Shoulder Evaluation for Wheelchair Users: An Evidence Based Approach for Clinicians

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Learning Objectives

Upon completion of this lecture participants will be able to:

1. List two pathologies of the glenohumeral joint and scapulo-thoracic joint common to individuals with spinal cord injury.

2. List three available research and current evidenced based practice sources on examination techniques for the shoulder complex.

3. List three basic shoulder examination techniques to appropriately identify structural pathology and assist in determining appropriate wheelchair selection.
Overall Goal of Presentation

Are we utilizing the best available evidence for examination of the shoulder complex when prescribing wheelchairs?

Evidence doesn’t tell us everything, but it certainly tells us a lot!
Why the big fuss?
Incidence in SCI

- According to the Consortium for Spinal Cord Injuries Clinical Practice Guidelines 2005 (Surveys and Cross Sectional Studies) it is estimated to be up to 60%.

- Shoulder pain is a problem in up to 86% of persons with spinal cord injury.

- General Population:
  - 30% of people experiencing shoulder pain at some stage of their lives up to 50% of the population experiencing at least one episode of shoulder pain annually.
Why do we need to revolutionize care?

- Only 2% of this population undergoes shoulder surgery treatment for rotator cuff tear and shoulder disability (out of 60% who reported pain).

- Reduction in shoulder pain were related to significant increases and social participation and improvements in quality of life in people with long term paraplegia.
Risk Factors in SCI

- Duration of injury
- Older age
- Higher BMI
- Use of manual wheelchair
- Poor seated Posture
- Decreased Flexibility
- Muscle imbalances of the rotator cuff and scapula stabilizers
- With a better understanding of the epidemiology, etiology, and basic patho-mechanics of shoulder pain in SCI, clinicians are in a better position to evaluate, treat, and prevent these disorders.

The shoulder is the most common joint above the level of injury where pain complaints are reported with persons with paralysis (tetraplegia or paraplegia) (Apple 2001).

The shoulder is not well designed to handle the higher intra-articular pressures required for both weight bearing and mobility (Apple 2001).

Partial innervation and impaired balance of shoulder, scapular and thoracolumbar muscles place individuals with tetraplegia at a higher risk for developing shoulder pain especially during weight-bearing upper limb activities such as wheelchair propulsion, transfers, and pressure reliefs.

Due to differences in trunk postural control, differences may also occur between individuals with high paraplegia (T2-T7) and low paraplegia (T8-T12).

Individuals with C1-C4 motor levels of injury are also at risk for shoulder pain.

SCI severity also may be associated with shoulder pain (Dyson-Hudson & Kirshblum 2004).

Lack of use of immobilization of the shoulder girdle muscles can limit their active joint movement and lead to muscle shortening and shoulder capsule tightness.
The development of pain is associated with decreased shoulder ROM.

Weakness and paralysis in these muscles can lead to increased reliance on the trapezius, which can result in overuse and pain in this muscle.

Shoulder pain can occur from nerve root injury or radicular pain with dysesthesias or phantom sensations.

People of certain age groups, those with higher cervical lesions and those with shorter lengths of bed rest may be at a greater risk.

Gender may be associated with shoulder pain in individuals with SCI (Pentland & Twomey 1991).

Body mass index (BMI) also may play a role in shoulder injuries in manual wheelchair using individuals with SCI because it directly relates to the amount of physical strain experienced during ADLs in these individuals (Bonninger et al. 2001; Jensen et al. 1996).

Shoulder pain is more common in individuals with tetraplegia and complete injuries and in women and duration of injury, older age, and higher BMI all may be risk factors for developing shoulder pain and/or abnormalities in persons with SCI (Dyson-Hudson & Kirshblum 2004).
Technicians vs. Clinicians
Clinicians vs. Technicians

• As PT’s and OT’s:
  – Doctoral and Master’s Level Education
  – Experts in: Biomechanics and Functional Movement
  – Best trained Clinicians in functional rehab intervention

• As ATP’s and SMS’s
  – Experts in Seating and Wheelchair Rx
Anatomy of the Shoulder

- **Starting point for Clinicians**
  - Must understand the Anatomy and Biomechanics to fully appreciate function.

- **Shoulder is not just 1 joint!**
  - Regional body complex made up of multiple joints.
  - Provides proximal stability for UE mobility.
Shoulder Complex Anatomy

- Sternoclavicular joint
- Acromioclavicular joint
- Glenohumeral joint
- Scapulo-thoracic joint
- Associated Musculature
Shoulder Complex Kinematics

- **Kinematics**: Rotation occurs in all 3 principle axes
  - Abduction/Adduction
  - Medial/Lateral Rotation (Internal/External Rotation)
  - Flexion/Extension
  - Circumduction

- **Elevation**: 180°
  - Glenohumeral Joint: 120°
  - Scapulothoracic Joint: 60°

- Extension: 45°-55°

- IR with arm at side: 75°-85°
- ER with arm at side: 60°-70°
  - 30° needed for GT to clear acromion
Muscular Stability of Glenohumeral Joint: Rotator Cuff

• Supraspinatus, Infraspinatus, Teres Minor, and Subscapularis are innervated by nerve roots from: C5 and C6.

• Impaired Rotator Cuff motor/strength will lead to Rotator Cuff dysfunction.
Key Scapula Stabilizers

- **Trapezius**: CN XI, C3,4
  - Middle and Lower
- **Rhomboids**: C4, 5
- **Serratus Anterior**:
  - Long Thoracic C5, 6, (7)
Breaking Down Biomechanics

Force Couples of the Shoulder Complex
Deltoid ↔ Rotator Cuff
Upper Trapezius ↔ Serratus Anterior & Lower Trapezius
Clinically relevant structures not included for detailed discussion in this lecture due to time constraints:

- Sternoclavicular joint mechanics
- A-C joint mechanics
- Elbow joint mechanics
- Wrist/hand mechanics
- Trunk mechanics
- Incomplete injuries with ability to ambulate
SCI Posture and Shoulder Dysfunction

• **Shoulder force couples are out of balance**
  – Hypertrophied Upper Trapezius
  – Overactive Levator Scapula
  – Elevated and Abducted Scapula
  – Tight and over dominant Pectorals
  – Weak Rhomboids
  – Weak Lower Trapezius
  – Weak Serratus Anterior
  – Overactive & tight Shoulder Internal Rotators
  – Weak Shoulder External Rotators

• **Dysfunction: “Anterior dominant” shoulder**
What happens to the body after Spinal Cord Injury?
When LE function is lost in SCI

- Shoulder → Hip
- Elbow → Knee
- Wrist/Hand → Ankle/Foot
Therapy Evaluation

- **History and Subjective Exam**
  - Ask the right questions!
  - **Functional Outcome Measure: WUSPI**

- **Systems Review**: need to rule out other causes

- **Clinical Examination Findings**
  - Range of Motion (Functional ROM): Active and Passive
  - Palpation: soft tissue and bony structures
  - Manual Muscle Testing
  - Posture Analysis
  - Tissue Provocation Testing
  - Differential Diagnosis/Special Tests
  - Balance Testing/Trunk Control
Therapy Evaluation

- Functional Activity Analysis: determine possible underlying causes and contributing factors
  - Observation of repeated movements
  - Pressure Relief (Bed and Wheelchair)
  - Bed Mobility skills
  - Transfers (including advanced transfers)
    » Transfer Assessment Index

- Seating Evaluation
- Wheelchair Propulsion/Biomechanics
  • Smartwheel if available
- Wheelchair Skills
- ADL and IADL Assessment
- Work, school, and recreation activity analysis
- Understanding open vs. closed chain activities
Daily Activity Analysis
Weight-bearing Tasks

• Potentially detrimental magnitude and direction of scapular and glenohumeral kinematics during weight-bearing tasks may pose increased risk for shoulder pain or injury in persons with SCI/D.

• Both the weight-relief raise and transfer result in scapular and humeral positions and directions of motion that may negatively impact the available subacromial space. This may present increased risk for injury or progression of shoulder pain in persons who must routinely perform these tasks.
Weight-bearing Tasks

• Forces beneath the trailing hand were larger than those in the leading, if there is weakness or pain in one arm, this arm should be selected as the leading. To avoid excessive load on the arms, technical aids and environmental factors should be very well adapted.

• For participants who perform assisted or dependent transfers, use of an evidenced-based, structured education program during acute inpatient rehabilitation has the potential to significantly improve the quality of transfers.
Weight-bearing Tasks


Wheelchair Propulsion vs. Gait

A: NEW GAIT TERMS
- Initial Contact
- Loading Response
- Midstance
- Terminal Stance
- Prewing
- Initial Swing
- Midswing
- Terminal Swing

B: CLASSIC GAIT TERMS
- Heel Strike
- Foot Flat
- Midstance
- Heel Off
- Toe Off
- Midswing
- Heel Strike

C: % of GAIT CYCLE
- STANCE PHASE: 0 - 50%
- SWING PHASE: 50 - 100%
- Acceleration
- Deceleration
Ideal Propulsion Mechanics

Pictures with special permission from Kendra Betz (PN March 2007)
SmartWheel®

http://www.out-front.com/smartwheel_overview.php

Wheelchair Propulsion Assessment
What is the SmartWheel®?

For each push, the SmartWheel Measures:

- Push forces exerted on pushrim
- Push frequency
- Push length/angle
- Push smoothness
- Velocity

Automated Reports Allow You To:

- Review patient performance and outcomes
- Compare outcomes with a national database
- Compare with patient’s past performance
Propulsion Mechanics

• Randomized control trial of strict use of the Paralyzed Veterans of America's Clinical Practice Guidelines for Preservation of Upper Limb Function affects wheelchair setup, selection, propulsion biomechanics, pain, satisfaction with life, and participation of individuals with new spinal cord injuries (SCIs).

• The intervention group showed better skills on key wheelchair propulsion biomechanics variables related to upper-limb health. Use of a structured education program may be an effective method of educating new manual wheelchair users to prevent the development of upper-limb impairments in an inpatient setting.


Wheelchair Configuration

- Research shows that vertical and horizontal wheel position are the most important adjustments to minimize impact on the UE during propulsion.

- **Horizontal**: Move the rear wheel as far forward as possible w/o compromising the stability of the user. (CPG 2005)

- **Vertical**: When the hand is on top of the rim, the angle between the arm and forearm should be between 100-120 degrees (CPG 2005)

  - Theresa Berner Slide ISS 2013
Advanced Wheelchair Skills

- Wheelies
- Opening Doors
- Pushing and pulling open doors
- Negotiating Ramps
- Ascending and descending
- Negotiating Curbs
- Ascending and descending
- Floor Recovery
- Negotiating Stairs (when necessary)
- Should Include Advanced Transfers
- Advanced terrain (e.g. grass, gravel, sand)

“Weighing the options”

- With daily activities require specialized ADL and IADL demands, propelling long distances, hills or uneven terrain, work duties, school demands, parenting duties....add on shoulder pain.

- Which option is best:
  - Manual wheelchair?
  - Manual wheelchair with performance add-on?
  - Manual with power assist wheels?
  - Manual with power add-on?
  - Basic power mobility?
  - Complex power Wheelchair?
Classic Therapy Examination
Differential Diagnosis

- Ruling out other causes
  - Visceral Referral
- Clearing the Cervical Spine
- Balance Testing
- Trunk Control
- Posture Analysis
- Functional ROM
  - Active and Passive
- Palpation
  - soft tissue and bony structures
- Manual Muscle Testing
- Tissue Provocation Testing
- Special Tests
- Joint and soft tissue mobility
Extrinsic Pain Referral

- Cervical Spine
- Neuropathic
- Cardiac
- Brachial Plexopathy
- Malignancy
- Infection
- Gall Bladder
- Spleen
- Diaphragm
  - Post laparoscopy (phrenic nerve and shoulder share C3-5 innervation)

Basic Rules for Mechanical Pain

• Symptoms present at time of Evaluation?
• Can you produce the symptoms?
  • Palpation
  • Movement → Repeated Movement
  • Posture → Sustained Posture
  • Mechanical Resistance (MMT)
  • Provocation Testing
• Can you make symptoms worse?
• Can you make symptoms better?
• No change in symptoms?
Ruling out Cervical Spine
Cervical Radiculopathy

- The cervical spine can refer symptoms throughout the entire upper extremity and must be cleared from involvement for any pain in neck, scapula, shoulder, arm, hand.
Cervical Radiculopathy

- Segmental Motor or Sensory signs associated with a nerve or nerve root disorder.

- **Common Symptoms:**
  - Pain in UE in dermatome pattern
  - Decreased sensation in dermatome
  - Weakness in myotome without spasticity
  - Atrophy in muscle (late stages)
  - May have hypoactive reflexes
  - Parasthesias

- Magee DJ. *Orthopedic Physical Assessment*. 2013
Mechanical Exam

4 Test Cluster for Cervical Radiculopathy

1. Positive Spurling’s Test
   - 93% Specificity

2. Positive Distraction Test
3. Positive Upper Limb Tension Test
4. < 60° Cervical Rotation to involved side.
   • 3/4 Positive (specificity of 94%)
   • 4/4 Positive (specificity of 99%)

4 Test Cluster

1. 

2. 

3. 

4.
Palpation

- **Transdeltoid Palpation (Rent Test)**
  - Full thickness rotator cuff tears.

- **A-C Joint**

- **Cervical Spine** if cervical involvement
- **Upper Trap** with rotator cuff weakness
- **Sup-Lat Shoulder Joint** with Subacromial Impingement
- **Anterior Joint Line** with Osteoarthritis

- **Soft tissue**: Myofascial Pain and Trigger Points
Myofascial Pain Syndrome

• **Common causes are poor posture** (or sustained postures) and **overuse syndromes**.
  - Abnormal muscle compensation: upper trap & levator scapula.
  - Shoulder is now asked to be a weight-bearing structure.
  - Upper extremity is primarily responsible for locomotion (manual w/c).
  - Upper extremity must reach beyond normal ranges (sitting position).
Common Postural Deviations

• Cervical Protrusion “Forward Head”
• Protracted Shoulders and Scapulae
  – Classic “Rounded Shoulders”
• Increased Thoracic Kyphosis
• Lumbar Kyphosis
• Posterior Pelvic Tilt
Posture

What is normal for individuals following Spinal Cord Injury?
**Predisposition to Overuse**

- Functional reach in wheelchair users is dramatically reduced compared to ambulatory population.

- **Required ROM for functional ADLs (Ambulatory):**
  - Flex: $121^\circ \pm 6.7^\circ$; Ext: $46^\circ \pm 5.3^\circ$; ABd: $128^\circ \pm 7.9^\circ$
  - cross body Add: $116^\circ \pm 9.1^\circ$; ER with arm 90°; ABd: $59^\circ \pm 10^\circ$
  - IR with arm at side: $102^\circ \pm 7.7^\circ$

Functional reach in wheelchair users

Picture: Jaimie Borisoff, PhD (ASCIP 2014)
IC22 Dynamic Wheeled Mobility: Next Chapter in the Ultralight Evolution
Steve Mitchell, OTR/L, ATP and Jaimie Borisoff, PhD
Most common problems isolated to the shoulder region in SCI

- Acromioclavicular Pathology
- Subacromial Impingement Syndrome
- Rotator Cuff Tear
- Long Head Biceps Tear
- Glenohumeral Arthritis
- Scapula Dyskinesia
A-C Joint Pathology

**A-C Joint Pathology**

- **Pain reported precisely over A-C joint**
  - Hypertonic Saline Injections into A-C

- **Palpation**

- **Compression**
A-C Joint Pathology Test Cluster

• **Cross Body Adduction Test**

• **A-C Resisted Extension Test**

• **O’Brien’s Test**
  
  – 3/3 Positive:
    ○ Specificity: 97%
    ○ Sensitivity: 25%
    ○ + Likelihood Ratios: 8.3
    ○ -Likelihood Ratio: 0.77

Shoulder Impingement Syndrome
Shoulder Impingement Syndrome

- Pain lateral aspect of the arm down to the deltoid tuberosity.
  - Hypertonic Saline Injections in subacromial space
Shoulder Impingement Testing

Shoulder Impingement Syndrome

- Painless movement
- 120°
- Painful arc
- 70°
- Painless movement
Shoulder Impingement Testing

• Painful Arc Test
  • Sensitivity 53%  Specificity 76%

• Hawkins-Kennedy Test
  • Sensitivity 79%  Specificity 59%

• Neer Test
  • Sensitivity 72%  Specificity 60%

Hegedus EJ, Goode AP, Cook CE, Michener L, Myer CA, Myer DM, Wright AA. Which physical examination tests provide clinicians with the most value when examining the shoulder? Update of a systematic review with meta-analysis of individual tests. Br J Sports Med. 2012 Nov;46(14):964-78.

Test Cluster for Shoulder Impingement

- **Positive Hawkins-Kennedy Test**
- **Painful arc (60–120 degrees)**
  - During active shoulder elevation
- **Positive Infraspinatus Test**
  - Resisted ER with arm along the body
  - Pain and Weakness Present
- All 3 positive: +LR of 10.56
  - Probability (95%) for any degree of impingement syndrome
- 2 of 3 positive: +LR of 5.03
- All 3 negative: -LR of .17

Rotator Cuff Tears

- **Rotator cuff tears: 63% Paraplegic; 15% able bodied**
  - 200 individuals (100 paraplegic; 100 able bodied)

- **Rotator cuff tears in 49%; 20% Unilateral; 29% Bilateral**
  - MRI of 317 individuals with paraplegia
Tests for Rotator Cuff Tear

• **Lateral Jobe Test**

• **Supraspinatus and Infraspinatus**
  - **External Rotation Lag Sign**
    - Sensitivity of 46-98% Specificity 72-98%
  - **Drop Arm Sign**
    - Sensitivity of 10-73% Specificity 72-98%

• **Teres Minor**
  - **Hornblower’s Sign**
    - Sensitivity of 100% Specificity 93%

Tests for Rotator Cuff Tear

• Subscapularis
  – Lift-off Test (and Lag Sign)
    • Sensitivity of 17-100%  Specificity 60-98%
  – Belly Press Test
    • Sensitivity of 40-43%  Specificity 93-98%
  – Belly-off Sign
    • Sensitivity of 14-86%  Specificity 91-95%
  – Bear Test
    • Sensitivity of 60%  Specificity 92%

Test Cluster for Rotator Cuff Tear

- **Painful arc (60–120 degrees)**
  - During active shoulder elevation

- **Positive Infraspinatus Test**
  - Resisted ER with arm along the body
  - Pain and Weakness Present

- **Drop Arm Sign**

- **Combination of tests: probability of 91% for full-thickness rotator cuff tears.**

Tests for Rotator Cuff Tear

Arm Drop Test

Positive Bear-Hug

Positive Belly-press
Long Head of Biceps

- Anterior Shoulder Pain
- Pain upon palpation

**Speed Test**

**Yergason’s Test**

Glenohumeral Arthritis

- Pain, loss of motion, decreased function.
- Worse with activity; better with rest.
- X-ray confirmation
Scapula Dyskinesis
Scapula Dyskinesis

- An alteration in the normal position or motion of the scapula during coupled scapulohumeral movements.
- Often is caused by injuries that result in the inhibition or disorganization of activation patterns in scapular stabilizing muscles.
- Causative mechanisms such as compromised anatomy (i.e. injury), muscle tightness, and scapular muscle weakness can contribute to the apparent dysfunction.
- Scapular dyskinesis is frequently identified in impingement syndrome and rotator cuff disease.


Not included in this lecture

- Due to brevity of lecture time, in depth analysis of the evidence on differential diagnosis and physical examination of the following:
  - CVA (stroke)
  - TBI
  - Pediatric shoulder complex
  - Neuropathic Pain
  - SLAP Lesions
  - Frozen shoulder
  - Posterior/Internal Impingement
  - Axillary Nerve (shoulder dislocation)
  - Long Thoracic (winging scapula)
  - CN XI (Deltoid atrophy)
  - Severe Spastic Hemiplegia, Tetraplegia
  - Brachial Plexus Injury
  - Suprascapular Nerve Entrapment
  - Thoracic Outlet Syndrome
  - Bursitis vs. Tendinitis vs. Tendinosis
  - Cervical Myelopathy
  - Post-op surgery
    - Acromioplasty, Rotator Cuff repair, SLAP repair, Bankart Repair, Total Shoulder Replacement
Imaging of the Shoulder

• Radiography (X-Ray)

• Computed Tomography (CT Scan)

• Magnetic Resonance Imaging (MRI)
Diagnostic Ultrasound

- Emerging area for Therapists
- Direct Access?
- Assigning a clinical diagnosis as therapists?

- Bonninger current study 2014.
Manual Exam and Imaging


- **Clinical examination by specialists can rule out the presence of a rotator cuff tear!**
- MRI or ultrasound could equally be used for detection of full-thickness rotator cuff tears, although ultrasound may be better at picking up partial tears.
- Ultrasound also may be more cost-effective in a specialist hospital setting for identification of full-thickness tears.
“This is all great stuff...... but aren’t SCI patients’ shoulders different?”
ASIA Exam

• Inherent in the ASIA Exam itself is solid evidence of what motor levels are intact.
ASIA UE Motor Exam Findings

- Upper Extremity Key Muscles:
  - C5 = Elbow Flexors (Biceps)
  - C6 = Wrist Extensors
  - C7 = Elbow Extensors (Triceps)
  - C8 = Finger Flexors (Grip)
  - T1 = 5th Finger Abduction

- Not included in ASIA UE Motor Exam but important to MD’s and Therapists functionally: Deltoid, Rotator Cuff, Scapula Stabilizers, Pec’s, Trunk.
C5 Intact Muscles

- Cervical Paraspinals
- Diaphragm
- Trapezius
- Deltoid
- Biceps
- Brachialis
- Brachioradialis
- Rhomboids
- Serratus Anterior (partially innervated)
- Rotator Cuff (partially innervated)
C6 Intact Muscles

• Same as C5, but now have the following:
  • Clavicular Pectoralis
  • Supinator
  • Extensor Carpi Radialis (Longus and Brevis)

• Serratus Anterior

• Rotator Cuff (fully innervated)
  • Latissimus Dorsi
C7, C8, T1 Intact Muscles

- **C7** now have Triceps
- **C8** now have Grip (hand function)
- **T1** (considered full hand function)
T2 and Below Intact Muscles

At T2 ASIA: Fully Intact UE Musculature

However don’t forget Trunk control

• Functional levels improve as progressive Trunk control (Abdominals and Erector Spinae) and strength improves.
  • Eg. Patient with T12 Paraplegia will have significantly more trunk control than T2 Paraplegia.

Importance of incorporating EBP shoulder examination techniques when evaluating individuals in a seating clinic.
Manual Wheel Chair Selection

• Then .......

• Current
Ultralight vs. Folding Wheelchair

• ZRA®

• Veloce®
Pushrim Performance

• The Natural-Fit®  

• The Surge®
Manual Assist add ons

- Wijit®
- Evo®
Manual add on to improve performance

• FreeWheel®
Power assist add on feature

- e-motion®
- Xtender®
Power add on products
Scooters and basic power mobility
Complex power mobility
Standing Feature
Sports and Recreation
Sports and Recreation
Other Considerations

- Level of injury
- Age
- Weight/body habitus
- Comorbidities:
  - level of fitness, cardiovascular, previous shoulder issues
- Overall Function:
  - Complete LE loss
  - UE Function
  - Ability to stand/ambulate
  - Trunk control
  - Ability to transfer
  - ADL’s and IADL’s
  - Ability to perform weight shifts for pressure relief (redistribution)
- Geographical region: city, hills, rural terrain
- Home Setting: space considerations (power chair)
- Transportation: vehicle
- Work, school, recreation activities
Adjunct to Seating

• As Clinicians you can’t just stop at ideal wheelchair Rx and think you have solved the problem fully!

• You must follow up with preservation Rx:
  – Posture correction
  – Flexibility
  – Strengthening
  – Proper cardiovascular conditioning
  – Mobility Training: Transfers, Pressure Relief, W/C Skills
  – ADL and IADL adaptive strategies

• If you are not a PT or OT, please refer to PT and OT to address the preservation components.
3 Key Therapy Interventions of a Shoulder Preservation Program

- Posture
- Flexibility
- Strengthening
Super 3 Posture Exercises

Combat the anterior tightness and posterior “over-stretched weakness”

- Cervical Retractions
- Scapula Retractions
- Backward Shoulder Rolls

- Using Mirror for biofeedback
- “Super 4”: Scapula Retraction with Depression
Flexibility of Key Musculature

- Stretching needs to focus on specific anterior musculature (contributors of imbalance):
  - **Pectoralis** (Major and Minor)
  - Shoulder Internal Rotators
  - Elbow Flexors
  - Upper Trapezius
Strengthening

“Reverse the anterior dominant shoulder!”

- Start in acute rehab!
- Target **Posterior** Musculature:
  - Supraspinatus
  - Infraspinatus and Teres Minor
  - Middle Trapezius and Rhomboids
  - Lower Trapezius
  - Serratus Anterior
Supraspinatus

• **Prone Full Can (in Scaption)**
  - Greatest amount of EMG (fine wire) activity for Supraspinatus and Posterior Deltoid.

• **Full Can (in Scaption) to 90°**
  - Greatest amount of EMG (fine wire) activity for Supraspinatus and less Deltoid
  - Minimizes humeral head superior migration
  - Allows clearance of greater tuberosity (ER of Humerus).

Infraspinatus and Teres Minor

- **Shoulder External Rotation (with towel roll)**
  - More focused EMG activity of Infraspinatus
  - Decreased compensatory activity of Deltoid

- **Side-lying ER (with towel roll)**
  - Greatest amount of EMG: Infraspinatus and Teres Minor.
  - Enhances ratio of lower to upper trapezius activity

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Middle Trapezius and Rhomboids

- **Prone Row**
  - High EMG Activity

- **Mid and Low Rows**
  - High EMG Activity

- **Scapula retraction** (progression→resistance)
  - Increased Supraspinatus strength potential
  - Increases width of subacromial space

Lower Trapezius

• **Prone Full Can**
  – High EMG and alignment of muscle fibers with movement

• **Bilateral External Rotation**
  – Excellent ratio of lower vs. upper trap activity
  – Bonus of Infraspinatus and Teres Minor strengthening

Serratus Anterior

• Push-up with Plus
• Dynamic Hug
• Serratus Punch at 120°

- High EMG activity with all
What does this all mean?
Are you using the best available evidenced based practice for evaluation and management of the shoulder?
Clinical Thoughts

• Given the high incidence of shoulder pain in individuals with Spinal Cord Injury who use wheelchairs as primary means of mobility:

• Improved examination and manual evaluation techniques help clinicians:
  • Recognize dysfunction earlier.
  • Prevent future problems.
  • Improve intervention strategies:
    – Seating and mobility.
  • Improve education of patients.
  • Create consistent best practice!
Anecdotal Implementation

- Paraplegia
- Tetraplegia
- Central Cord
- Multiple Sclerosis
- CVA
- TBI
- Brachial Plexus
- Impingement Syndrome
- Rotator Cuff Repair
- Total Shoulder Replacement
- Dislocation
- Subluxation
- Biceps Tendinitis
- SLAP
- Proximal Humeral Fractures
- Pediatrics
Just when you thought we were all done

- We added a whole new complexity to the equation.
- 1 more reason to emphasize strengthening the shoulder in SCI.
Questions?
Thank You!

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