Objectives -

- Upon completion of this lecture the learner will be able to:
  - Understand basic anatomy and biomechanics of scapular anatomy
  - Demonstrate and apply an assessment of scapular dysfunction
  - Analyze and select therapeutic activities for selected patients with scapular dysfunction

Scapula

- Not true joint
- Point of contact between posterior lateral wall of thorax and anterior surface of scapula

Scapulothoracic Dysfunction

An alteration in resting position or dynamic motion of the scapula

Changes in scapular muscle recruitment that can affect normal shoulder function

References:


Scapular Dyskinesis

- Studies correlating abnormalities in scapular position and motion with impingement, rotator cuff dysfunction and instability.


Normal Scapular Kinematics

Scapulohumeral Rhythm

Scapular Rotations

- Upward Rotation / Downward Rotation

Decreased Scapular Upward Rotation!

- Inadequate upward rotation.
- Cause of "painful arc"
- Contributor of SAIS


Scapular Translations

Anterior / Posterior Tilt
Superior / Inferior

Increased Posterior Tilt
- Posterior tipping range is much less than that of upward rotation
- Elevates the anterior acromion which is predominate site of impingement
- May be more important!


Decreased Posterior Tilt

Scapular Muscle Control & Force Couples

Scapulothoracic Elevators
- Upper Trapezius
- Levator scapulae
- Rhomboids


Scapular Muscle Control

Scapulothoracic Depressors
- Lower trapezius
- Latissimus dorsi
- Pectoralis minor
- Subclavius


Scapular Muscle Control

Scapulothoracic Protractors
- Serratus anterior

### Scapular Muscle Control

- **Scapulothoracic Retractors**
  - Middle trapezius
  - Rhomboids
  - Lower trapezius

- **Scapulothoracic Upward Rotators**
  - Serratus anterior
  - Upper, middle and lower trapezius

**Neumann DA. Kinesiology of the Musculoskeletal System. Foundations for Physical Rehabilitation. Mosby, St. Louis, 2002.**

### Serratus Anterior and Trapezius

- Weakness of these muscles may accompany impingement syndrome or glenohumeral instability


### Throwing Athletes

- Electromagnetic tracking of scapular movements
- 21 throwing athletes
- 21 control subjects

**Throwing Athletes**

- During humeral elevation the throwing athletes exhibited:
  - ↑ upward rotation
  - ↑ internal rotation
  - ↑ retraction


**Throwing Athletes**

- Consistent with others
- Increased scapular upward rotation


**Throwing Athletes**

- Some changes may be adaptive
- Allows for more efficient throwing performance


**Throwing Athletes**

- Increased scapular internal rotation seen in healthy shoulders of throwers may account for some of the SICK scapula
- Further study is needed!


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**SICK Scapula**

- Scapula has Inferior medial border prominence
- Coracoid pain and malposition
- DysKinesia of movement


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**Scapular Dysfunction**

- Causes of Scapular Dysfunction
  - Bony
    - Thoracic kyphosis
    - Clavicle fractures non union or mal union
  - Joint
    - AC-instability
    - AC-arthritis
    - Instability
    - GH internal derangement

- Cont.
  - Neurologic
    - Cervical radiculopathy
    - Long thoracic nerve
    - Spinal accessory nerve
  - Alterations in muscle activation
    - Serratus anterior
    - Upper/Lower trap force couple
Scapular Dysfunction

- Rotator Cuff Injury -
  - "We noted an increased reliance on scapular contributions to overall humeral elevation with increased levels of pain and rotator cuff tear size."
  - "Pain associated with a rotator cuff tear serves as a primary contributor to the kinematic patterns exhibited in patients with rotator cuff tears."

Scapular Examination

- Clinical evaluation of scapula should include three basic elements:
  1) Visual observation to determine presence or absence of scapular dyskinesis
  2) Effect of manual correction of the scapular dysfunction on symptoms
  3) Evaluation of surrounding anatomic structures that may be responsible for observable dyskinesis

Scapular Examination

- Passive/Active Range of Motion Loss
  - Pectoralis minor and short head of biceps
    - Borstad & Ludewig, JOSPT 2005
  - Latissimus dorsi
  - Glenohumeral joint capsule (GIRD)
    - Kibier et al., BJSM 2013

Scapular Examination

- Muscle Strength –
  - Upper Trapezius
  - Lower Trapezius
  - Middle Trapezius (poor)
  - Serratus Anterior (poor)

Scapular Examination

- 40 healthy college aged subjects
  - With and without dyskinesis
  - RTC and scapular muscles assessed with HHD
  - No difference in strength scores between two groups

Scapular Examination

- Reliability and Validity:
  - Videotaped and observed
  - Shoulder flexion
  - Shoulder abduction
- Outcomes:
  - Normal or subtle
  - Dyskinesis
- Results:
  - Reliability: 75-82% agree
  - Validity: K = 0.48 to 0.61


Scapular Examination

- Examination of Surrounding Tissue
- Strength
- Motor control
- Postural abnormalities
- Flexibility
  - *Comprehensive Examination is key

Scapular Examination

- Shoulder Flexion -
  - Scapular upward rotation and abduction
- Shoulder Abduction -
  - Scapular upward rotation

Scapular Examination

- Scapular asymmetry in motion of position
- Abnormal motion and symmetry noted in those with and without pathology
- Scapular motion alterations and pain not always related


Scapular Examination

- Shoulder impingement patients
- Scapular dyskinesis via 3-D analysis
- 6-week training session
- Decreases in pain and symptoms
- Dyskinesis did not change


Scapular dyskinesis is presented as singular noun
Most likely it is a collective noun!
Dyskinesis may be more like a syndrome

Posture

- 3-D scapular kinematic assessment
- 45 impingement; 45 age matched controls
- Outcomes:
  - Posture

MCClure PW, Michener LA, Karduna AR. Shoulder function and 3-dimensional scapular kinematics in people with and without shoulder impingement syndrome. Phys Ther 2006;86:1075-1090.

Posture

- No differences between groups in upper thoracic spine sagittal-plane posture

MCClure PW, Michener LA, Karduna AR. Shoulder function and 3-dimensional scapular kinematics in people with and without shoulder impingement syndrome. Phys Ther 2006;86:1075-1090.

Shoulder impingement patients
- RCT
- Scapular focused rehab vs standard RTC rehab
- 4-8 week training session


Scapular Oriented Ex
- Rotator Cuff Oriented Ex


135 patients; 67 pain; 68 healthy
- Scapular Dyskinesis Test
- Watching movements of flexion, abduction
- Normal
- Subtle dyskinesis
- Obvious dyskinesis


No difference between those with and without shoulder pain in prevalence of dyskinesis
- Scapular dyskinesis may represent normal movement variability

Scapular Rehabilitation

Rehabilitation Overview
- NSAIDS
- Modalities
- Correction of postural faults
- Scapular taping
- Strengthen weak musculature
- Stretch inflexible musculature

Modalities
- Nonsteroidal anti-inflammatory meds
- Ice
- Heat
- Ultrasound
- Diathermy
- Iontophoresis

Rehabilitation Overview
- Direction of rehabilitation depends on the factors that are causing scapular dysfunction

Postural Training

Posture
- Increased thoracic kyphosis
- Forward head
- Bilaterally rounded shoulders
- Abducted and anteriorly tipped scapula
- Significant asymmetry
Posture

- C-spine retraction

Functionally Tight vs. Functionally Weak


Posture – Tightness (Red)

- Pectoralis major and minor
- Levator scapula
- Upper trapezius
- Latissimus dorsi
- Subscapularis
- Sternocleidomastoid
- Rectus capitus
- Scalenes

Posture – Weakness (Yel)

- Rhomboids
- Mid and lower traps
- Serratus anterior
- Teres minor
- Infraspinatus
- Posterior delt
- Longus colli and longus capitus

Posture - Weakness

- Serratus anterior
- Middle trapezius
- Lower trapezius

Posture - Weakness

- Weaker muscles cannot be optimally strengthened if their antagonistic counterparts are not stretched

Posture - Weakness

Stretch inflexible muscles
- Pectoralis minor
- Pectoralis major

Posture - Weakness

Stretch inflexible muscles
- Trapezius

Posture - Weakness

Stretch inflexible muscles
- Trapezius
- Lats

Posture - Weakness

Proper postural alignment allows for:
- Maximal neuromuscular efficiency
- Normal length tension relationships


Posture - Weakness

Proper postural alignment allows for:
- Force couple relationships
- Normal arthrokineamatics

Posture - Weakness

Avoid prolonged – excessive scapular protraction and elevation positions
- This will improve biomechanical advantage of shoulder to perform activities


Posture - Weakness

- Scapular abduction and elevation place pressure on underlying soft tissue structures and strain tendons and muscles.


Posture - Weakness

- Compression leads to alteration of muscle strength
- Can lead to increased friction between the vertebral border of scapula and rib cage


Scapular Exercises and Drills

- Scapular weakness and abnormal rhythm associated with multiple other shoulder problems


Scapular Weakness

- Scapular role is that of proximal stability for distal mobility


Scapular Weakness

- Typically help with static and dynamic posturing of shoulder
- Endurance training should be emphasized
- Not typically required to produce enormous forces

Endurance
Straight Plane Side-lying Scapular Patterns

Straight Plane Seated Scapular Patterns

Scapular Exercises


Scapular Exercises


Serratus Anterior

- Flexion
- Scaption
- Abduction
- Pushup (+)
- Press-up


Serratus Anterior

- Push up + greatest average SA muscle activity (63% MVIC)
- Dynamic hug greatest peak SA muscle activity (105% MVIC)

Serratus Anterior

- Alterations of push up +
  - Knee push-up plus+
  - Elbow push-up+
  - Wall push-up plus+
  - Standard push-up +


- All low UT/SA ratios
  - UT activation 2x that of SA

Middle Trapezius

- Horizontal abduction
- Horizontal abduction with shoulder ER
- Prone extension


**Lower Trapezius**
- Shoulder abduction
- Rowing
- Horizontal abduction with shoulder external rotation
- Flexion


**Lower Trapezius**
- Horizontal abduction
- Scaption > 120°
- Scaption < 80°


**Moseley’s Core Scapular Exercise**
- Scaption
- Rowing
- Push up with plus
- Press up


**Scapular Muscle Balance**
- Compensations
  - Excess UT combined with decreased LT and SA
  - Assessed muscle ratios for UT/LT, UT/MT, and UT/SA during various exercises


**UT/LT Ratio**
- Side-lying external rotation
- Side-lying forward flexion
- Prone horizontal abduction with external rotation

**UT/LT Ratio**

- Horizontal abduction with external rotation revealed even lower UT/LT ratios than straight horizontal abduction


**UT/LT Ratio**

- No rowing exercise selected based on UT/LT ratios
- Rowing commonly suggest use for LT


**UT/MT Ratio**

- Side-lying ER
- Side–lying forward flexion
- Prone extension
  - Done in standing does not result in optimal MT/LT ratios


**UT/MT Ratio**

- Most of these studies done on normal healthy patients
- Extrapolation of results
- Done with caution


**Integration**

- CKC wall rhythmic stabilization exercises
- CKC exercises beneficial early due to co-contraction of scapular and RTC muscles

**Scapular Exercises**

- Improved stability with less risk of overloading static and dynamic restraints.

Integration
High-Level

- Push up plus with fall from knees
- Stable vs Labile

Integration
High-Level

- Wall push up plus
- Wall push up with manual resistance

Scapular Exercises

- Care must be taken
- Increase cautiously
- DOMS and increased tension to musculotendinous unit

Core Exercises

- Most trunk stabilizers are type I slow-twitch fibers
- Much like scapular stabilizers

Core Exercises

- Functional movement patterns
- Lower trapezius with contralateral gluteus maximus via thoracolumbar fascia

Core Exercises

- Want to ensure strengthening in isolation as well
- Isolated strength deficits should be addressed


Surgical Considerations

- Those that fail extensive (6 month trial) conservative treatment
- Nerve damage
- Bony incongruities
- Voluntarily snappers (?)
- Secondary gain (?)

Closing Remarks

- Proper diagnosis key!
- Some causes of scapular dysfunction may require surgical correction
- Careful exercise prescription
- Emphasis on posture and scapular endurance

Closing Remarks

- General understanding of scapular anatomy and biomechanics critical to assessment and treatment of scapular dysfunction
- Scapular stability and proper positioning important for full range of OH activities
- Some evidence for biasing scapular muscles when assessed via EMG on normal populations
- Scapular strength studies limited

Thank You!
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