Evaluation and Management of Scapular Dysfunction

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Goals of this presentation

- Relevance of scapular dysfunction to common shoulder pathologies
- Normal scapular motion & function
- Key examination techniques to identify scapular dysfunction
- Key treatment concepts and techniques to address scapular dysfunction

Why all the fuss about the scapula?

- Is it a direct source of symptoms?
  - Rarely
  - Scapular pain: think *cervical spine* first

Scapular Dysfunction

The Big Picture

- "Scapular Dysfunction"
  - Something not working correctly
  - Medical Diagnosis or Physical Impairment?

Scapular Dysfunction

The Big Picture

- Medical diagnosis
  - RC tendinopathy/tear, instability, SLAP, frozen shoulder
  - helps direct general course of care and prognosis
  - does not dictate specific rehab
- As therapists, we treat *physical impairments*
  - identified through an examination
  - *Assumption*: improving impairments (strength, ROM, motor control, posture etc) => ↓pain & ↑function
- Identified impairments dictate specific rehab

Common Shoulder Diagnoses

- Rotator Cuff / Impingement
- Frozen Shoulder
- Glenohumeral Instability
- Other

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<td>Hx disloc / sublux</td>
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<td>No pain</td>
<td>Red Flag Conditions</td>
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Scapular Dysfunction is an Impairment

- Is it related to common shoulder pathologies?
  - Maybe
  - Subacromial Impingement
    - Abnormal motion leads to decrease in subacromial space => impingement/tendinopathy
    - Abnormal motion results in overuse of rot cuff => impingement/tendinopathy
    - Rot cuff may be the “victim” but scap dysfunction may be “culprit”

Scapula Dysfunction

- Is it related to common shoulder pathologies? *Maybe*
  - Frozen Shoulder
    - Compensatory early/excessive scapular motion has been identified
    - May be difficult to “unlearn”
  - SLAP / GH Instability
    - Unstable or malpositioned scapula may lead to over stress of labrum and GH capsular structures, especially overhead sports
  - How can we determine if scapula dysfunction is related to symptoms?
    - SYMPTOM ALTERATION TESTS

The Scapula

- Functional Role
  - Base for UE function
  - Mobility Requirement for proper positioning:
    - maintain length-tension relationship for GH muscles
    - maintain GH stability during UE task by “following the humerus”
  - Stability Requirement:
    - base for force generation through UE

The Scapula Normal Motion

- Is it as simple as 2:1?

Direct Three-Dimensional Measurement of Scapular Kinematics.


- Subjects
  - Eight healthy volunteers
  - One patient with impingement syndrome
- Protocol/Data Analysis
  - 2 bone pins inserted directly into scapula
  - Mount sensors and set up coordinate systems
Description of Motion

Upward Rot  Posterior tilt  External Rot  Clav Retract  Clav Elev

Scapular Plane Elevation: Scap Upward Rot

Mean = 50°

Scapular Plane Elevation: Scap Posterior Tilting

Mean = 30°
Scapular Plane Elevation: **Clavicular Elevation**

- Mean = 10°

![Graph of Clavicular Elevation](image)

Scapular Plane Elevation: **Scap Ext Rot**

- Mean = 24.0°

![Graph of Scapular External Rotation](image)

Scapular Plane Elevation: **Clavicular Retraction**

- Mean = 21°

![Graph of Clavicular Retraction](image)

**Shoulder Girdle Motion**

- Four Articulations
  - Glenohumeral
  - Scapulothoracic
  - Acromioclavicular
  - Sternoclavicular

![Diagram of Shoulder Girdle Motion](image)
Assessment of Scapular Dysfunction

- Visual Classification: Scapula Dyskinesis Test
- Symptom Altering Tests: SRT, SAT
- Force Measures
  - Trap
  - Serratus
- Related Areas
  - Pec Minor
  - Posterior Capsule
  - Thoracic spine

Classifying scapular motion: the scapula dyskinesis test (SDT)  
(McClure et al. JAT, 2009 Tate et al, JAT, 2009)

- 5 repetitions:
  - Flexion (weighted)
  - Abduction (weighted)
- Rate scapular motion on each test as:
  - Normal (N) motion: no evidence of abnormality
    - Medial border and inferior angle relatively flat
  - Subtle (S) dyskinesis: mild/questionable evidence of abnormality, not consistently present
  - Obvious (O) dyskinesis: striking, clearly apparent abnormalities, evident on at least 3/5 trials
    - Winging 1” or greater displacement of scapula from thorax
    - Dysrhythmia

Dyskinesis: Dysrhythmia

- Describes a lack of “smooth” scapulohumeral rhythm
  - A “hitch or a jump in the otherwise smooth motion.” (Kibler, 2003)
  - Most common pattern is early/excessive scapular elevation (shrug)
  - Another common pattern: rapid downward rotation during lowering (dump)

Dyskinesis: Winging

- Movement of medial border and/or inferior angle away from the thorax, becoming more prominent during arm motion with a sulcus/gap between the scapula and the thorax:
  - ≥1” is considered abnormal
  - May be unilateral or bilateral

Scapula Dyskinesis Test

- 5 repetitions
  - Flexion
  - Abduction
- Weight (if able)
  - 50 if>150 lbs or >
  - 30 if <150 lbs
- Look for
  - Winging (1” or >)
  - Dysrhythmia
- Grade
  - Normal
  - Subtle
  - Obvious
Symptom Altering Tests

- **Modified Scapular Assistance Test**
  - Posteriorly tilt and upwardly rotate scapula (Rabin et al, 2006)

- **Scapula Retraction Test**
  - Evaluation of supraspinatus strength in patients with shoulder injury using the SRT (Kibler, 2006)

- **Scapula Reposition Test**
  - Tate, McClure et al, JOSPT, 2008

Methods: Effect of SRT on Pain

- **Physical exam by ATC**
  - Impingement tests
    - Hawkins
    - Neer
    - Jobe
  - Symptomatic impingement tests with SRT
    - Numeric Pain Rating (0-10)

Procedure: Effect of SRT on Isometric Elevation Strength using Dynamometer

- Three submax practice trials
- Three 5-second max trials
  - 1 min b/w reps
- Positions
  - Natural
  - SRT
  - 2 min rest
  - (order randomized)

Results: Pain provocation and strength

- Pain with impingement test
  - 1 positive impingement test in 98/142 athletes
  - With SRT 46/98 athletes had 1pt or more ↓ in pain

- Strength
  - 26-29% significant increase in strength

- Relevance of SRT
  - identify those in whom scapular interventions are indicated

Purpose

- **SRT**
  - Reduce pain?
  - Increase elevation force?
- **Overhead athletes (N=142)**
  - Symptomatic
  - Asymptomatic
Results: Pain Reduction
- 98/142 athletes “+” impingement tests
- SRT: 46/98 ↓ in pain

Results: Strength
- 26-29% increase in strength
- Strength gains were not associated with reduction in pain

Relevance of SRT
- Identify those in whom scapular interventions are indicated

To Perform SRT: Jobe empty can test
- Arm abducted in scapular plane with humerus internally rotated with thumb pointing inferiorly
- Apply resistance just proximal to patient’s wrist
- Document elevation strength and presence of pain (NRS 0-10)

Modified Scapula Assistance Test (Rabin et al, 2006)
- Pain rating during scaption or sagittal plane elevation /10
- Stabilize the upper scapular border into mild retraction
- Heal of other hand over inferior angle with fingers wrapped around thorax to assist upward rotation during elevation
- Pain rating __/10

Possible Causes for Scapular “Mis-position”
- Muscle weakness
  - Serratus anterior
  - Lower/middle traps
- Soft tissue/Muscle tightness
  - Posterior capsule/cuff
  - Pectoralis minor
- Thoracic spine/Posture

Jobe with scapula reposition test (Tate et al, 2008)
- Grasp scapula medial to the lateral aspect of acromion with fingers on clavicle/ACj
  - Forearm is obliquely angled toward inferior angle for additional support
- Apply moderate posterior tilting and external rotation force
- Passively elevate arm and repeat Jobe test
- Document pain (NRS 0-10)

Serratus Muscle Test
- Highest ms activity: Flexion or scapular plane elevation and resist shoulder elevation
- Resisting protraction: does not elicit as much as SA emg activity
Strength: Serratus anterior
- Patient seated, no back support
- Arm flexed to 125°
- Apply downward resistance just proximal to patient’s elbow
- Monitor inferior angle of scapula and grade based on ability of serratus to hold upward rotation

Normal strength
Reduced strength

Strength: Middle Trapezius
- Prone
- Horizontal abduction with thumb pointed superiorly
- Apply downward resistance just proximal to patient’s elbow
- Stabilize thorax
- Monitor medial border of scapula, grade on ability to maintain retraction

Normal strength
Reduced strength

Strength: Lower Trapezius
- Prone
- Arm elevated overhead in line with lower trapezius
- Apply downward resistance just proximal to patient’s elbow
- Stabilize thorax
- Monitor medial border of scapula, grade on ability to maintain retraction

Normal strength
Reduced strength

Forward shoulders/protracted scapulae
- Are they a problem?
  - Solem-Bertoft
    - anterior opening of subacromial space narrowed with protracted vs retracted position
- Reduced pec minor length
  - Solom-Bertoft
- Reduced posterior tipping at 90, 120 elevation
- Reduced external rotation during abduction 30, 60, 90 deg
- Significance: reduce the subacromial space

Normal strength
Reduced strength

Pectoralis Minor length
- Normal: posterior acromial heights = bilaterally or involved side is lower
- Reduced: acromion is significantly higher (>1cm) on involved side
- Measure and palpate lower ribs for elevation during passive shoulder flexion

Normal strength
Reduced resting pec minor length on right

Shoulder ROM, Posterior Capsule Length
Posterior Capsule (Harryman, 1990)
- Increased posterior shoulder tightness
- HH sup translation & decreased GH IR AROM
- Decreased subacromial space
- Mechanical compression of SA tissues

A
B

Reduced pec minor length on right

Reduced resting pec minor length on right
Posterior Capsule tightness

- Superior migration of humerus with posterior capsule tightness (Harryman, 1990)
- Loss of internal rotation (GIRD)
- May cause scapula to protract excessively during follow-through (add/IR)
  - Throwing

AROM: Internal Rotation behind back
(Hoving 2002, Green 1998)

- Standing
- Ask patient to "reach behind your back as high as you can"
- Hand should stay flush against back with thumb pointing superior
- Record position of thumb
- Landmarks:
  - PSIS = S2
  - Iliac crest = L4-L5
  - Inferior angle of scapula = T7
  - Spine of scapula = T4

Posterior Shoulder Tightness:
What do we measure?

- PROM: Internal Rotation 90° abduction
- Horizontal adduction

PROM: Horizontal adduction
(Myers, AJSM 2007)

- Supine "squeeze shoulder blades together"
- PT stabilizes scapula into maximal retraction using thenar eminance against lateral scapular border
- Passively horizontally adduct humerus to end range
- Rate
  - Restricted = adduction less than sagittal plane (90°)
  - Normal = adduction beyond sagittal plane (90°)
  - Typical measure is 95°

Practice

- SDT (Scap Dyskinesis Test)
  - Flex +/- wt
  - Abd +/- wt
- SRT (Scap Reposition Test)
  - Empty can w/o scap stabilization
  - ? Pain reduced
  - ? Obvious strength increase
- SAT (Scap Assist Test)
  - Use if elevation is painful
  - Assist scap upward rot during painful elevation movement

Strength Assessment
- Mid trap
- Low trap
- Serr Ant

Post Capsule Tightness
- IR at 90 degrees
- Horiz Adduction with scap blocked
- Pec minor tight?
  - Coracoid ht supine, palpate ribs during arm elevation
Interventions

**Stretch if tight**
- Scapula mobilizations
- Pectoralis minor
- Posterior capsule/cuff

**Reeducate/strengthen if reduced muscle performance**

**Other**
- Tape
- Brace
- NMES

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**ST inferior glide**

- **Patient Position:** side-lying with upper limb draped over the tester’s arm
- **Tester Position:** one hand across the acromion to guide motion and the other around the inferior angle of the scapula.
- **Description:** The scapula is moved in the inferior direction by pushing the acromion and lifting the inferior angle.

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**ST protraction**

- **Patient Position:** side-lying with upper limb draped over the tester’s arm
- **Tester Position:** one hand across the acromion to guide motion and the other around the inferior angle of the scapula.
- **Description:** The scapula is moved into protraction by pushing the acromion and lifting the inferior angle.

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**ST retraction**

- **Patient Position:** side-lying with upper limb draped over the tester’s arm
- **Tester Position:** one hand across the acromion to guide motion and the other around the inferior angle of the scapula.
- **Description:** The scapula is moved into retraction by pushing the acromion and lifting the inferior angle.

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**Scapulo thoracic superior glide**

- **Patient Position:** side-lying with upper limb draped over the tester’s arm
- **Tester Position:** one hand across the acromion to guide motion and the other around the inferior angle of the scapula.
- **Description:** The scapula is moved in the superior direction by pushing the acromion and lifting the inferior angle.
**ST distraction**

- **Patient Position:** side lying with upper limb draped over tester’s arm.
- **Tester Position:** One hand is over the acromion and the other is either stabilizing the inferior border of the scapula or the fingers are at the medial border.
- **Description:** The scapula is moved over the stabilizing hand or the fingers are worked under the scapula while pushing on the acromion to lift the scapula off the thorax.

**Posterior Capsule/Cuff Stretching**

- **Manual Techniques**
  - Supine
  - Prone

**Pectoralis Minor Stretching**

**Posterior Capsule Mobilizations**

- **Posterior glide**
- **Posterior glide in 90 degrees flexion**

**Posterior Capsule/Cuff Stretching**

- **Patient Generated**
  - Cross-body
  - Sleeper

**Surface EMG analysis of Ex for trapezius and serratus anterior** (Ekstrom, 2004)

- **N=30 healthy subjects**
- **Which exercises elicit greatest emg?**
  - Middle trap: overhead arm raise in line w/ trap & horizontal ext w/ ER ("T" and "Y")
  - Lower trap: overhead arm raise in line w/ trap
    - Alternate: prone ER w/ 90 abd
  - Serratus anterior: scaption > 120 & combined flexion, horiz. flexion and ER
Relative Balance of Serratus Anterior and Upper Trapezius Muscle Activity During Push-up Exercises
Muscle Activity During Push-up Exercises

Scapular Exercise: EARLY PHASE

Scapular Exercise: MIDDLE PHASE

Flexion, horizontal flexion, external rotation
Based on Ekstrom 2003
Scapular Exercise: LATE PHASE

Scapular Exercise Principles
- Quality vs Quantity
  - GH range limited to where scap control is achieved and maintained
- CKC or OKC?
- Trunk motion to facilitate scap motion
- Multiple planes (safer => more challenging)
- Taping/bracing

NMES for strengthening
- Increase peak force production of shoulder musculature with NMES (Reinold et al., AJSM, 2008)
- Cortical activation change induced by neuromuscular electrical stimulation: increase efficiency of cerebral cortex during execution of motor tasks (Jang SH, et al., Journal of NeuroEngineering and Rehabilitation, 2014)

Parameters for strengthening
- **Phase Duration**: 200-600ms (usually use 400-500 ms)
- **Pulse Frequency**: 50pps to 90pps
- **Duty Cycle**: 1 to 5 (10 seconds on and 50 seconds off)

Protocol for Subacromial Impingement (Tate et al, JOSPT, 2010)
- Use NMES bilat mid trap with resisted retraction
- Bilat mvmts increase cortical excitability and maximize potential for strengthening corticospinal papathways (Baldwin et al, Physiotherapy Canada, 2012)
- Use NMES on unilat mid/low trap and serratus anterior using toggle during arm elevation/lowering
Treatment Summary & Practice

- **Stretching**
  - Post capsule/cuff
  - Pec minor
  - Post GH mobs

- **Strengthening**
  - Motor control vs strength
  - SA, LT +/- NMES
  - Core and whole body patterns
  - Cuff strengthening also effects scapula

- **Taping / Bracing**
  - Adjunct to facilitate pain-free exercise

Thank you

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