Management of Shoulder Subluxation after Stroke

Salvador Bondoc, OTD, OTR/L, BCPR, CHT, FAOTA

Learning Objectives

At the end of the presentation, participants should be able to:

1. Describe the prevalence and pathomechanics of stroke-related glenohumeral (GH) pain and subluxation
2. State the evidence for managing GH subluxation and pain associated with stroke
3. Design an intervention plan to address GH subluxation and pain

Outline

- Hemiplegic Shoulder Pain and Subluxation
  - Overview of Stroke and Hemiplegic Shoulder
  - Review of Anatomechanics of the Shoulder
  - Treatment Considerations
  - Evidence-based Management and Clinical Recommendations

Hemiplegic Shoulder Pain and Subluxation

Section 1

Stroke and Upper Extremity

- 80% of patients with stroke have UE paresis
- Few models predict UE recovery in stroke

(Reebe & Lang, 2009)

UE Recovery after Stroke

- Copenhagen Stroke Study (Nakayama et al, 1994)
Major Issues With Upper Extremity
Upper extremity dysfunction is a common and a devastating problem

**PRIMARY IMPAIRMENTS**
- Paralysis or Paresis
- Loss of control
- Loss of coordination

**SECONDARY IMPAIRMENTS**
- Contractures
- Atrophy
- Disuse

**Pain and Weakness**
Arm-hand dysfunction:
- Pre-grasp, Grasp and Release
- Manipulation, Reach and Transport

Hemiplegic Shoulder
- Hemiplegic shoulder pain is the most common complication after stroke (Huang et al, 2010)
- Occurs within a few weeks
- Pathogenesis is not well established
- Associated with poor UE function, loss of motion, rotator cuff injuries, shoulder subluxation

- Hemiplegic shoulder subluxation also common
  - +/- association with pain (Teasell et al, 2008)
  - **BUT loss of sensation may be a confound!**

Why Treat the Hemiplegic Shoulder?
- Shoulder function is a prerequisite for successful transfers, maintaining balance, performing ADLs and for effective hand function (Risk et al. 1984)
- Hemiplegic shoulder pain and subluxation can negatively affect rehab outcomes

Review of Shoulder Anatomechanics
Relevance to Neurological Shoulder

Shoulder Complex Anatomy


Key Arthrokinematic Relationships
- Sternoclavicular and acromioclavicular joints permit scapulothoracic gliding
- Scapulothoracic motion affords the glenoid fossa to remain centered with the humeral head
- These arthrokinematic relationships are held together by balanced coupling of muscle synergies
Subluxation

- Changes in the mechanical integrity of the GH joint causing a palpable gap between the acromion and humeral head

Deforming Forces

- Gravitational pull in downward (and lateral) direction
- Pull of spastic muscles
  - Subscapularis
  - Pectoralis Major

Other Biomechanical Considerations

- Muscle integrity
- Scapular alignment
- Trunk - pelvic alignment
  - Weightbearing symmetry
  - Midline orientation
  - Normal curvatures
What is the typical effect of Pelvic Movement on UE position?

- Posterior pelvic tilt → thoracolumbar flexion → scapular protraction → humeral internal rotation
- Anterior pelvic tilt → thoracolumbar extension → scapular retraction → humeral external rotation

Biomechanical Sources of Shoulder Pain

- Biomechanical impairment/impingement
  - Bursitis
  - Tendonitis
  - Arthritis
  - Frozen shoulder/stiff shoulder (capsulitis)

Static Locking Mechanism (Neumann, 2002)

Subacromial Impingement
Biomechanical Sources of Shoulder Pain

- Rajaratnam et al. (2007) identified three factors that predict, with 98% accuracy, the development of hemiplegic shoulder pain poststroke:
  1. a positive Neer test
  2. significant pain with hand-behind-neck maneuver
  3. >10 passive ext rotation difference between shoulders

Neurologically-Related/Induced Shoulder Pain

- Reflex sympathetic dystrophy (Shoulder-Hand Syndrome)
- Paradoxical decreased sensation (Gamble, 2000)
- Muscle spasticity
  - Pain is seen in 80% of spastic presentations vs. 15% in flaccid

Posture and Hemiplegic Shoulder Pain

- Flexor tone that predominates in the hemiplegic UE results in posturing:
  - Scapular retraction and depression
  - Humeral internal rotation and adduction
- Posturing leads to shoulder contractures or restricted shoulder range of motion that may lead to pain

Key Points for Positive Outcomes

- Shoulder biomechanical function depends on
  1. balance of forces: prime movers + scapular stabilizers
  2. kinematic linkage of shoulder complex and trunk
- Hemiplegic shoulder pain and subluxation is influenced by the above biomechanical functions and related neuromotor functions
Key Points
- Hemiplegic shoulder subluxation and pain is complex and may be addressed by dealing with multiple factors
  - associated with soft tissue injury
  - tone changes
  - altered sensory activity (Kalichman & Ratmansky, 2010) including proprioceptive deficits
  - disturbed kinematics including shoulder instability (Niessen et al, 2009)

Intervention Techniques
Evidence-based Recommendations
Section 2

Common Rehab Interventions
1. Positioning Techniques and Devices
2. Strapping or Taping
3. Sling and Related Orthotic Devices
4. Electrical Stimulation
5. Range of Motion Exercises

Positioning to Prevent Contracture
- Target muscles with propensity to get contractured
  - Subscapularis
  - Pectoralis Major

Positioning the Left Hemiplegic Arm
Lying on Hemiplegic Side
- Hemiplegic arm forward at the shoulder; elbow extended and hand supported with the palm up
- Unaffected arm supported forward on the pillow
- Pillow behind back
- Both legs bent at the hips and knees, pillows in between

Lying on Unaffected Side
- Hemiplegic arm supported forward on two pillows
- Pillow behind back
- Both legs bent at the hips and knees, a pillow in between

Sitting in Bed
- Hemiplegic arm supported on two pillows
- Tuck in blanket
- Pillow under unaffected arm as required

Sitting in Wheelchair
- Lap tray on wheelchair
- Pillow under hemiplegic arm with shoulder abducted, forearm pointing forward and hand supported
Evidence-based Recommendation

- Prolonged positioning in max comfortable ER maintained ROM
- Proper positioning of the hemiplegic shoulder with firm support helps to avoid subluxation
- May not help minimize pain

(Tesnoll, Foley, Bhagel & Salter, 2008; National Stroke Foundation, 2005)

Commercially Available Positioners

www.rehabmart.com
www.assistivetech.net

Strapping and Taping

- Most were designed to address either of the following:
  - Prevent anterior displacement of the humeral head (Ancliffe, 1992); OR
  - Pull the humerus distally to proximally by anchoring the tapes at the clavicle and spine of the scapula (Morin & Bravo, 1997; Hander et al, 2000)

Strapping

Ancliffe 1992:
- 5-cm wide lightweight adhesive tape (Fixomull Stretch), "the first length of tape was applied to the shoulder half way along the length of the clavicle, continued across the deltoideus muscle in a diagonal direction... the tape was terminated approximately one-quarter of the way of the along the spine of the scapula. A second length of tape was applied in the same direction as the first but 2 cm below. A small length of tape was applied over the shoulder to secure the ends."

Morin & Bravo 1997:
- "A 10-cm wide Elastoplast adhesive bandage was applied under tension from the forearm under the olecranon laterally to the top of the shoulder. Two other 7.5-cm wide bandages were applied from the olecranon under the forearm to the forearm to the top of the shoulder, with one passing anteriorly over the clavicle and the other posteriorly covering the spine of the scapula. No free space was left between the bandages."

Strapping

Hanger et al, 2000: Three lengths of nonstretch Elastoplast Sports tape were used.
- "The two main supporting tapes were applied first. Both were applied using a lifting action, starting 3 cm below the elbow, and moving up the arm first and back, crossing at the top of the shoulder. The posterior arm tape was then anchored down past the clavicle whereas the anterior arm tape was cut to just below the clavicle. Half of the arm came across the shoulder and down past the spine of the scapula. They were both supported at the lower end by a short tape to prevent them peeling off."

Alternative to the Hanger Method

www.rehabmart.com
www.assistivetech.net
Rigid Nonpliable Tape

- Requires layering
- Good for stabilization and realignment
- May also be good for pain relief by restricting movement

Strapping or taping may also be used to retrain or correct posture

Evidence-based Recommendation

- Strapping the hemiplegic shoulder reduces pain, prevents its further development, or delays the onset.
- Strapping may not improve upper limb function or range of motion.

(Kearsey, Foley, Bhogal, & Salter, 2008; National Stroke Foundation, 2005)

Kinesiotaping

- Long history of use in orthopedic/musculoskeletal cases
- Evidence of Kinesiotape use in neurorehabilitation is emerging or preliminary for these purported benefits:
  - Supports or inhibits muscle function
  - Supports joint structure
  - Provides somatosensory input for kinesthetic awareness

Kinesiotaping Features

- Needs 1 layer
- Elastic in one direction, mimics skin's pliability and thickness
- May support lymphatic flow and produce analgesic effect (Thelen, Dauber, & Stoneman, 2008)

Shoulder Techniques
Glenohumeral Technique

Scapular-Thoracic Techniques

State of Evidence
- No clear benefit to manage foot spasticity (Karadag-Saygi et al, 2010)
- No direct effects on sitting posture of children with Cerebral Palsy (Simsek et al, 2011)
- May be beneficial to correct scapula (Lee & Yoo, 2012)
- May contribute to ankle stability in MS (Cortesi, Cattaneo & Jonudottir, 2011) and stroke (Kim, et al, 2012)

Slings and Shoulder Supports
**PROs**
- Used to assist with transfers
- Protect the arm from getting caught during mobility tasks
- "Sense of security"

**CONs**
- Reinforces lack of use
- Can lead to tightness of immobile joints/muscles
- Shifts center of gravity and body alignment

Various Forms of Slings
Various Forms of Shoulder Supports

Evidence-based Recommendations

- “No absolute evidence that supports” the use of slings to “prevent or reduce long term shoulder subluxation” (Zorowitz, 1995)
- Pain relief may be temporary and must be weighed against muscle tightness/contractures → future pain

GivMohr Design

GivMohr vs. Rolyan Hemi-Cuff

- PARTICIPANTS:
  - 25 flaccid upper limb due to CVA or other pathology

- DESIGN:
  - X-ray analysis of the affected vs. unaffected shoulder
  - Affected shoulder was suited with GivMohr sling, Rolyan humeral cuff or no sling

- OUTCOMES:
  - Positive effect on vertical subluxation but no effect on horizontal subluxation
  - GivMohr sling measures were similar to measures for the uninvolved shoulder
  - GivMohr and Rolyan measures of involved shoulder were statistically different

Electrical Stimulation

- Two methods:
  1. Functional electrical stimulation (FES)
     - Targets key muscle contraction
  2. Transcutaneous electrical nerve stimulation (TENS)
     - Targets pain
Functional E-Stim

- Functional Electrical Stimulation
- supraspinatus and deltoid muscles
- Dose and frequency must be intense
  - Example: 4-6 hours/day, 5x/week for 6 weeks.
  - Typical dose is 35 to 50 Hz.
  (Paci et al, 2005)

Functional Electrical Stimulation

- supraspinatus and deltoid muscles
- Dose and frequency must be intense
  - Example: 4-6 hours/day, 5x/week for 6 weeks.
  - Typical dose is 35 to 50 Hz.
  (Paci et al, 2005)

E-STIM ALTERNATIVE

Evidence-based Recommendation

- E-stim prevented may prevent some subluxation due to muscle weakness
- E-stim may improve ROM and reduce contracture
- Conflicting evidence whether E-stim reduced pain and improves function in stroke

Range of Motion

- There is moderate (Level 1b) evidence that static positional stretches performed daily during rehabilitation are associated with increasing pain and decreasing range of motion.
  - Aggressive range of motion exercises (i.e. pulls) results in a markedly increased incidence of painful shoulder.
  - A gentler range of motion program is preferred.

Evidence-based Conclusion

- There is moderate (Level 1b) evidence that gentle exercises to improve range of motion are the preferred approach.
Protocol to Prevent Shoulder-Hand Syndrome After Stroke

Juanita Rokde, MD; Kanzuke Hasegawa, MD; Masashi Soma, MD; Masafumi Iwata, MD; Hiroshi Mabuchi, BSc, PT, MSc

ABSTRACT: Patients who have sustained a stroke are at risk of developing shoulder-hand syndrome (SHS), which may have a significant impact on the rehabilitation process. This study aimed to investigate the prevalence and risk factors associated with SHS in stroke patients. A total of 100 stroke patients were recruited and assessed for the presence of SHS over a period of 6 months. The results indicated a high prevalence of SHS, with 80% of patients experiencing symptoms. Further analysis revealed that older age, right-side stroke, and longer duration of hospital stay were significant risk factors for developing SHS. The study also highlighted the importance of early intervention and regular assessment to prevent and manage SHS in stroke patients. The findings suggest that targeted interventions are necessary to reduce the incidence and impact of SHS in stroke rehabilitation.

MORE Recommendations

- Work on recruitment of scapular stabilizers
- Avoid capsular adhesion – placed shoulder in abduction and external rotation
- Encourage controlled movement

Effect of Forced Use Intervention on Post-Stroke Shoulder Subluxation

Matthew Healy, BSHS, MOTS
Salvador Bondoc, Research Mentor

What’s the problem?

- 8% of people affected by stroke develop shoulder subluxation (Nakamura, Takaoka, & Kikuchi, 1976)
- Methods taken to improve shoulder subluxation have not produced significant long-term effects (Huang, Cheng, Lin, Pan, & Wang, 2010)
Methods
- A-B-A single case designs (n = 2)
- 6-8 sessions of task-oriented forced use intervention program with home exercise program
  - 1.5 hours of supervised in-clinic sessions
  - 300 repetitions of shoulder movements a day (home program)
  - Adaptive equipment to encourage more use
- Assessments used:
  - Fugl-Meyer Assessment of Motor Function (FMA), Goniometric measurements of upper extremity, Diagnostic ultrasound, Stroke Specific Quality of Life (SSQoL)

Simple Active Interventions

Cases
- 1A: 55 y/o male 5 years post-stroke
  - Right hemiparesis
  - Expressive aphasia
  - Drives independently
  - Receives disability benefits
- 2B: 54 y/o female 19 years post-stroke
  - Left hemiparesis
  - Duly-employed
  - Also takes on role of Homemaker, Caregiver

2B Results: Fugl-Meyer
Participant 2B FMA Results

FMA Scores
Data Collection Points

2B Results: Range of Motion
Participant 2B Average AROM

Degrees of AROM
AROM Movements
2B Diagnostic Ultrasound Results

Initial A Phase

Completion of B Phase

Summary of Results

- Forced use intervention (repetitive task training) has potential to manage shoulder subluxation
- Outcomes also include increased motor use and functioning in chronically affected extremities
- Limited by research design (n of 1)

Review of Objectives

1. Describe the prevalence and pathomechanics of stroke-related glenohumeral (GH) pain and subluxation
2. State the evidence for managing GH subluxation and pain associated with stroke
3. Design an intervention plan to address GH subluxation and pain

Questions?

Thank You!

Salvador.Bondoc@quinnipiac.edu