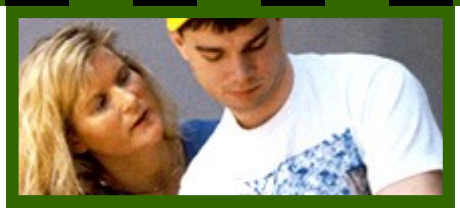
Spinal Cord Injury SIG

Spring/Summer 2015



Letter from the Chair

KJ Hutchinson
SCI SIG Chair

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, MAppSc, 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.

Inside this issue:

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

elearnSCI.org

Modules for Therapists, Doctors, Nurses, and other professionals.
Topics include assessment, acute management, respiratory, nutrition, bowel, bladder, sexual function, assistive technology, community inclusion, psychosocial, outcomes, vocational rehab, issues specific to women, cell transplant therapy and more!
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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.

Dr. Bruce was active in the APTA Neurology Section, serving as the SCI-SIG Chair 2005-2008 and Secretary 2009-2012. She also helped bring together SCI physical therapists from around the world by working with Lisa Harvey from Australia and forming the international group, SCIPT. She served as the Vice-Chair of SCIPT from 2010-2014 and was just about to take her position as Chair of this organization when she received her diagnosis of brain cancer.

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.

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.

Aging After Spinal Cord Injury: An Overview

By: Rachel Tappan, PT, DPT, NCS

Rachel Tappan,

In recent decades, the short-term survival after spinal cord injury (SCI) has improved,[1] and the mean age of the population with a spinal cord injury (SCI) has incresaed.[2] As a result, physical therapists need to be evermore 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.[3] 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.[3]

With these age-related changes comes an eventual increase in physical disability.[4,5] 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.[5] In another study, older age at initial onset of SCI was associated with a more rapid decline in functional status in later years.[4] Despite this increase in disability, however, people with spinal cord injury sustain quality of life and participation in life activities.[5] Indeed, they tend to have an increase in psychological adjustment[5,6] and an improvement in some aspects of satisfaction with life.[6,7]

Online Education Resources for People with SCI Related to Aging:

National Spinal Cord Injury Assocation Resource Center:

Aging with SCI:
http://www.spinalcord.org/resource-center/askus/index.php?pg=kb.page&id=266

Northwestern Regional Spinal Cord Injury System Education Videos:

Everybody's Doing It! Aging with a Spinal Cord Injury:
http://sci.washington.edu/info/forums/reports/aging-2012.asp

Aging with a Spinal Cord Injury:
http://sci.washington.edu/info/forums/reports/aging_6.09.asp

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.[8] 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 cardiopulmonary 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:

1. Strauss DJ, Devivo MJ, Paculdo DR, Shavelle RM. Trends in life expectancy after spinal cord injury. *Arch Phys Med Rehabil.* 2006;87:1079-1085.
2. Groah SL, Charlifue S, Tate D, et al. Spinal cord injury and aging: challenges and recommendations for future research. *Am J Phys Med Rehabil.* 2012;91:80-93.
3. Jensen MP, Truitt AR, Schomer KG, Yorkston KM, Baylor C, Molton IR. Frequency and age effects of secondary health conditions in individuals with spinal cord injury: a scoping review. *Spinal Cord.* 2013;51:882-892.
4. Rodakowski J, Skidmore ER, Anderson SJ, et al. Additive effect of age on disability for individuals with spinal cord injuries. *Arch Phys Med Rehabil.* 2014;95:1076-1082.
5. Pershouse KJ, Barker RN, Kendall MB, et al. Investigating changes in quality of life and function along the lifespan for people with spinal cord injury. *Arch Phys Med Rehabil.* 2012;93:413-419.
6. Krause JS, Broderick L. A 25-year longitudinal study of the natural course of aging after spinal cord injury. *Spinal Cord.* 2005;43:349-356.
7. Krause JS, Coker JL. Aging after spinal cord injury: A 30-year longitudinal study. *J Spinal Cord Med.* 2006;29:371-376.
8. Hitzig SL, Eng JJ, Miller WC, Sakakibara BM. An evidence-based review of aging of the body systems following spinal cord injury. *Spinal Cord.* 2011;49:684-701.

Aging of the Shoulder Following Spinal Cord Injury:
Why physical therapy may be the best way to address this problem

By:
Meegan Van Straaten, PT, MSPH;
Beth Cloud, DPT;
Kristin Zhao, PhD;
Missy Morrow, PhD

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).[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).[2] In adults who use manual wheelchairs, reports of pain range from 31-73% while 50% of adults who use motorized wheelchairs report shoulder pain.[3] Among adults with a SCI who ambulate with a crutch or cane, roughly 50% report shoulder pain. [3] 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.[4] 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. [1-3,5-7] 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.[8] 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

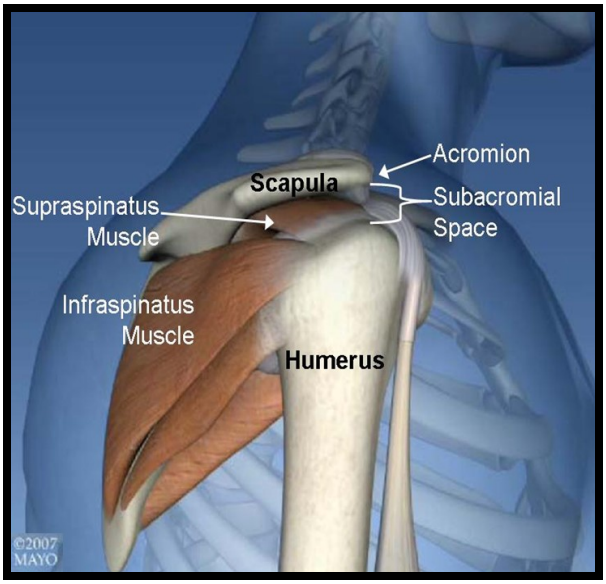

Figure 1: Anatomy of the shoulder highlighting the supraspinatus and infraspinatus muscle tendon that attach to the humerus within the subacromial space. Copyright Mayo Foundation; used with permission

Meegan Van Straaten
Meegan Van Straaten, PT, MSPH is a research physical therapist at Mayo Clinic, Rochester MN with special interest in the preservation of shoulder health of manual wheelchair users.

Beth Cloud
Beth Cloud, PT is completing her PhD in the Clinical and Translational Science Track at Mayo Graduate School. The focus of her thesis is evaluating shoulder kinematics and spinal posture during propulsion in different seating conditions.

Kristin Zhao
Kristin Zhao, PhD is the Director of the Assistive and Restorative Technology Laboratory in the Rehabilitation Medicine Research Center at Mayo Clinic, Rochester.

Missy Morrow
Missy Morrow, PhD is a Research Associate and Assistant Professor of Biomedical Engineering in the Division of Orthopedic Research at Mayo Clinic, Rochester. Her research and clinical interests include secondary complications of SCI including skin care and musculoskeletal health.

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

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.[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)
- 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 glenohumeral 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 Wheelchair Users Shoulder Pain Index (WUSPI)[6, 27] 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 Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH)[28] and the 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 Patient Specific Functional Scale (PSFS)[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.

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

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.[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 long-standing chronic pain.[13, 15-21] Well-documented, evidence-based exercise programs, including photographs and videos, are emerging, allowing for immediate translational use in the clinic.[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.[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.

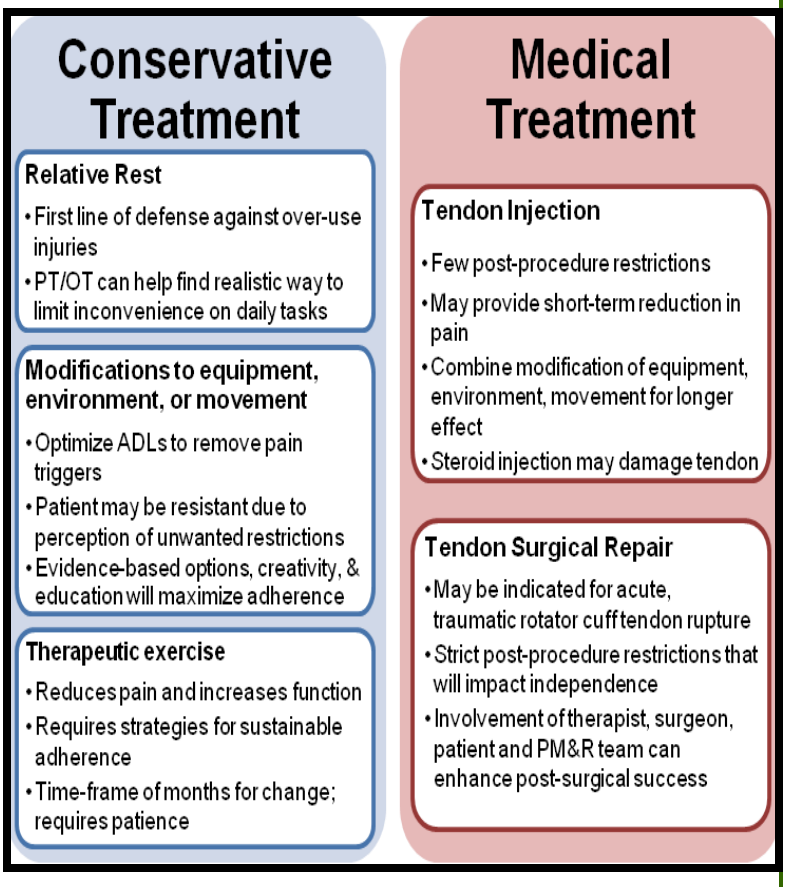

Figure 2

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,[24] 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.[25] 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.[26] 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.[12] 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:

1.Ludewig PM, Braman JP. Shoulder impingement: biomechanical considerations in rehabilitation. Man Ther 2011;16(1):33-9.
2.McCasland LD, Budiman-Mak E, Weaver FM, Adams E, Miskevics S. Shoulder pain in the traumatically injured spinal cord patient: evaluation of risk factors and function. J Clin Rheumatol 2006;12 (4):179-86.
3.Jain NB, Higgins LD, Katz JN, Garshick E. Association of shoulder pain with the use of mobility devices in persons with chronic spinal cord injury. Pm R 2010;2(10):896-900.
4.Alm M, Saraste H, Norrbrink C. Shoulder pain in persons with thoracic spinal cord injury: prevalence and characteristics. J Rehabil Med 2008;40(4):277-83.
5.Curtis KA, Drysdale GA, Lanza RD, Kolber M, Vitolo RS, West R. Shoulder pain in wheelchair users with tetraplegia and paraplegia. Archives of Physical Medicine & Rehabilitation 80(4):453-7, 1999 Apr 1999.
6.Curtis KA, Roach KE, Applegate EB, Amar T, Benbow CS, Genecco TD et al. Development of the Wheelchair User's Shoulder Pain Index (WUSPI). Paraplegia 1995;33(5):290-3.
7.McCasland LD, Budiman-Mak E, Weaver FM, Adams E, Miskevics S. Shoulder pain in the traumatically injured spinal cord patient: evaluation of risk factors and function. J Clin Rheumatol 2006;12(4):179-86.
8.Morrow MM, Van Straaten MG, Murthy NS, Braman JP, Zanella E, Zhao KD. Detailed shoulder MRI findings in manual wheelchair users with shoulder pain. Biomed Res Int 2014;2014:769649.
9.Braman JP, Zhao KD, Lawrence RL, Harrison AK, Ludewig PM. Shoulder impingement revisited: evolution of diagnostic understanding in orthopedic surgery and physical therapy. Medical & Biological Engineering & Computing 2014;52(3):211-9.
10.Camargo P, Alburquerque-Sendin F, Salvini T. Eccentric training as a new approach for rotator cuff tendinopathy: Review and perspectives. World Journal of Orthopedics 2014;5(5):634 - 44.
11.Mohammed K, Dunn J. Shoulder pain in tetraplegia. Orthopedics and Trauma 2014;28(1):27-32.

(Continued on page 12)

Clinician's Corner:

By: Craig Newsam, PT, DPT

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 of pain 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[a,b] may also reduce the loads of the propulsion effort.
- Consider power-assisted or power wheelchair for those with tetraplegia or shoulder pain.

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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.[7] 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 glenohumeral joint integrity.[8]
    2. In people with bilateral shoulder dysfunction or for general joint preservation, vary the direction of transfers as often as possible.[8]

Adaptive Equipment:

Transfer boards

- 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.[C]

Wheelchair Configuration:

- A forward wheel position, while optimal for propulsion mechanics, may make transfers more challenging as the wheel represents another challenge to negotiate.
- An inclined seat (i.e. bucketing), which may aid in sitting stability, will make a transfer from the wheelchair essentially an uphill task.

Mechanical Lifts:

- Generally recommended for individuals who are unable to safely transfer independently or with assistance.
- Consider as a reasonable transfer method in order to preserve shoulder function

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.

Adaptive Equipment:

- 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.[9]

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.

Adaptive Equipment:

Assistive Device: Consider upper limb loads in decision-making

- Walker use significantly reduces vertical shoulder joint forces compared with those experienced during crutch ambulation.[10]
- In people with wrist pain, consider use of a walker or crutches with platform attachments in order to avoid position of extreme wrist extension.

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)

Bed Positioning and Mobility

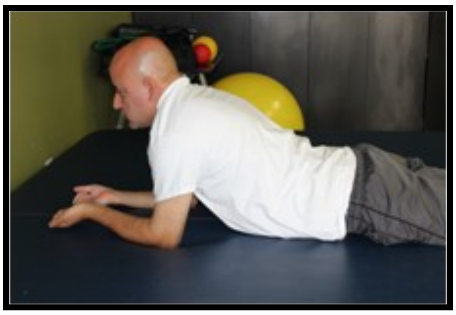
Movement Optimization:

Positioning:

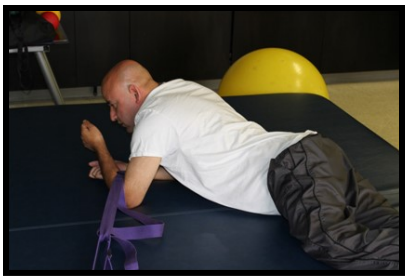
- Use pillows to support the UEs in positions that avoid muscle shortening as well as extreme, end-range postures.[3] For example:
  - In supine, support one arm in approximately 45° of abduction and external rotation and the other arm in 90° of abduction with external rotation and elbow flexion.

Supine to Sit:

- Avoid extreme, end-range positions and periods of prolonged weight-bearing. For example:



- During sidelying to long-sit, avoid stress at the shoulder joint training adequate dynamic response from the thoracohumeral, rotator cuff, and scapular musculature during weightbearing through the UE.
- Avoid resting longer than needed in reclined long sitting on extended arms as this position may stress anterior shoulder and wrist structures.



Adaptive Equipment:

Loops:

- Bed or leg loops can assist with the transition from side-lying to long-sit, potentially eliminating the need for weight-bearing on elbows position described above.
- Commercially available range of motion loops[d] are very effective yet simple, alternatives include use of gait belts or yoga straps.
- To avoid unwanted pressure or shear when pulling on loops, consider padding straps with foam padding (e.g. forearm or shin pads from sporting goods stores) or sheepskin covering (e.g. seat belt padding from auto parts stores).

Bed Rail:

- Use of a portable bed rail[e] may greatly improve bed mobility while reducing overall all demand on shoulders and wrists.

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 during daily activities and targeted strengthening outside of daily function.

PRODUCT REFERENCES

a - http://www.flexrim.com/
b - http://www.out-front.com/naturalfit_overview.php
c - http://www.pattersonmedical.com/app.aspx?cmd=getProduct&key=IF_921028745
d - http://www.pattersonmedical.com/app.aspx?cmd=getProductDetail&key=070_921107291
e - http://www.pattersonmedical.com/app.aspx?cmd=getProductDetail&key=070_921079526

REFERENCES

1. Sie IH, Waters RL, Adking RH, Gellman J. Upper extremity pain in the post-rehabilitation spinal cord injured patient. *Arch Phys Med Rehabil*. 1992; 73:44-48.
2. Schroer W, Lacey S, Frost FS, Keith MW. Carpal instability in the weight-bearing upper extremity. *J Bone Joint Surg* (Am) 1996; 78:1838–43.
3. Consortium for Spinal Cord Medicine. Preservation of upper limb function following spinal cord injury: a clinical practice guideline. *Paralyzed Veterans of America*. 2005
4. Kulig K, Rao SS, Mulroy SJ, Newsam CJ, Gronley JK, Bontrager EL, Perry J. Shoulder joint kinetics during the push phase of wheelchair propulsion. *Clin Orthop Rel Res.* 1998; 354:132-143.
5. Mulroy SJ, Newsam CJ, Gutierrez DD, Requejo P, Gronley JK, Lighthall Haubert L, Perry J. Effect of fore-aft seat position on shoulder demands during wheelchair propulsion: Part 1 – A kinetic analysis. *J Spinal Cord Med* 2005;28:214-221.
6. Boninger ML, Baldwin MA, Cooper RA, Koontz AM, Chan L. Manual wheelchair pushrim biomechanics and axle position. *Arch Phys Med Rehabil,* 2000;81: 608–13.
7. Newsam CJ, Lee AD, Mulroy SJ, Perry J. Shoulder EMG during depression raise in men with spinal cord injury: The influence of lesion level. *J Spinal Cord Med.* 2003; 26:59-64.
8. Perry J, Gronley JK, Newsam CJ, Reyes ML, Mulroy SJ. Electromyographic analysis of the shoulder muscles during depression transfer in subjects with low-level paraplegia. *Arch Phys Med Rehabil,* 1996;77:350-305.
9. Waters RL, Adkins R, Yakura J, Vigil D. Prediction of ambulatory performance based on motor scores derived from standards of the American Spinal Injury Association. *Arch Phys Med Rehabil,* 1994;75:756-760.
10. Lighthall Haubert L, Gutierrez DD, Newsam CJ, Gronley JK, Mulroy SJ, Perry J. A comparison of shoulder joint forces during ambulation with crutches and a walker

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References (continued from page 8):

12.Fattal C, Coulet B, Gelis A, Rouays-Mabit H, Verollet C, Mauri C et al. Rotator cuff surgery in persons with spinal cord injury: relevance of a multidisciplinary approach. Journal of Shoulder & Elbow Surgery 2014;23(9):1263-71.
13.Mulroy SJ, Thompson L, Kemp B, Hatchett PP, Newsam CJ, Lupold DG et al. Strengthening and optimal movements for painful shoulders (STOMPS) in chronic spinal cord injury: a randomized controlled trial. Physical Therapy 2011;91(3):305-24.
14.Requejo PS, Furumasu J, Mulroy SJ. Evidence-based strategies for preserving mobility for elderly and aging manual wheelchair users. Topics in Geriatric Rehabilitation 2015;31(1):26-41.
15.Curtis KA, Tyner TM, Zachary L, Lentell G, Brink D, Didyk T et al. Effect of a standard exercise protocol on shoulder pain in long-term wheelchair users. Spinal Cord 1999;37(6):421-9.
16.Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction workers. Occupational & Environmental Medicine 2003;60(11):841-9.
17.Nash MS, van de Ven I, van Elk N, Johnson BM. Effects of circuit resistance training on fitness attributes and upper-extremity pain in middle-aged men with paraplegia. Archives of Physical Medicine & Rehabilitation 2007;88(1):70-5.
18.Nawoczenski DA, Ritter-Soronen JM, Wilson CM, Howe BA, Ludewig PM. Clinical trial of exercise for shoulder pain in chronic spinal injury. Physical Therapy 2006;86(12):1604-18.
19.Van Straaten MG, Cloud BA, Morrow MM, Ludewig PM, Zhao KD. Effectiveness of home exercise on pain, function, and strength of manual wheelchair users with spinal cord injury: a high-dose shoulder program with telerehabilitation. Archives of Physical Medicine & Rehabilitation 2014;95(10):1810-7 e2.
20.Littlewood C, Ashton J, Chance-Larsen K, May S, Sturrock B. Exercise for rotator cuff tendinopathy: a systematic review. Physiotherapy 2012;98(2):101-9.
21.Michener LA, Walsworth MK, Burnet EN. Effectiveness of rehabilitation for patients with subacromial impingement syndrome: a systematic review. Journal of Hand Therapy 2004;17(2):152-64.
22.Holmgren T, Bjornsson Halgren H, Oberg B, Adolfsson L, Johansson K. Effect of specific exercise strategy on need for surgery in patients with subacromial impingement syndrome: randomised controlled study. BMJ 2012;344:e787.
23.Shoulder Community of Practice. Managing Rotator Cuff Tendinopathy 2013 [cited 2015 23 March]. Available from: URL: http://www.shouldercommunity.com/uncategorized/2335/.
24.Finnoff JT, Hall MM, Adams E, Berkoff D, Concoff AL, Dexter W et al. American Medial Society for Sports Medicine (AMSSM) position statement: interventional musculoskeletal ultrasound in sports medicine. British Journal of Sports Medicine 2015;49(3):145-50.
25.Coombes BK, Bisset L, Vicenzino B. Efficacy and safety of corticosteroid injections and other injections for management of tendinopathy: a systematic review of randomised controlled trials. Lancet 2010;376(9754):1751-67.
26.Rudzki JR, Shaffer B. New approaches to diagnosis and arthroscopic management of partial-thickness cuff tears. Clin Sports Med 2008;27(4):691-717.
27.Curtis KA, Roach KE, Applegate EB, Amar T, Benbow CS, Genecco TD et al. Reliability and validity of the Wheelchair User's Shoulder Pain Index (WUSPI). Paraplegia 1995;33(10):595-601.
28.Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). American Journal of Industrial Medicine 1996;29(6):602-8.
29.Horn KK, Jennings S, Richardson G, Vliet DV, Hefford C, Abbott JH. The patient-specific functional scale: psychometrics, clinimetrics, and application as a clinical outcome measure. Journal of Orthopaedic & Sports Physical Therapy 2012;42(1):30-42.