Shoulder Dysfunction

Understanding the Foundational Importance of the Scapula

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Learning Objectives

1. Discuss the various roles of the scapula in regards to glenohumeral joint motion and control
2. Discuss dynamic muscle control of scapula rotation
3. Discuss various causes of Scapular Dyskinesis
4. Discuss proper evaluation techniques for the scapular dysfunction
5. Discuss various evidence based treatment techniques for scapular stability.

Deep Thoughts to Start

- "Acquired knowledge needs regular REVIEW, so it remains clear to us" Unknown Author

By the Numbers

- Finding demonstrate that scapular dysfunction is found in as many:
  - 68% of patients with rotator cuff pathology,
  - 94% with labral tears,
  - 100% with glenohumeral instability
    - (Warner 1992, Paletta 1997, Burkhart 2000)

Work below the Surface

What can Cause shoulder PAIN?

1. Scapular dysfunction
2. Intrinsic glenohumeral pathology
   - Capsulolabral structures
3. Extrinsic musculature
   - Rotator cuff
4. Neurovascular structures

Roles of the Scapula

- Provide motion along the thoracic wall
- The scapula retracts (externally rotates), facilitating a cocking position
  - Important in baseball, tennis serve, swimming, and volleyball spike
  - Creates a stable base for an arm that is abducted or elevated during ADLs such as reaching, pushing, or pulling.
- The scapula protracts laterally (internally rotates), during acceleration phase of throwing
- Dissipates some deceleration forces that occur in the follow through

Kibler, et al 2003

Roles of the Scapula

- Elevation of the acromion
  - Occurs during arm elevation
- Clearing of the acromion decreases risk of rotator cuff impingement

Kibler, et al 2003

Roles of the Scapula

- Kinetic chain:
  - Various muscle activation patterns stabilize the scapula and allow increased control of upper arm movement
  - Scapula assists in transferring large forces of high energy from the lower extremities, back, and trunk to the arm and hand.
  - Thus allowing increased velocity that could not be achieved by the arm musculature alone (ie. Rotator cuff).
  - Absorbs high loads from distal-to-proximal with long lever arms when upper extremity are abducted or elevated.

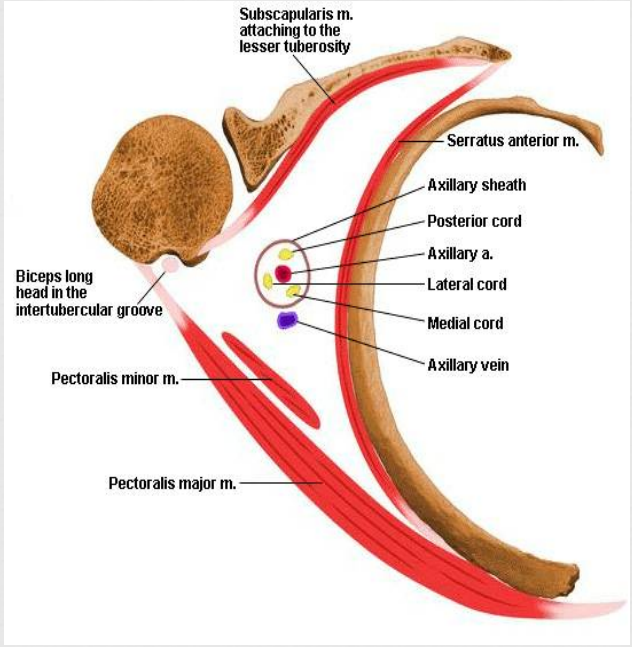
Kibler, et al 2003

Shoulder Kinematics

- **Alterations in Shoulder Kinematics and Associated Muscle Activity in People with Symptoms of Shoulder Impingement**
  - Analyze GHJ and scapulothoracic kinematics associated with scapulothoracic muscle activity with patients with shoulder impingement
  - 52 subjects
  - EMG sensors tracked 3-demensional rotation of trunk, scapula and humerus
  - Findings: Impingement group had decreased scapular upward rotation, increased anterior tipping, and decreased Serratus anterior muscle activity
    - Ludewig, 2000

Muscle Functions

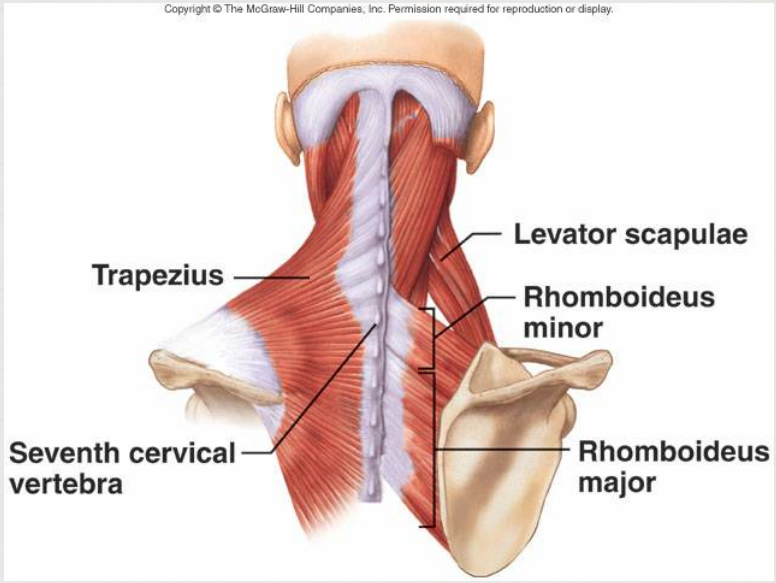
- Serratus Anterior Muscle
  - Maintains the medial border of the scapula against the ribs
  - Contraction: upward rotation and protraction of the scapula
  - Upward rotation of scapula is necessary for full humeral abduction and forward elevation
  - Serratus Anterior and Trapezius co-contraction are necessary for complete scapula upward rotation with dynamic control.



Pratt, 1991

Muscle Functions

- Trapezius Muscle
  - Upper, Middle, Lower
  - All three together act as strong adductors of the scapula
  - Upper and Lower co-contraction produce upward rotation of the scapula



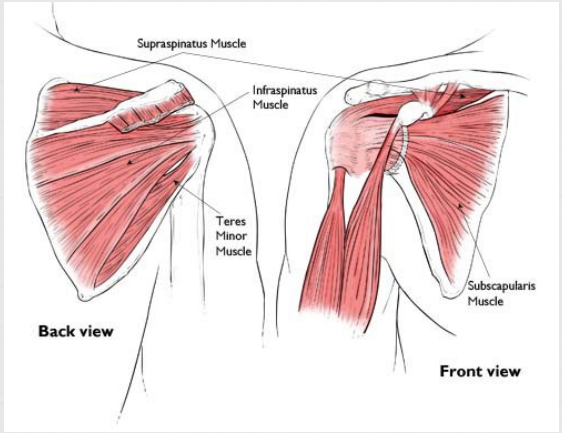
Pratt, 1991

Muscle Functions

Rotator Cuff

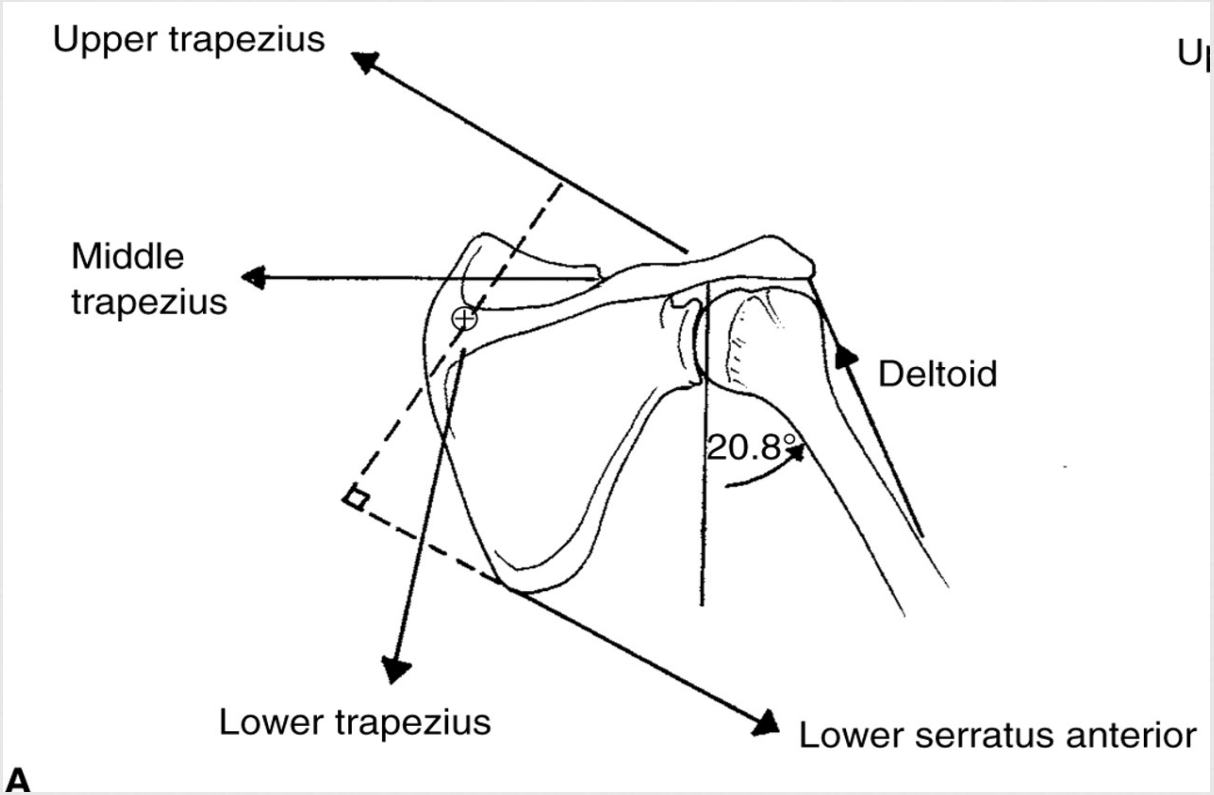
Origins of the cuff muscle arise from the scapula

- **Subscapularis Muscle**
  - Medial rotator of humerus
- **Supraspinatus Muscle**
  - Initial abduction of the humerus
  - Assist deltoid
  - Hold humeral head down during full abduction ROM
- **Infraspinatus Muscle and Teres Minor Muscle**
  - Externally rotate humerus



Pratt, 1991

Muscle Functions



Proximal before Distal

No Stability

Scapular Dyskinesis

- "Observable alterations in the position of the scapula and the patterns of scapular motion in relation to the thoracic cage"
  - Kibler et al, 2003

S.I.C.K Scapula

- **S**: **S**capular malposition
- **I**: **I**nferior medial border prominence
- **C**: **C**oracoid pain and malposition
- **K**: Dys**K**inesis of scapular movement

Burkhar et al, 2003

Case Study

Causes of Scapular Dyskinesis

Bony Posture or Injury

- Thoracic kyphosis with increased cervical lordosis
  - Result of excessive scapula protraction and acromial depression
  - Increase risk of impingement
- Fractures of the clavicle
- Acromioclavicular (AC) joint injuries, instabilities, arthosis

Kibler, et al 2003

Causes of Scapular Dyskinesis

Muscle Alterations

Primary cause is alteration in muscle coordination during activation, thus poor scapular stabilization.

- Muscle Injury Causes
  - Nerve
    - Injury to Long Thoracic Nerve (serratus anterior)
    - Injury to Spinal Accessory Nerve (trapezius muscle)
  - Direct-blow or trauma
  - Microtrauma (strain) leading to muscle weakness
  - Fatigued secondary to repetitive use
  - Inhibited by painful conditions surrounding the shoulder*
    - Tendonitis, tendonopathy, bursitis

Kibler, et al 2003

Causes of Scapular Dyskinesis

Muscle Alterations

- **Muscle Inhibition:**
  - *Serratus anterior and lower trapezius muscle most susceptible to effect of inhibition.*
  - Exact nature of the inhibition is still not clear
  - What we know:
    - Pain, muscle injury, fatigue, and or muscle strain have been shown to alter proprioceptive input form Golgi tendon organs and muscle spindles.

Kibler, et al 2003

Causes of Scapular Dyskinesis

Flexibility Issues

- Pectoralis Minor tightness
  - Attach to coracoid process
  - Create anterior tilt and forward pull of scapula
- Lack of full Internal Rotation at the glenohumeral joint
  - Capsular or muscle tightness
  - Create excessive amount of protraction
    - During follow thorough with throwing or serving
    - During arm elevation with worker

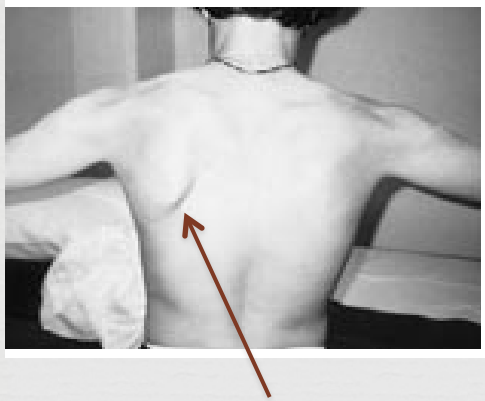
Kibler, et al 2003

Classifications of Scapular Dyskinesis

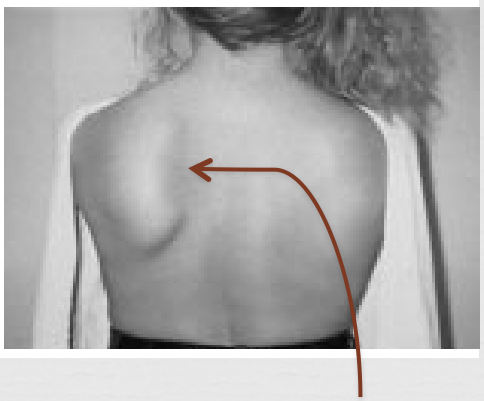
- Type I
  - Visual prominence of the inferior medial scapular border
- Type II
  - Visual prominence of the entire medial scapular border
- Type III
  - Superior Translation of the entire scapula and visual prominence of the superior medial scapular border
- Type IV
  - Normal

Kibler, et al 2003

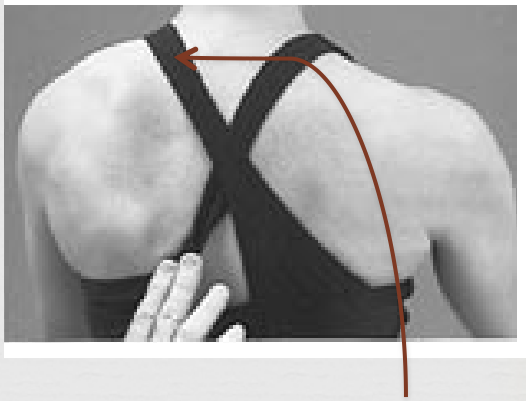
Classifications of Scapular Dyskinesis



Type I



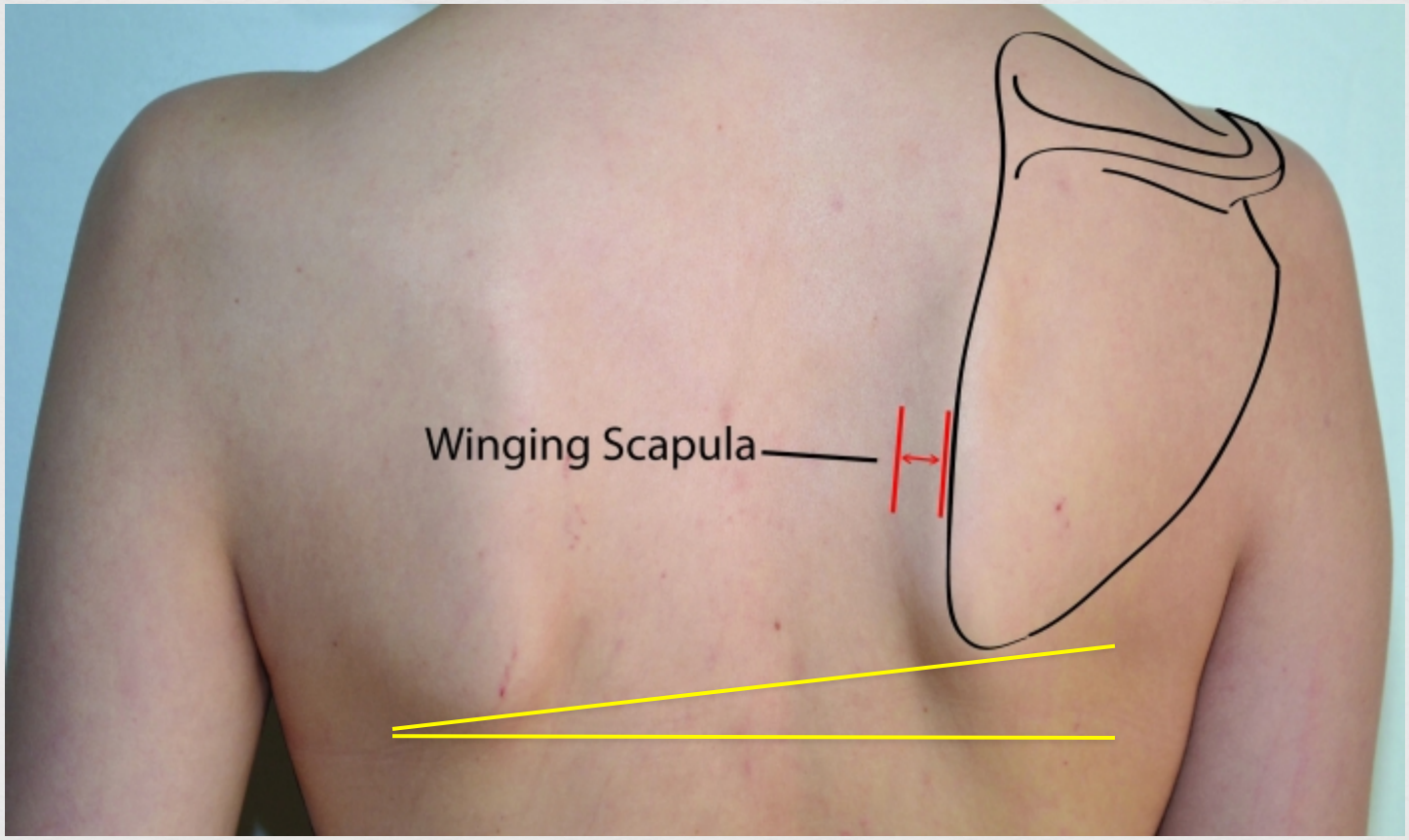
Type II



Type III

Kibler, et al 2003

Winging Scapula

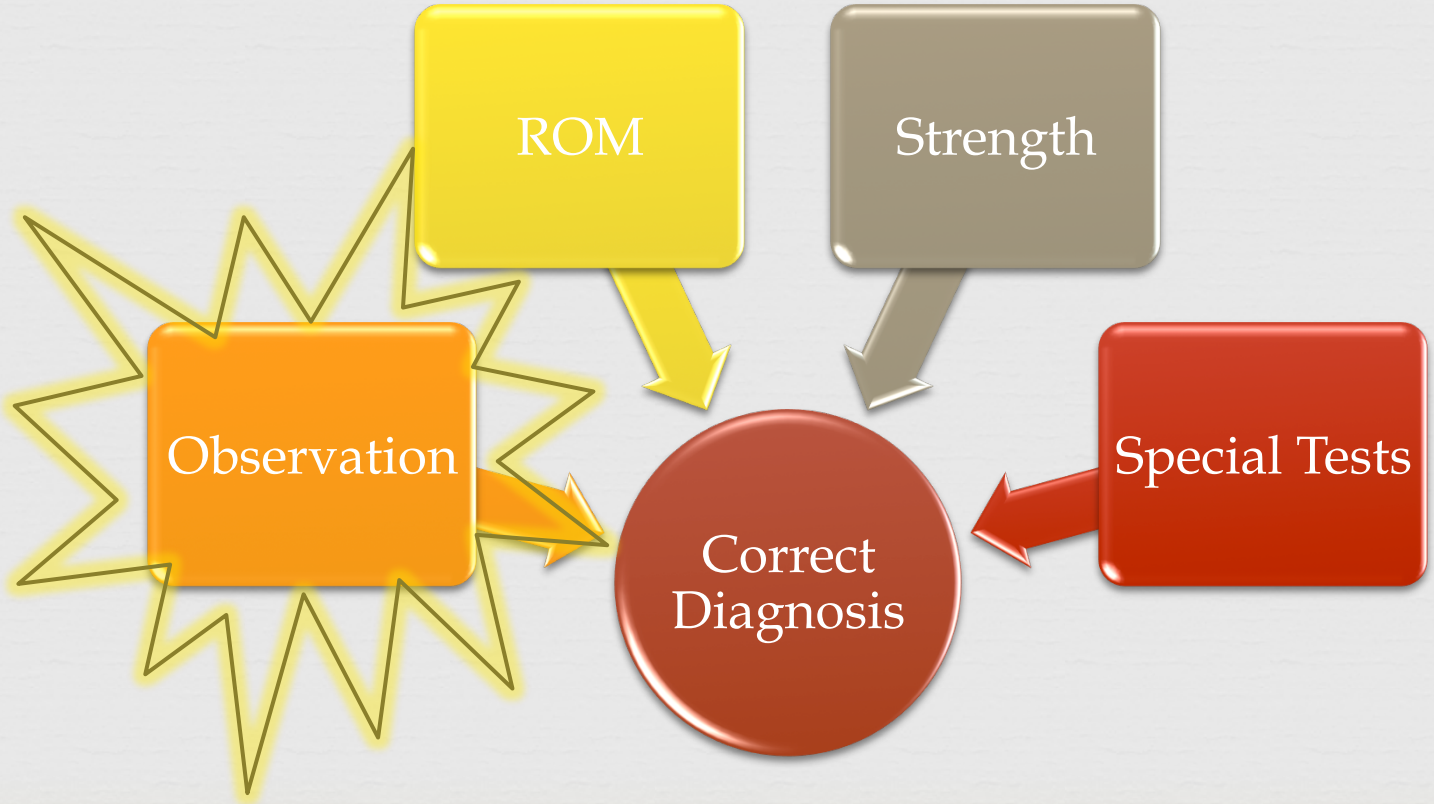


Effects of Scapular Dyskinesis

- **Loss of Retraction Control**
  - Loss of stable base (foundation) in arm elevation
- **Loss of Protraction Control**
  - Increases deceleration forces in the glenohumeral joint
- **Too much Protraction**
  - Caused by tightness of joint capsule or anterior musculature increases risk of impingement
- **Loss of Elevation Control**
- **Loss of Kinetic Chain Function**
  - Forces generated from the trunk and lower extremity will not be effectively transmitted to the upper extremity

Kibler, et al 2003

Evaluation

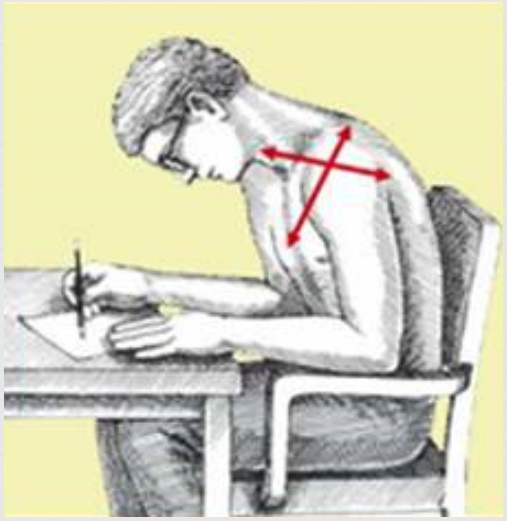

ROM
Strength
Observation
Special Tests
Correct Diagnosis

Observation

If you Can't see it, you can't fix it…

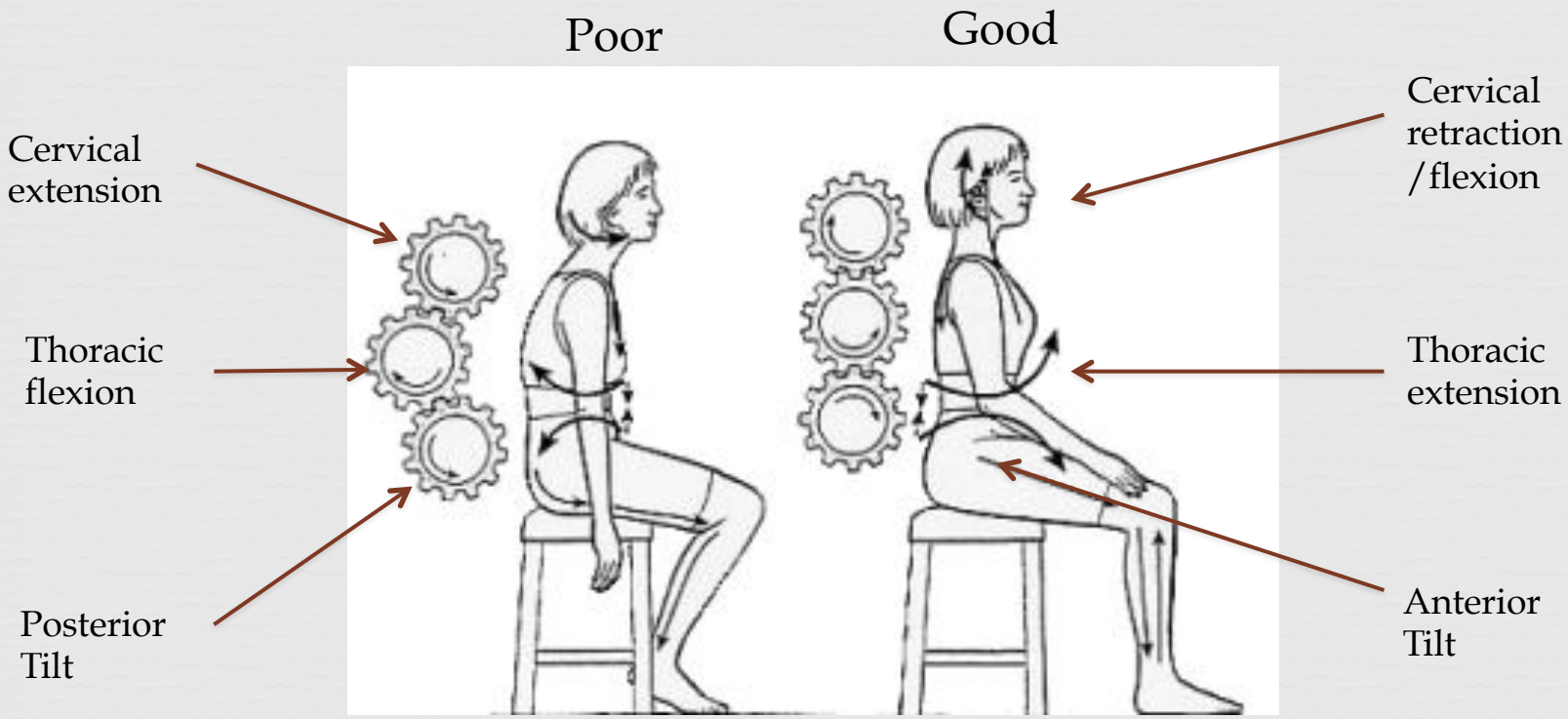
Observation

- Static posture
  - Lumbar, thoracic, cervical
- Scapular position
  - Elevation, winging, rotation
- Dynamic shoulder/scapular motion
- Compare bilaterally



Kibler, et al 2003

Posture


Poor
Good
Cervical extension
Thoracic flexion
Posterior Tilt
Cervical retraction /flexion
Thoracic extension
Anterior Tilt

Observation

Diagnosis ???

Facioscapulohumeral Muscular Dystrophy

- Symptoms:
  - Facial muscle weakness (eyelid drooping, inability to whistle, decreased facial expression, depressed or angry facial expression, difficulty pronouncing the letters M, B, and P)
  - Shoulder weakness (difficulty working with the arms raised, sloping shoulder)
  - Hearing loss
  - Abnormal heart rhythm
  - Unequal weakening of the biceps, triceps, deltoids, and lower arm muscles
  - Loss of strength in abdominal muscles (causing a protuberant abdomen and lumbar lordosis) and eventual progression to the legs

Treatment Evidence Based Practice

- **EMG analysis of the scapular muscles during a shoulder rehabilitation program**
- Moseley et al, AM J. Sports Medicine, 20 (2): 128-134, 1992
- Purpose: determine which exercises most effectively use the scapular muscles
- 8 muscles in 9 subjects
  - Upper, Middle, Lower Trapezius, Levator Scapula,Rhomboids, Pectoralis Minor, and Middle/lower Serratus Anterior
- Which exercises generated most muscle contraction strength?
  - 50% max or better

Treatment
Evidence Based Practice

- **EMG analysis of the scapular muscles during a shoulder rehabilitation program**
  - Moseley et al, AM J. Sports Medicine, 20 (2): 128-134, 1992
- 4 exercises identified as a "core scapular strengthening program"
  1. Scaption (scapular plane elevation)
  2. Rowing
  3. Push-up with a plus
  4. Press up

Core Scapular Strengthening Program

- Scaption (scapular plane elevation)

Moseley et al, 1992

Core Scapular Strengthening Program

- Rows

Moseley et al, 1992

Core Scapular Strengthening Program

- Push-up with a plus

Moseley et al, 1992

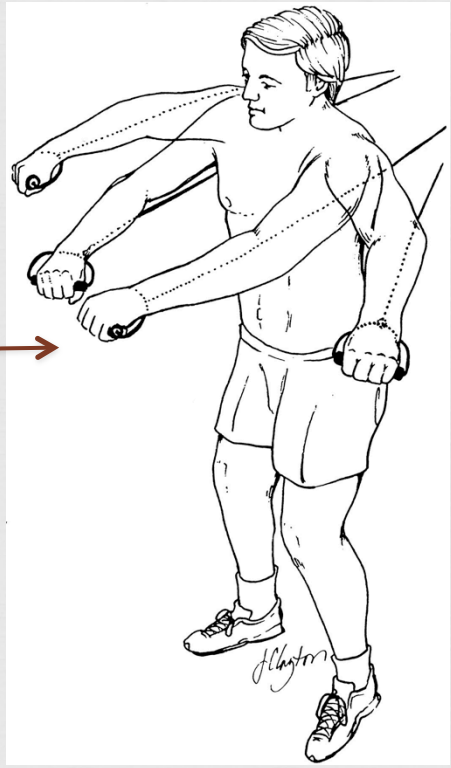
Core Scapular Strengthening Program

- Press up

Moseley et al, 1992

Serratus Anterior

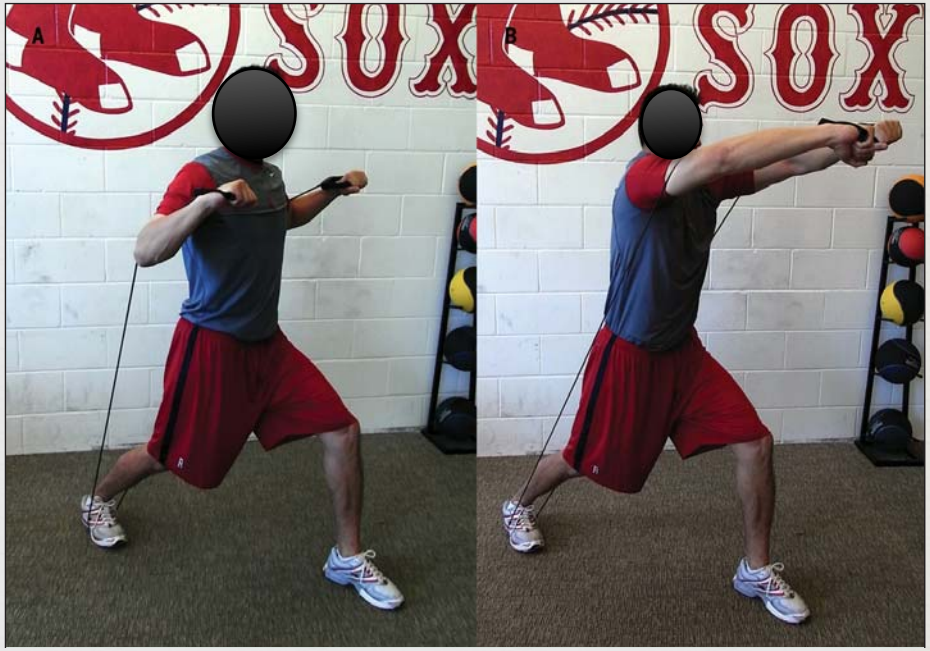
- **Serratus anterior muscle activity during selected rehabilitation exercises**
  - Decker et al, 1999
- Exercises for Serratus Anterior
  1. Dynamic Hug
  2. Push up Plus (Elkstrom et al, 2004)
  3. Forward punch
  4. Scaption (above 120 degrees)
     - Ekstrom et al, 2003



Manske, 2006

Serratus Anterior

- Ekstrom et al, 2003
- Serratus anterior punch performed at 120 degrees flexion



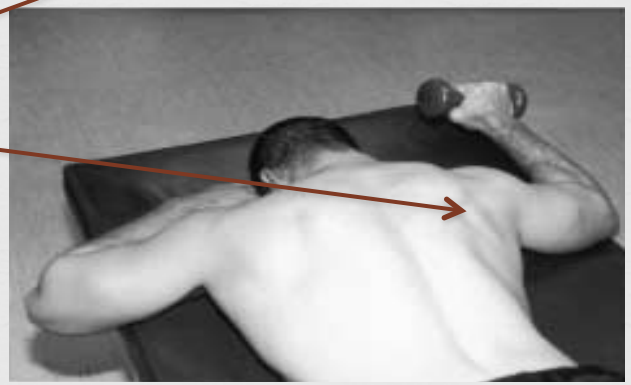
Reinold et al, 2009

Trapezius

- **Surface EMG Analysis of Exercises for the Trapezius and Serratus Anterior Muscle**
  - Elkstrom et al, 2003
- Scapular upward rotation 58 to 65 degrees
- Glenohumeral motion ranged from 103 to 112.5 degrees during full shoulder elevation

Trapezius

- Upper Trapezius
  - Unilateral shoulder shrug
- Middle Trapezius
  - Prone arm raise overhead
  - Shoulder horizontal extension with ER
- Lower Trapezius
  - Prone arm raise overhead
  - Prone ER at 90 degrees Abd
  - Press ups
  - Bilateral shoulder ER
  - Scapular depression

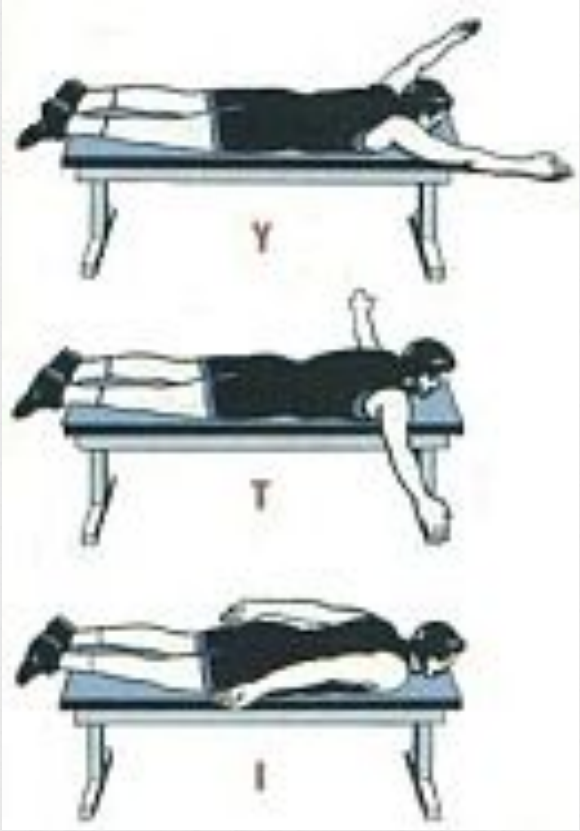


Ekstrom et al, 2003

Proper Scapular Position

- Set the scapula
- Set the Scapula
- Set the Scapula
- Retraction of scapula (set) before exercise

Y, T, I



Y, T, W

Y

T

W

Supraspinatus

- **The manual muscle examination for rotator cuff strength, an EMG investigation**
  - Kelly et al, 1996
  - **Scaption with Thumb up** (full can position) generates most activity of supraspinatus
- Reinold et al, 2002, Blackburn et al, 1990, and Worrell et al, 1992
  - **Prone horizontal abduction, elbow extended, and GHJ ER, Abd to 100 degrees**

Manske, 2006

Supraspinatus "Empty-Can"

- **Scapul… K… …tus rehab… …full-can versus…**
  - Thig…
- Increas… …ng and IR
  - Emp…
- Not app… …onditions
- Full-can… …supraspinatus

Manske, 2006

Subscapularis

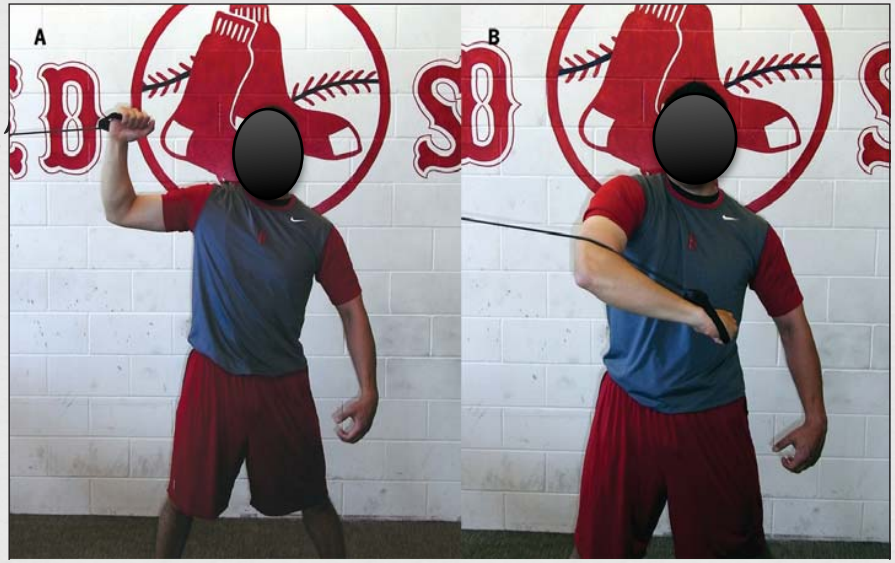
- **Subscapularis muscle activity during selected rehabilitation exercises.**
  - Decker et al, 2003

1. Dynamic Hug
2. Push-up plus
3. IR with arm at side
4. IR with arm ABD 40 degrees

Manske, 2006

Subscapularis

- **Current Concepts in the Scientific and Clinical Rationale Behind Exercises for the Glenohumeral and Scapulothoracic Musculature.*****
  - Reinold et al,2009
- "Diagonal IR Exercise"



Infraspinatus and Teres Minor

- **EMG activity of selected shoulder muscles in commonly used therapeutic exercises,** Ballantyne et al, 1993
- **EMG analysis of the rotator cuff and deltoid musculature during common shoulder external rotation exercises,** Reinold et

1. Side-lying ER
2. Standing ER at 40 degrees

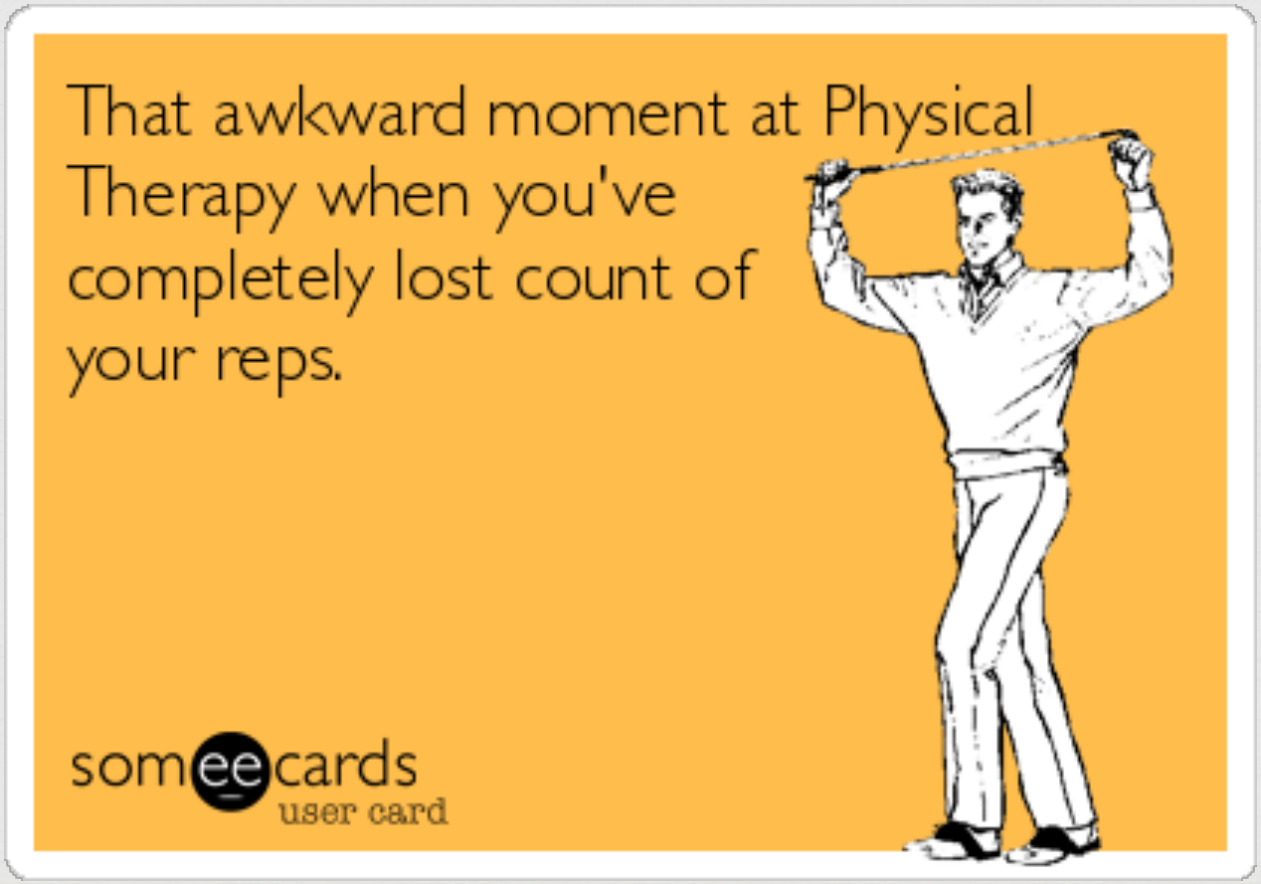
Manske, 2006

Infraspinatus and Lower Trapezius

- McCabe et al, 2007
- Bilateral ER at 0° Abduction

Reinold et al, 2009

How Many?

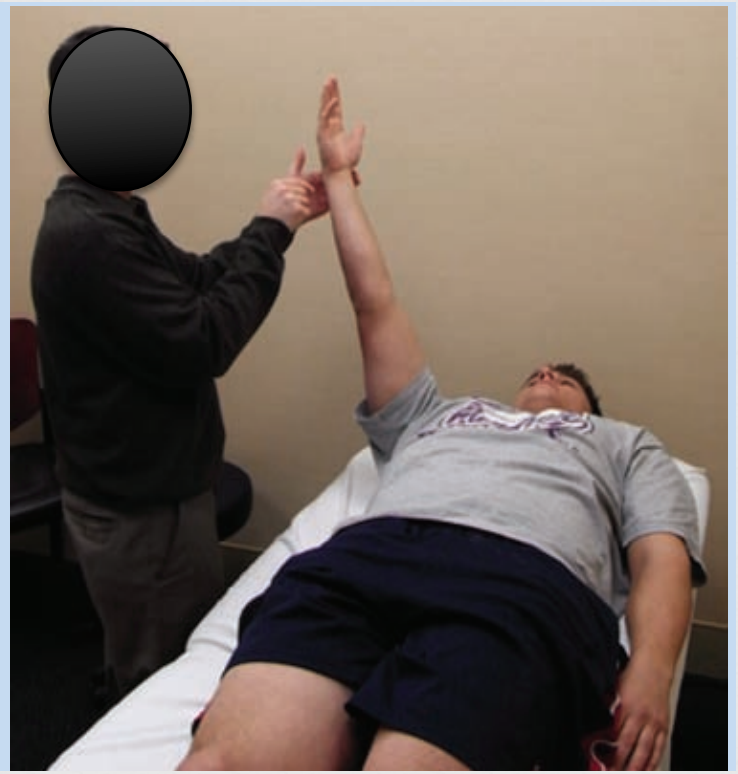

That awkward moment at Physical Therapy when you've completely lost count of your reps.
someecards
user card

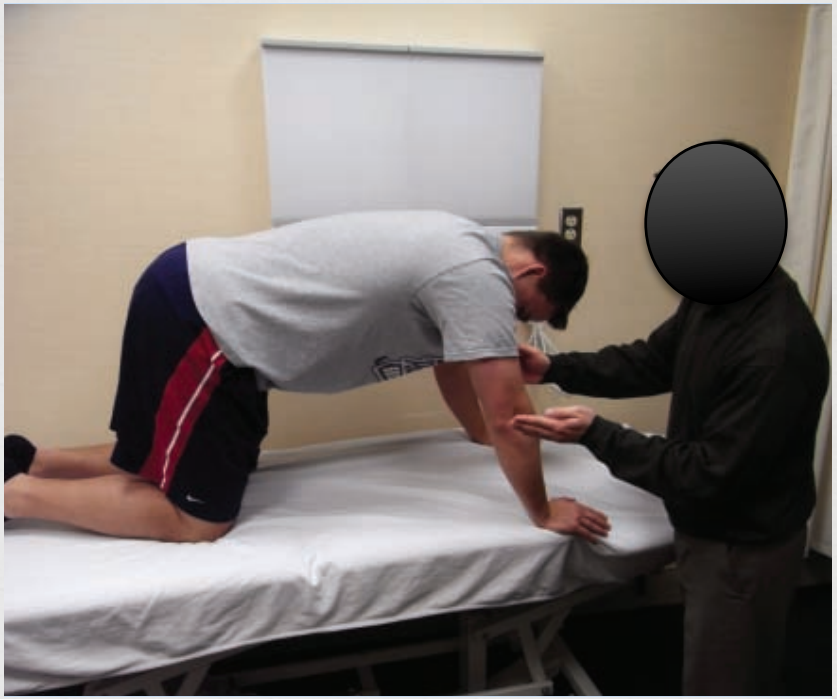
Dynamic Stabilization Neuromuscular Control

- Efficient dynamic stabilization and neuromuscular control of the GHJ is essential for the overhead athlete to avoid INJURY.
- **Reactive, functional, and <u>sport specific positions</u>**
- Neuromuscular Control
  1. **Rhythmic stabilization**
  2. **Reactive neuromuscular control drills**
  3. **Closed kinetic chain**
     - Stress joint in load bearing position
  4. **Plyometric exercises**
     - Quick, powerful movements by a prestretch of the muscle, activate stretch shortening cycle

Reinold et al, 2010

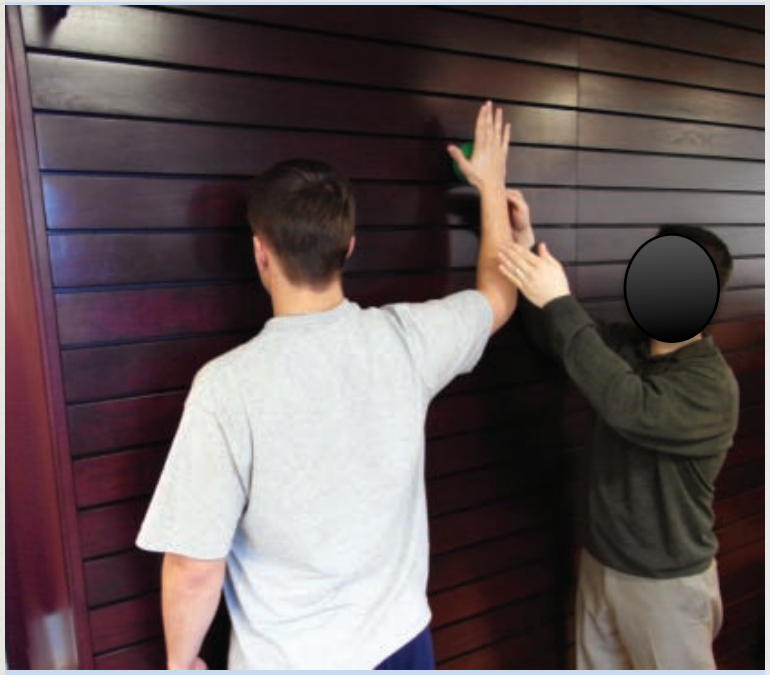
Rhythmic Stabilization





Reinold et al, 2010

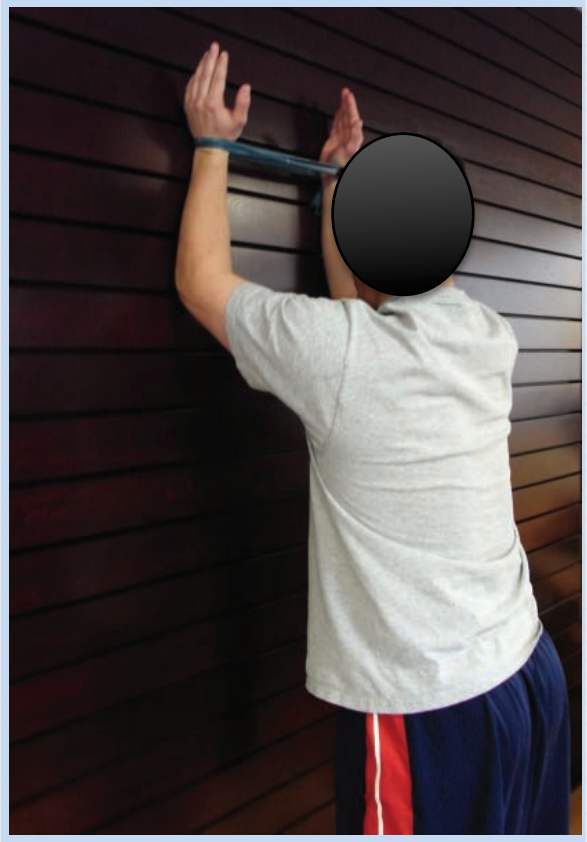
Rhythmic Stabilization



Progression is Key: Stable to Unstable

Reinold et al, 2010

Neuromuscular Control Drills



Reinold et al, 2010

Closed Kinetic Chain

Plyometrics

- Chest pass
- Overhead throw
- Alternating side to side throw
- Wall dribbles
- Deceleration ball flips
- S/L or prone ball flips

Reinold et al, 2010

Balance


Joint Compensation
Imbalance in Strength
Poor Endurance
Decreased Stability
Fatigue
Abnormal Arthrokinetmatics
INJURY

Scapular Assistance Test

- Evaluates scapular and acromial involvement in subacromial impingement
- Manually stabilizing the scapula and rotating the inferior border of the scapula as the humerus forward elevates
- This test simulates the Serratus Anterior and Lower Trapezius muscle function of upward rotation.
- **Positive Test:** Reduction or elimination of impingement symptoms

Kibler, et al 2003

Scapular Retraction Test

- Manual stabilization of the scapula in a retracted position on the scapula
- Stabilize medial border of scapula during humeral flexion or ER
- Provides stable foundation for rotator cuff
- **Positive Test:** Improved rotator cuff strength during manual stabilization

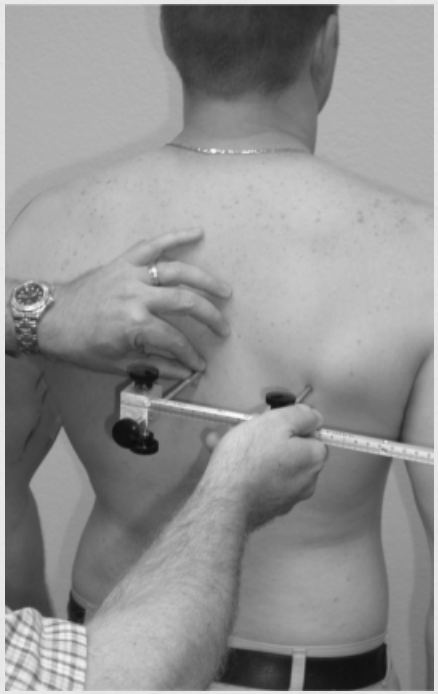
Kibler, et al 2003

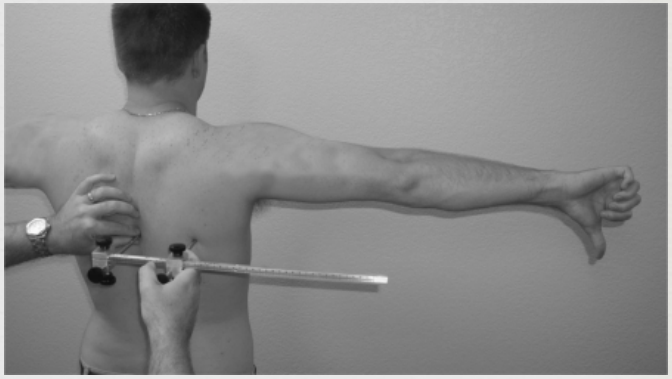
Lateral Scapular Slide Test

- Quantitative measurement
  - Measures distance from inferior angle of scapula to nearest vertebral spinous process
  - Asymmetry of greater than 1.5cm is threshold for abnormality
  - Most commonly seen in position three
- Three positions of scapula and compared bilaterally
  - Arms relaxed at side
  - Hands on hips, fingers are anterior and thumb is posterior, with slight shoulder extension
  - Arms at 90 degrees of elevation in scapular plane with IR of the glenohumeral joint (thumbs down)

Curtis et al, 2006

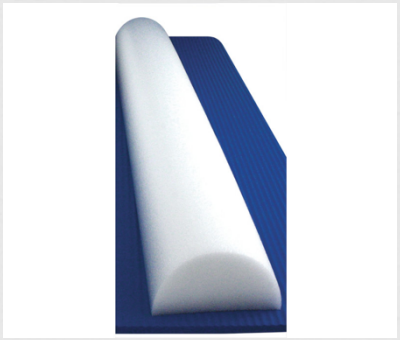
Lateral Scapular Slide Test





Curtis et al, 2006

Anterior Tilt Test



- Supine on ½ foam roll (6 inch)
- Lay for 1 minute, take deep breaths
- Observe bilateral anterior acromion
- Positive test: symptomatic side acromion will be elevated
- Possible Pectoralis Minor tightness

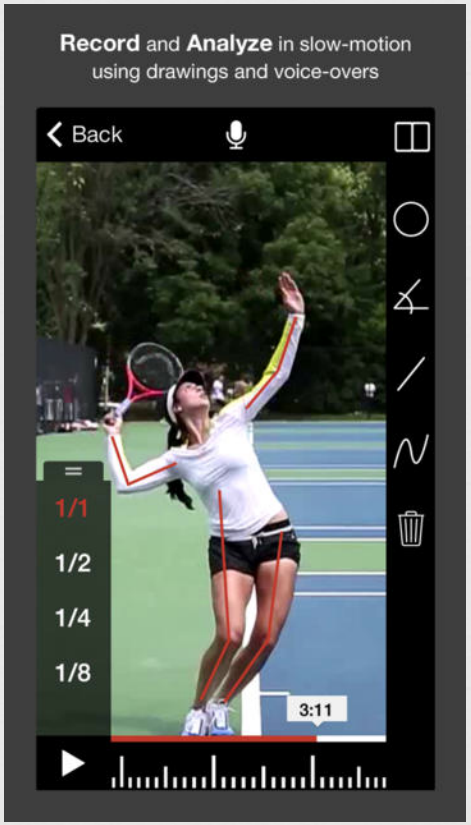
Throwers 10 Program

Posture Shirts

- Not for EVERYONE
- Not a Brace
- Just a friendly reminder to retract shoulders
- Performance and fatigue in baseball pitchers using Intelliskin compression shirt (Shepard et al)

Free Video Apps

Hudl Technique Elite



CROSSOVER SYMMETRY

Conclusion

- Scapula is the Foundation of the shoulder
  - RTC muscles originate from scapula
  - RTC can't stabilize efficiently on a unstable foundation
- Remember: If you can't see it, you can't fix it….
- Observation is essential in proper diagnosis.
- Be creative with exercises

Thank You

References

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