchair become more difficult and puts greater strain on your shoulders, arms and wrists.
- Make sure your wheelchair fits you properly. For manual wheelchair users, check that the wheel axle position and seat height are correct for you. For all wheelchair users, your seating system should provide enough trunk support so you don't rely on your shoulder muscles to keep you upright.
- Maintain good technique for transfers and wheelchair propulsion.
- If you walk using canes or crutches, a physical therapist can show you how to use good biomechanics so you don't harm your upper body joints.

I already have pain—what can I do?

- See a physical therapist to make sure your wheelchair still fits you properly. Improper wheelchair fit can cause or worsen pain and injury to the shoulders and arms.
- Review safe transfer and wheelchair propulsion techniques with a physical therapist.
- Consider how many times each day you are transferring, how far each day you are pushing your wheelchair, how you disassemble and store your wheelchair in the car, and what sorts of activities you do for work and fun. Could any of these activities be causing you harm? What can you do to reduce the stress you are putting on your body? Talk to your SCI doctor and therapists about changes you can make in your daily life to reduce harm and pain.

Treatments

Treatment options for upper limb pain may include therapeutic exercise, weight loss, heat or ice, medications, injections, or surgery. This will depend on the cause of your pain and what you and your doctor decide is the most appropriate treatment for you.

Rest is often the best thing for musculoskeletal pain. Unfortunately, it is very difficult to rest your upper limbs if you have an SCI because you rely on your arms to transfer, push a wheelchair, walk with crutches, etc.

If pain and injury are severe enough, you may need to consider switching to a power wheelchair, at least for part of the time. Power wheelchairs will help to reduce repetitive strain and overuse, conserve energy, and improve speed and ease of travelling over different distances and types of terrain. Of course, there are downsides to using a power wheelchair, and you will need to discuss the pros and cons with your health provider.

Finally, keep in mind that recovery from an upper limb injury or surgery may take a long time. Even after relatively minor surgery, you may need to stay in the hospital for a while so you can adequately rest your upper limbs to allow for healing, prevent skin break down, and get help accomplishing basic daily activities.

Resources

Preservation of Upper Limb Function: What you should know: A Guide for People with Spinal Cord Injury. Consortium of Spinal Cord Medicine. Paralyzed Veterans of America (2008), *(www.pva.org*; 888- 860-7244).

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His contractor friend, Dean Sander, checked it out before closing and said "Sure, I can make this work."

"My goal was to make it accessible, convenient, safe and fully useable—on a budget," Sander said. "Larry gave me a free hand to do what I thought was best." Sander stripped the house down to the studs and rebuilt the whole interior.

He had done ADA compliance work in the past and was familiar with the codes. "But ADA is just a standard," he said. "It doesn't necessarily work for the individual." For example, there's an ADA-compliant toilet, but the flush is on the right, and Mohrman can only use his left hand since the injury. "I wanted to make sure everything worked for Larry," he said. "I walked through the place daily and put myself in his position."

He removed walls between several rooms, enlarged interior door openings to 36 inches, added concrete ramps and landings with guard rails at both outside doors, installed lever-style door handles, and made all the floors hardwood or linoleum.

In the kitchen he installed a roll-under sink and stove top, custom cabinets and counters, and positioned the oven at a height that was accessible from a wheelchair. (See photo upper right.)

The main bathroom has a custom concrete sloping base, roll-in shower, durable porcelain tile throughout the bath floor and shower walls, cathedral ceiling, both remote and rain-sensor controlled skylight, and single handle faucets and shower mixer valves.

The house has additional accessibility features such as keyed-alike locks for all entrances and remote-controlled garage doors and gas fireplace. It was also rebuilt to be energy-efficient.

Sander has worked on many big projects over the years, including several multi-million-dollar private homes and said, "not one has meant more to me than this one. It opened my eyes and made me aware of what a person with a disability has to go through in life. I've never seen Larry happier. He's independent again."

Mohrman agrees. "It's all perfectly done," he said. He hopes that by sharing his remodel experience with others with SCI, they can see what is possible and how changes in their home can vastly improve their independence, comfort and quality of life.

Larry Mohrman's kitchen was completely torn apart and remodeled to be completely accessible to him. Now he can roll his wheelchair under the stove, sink and counter. and the oven for easy reach. Upper cabinets have pull-down accessible shelf racks. See more photos at *http://sci.washington.edu/info/newsletters/articles/12_spr_remodel.asp*.

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See before and after photos of Larry Mohrman's remodel on our website at *http://sci.washington.edu/info/newsletters/articles/12_spr_remodel.asp*.

The front of Larry Mohrman's remodeled house, left, shows the accessible ramp and entry.

The back entry was also remodeled with a new ramp and doorway. .

Single keyed-alike access for all entrances provides accessibility and security.

Resources

- **A word about contractors—** When looking for a contractor, it's important to find someone who really listens to you and is sensitive to your specific needs, Dean Sander says. "The remodel has to work. It's not just aesthetics." Sander is happy to talk to people in the Seattle area about accessible remodel questions. He can be reached at 425-443-6204 or *dean_sander@hotmail.com*.
- *Accessible Home Design*, 2nd Edition, Paralyzed Veterans of America; order at *www.pva.org* or call 888-860-7244.
- Master Builders Association of King and Snohomish County provides practical information and referrals about home building and remodeling. Contact them at 425-451-7920 or *http://www.masterbuildersinfo.com/*.
- "Home Adaptations & Modifications after SCI," SCI Forum presentation, June 12, 2007, Northwest Regional SCI System; *http://sci.washington.edu/info/forums/reports/home_mod_07.asp*.
- See more resources on our website at *http://sci.washington.edu/resources/housing.asp*

forum report

The SCI Forum is an evening presentation and discussion series on topics of interest to persons with spinal cord injury and their family members, friends, caregivers and health care providers, held at the University of Washington Medical Center. To learn about upcoming SCI Forums, read reports of past forums, watch forum videos, or subscribe to the SCI Forum mailing list, go to *http://sci.washington.edu/info/forums*.

Ultralight Wheelchair Skills: From Rehab to Real World

Presented by Elisa Smith, DPT, on November 8, 2011 at Harborview Medical Center.

Watch the video of this presentation online at *http://sci.washington.edu/info/forums/reports/wc_skills_2011.asp*.

The wheelie: an essential skill

A "wheelie" is the act of balancing on your rear wheels. Wheelies may look like tricks, but "they are the essential building blocks of community wheelchair skills," said Elisa Smith, physical therapist at Harborview Medical Center. Unfortunately, many people don't learn this skill before they are discharged home from rehab and then have few opportunities to learn them later on.

"Rehab stays now are getting so short that therapists only have time to focus on basic transfers, caregiver training and testing different chairs," Smith said. "There isn't much time to practice many ultralight wheelchair skills while still in the hospital." Once patients get home, there may not be many therapists in their communities who are familiar with wheelchair skills.

"Newly injured patients often assume wheelies are simply tricks and not essential to their rehab," Smith said. "People will say to me, 'I don't care about tricks right now. I just had this major tragedy in my life, and I don't want to focus on doing stunts.'"

Other patients are just too overwhelmed and fearful in the early weeks. "They can't imagine doing anything outside of the hospital by themselves," Smith said. "They'll say, 'I'm always going to have somebody pushing my chair, so I don't need to learn how to do this on my own,' or 'It seems like wheelies are impossible. I'm just getting used to a chair, and I don't want to do anything where I'm going to put myself at risk for falling back and hitting my head or losing control of the chair.'"

Why learn wheelies?

- **Choosing the best wheelchair**

"The more skills you learn, the more you understand how a chair needs to fit you and what kinds of features and accessories you want," Smith said. "Then when you are talking to therapists or vendors, you are more likely to get a chair that is ideally set up for you."

- **Improved quality of life**

Several studies have shown that learning wheelies and related skills can improve your quality of life because they help you be more independent and more active in the community, such as going to school, work and social activities. "And if you get invited to a barbecue at a friend's house, you will be able to go through the grass to get to the back yard," Smith said.

- **Less pain, fewer falls**

For example, if you are able to pop a wheelie to hop off a curb at an intersection, you can see the traffic and have more control of the chair and be less likely to tip over than if you back down the curb.

Where to learn wheelies

If you didn't learn these skills while still in rehab, or if you want to improve your skills, you can get help and information from a variety of sources, such as:

- **Physical therapists:** see your physical therapist in your clinic or other outpatient setting.
- **Wheelchair Skills Training Program** (*www.wheelchairskillsprogram.ca*) from Dalhousie University (Canada). This website features "how-to" videos and detailed descriptions of many wheelchair skills.
- **The Manual Wheelchair Training Guide**, by P. Axelson, et al. 1st ed. San Francisco, CA: PAX Press; 1998.
- **Other wheelchair users**
  - Visit online forums such as Rutgers' CareCure Forum (*http://sci.rutgers.edu/forum/*).
  - Local events like the UW's SCI Forums (*http://sci.washington.edu/info/forums/*) and SCI Support Group (*http://sci.washington.edu/info/sig.asp*).

Wheelchair skills

Following is a brief summary of the wheelchair skills and techniques presented at this forum. Watch the video to get the full descriptions and see demonstrations of these different skills.

Caution! Consult with your physician and physical therapist before attempting any of these wheelchair skills. Always use a physical therapist or trained spotter to prevent falls while learning wheelchair skills like the ones described here.

A therapist also can train a family member or friend to help spot you while you are learning these skills. Spotting is especially important while you are working on getting your balance in a wheelie.

Stationary wheelie & pop-ups

- Training progression involves three phases: take off, balance and landing.
- **Balancing in a wheelie: surface, balance, tipping back**. "Have a spotter put you back in your balance point on your back wheels so you can see how far back it is," Smith said. "Usually it's farther back than you might expect."
- **Popping into a wheelie**: partial versus full. "It's good to practice going into a partial wheelie, where you're popping up, but not all the way to your balance point," Smith said. "Partial wheelies help you go over obstacles and with being able to time a pop up so you can go up a curb."
- **Landing a wheelie**: push forward on the rim as you land to soften the impact.
- **Take-off strategies**:
  - Backward: pull back and then push forward on the rims.
  - Forward: push forward on the rims to pop up. This strategy may be

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slower and require more force, but it enables pop-ups during forward propulsion and in tight spaces.

- **Self-recovery**: pull back on the rims to tip forward out of a wheelie.
- **Safe falls.** There is no ideal way to fall safely, Smith said. If you are falling backward, "try to keep your head as far forward as you can so the frame hits the ground first, and do some combination of blocking your knees (so they don't hit you in the face) and blocking your head, or blocking your head with both arms."

Dynamic wheelie

A dynamic wheelie is moving or propelling while balancing on your rear wheels. You can go forward, backward, turn, and pivot in place.

Practice going forward by setting up a slalom course to propel around obstacles in a wheelie.

"Reverse is the most difficult and requires a lot of practice because pulling back to go in reverse tips the chair forward out of a wheelie," Smith said.

Indoor Skills

- **Thresholds** or flooring transitions: perform a partial pop-up to ascend.
- **Thick carpet**: propel in a wheelie.
- **Tight spaces** (restrooms, elevators): back into the space and turn in a wheelie.
- **No-hands wheelie** (against wall): back up against a wall, tip back, and lock your wheels. "The idea with a no-hands wheelies is that you can lean back and not have to be balancing your chair," Smith said. "This can be good for reading, making phone calls or giving your back a rest. It can be used for pressure reliefs and provides a better neck position for looking up during conversations."
- **Stairs**: Stairs are challenging and can be risky, Smith said. "Doing stairs is one of the most physically demanding skills. It's not just about balance and technique, like most of these other skills. Stairs, especially going up, takes a tremendous amount of arm strength, and it can really go wrong. Even if it goes smoothly, there is a lot of wear and tear on your arms, especially your shoulders." Like using escalators (below), going up and down stairs is the kind of skill you might want to know about just for emergencies, if you're in a building and there's a fire and the elevators stop working."
- **Escalators**: "Some places will ask you not to go on an escalator because they're afraid you'll get stuck," Smith said. "You need to ascend and descend facing up. Timing and trunk position are important." There is a risk of falling or getting stuck, so proceed with caution.

Watch the video on our website:
http://sci.washington.edu/info/forums/reports/wc_skills_2011.asp

Outdoor Skills

- **Uneven terrain** (snow, grass, gravel, sand): "You pop up into your wheelie and keep the front wheels up as you propel forward," Smith said. "This is a dynamic wheelie and is very labor-intensive because there's a lot more friction to push against." Consider knobby tires or larger casters for these activities. Also, be aware that some surfaces can damage wheelchair components.
- **Depressions** (potholes, grates): Pop into a partial or full wheelie, which lifts your casters out of the depression, and go across on your rear wheels.
- **Freeing wheels** from being stuck in a grate or hole: rock side to side.
- **Raised obstacles** (roots, railroad tracks, hoses): Pop your casters over the obstacle, flex your trunk, and use push strength or momentum to go over the obstacle with the rear wheels as your casters land beyond the obstacle.
- **Hills and ramps**
  - **Crossing a slope**: push faster with one hand than the other.
  - **Going up**: If you don't have enough balance or momentum and you can't stay forward enough to go up hills, get your chair configuration and fit evaluated by a therapist. You might want to consider mechanical assist or power assist options such as hill climbers, Magic Wheels, or even a power chair.
  - **Going down**: pop into a wheelie while you're on a level area, find your balance point, and lean back as you descend, letting the rims slowly slide through your hands. "Descending in a wheelie allows you to control your speed a little better," Smith said, "and if the hill is really steep, it keeps you from pitching over as you go down." Plastic rims will burn when descending quickly, so use gloves to increase your power and decrease burning.
- **A word about chest straps**: "Even if it gives you some stability on the levels, if you're always cinched down into the backrest with the chest strap you can't lean forward and back enough to keep your balance with many of these skills," Smith said.
- **Curbs—going up**
  - **Timing of caster pop up:** Low or late pop up may result in casters hitting the curb, abruptly stopping the wheelchair. High or early pop up may result in rear wheels hitting the curb too soon, decreasing momentum. "Practice going up to the curb and popping up without worrying about getting on top of it, so you can get comfortable with the timing of the pop up and with how high you need to get the casters up," Smith said.
  - **Rear wheel ascension**: getting the rear wheels up on the curb after your casters are up there depends on wheelchair pitch angle, velocity, trunk position, and hand position.

- **Curbs—going down**
  - **Face forward** for improved visibility and shock absorption, and to avoid flipping over backward (see photo above). If you do go down backward, flex your trunk to avoid flipping. Descending backward can cause more pain and discomfort than descending forward because the shock goes through the front casters, which can't absorb it as well as the rear wheels.

literature review

The articles previewed below were selected from a recent screening of the National Library of Medicine database for articles on spinal cord injury. In the judgment of the editors, they include potentially useful information on the diagnosis or management of spinal cord injury. You may obtain copies of the complete articles through your local medical library or from UW Health Sciences Library Document Service (http://www.lib.washington.edu/ill).

SEXUAL FUNCTION & FERTILITY

■ Pregnancy outcomes by intravaginal and intrauterine insemination in 82 couples with male factor infertility due to spinal cord injuries.

Eighty-two male patients with spinal cord injuries and their female partners received infertility services in this study. Sperm were obtained by masturbation in 4 men (4.9%), penile vibratory stimulation in 42 men (51.2%), and electroejaculation in 36 men (43.9%). Intravaginal insemination (IVI), performed mostly at home, was undertaken in 45 couples, 17 of whom (37.8%) achieved 20 pregnancies. Intrauterine insemination (IUI)was performed in 57 couples, 14 of whom (24.6%) achieved 19 pregnancies. Overall, 18 live births occurred by IVI and 21 occurred by IUI. The authors conclude that IVI and IUI are reasonable options for this patient population and should be used before proceeding to assisted reproductive technologies (ART).

Kathiresan AS, Ibrahim E, Aballa TC, et al.
Fertil Steril. 2011 Aug;96(2):328-31.

■ Assessing and conceptualizing orgasm after a spinal cord injury.

A total of 97 men with SCI underwent sexual stimulation using various techniques (natural stimulation, vibrostimulation or vibrostimulation combined with midodrine). Injury level ranged from C2 to S5 and involved both complete (49%) and incomplete (51%) lesions. Among the 89 (92%) who achieved ejaculation, 50 experienced autonomic hyperreflexia (AHR, also known as autonomic dysreflexia or AD) at ejaculation and 39 did not. Significantly more sensations were described at ejaculation than with sexual stimulation alone. Men with SCI who experienced AHR at ejaculation reported significantly more cardiovascular, muscular, autonomic and dysreflexic responses than those who did not. There was no difference between men with complete and those with incomplete lesions. The findings show that the questionnaire is a useful tool to assess orgasm and to guide patients in identifying the bodily sensations that accompany or build up to orgasm. The findings also support the hypothesis that orgasm may be related to the presence of AHR in individuals with SCI.

Courtois F, Charvier K, Vézina JG, et al.
BJU Int. 2011 Nov;108(10):1624-33.

ARM, HAND & SHOULDER

■ Changes in skills required for using a manual wheelchair after reconstructive hand surgery in tetraplegia.

Surgical reconstruction of arm and hand function has developed tremendously over the last decade. Several studies have documented the functional improvements after surgery and rehabilitation: better control and strength of elbow extensors; lateral pinch; grip function; and opening of the hand. In this study, 16 individuals with C5-C7 tetraplegia underwent a total of 23 grip and/or elbow extension reconstruction surgeries to improve arm and/or hand function. Functional tests of wheelchair control were performed before and 12 months after the reconstructive surgery. Sixty-eight percent of the individuals improved their wheelchair maneuvering skills after hand surgery. Improvements were also observed in their ability to perform tests that were impossible to perform before surgery. The type of reconstruction and level of injury affected the degree of improvement achieved. Hand and arm function are highly prioritized goals in this population, and increased mobility is a crucial factor in living a more active life.

Lamberg AS, Fridén J.
J Rehabil Med. 2011 Jul;43(8):714-9.

■ A cross-sectional study of demographic and morphologic features of rotator cuff disease in paraplegic patients.

Shoulder pain affects up to 67% of the SCI population, a rate that is four times higher than the able-bodied population. In this study, 317 individuals with paraplegia between T2 and L3 underwent clinical exams and magnetic resonance imaging (MRI) of both shoulders. Participants averaged 26.7 years of wheelchair dependency (range, 5-56 years). While 161 patients (51%) had no rotator cuff tears, 156 (49%) had tears in one (unilateral, 20%) or both (bilateral, 29%) shoulders. Patients with bilateral tears were older and had been injured longer than those with unilateral or no tears. In patients with unilateral tears, a full-thickness rupture of the supraspinatus tendon was found in 67%, whereas a partial-rupture was detected in 33%. Of the patients with bilateral tears, 75% presented with a full-thickness rupture and 25% with a partial rupture. These findings support the theory of "wear and tear" in patients with spinal cord injury and that the occurrence of cuff tears depends on the duration of wheelchair dependency as well as age.

Akbar M, Brunner M, Balean G, et al.
J Shoulder Elbow Surg. 2011 Oct;20(7):1108-13. Epub 2011 Jul 2.

AUTONOMIC DYSREFLEXIA

■ Autonomic dysreflexia: current evidence related to unstable arterial blood pressure control among athletes with spinal cord injury.

Spinal cord injury is commonly associated with a range of autonomic dysregulation that can interfere with cardiovascular, bladder, bowel, temperature, and sexual function. Individuals with a cervical or high-thoracic SCI face lifelong abnormalities in systemic arterial pressure control. In general, their resting arterial pressure is lower than that in able-bodied individuals and is commonly associated with persistent orthostatic intolerance. In addition, they experience fleeting episodes of life-threatening hypertension, known as autonomic dysreflexia (AD), which often is associated with disturbances in heart rate and rhythm. AD occurs in up to 90% of individuals with a cervical or high-thoracic SCI and requires immediate medical attention. During athletic activities, self-induced AD is used by some individuals to improve their performance, a technique known as "boosting." For health safety reasons, boosting is officially banned by the International Paralympic Committee. Medical practitioners who are involved in the care of wheelchair athletes should be aware of the unique cardiovascular dysfunction that results from SCI and may occur at any time, even with seemingly harmless triggers. Prompt recognition and management of these conditions, including episodes of AD, could be life saving.

Krassioukov A.
Clin J Sport Med. 2012 Jan;22(1):39-45.

UROLOGICAL PROBLEMS

■ Multicenter randomized controlled trial of bacterial interference for prevention of urinary tract infection in patients with neurogenic bladder.

This study involved individuals with neurogenic bladder due to spinal cord injury and a history of recurrent urinary tract infections (UTIs). Participants were randomized to receive a bladder inoculation of either *Escherichia coli* HU2117 (experimental group) or sterile saline (control group). Urine cultures were obtained weekly during the first month and then monthly for 1 year. Of 17 patients colonized with *E. coli* HU2117 and the 10 control patients, 5 (29%) and 7 (70%) developed more than 1 episode of UTI, respectively. The average number of episodes of UTI per year was also lower in the experimental than in the control group.

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E. coli HU2117 did not cause symptomatic UTI. The authors conclude that bladder colonization with *E. coli* HU2117 safely reduces the risk of symptomatic UTI in patients with spinal cord injury. Effective, but less complex, methods for achieving bladder colonization with *E. coli* HU2117 are under investigation.
Darouiche RO, Green BG, Donovan WH, et al.
Urology. 2011 Aug;78(2):341-6. Epub 2011 Jun 17.

TECHNOLOGY AND MOBILITY

■ **Technology for mobility in SCI 10 years from now.**
A person's level of disability is an interaction between their impairment and the environment. Technology impacts this in a number of ways and has the potential to fully eliminate disability. The authors believe technology will eventually allow complete independence someday, but economic factors and systems of care will impact the extent to which individuals with SCI will fully benefit from technological advances. The authors review expected advances in specific areas of technology, such as power sources, processing, sensors and software, and describe the ways specific devices will be impacted by them. They also discuss the social context of technology for mobility and how the political, social and economic environment is likely to impact advances. Although technology advances are exciting, a large challenge for the research community will be how to effectively apply and deploy this technology. Advances occurring in the next 10 years that reduce cost of technology may be more important to the population with SCI than brand new technologies.
Boninger M, French J, Abbas J, et al.
Spinal Cord. 2012 Jan 17.

ELECTRICAL STIMULATION

■ **Muscle changes following cycling and/or electrical stimulation in pediatric spinal cord injury**
Muscle atrophy (wasting) is common in people with SCI and has negative health effects such as increased risk for cardiovascular disease, insulin resistance, glucose intolerance and type 2 diabetes. Children with SCI also are at higher risk for these problems, and intervening at an earlier age may be beneficial. Functional electrical stimulation while cycling (FESC) can increase muscle mass and strength in adults with SCI, and this study examined whether it can be helpful for children with SCI. Thirty children with SCI aged 5-13 were randomly assigned to do FESC, passive cycling (no electrical stimulation) or electrical stimulation without cycling (ES) at home for 1 hour, 3 times per week. After 6 months, tests showed that children receiving either FESC or ES exercise had changes in muscle size, stimulated strength, or both. The ES group had greater changes in quadriceps muscle size, and the FESC group had greater changes in strength. These changes may decrease their risk of cardiovascular disease, insulin resistance, glucose intolerance, and type 2 diabetes. Children in the PC group had no improvements.
Johnston TE, Modlesky CM, Betz RR, Lauer RT.
Arch Phys Med Rehabil. 2011 Dec;92(12):1937-43.

■ **Increased aerobic fitness after neuromuscular electrical stimulation training in adults with spinal cord injury.**
Fourteen participants with SCI (T4-11; ASIA A and B) completed training of a new neuromuscular electrical stimulation (NMES) system designed to improve aerobic fitness in persons with SCI. For the training, four electrodes were placed on the quadriceps and hamstrings muscle groups, and subtetanic contractions were elicited using the NMES device. Participants did the training unsupervised at home for 1 hour, 5 days/wk for 8 weeks. A treadmill wheelchair propulsion exercise test with simultaneous cardiopulmonary gas exchange analysis found a significant increase in Vo(2) peak and HRpeak between baseline and follow-up testing. This novel form of NMES is an effective method of improving aerobic fitness in a sedentary adult SCI population. Compliance with training was high, possibly indicating the convenience of using this system. Results compare favorably with current functional electrical stimulation exercise systems. This system offers a portable and convenient method of aerobic exercise, with the potential to provide the associated health benefits of exercise to the SCI population.
Carty A, McCormack K, Coughlan GF, et al.
Arch Phys Med Rehabil. 2012 Mar 21.

PRESSURE ULCERS

■ **A telerehabilitation intervention for persons with spinal cord dysfunction.**
Pressure ulcers and depression are common preventable conditions in people with spinal cord dysfunction (SCD). However, few successful, low-cost preventive approaches have been identified. The authors developed a dynamic automated telephone calling system, termed Care Call, to motivate people with SCD to improve their skin care, seek treatment for depression, and appropriately use the healthcare system. This system supplements face-to-face health care with a clinician. It uses a digitized human voice and functions as an at-home monitor, educator and counselor for reinforcing or changing health-related behaviors. Individuals with SCD pilot-tested the system and provided feedback. Results of a randomized controlled trial using this system will test whether the intervention will successfully promote self-management in a cost-effective manner.
Houlihan BV, Jette A, Paasche-Orlow M, et al.
Am J Phys Med Rehabil. 2011 Sep;90(9):756-64.

■ **Necrotizing fasciitis in patients with spinal cord injury: an analysis of 25 patients.**
A retrospective chart review found 25 SCI patients (19 with paraplegia and 6 with tetraplegia) who were treated for necrotizing fasciitis during a 9-month period. Necrotizing fasciitis (NF) is an infection that causes tissue to die (sometimes called "flesh-eating bacteria"). In 18 cases, NF developed due to pressure sores. Grade 4 pressure sores were identified in 15 cases and grade 3 pressure sores in 3 cases. The incidence of developing NF is significantly higher in patients with grade 4 pressure sores than in those with a lower-grade lesion. The most common bacteria were streptococci. During the hospital stay, six patients developed sepsis and two died because of septic multi-organ failure. The authors recommend that close clinical and laboratory monitoring of all patients with grade 3 or 4 pressure sores is appropriate so that any early clinical signs of NF can be recognized and evaluated for early and aggressive treatment.
Citak M, Backhaus M, Tilkorn DJ, et al.
Spine 2011 Aug 15;36(18):E1225-9.

ADJUSTMENT

■ **An exploration of modifiable risk factors for depression after spinal cord injury: Which factors should we target?**
A total of 244 community-dwelling individuals with SCI (77% men, 61% white; mean age, 43.1y; 43% with tetraplegia) who were at least 1 month postinjury completed questionnaires on depression (PHQ-9), physical activity (International Physical Activity Questionnaire [IPAQ]), pleasant and rewarding activities (Environment Rewards Observation Scale [EROS]), and self-efficacy to manage the effects of SCI (Modified Lorig Chronic Disease Self-Management Scale). The study found that more severe depression was associated with being 20 to 29 years of age, not completing high school, not working or attending school, and being 4 or fewer years post-SCI. Having rewarding activities and, to a lesser extent, having confidence in one's abilities to manage SCI, were associated with being less depressed. Treatments designed to increase the level of rewarding activities and positive reinforcement in the daily lives of people with SCI may be an especially promising approach to treating depression in this population.
Bombardier CH, Fann JR, Tate DG, et al.
Arch Phys Med Rehabil 2012;93(5):775-781.

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Upper Limb Pain in SCI

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