Welcome to our Spring/Summer Newsletter!

The Neurology Section Special-Interest-Group (SIG) elections concluded earlier this Spring, and it is my pleasure to welcome our two newest SCI SIG members. Colleen Sullivan, PT, DPT, NCS joins us from Magee Rehabilitation in Philadelphia, PA and will serve as our secretary and Timothy Faw, PT, DPT, NCS from The Ohio State University in Columbus, OH joins us on the nominating committee. Welcome, Colleen and Tim! We are grateful to have you on our team. I would also very much like to thank everyone who ran for a position. I hope you will continue to be involved in our SIG and consider running for SIG positions in the future. In addition, we have two members who will be rotating off the SIG following completion of their term of service. Let me extend my heartfelt thanks, to both Erin Culverhouse PT, DPT, NCS Nominating Committee Chair, and Marcie Kern, MS, PT, NCS Secretary. Your dedication to our SIG has been inspiring to me and has significantly improved our SIGs ‘reach’. You have left behind very big shoes to fill but I am sure Colleen and Tim are up to the task!

Our past newsletters have revolved around different themes, for example one series of newsletters focused on Health and Fitness after SCI. Most recently we chronicled bowel/bladder/sexual function and parenting after SCI (see http://www.neuropt.org/special-interest-groups/spinal-cord-injury/newsletters). For our next newsletter ‘series’, we embark on a new topic, “Aging and SCI”. Rachel Tappan PT, DPT, NCS has outlined an impressive sequence of newsletters starting with our current newsletter topic on musculoskeletal considerations for those aging with a spinal cord injury. She has convened the experts, Meegan Van Straaten, PT, MSPH; Beth Cloud, PT, Kristin Zhao, PhD, and Missy Morrow, PhD to give us an overview of the examination and treatment of shoulder pain after SCI. This is followed by our Clinician’s Corner Section, in which Craig Newsam, PT, DPT has shared a comprehensive perspective on optimizing movement strategies to increase function and minimize musculoskeletal pain after SCI. These two articles blend well and together help us to ‘paint the picture’ for musculoskeletal concerns when aging with injury. Thanks to all our experts for lending your time and sharing your wisdom with our readers! We are very fortunate to have your input in this newsletter.

And finally, it is with a very heavy heart that I relay to you the passing of our dear friend and colleague, Joy Bruce, MS PT, PhD. Joy has been a leader for SCI Care for many years. She has held several leadership positions both within and outside of the APTA. While she received modest recognition for her efforts in mobilizing an international group of “physios,” as Joy would say, perhaps most remarkable is her contribution to the creation of SCIPT.org with Lisa Harvey BAppSc, MAAppSc, PhD from Australia. This extensive on-line resource reveals her dedication to the training of Physical Therapists in the care of persons with SCI, and has helped hundreds in the recent past and possibly thousands of patients in the future who will suffer a SCI anywhere in the world. I encourage you to turn to page 3 for a moving remembrance shared with us by her good friend and co-worker, Leslie Van Hiel, PT, DHScPT. Rest in peace, dear friend.

Until next time……
Karen J. Hutchinson

SCI SIG Officers:

- Karen J. Hutchinson, Chair
- Meghan Joyce, Vice Chair
- Marcie Kern, Secretary
- Twala Maresh, Chair, Nominating Com.
- Erin Culverhouse, Nominating Com.
- Rachel Tappan, Nominating Com.

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Next Issue:

SCI and Aging: Cardiopulmonary System
Combined Sections Meeting February 2015
Recap of SCI SIG Programming

“Problem-Solving Complex Seating and Mobility Technology Needs for Individuals with Spinal Cord Injury”

Presented by Cindy Smith, PT, DTP, ATP, Allison Fracchia, PT, ATP/SMS, and Twala Maresh, PT, DPT, NCS, ATP. Recommendations were made through case study presentations demonstrating the importance of individualized seating and mobility equipment recommendations that incorporate each patient’s goals and preferences, the aging process, home and community environment, transportation needs, and physical attributes unique to each patient. This valuable course emphasized the importance of listening to the client and problem-solving as a team.

“Assessment and Management of Overweight or Obese Patients with Spinal Cord Injury”

Presented by Daniel Dale, PT, DPT, K. Hutchinson, PT, DPT, PhD, Kristy Prox, RD, LD, and SueAnn Sisto, PT, MS, PhD, FACRM. Sobering statistics on the obesity epidemic in the US, laid the framework for discussion on persons with Spinal Cord Injury (SCI) developing obesity and obese persons suffering SCI. This 2 hour educational symposium focused on key concepts for consideration after SCI. Secondary health conditions, nutritional guidelines, and suggestions for exercise prescription were followed by comprehensive case studies.

Handouts for both presentations are available for CSM attendees at the APTA website: http://aptaapps.apta.org/AttendeeHandouts/Login.aspx?Process=CSM&LoggedIn=0

Conferences and Resources:

Academy of Spinal Cord Injury Professionals 2015

International Network of Spinal Cord Injury Physiotherapists

www.scipt.org

American Congress of Rehabilitation Medicine 2015

ACRM 92nd Annual Conference

NON-STOP CONTENT: BRAIN INJURY • SPINAL CORD INJURY • STROKE • NEURODEGENERATIVE DISEASES • PAIN • CANCER
In Memorium: Joy Bruce

Joy Bruce, MSPT, PhD
1972-2015

By Leslie Van Hiel

Hers was an outstanding life. Joy Bruce’s career as a physical therapist was a powerful part of that life. She had a strong devotion to treating her patients and mentoring her colleagues and students. Her perpetual confidence and enthusiasm drove her to try to improve the health care world in the United States and internationally. Even President Obama received multiple letters from her with suggestions for US health care.

After graduating from the University of Virginia in 1993, she served as an EMT. She then graduated from North Georgia University in 2000 with her MSPT degree. After a year at a local Atlanta hospital and a year as an outpatient PT at Shepherd Center, she moved to North Carolina in 2003. She served as a PT at local medical centers and at Thomas Rehabilitation Hospital through 2005. She also began her PhD degree in Health Related Sciences at the Medical College of Virginia. During the years working toward her PhD, she was also an adjunct professor in the Physical Therapy Department at Western Carolina University (2003-2005) and, after returning to Georgia, an assistant professor in the Department of Physical Therapy at North Georgia University (2006-2008).

In 2008 she joined the staff at Shepherd Center in Atlanta, GA. She became a full-time clinical researcher and manager of the Hulse SCI Research Lab in 2009, and earned her PhD in 2011. She worked on studies ranging from a tongue-operated power wheelchair for people with high-level tetraplegia to studying spinal reflexes during stepping in a robotic gait device. She published 4 papers, and presented numerous times through platforms and posters at national conferences. Her most recent interest was to use lumbar or cervical transcutaneous spinal cord stimulation to decrease spasticity and improve function in people with incomplete spinal cord stimulation. The Hulse Lab continues work in this area today.

In addition to this extra responsibility, she was writing a chapter in a planned textbook for spinal cord injury care. She installed and taught people how to use FES cycles at home. She also spent two weeks in Germany at the request of a rehabilitation physician, comparing therapy techniques with a group of European physiotherapists.

For those of you who only knew the professional, intellectual side of Dr. Bruce, you should know that Joy lived up to her name. She was incredibly witty, laughing while quoting Monty Python and talking in bad accents. She used ridiculous vocabulary words just for fun. She wore her UVA Cavaliers hat with pride. Her impression of a T-Rex was priceless. She reveled in the outdoors through cycling and hiking. She had played just about every sport possible, although rugby was her favorite. She had even tried out for the US Women’s bobsled team. She loved—as was loved by —her wife, her family, her friends, her pets, and her patients. She was truly joyous.

In 2008 she joined the staff at Shepherd Center in Atlanta, GA. She became a full-time clinical researcher and manager of the Hulse SCI Research Lab in 2009, and earned her PhD in 2011. She worked on studies ranging from a tongue-operated power wheelchair for people with high-level tetraplegia to studying spinal reflexes during stepping in a robotic gait device. She published 4 papers, and presented numerous times through platforms and posters at national conferences. Her most recent interest was to use lumbar or cervical transcutaneous spinal cord stimulation to decrease spasticity and improve function in people with incomplete spinal cord stimulation. The Hulse Lab continues work in this area today.

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She was a very special part of Shepherd Center and requested that her memorial be held there. The auditorium was standing room only, filled with family, friends, and colleagues. There was time designated to share stories about her. Appropriately, a former patient was the first to speak, recalling how she pushed him to work harder on the FES cycle, and then increased the resistance to work harder still. The final comment was made by a fellow PT, who described how as a new graduate he had asked her what accomplishment she was most proud of, she had replied “I haven’t done it yet.” That was Joy.

Leslie VanHiel, PT, DScPT was a close friend and colleague of Joy’s and currently is the SCI Research Coordinator in the Hulse SCI Lab at Shepherd Center, Atlanta, GA.
In recent decades, the short-term survival after spinal cord injury (SCI) has improved, and the mean age of the population with a spinal cord injury (SCI) has increased. As a result, physical therapists need to be more aware of the issues that arise for people with SCI as they age. People with SCI experience many of the same changes with aging that occur in the general population, but these changes often happen earlier and at an accelerated rate. Additionally, some unique challenges associated with aging with a SCI exist. For example, people with SCI of longer duration are more likely to have contractures, generalized bone mineral density loss, and increasing shoulder pain. And increased age is associated with more fecal incontinence, higher prevalence of obstructive sleep apnea and respiratory problems in people with SCI.

With these age-related changes comes an eventual increase in physical disability. In a sample of people with SCI with onset between 15 and 55 years of age, a decline in motor abilities was most prevalent in people 25 years or more after their SCI. In another study, older age at initial onset of SCI was associated with a more rapid decline in functional status in later years. Despite this increase in disability, however, people with spinal cord injury sustain quality of life and participation in life activities. Indeed, they tend to have an increase in psychological adjustment and an improvement in some aspects of satisfaction with life.

Many of the problems that people with SCI experience as they age are modifiable, and physical therapists have an important role in the education, training, and equipment prescription that can help optimize the aging process for people with SCI. For instance, people with SCI are at a higher risk of developing diabetes and cardiovascular disease compared to the general population. Therefore, incorporating cardiovascular exercise into our exercise prescriptions for people with SCI and providing education regarding the importance of this exercise long-term may help decrease the incidence or severity of these problems in our patients. In this and other problems that occur with aging with a SCI, physical therapists can help our patients anticipate what problems will arise and either reduce or eliminate the impact.

In the next four newsletters, we will explore some of the changes that happen as people with a SCI age. These include: musculoskeletal changes such as overuse injuries (which is the focus of this newsletter), changes to the cardio-pulmonary and integumentary systems, and changes in psychological adjustment and emotional wellbeing. We will discuss these changes and the role of physical therapists in addressing them in order to help maximize the functional abilities and quality of life of people with SCI. In this newsletter, Melissa (Missy) Morrow, PhD, Meegan Van Straaten, PT, MSPH, Beth Cloud, DPT, Kristin Zhao, PhD, and Craig Newsam, PT, will help us better understand overuse injuries in people with SCI.

References:

Online Education Resources for People with SCI Related to Aging:

National Spinal Cord Injury Association Resource Center:

Northwestern Regional Spinal Cord Injury System Education Videos:
**Introduction**

Musculoskeletal overuse disorders of the shoulder are common in people with a SCI. Unfortunately, pain resulting from shoulder soft tissue injury/disease is difficult to treat and often overlooked by patients who have a wide range of secondary complications. The most common etiology of the shoulder overuse injury involves damage to the rotator cuff or biceps tendon from mechanical impingement of the tendon between the boney anatomy of the shoulder (Fig 1). The pain and related dysfunction tends to increase with age and is compounded by expected age-related degenerative arthritis. This article will focus discussion on evidence-based evaluation and treatment specific to rotator cuff disease; however, the conservative therapies reviewed here are important for shoulder health in general and will help slow the aging process of the entire shoulder. Careful attention to the shoulder health of patients with SCI can lead to preservation of shoulder function and independence.

**How common is shoulder pain following a SCI?**

When describing shoulder pain after SCI, it is helpful to consider differences across injury level and ambulation status to delineate the effects of varying degrees of impairment and weight-bearing by the shoulder. By injury level, the prevalence of shoulder pain is higher in people with tetraplegia (81% reporting pain) compared to people with paraplegia (58% reporting pain). In adults who use manual wheelchairs, reports of pain range from 31-73% while 50% of adults who use motorized wheelchairs report shoulder pain. Among adults with a SCI who ambulate with a crutch or cane, roughly 50% report shoulder pain. Half of adults with a SCI reporting shoulder pain will have bilateral symptoms and the majority will have chronic pain that lasts more than 1 year. The prevalence and severity of shoulder pain increases with age.

**What is known about the mechanism of shoulder pain and injury in adults with a SCI?**

Self-reported questionnaires indicate that shoulder pain is most intense during activities of daily living including wheelchair propulsion up an incline, transfers, grasping objects overhead, and other weight-bearing tasks. However, the exact biomechanical mechanism of rotator cuff injury in the SCI population is largely unknown. It is theorized that mechanical subacromial impingement is a major contributor to the reported rotator cuff disease (tendinopathies and tears) seen with imaging and concomitant pain. However, current concepts in rotator cuff disease are evolving. Subtypes of impingement have been identified including subacromial or external impingement, internal impingement, and subcoracoid impingement, each with a unique contribution to the development of rotator cuff injury.

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**Figure 1: Anatomy of the shoulder highlighting the supraspinatus and infraspinatus muscle tendon that attach to the humerus within the subacromial space. Copyright Mayo Foundation; used with permission**
How can shoulder pain and injury be thoroughly evaluated in your patient with a SCI?
Since shoulder pain and dysfunction in patients with a SCI is known to be multifactorial, a thorough physical evaluation is necessary for differential diagnosis.\textsuperscript{10,11}

Evaluation of the shoulder:

- Perform probing history, determine onset of pain, location of pain, and activity-related aggravators (may appear as avoidance of activity or fatigue during activity)
- Use validated, responsive, and sensitive self-reported questionnaires to quantify and track function and pain intensity (examples below)
- Use upper quarter screen. Rule out pain of cervical origin
- Perform provocation tests that load multiple structures to reproduce pain (such as, Neer, Hawkins-Kennedy, Speeds, external rotation resistance)
- Determine goniometric range of motion (active and passive). Pay particular attention to internal and external gleno-humeral rotation; internal rotation deficits closely related to impingement
- Assess scapulothoracic flexibility, symmetry and quality of movement
- Assess muscle strength. Consider strength quantification using dynamometry, if available. Determine side-to-side asymmetries or measurements below age established norms that manual muscle testing cannot capture
- Assess muscle tone and spasticity (throughout the body) and the effect on shoulder kinematics
- Evaluate posture and chair set up. Look for rounded shoulder posture
- Evaluate movement during ADLs, including wheelchair propulsion and transfers; document risky patterns for the upper extremity
- Palpate the shoulder. Note areas of sensitivity
- Review imaging findings, if available

Evaluation items to pay particular attention to:

- Look for worsening in shoulder pain symptoms over time. Any change in severity of regularly experienced pain may indicate new or worsening shoulder tendon pathology
- Progression of any upper limb weakness. Immediate referral to a specialist indicated
- Acute trauma with suspected tearing of a rotator cuff tendon. Immediate referral to a specialist indicated; timeliness of treatment necessary for surgical repair of complete tears

What self-reported outcome measures are available to track shoulder pain and dysfunction?
Patients with SCI may not seek treatment for or even report shoulder pain. However, due to the fact that pathology, pain, and loss of function increase with age and time since SCI, it is important that this issue be addressed continuously rather than waiting until significant loss of function. Validated and reliable options for a self-report questionnaire to include as part of ongoing outpatient therapy or annual clinic appointments are highlighted below:

- The \textit{Wheelchair Users Shoulder Pain Index (WUSPI)}\textsuperscript{6,22} allows the patient to rate pain intensity during common activities performed by wheelchair users. The activities shown to be most pain provoking can then be modified as part of the treatment plan. Although not standardized, clinicians who treat ambulatory patients or patients who use power wheelchairs may consider adding or modifying questions to include appropriate questions regarding mobility and activities of daily living.
- The \textit{Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)}\textsuperscript{28} and the \textit{Quick DASH} were designed to determine upper extremity symptoms and function. They have been utilized as an outcome measure to detect change in clinical intervention studies of shoulder pain after SCI. Since the DASH queries the patient to answer questions about the entire upper extremity, problems with the wrist and elbow may be identified as a result of the completion of this survey.
- The \textit{Patient Specific Functional Scale (PSFS)}\textsuperscript{29} is used to assess functional ability to complete specific activities. The respondent identifies and rates up to five activities that are causing difficulty for them, allowing activities important to the patient to be identified that may not have been captured with other questionnaires. At follow-up visits the patient can nominate new activities if the initial ones have resolved.
What conservative treatment options exist for SCI patients with shoulder pain and injury?

Once it has been determined that mechanical subacromial impingement is a major contributor to shoulder pain/dysfunction, the first line of defense is often physical therapy (Fig 2). In addition to the necessary environmental, equipment, and functional movement optimization that are part of a successful physical therapy program, therapeutic exercise has been proven to be effective for this clinical problem.\(^\text{12-14}\) Studies in the able-bodied and SCI population have found exercise to reduce pain and increase function to a clinically significant degree even in populations with longstanding chronic pain.\(^\text{13, 15-21}\) Well-documented, evidence-based exercise programs, including photographs and videos, are emerging, allowing for immediate translational use in the clinic.\(^\text{13, 19, 22, 23}\)

Exercise interventions to treat mechanical subacromial impingement in the shoulder should include:

- Strengthening of the scapular stabilizers and rotator cuff with emphasis on:
  - Glenohumeral external rotators
  - Scapular depressors and retractors
  - Balancing synergistic muscles that limit humeral head superior and anterior translation
- Stretching of tight soft tissue structures with special consideration of:
  - Anterior chest musculature
  - Posterior capsule/structures, with finding of glenohumeral internal rotation deficit (GIRD)
- Progressive advancement over at least 12 weeks prior to maintenance program
- Dosing to increase strength, muscular endurance, and agonist/antagonist balance
- Modifications, if needed, to maintain neutral cervical and thoracic posture throughout exercise regime:
  - Supine position
  - Reduce range of motion allowed during active exercise
  - Begin with isometrics
  - Initial reduction of resistance or number of repetitions
- Methods to assure proper technique, including centering maneuver of the humeral head in the glenoid, and avoiding substitution (scapular elevation common), and progressing program when appropriate
- Time requirements, equipment and resources that encourage adherence, naturally fit into daily routine, and are sustainable throughout the length of the program

Standard therapeutic exercise programs have focused on concentric loading exercises; however eccentric loading exercises are a part of a growing body of literature demonstrating the effectiveness of loading an injured tendon to treat tendinopathies.\(^\text{10}\) It is theorized that eccentric loading causes healing through regeneration of the tendon. Limited studies have utilized eccentric exercise to treat rotator cuff tendinopathies, and the practitioner should be on the lookout for new evidence, as studies emerge utilizing control groups and dose-response study designs.

To prevent and heal over-use injuries in the shoulder, the importance of rest should not be underestimated. Seemingly difficult to implement in the SCI population, resting the shoulder may be under-appreciated. Rest does not necessarily mean disuse of the upper extremity, but rather a relative reduction of stress on the shoulder or breaks implemented during repetitive tasks such as manual wheelchair propulsion. ADLs and other aspects of the regular routine should not feel overly strenuous or cause pain to the shoulder. If they do, a temporary solution to reduce the stress should be considered. Working with the patient to determine realistic solutions may include reassessing wheelchair fit and activities of daily living.
Aging of the Shoulder Following Spinal Cord Injury (Van Straaten et al): Intervention (continued)

**Do the costs outweigh the benefits of some of the medical treatment options that exist?**

**Steroid injection to the tendon:**
An injection of anti-inflammatory steroid medication may provide short term relief of pain from rotator cuff disease, but should not be used in isolation since it does not treat the underlying cause of pathology. Its’ effectiveness may be optimized when the injection is administered under ultrasound (US) guidance for accurate needle positioning, and this method may result in less post-procedure pain. Post-procedure restrictions only require a few days of reduced use of the arm. However, use of steroid injections requires careful consideration because of the steroids’ secondary harm to the tendon. There are mixed opinions among providers on the appropriateness of steroid injections in the SCI patient due to the tendon damage that an already heavily loaded tendon may not tolerate.

**Surgical repair of torn tendons:**
While surgical repair for acute, traumatic rotator cuff rupture may be required, there are no clear guidelines for timing of repair for degenerative and overuse tendon tears (Fig 2). A couple of reasons for this are the fact that determining which partial tears will progress is often unpredictable, and pathological findings don’t always align with clinical symptoms. Conservative treatment is almost always prescribed first for the non-acute tear; however, surgical repair may no longer be possible after significant muscle atrophy and fatty infiltration, so intervening early with surgery may have benefits. Surgical procedures continue to require total immobilization and disuse of the upper extremity for 6-8 weeks following the procedure. Active assistive range of motion is allowed at the 6-8 week time point, but aggressive strengthening is not prescribed until 6 months post-operatively. Surgical outcome studies in the SCI population are extremely limited; however, Fattel et al. reported successful outcomes following rotator cuff surgery utilizing a multidisciplinary team approach. Involvement of the therapist, surgeon, patient and PM&R team all acting in the decision-making process was a key contributor to the post-surgical success.

**Conclusions**
Shoulder pain from mechanical impingement is a substantial issue in individuals with SCI. Thorough evaluation of the shoulder complex can provide significant insight to the underlying pathology, inform the execution of an effective exercise-based treatment program, and provide outcomes through which to monitor shoulder pain and function over time. Invasive treatment options for rotator cuff injuries are often limited for the SCI population, due to their dependence on their upper extremities, difficulty adhering to post-treatment load/motion restrictions, and due to the drawbacks of the treatments themselves, including the recurrence/failure rates of the treatments. Fortunately, a strong shoulder with proper alignment and good balance of opposing muscles can often be quite functional and pain-free even in the presence of rotator cuff non-reversible pathology.

**References:**

(Continued on page 12)
Upper Extremity Preservation During Function After Spinal Cord Injury: Equipment recommendations and movement optimization

Background
Upper limb pain is common among individuals living with a spinal cord injury (SCI). Prevalence of shoulder pain has been reported to range between 30-73%\(^1\) and is as common among those with paraplegia as tetraplegia. Wrist pain has a similar occurrence\(^2\) whereas elbow pain is less common. Despite these reports, upper limb pain can be managed and prevented, and its effect on quality of life cannot be overlooked. The focus of this article is to provide strategies to reduce the demands of function through the use of equipment or by optimization of movement to increase efficiency and/or avoid tissue damage.

General Recommendations:

Movement Optimization: movement optimization strategies are often sufficient to preserve function or reduce upper limb pain. For example, function may be improved by minimizing extreme or potentially injurious positions\(^3\) such as shoulder abduction with internal rotation (impingement position) or wrist hyperextension during weight bearing activities.

Adaptive Equipment: the use of adaptive equipment can greatly reduce the demands of various daily functions for persons with SCI. Although there are many products available for purchase, clinicians often need to be creative to solve the specific needs of an individual with SCI. For every function and for every individual, there are numerous options that can be utilized to mitigate the demands of daily function following SCI. Consideration of current literature support as well as patient preference (i.e. an evidence-based practice approach) can guide your decision process.

Specific strategies for movement optimization and adaptive equipment follow for: 1) Wheelchair Mobility, 2) Transfers, 3) Reaching Activities, 4) Ambulation, 5) Bed Positioning and Mobility

Wheelchair Mobility
Manual wheelchair (WC) propulsion is a highly-repetitive, bilateral weight-bearing activity which places high demands on the upper limbs. However, there are many opportunities to mitigate upper limb demand.

Movement Optimization:
- Cue to “use a long, smooth stroke” in order to reduce upper limb loads.\(^3\)
- Avoid high impact during the early portion of the push phase (hand before the top center of the wheel).
- With pneumatic tires, push directly on the tire can help to absorb the shock of high impact forces.
- Fast WC propulsion and management of inclines increase vertical shoulder joint forces by as much as three-fold.\(^4\)

Consider the following changes:
- Reduce propulsion speeds, particularly in the context of shoulder pain
- On inclines, use a slalom-style/weaving approach.

Equipment Modifications:
- For manual WC users, a lightweight, adjustable and rigid frame WC keeps propulsion demands as low as possible.
- Forward wheel axle position helps to avoid extreme shoulder extension and internal rotation in the early push phase which leads to a reduced superior shoulder joint force\(^5\) subsequently decreasing the risk for impingement of subacromial structures.
- Seat height adjusted for an elbow flexion angle of approximately 60° when the hand is placed at the top center (i.e. 12 o’clock position) of the wheel.\(^6\)
- Set the seat in no more incline than necessary for safety.
- Alternate style pushrims\(^\text{a,b}\) may also reduce the loads of the propulsion effort.
- Consider power-assisted or power wheelchair for those with tetraplegia or shoulder pain.

Craig Newsam, PT, DPT
Craig Newsam, PT, DPT is an Assistant Professor and the Neuromuscular Curriculum Coordinator at Mount Saint Mary’s University Doctor of Physical Therapy Program in Los Angeles.
Equipment recommendations and movement optimization for preservation of upper limb function following spinal cord injury. (continued)

**Transfers**

Transfers create a risk for upper limb pain because of the high loads as well as the potential for injurious limb positioning. This is particularly true for individuals with tetraplegia who lack strength of key muscles such as sternal pectoralis major, latissimus dorsi, and triceps. Additionally, as the height differential of the transfer increases during tub, car, and floor transfers, a greater demand and more extreme ranges are experienced.

**Movement Optimization:**
- Make the height between transfer surfaces as level as possible. An interim level to complete the transfer may help with large differences in height (e.g. initially transferring to a low stool for floor to chair transfer) in order to avoid extreme bilateral shoulder extension.
- Place transfer surfaces as close together as possible.
- Avoid the extreme positions of shoulder abduction and internal rotation during weight bearing, particularly when the transfer surfaces are far apart such as during car transfers.
- Avoid positions of extreme wrist extension by weight-bearing on the fist with a neutral wrist during transfers, if UE strength allows.
- The direction of transfers presents different demands on the two arms. One of two strategies is recommended:
  1. In a person with an existing unilateral shoulder problem, transfer toward the painful shoulder because of the greater muscular response of the large thoracohumeral muscles which may protect gleno-humeral joint integrity.
  2. In people with bilateral shoulder dysfunction or for general joint preservation, vary the direction of transfers as often as possible.

**Adaptive Equipment:**
- Consider using transfer boards – even when a lateral transfer may be possible – to allow the transfer to be completed in multiple steps, particularly for complex transfers or in the context of shoulder dysfunction.
- Transfer boards can be simple or more complex to allow greater ease of transition between surfaces.
- Walker use significantly reduces vertical shoulder joint forces compared with those experienced during crutch ambulation.

**Reaching Activities**

Similar to the overhead athlete, wheelchair users often experience shoulder pain because of an increased need to perform tasks in an overhead position. In addition, picking objects up from the floor while sitting in a wheelchair creates the same movement patterns and mechanical challenges as an overhead reach. Therefore similar recommendations apply to reaching low as to reaching overhead.

**Movement Optimization:**
- Lift and hold objects close to the body to decrease the external demand of the task.
- Use a reacher to obtain items out of reach as well as closer items in order to avoid extreme shoulder positions.

**Ambulation**

Ambulation following SCI also introduces a potential for high demands on the upper limbs. Previous investigations have demonstrated that lower limb strength is inversely related to upper limb demands during ambulation following SCI.

**Movement Optimization:**
- Avoid extreme positions of shoulder during sit-to-stand transfer when possible, for instance by pushing up from chair with at least one arm when possible or avoiding sitting on low surfaces.
- Walker use significantly reduces vertical shoulder joint forces compared with those experienced during crutch ambulation.
- In people with wrist pain, consider use of a walker or crutches with platform attachments in order to avoid position of extreme wrist extension.

**Adaptive Equipment:**
- Walker use significantly reduces vertical shoulder joint forces compared with those experienced during crutch ambulation.

**Orthotic devices:**
- Proper lower extremity orthotics can help decrease reliance on upper extremities for stability and forward propulsion during ambulation.
Equipment recommendations and movement optimization for preservation of upper limb function following spinal cord injury. (continued)

CONCLUSION
Upper limb pain remains a common secondary condition for individuals with SCI. Attempts to decrease the demands of daily function are necessary to preserve upper limb function and potentially reduce pain. Equipment and movement optimization recommendations are similar for preservation of function and for recovery in the presence of upper limb pain.

Given the typically younger age of SCI onset as well as the improved life expectancy, long-term preservation of upper limb function must be considered to maintain daily activities and overall quality of life. While we often use functional activity to train as well as develop strength during the initial rehabilitation process, beyond the rehabilitation phase we should consider shifting focus toward reducing demands of daily activities and targeted strengthening outside of daily function.

PRODUCT REFERENCES
a - http://www.flexrim.com/

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Aging of the Shoulder Following Spinal Cord Injury (Van Straaten et al, continued)

References (continued from page 8):


