Background

Our assumption is that subtle deviations in the precision of scapular and glenohumeral movement are the cause of the tissue injury.

In cases of trauma, alterations of normal movement will perpetuate the pain.

Movement Examination

The purpose of the exam is to determine:

- the diagnosis (identify the Movement System Impairment – MSI-syndrome) and
- the contributing factors

Associates

Clinical Emphasis:
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Research Emphasis
- Linda Van Dillen, PT, PhD
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Movement Examination

Consists of:

- tests of alignment and movement performed in a variety of positions: standing, supine, prone, quadruped and sitting
- analysis of functional activities
**Movement Examination**

- During the examination, the patient’s preferred alignment and movements are analyzed to determine their effect on the chief complaint.

- The preferred pattern is followed immediately by a secondary test modifying the movement to determine the effect on the chief complaint.

  Kibler WB et al. Scapular summit 2009 support idea of secondary test

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**Definitions of Scapular Movements**

- **Internal rotation (AC joint)**
  - rotation of the scapula about a vertical axis
  - lateral border of the scapula moves anteromedially
  - vertebral border moves posterolaterally such that the costal surface of the scapula faces more toward the midline of the body
  - SC joint
  - Clavicular protraction also results in scapular IR

- **External rotation**: lateral border of the scapula moves posterolaterally vertebral border moves anteromedially

  Ludewig PM et al. 2009

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**Clinical Assessment: Criteria for Normal Scapular Motion**

- By the end range of arm elevation:
  - Acromion should be aligned with C6-7
  - Root of spine of scapula should be aligned with T3
  - The vertebral border of the scapula should reach 55-60° (+ or - 5°).
  - Normal scapular abduction is 7.5 cm (3”) from the vertebral spine to the root of the spine of the scapula.
  - Scapula should posteriorly tilt 10°. Ludewig PM 2009
  - Scapula should externally rotate so it is 10-20° anterior to the frontal plane Ludewig PM 2009

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**Normal Scapular Motion During Arm Lowering**

- You shouldn’t see increased anterior tilting during arm lowering
- No prominence of vertebral border
  - Scapula had greater posterior tilting (2°) during arm lowering compared to arm raising Ludewig PM 2009

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**MSI Scapular Syndromes**

- **Internal rotation (AC joint)**
  - With anterior tilt (AC joint)
  - With insufficient UR (SC & AC joint)
  - With abduction (SC joint)

- **Depression (SC joint)**
  - With insufficient UR (SC & AC joint)

- **External rotation/adduction (SC & AC joint)**
  - With insufficient UR (SC & AC joint)

- **Winging (pathological) (AC joint)**

  Elevation (SC joint)
Normal Scapular Motion During Arm Lowering

Arm lowering
- There should be decreased scapular relative to GH movement during arm lowering compared to arm raising

Braman JP 2009

Evidence for Scapular Movement Impairments - Impingement

- Decreased scapular posterior tilting
  - Lukasiewicz AC et al, JOSPT 1999
  - Ludewig PM & Cook TM, Phys Therapy 2000
  - Hebert Lj et al, Arch Phys Med Rehabil,2002
  - Endo K et al, J Orthop Sci 2001
  - Lin Jl et al 2006
- Decreased scapular upward rotation
  - Ludewig PM & Cook TM, Phys Ther 2000
  - Endo K et al, J Orthop Sci 2001
  - Lin et al 2006
  - Lawrence RL 2014
- Increased scapular internal rotation
  - Ludewig PM & Cook TM, Phys Ther 2000

Other Findings of Scapular Movement Impairments in Patients with Impingement

- Increased elevation
- Increased upward rotation
- Decreased internal rotation

- The most frequent finding across studies seems to be increased anterior tilt and internal rotation. From oral presentation Capstone – Emily Schmidt, Jan 2012

Torque capabilities of Trapezius
(Fey AJ, ......Ludewig PM JOSPT Jan 2007 Abstract)

- Used 3-D motion analysis and computer modeling of muscle moment arms
- Findings of Primary Torque Capability:
  - Upper trap = clavicular elevation
  - Middle trap = scapular external rotation
  - Lower trap = scapular external rotation and upward rotation
  - Serratus anterior = upward rotation, posterior tilt and external rotation

Scapular Internal Rotators

- Posterior deltoid
- Teres major
- Teres minor
- Infraspinatus
- Pectoralis Minor (Ludewig PM)
SCAPULAR INTERNAL ROTATION WITH ANTERIOR TILT

Scapular Internal Rotation
Primary movement impairment is scapular internal rotation which occurs
• with scapular anterior tilt,
• abduction,
• insufficient upward rotation
• either individually or combined.

Scapular Internal Rotation (AC joint) With Anterior Tilt
Movement impairments
1. Insufficient scapular external rotation and posterior tilt at the end range of arm elevation
   (Ludewig PM 2000 and Lukasiewicz AC 1999, Hebert LJ 2002)
2. Scapular internal rotation and anterior tilt on the return from arm elevation or during early arm elevation due to an issue with patterns of muscle activation
   Serratus Anterior is key

Scapular Internal Rotation
Scapular Internal Rotation with Anterior Tilt - End range
- What do you see at end range?
  - Excessive scapular IR
  - May not see anterior tilt
- What should you see?
  - 10 degrees posterior tilt
  - 10-20 degrees scapular ER (Ludewig PM)

Scapular Internal Rotation with Anterior Tilt - Muscle activation
- Movement Impairments when there is a muscle activation problem
- These patients usually have a combination of IR and tilting
Scapular Internal Rotation with Anterior Tilt - Muscle activation

- Movement Impairments when there is a muscle activation problem
- These patients usually have a combination of IR and tilting

Secondary test:
- correction by verbal and manual cues to dissociate GH from ST motion decreases symptoms

Axioscapular Muscle Control > Scapulohumeral

SCAPULAR INTERNAL ROTATION WITH INSUFFICIENT UPWARD ROTATION
Scapular Internal Rotation with Insufficient Upward Rotation

- The movement impairment can happen anywhere in the ROM.
- Serratus anterior is the best upward rotator.

Scapular Internal Rotation with Abduction

Excessive scapular abduction and internal rotation during shoulder flexion

Corrected

Scapular IR with AT and ABD

video
Scapular Depression with Insufficient Scapular Upward Rotation

Alignment
- Increased slope of shoulders
- Vertebral border of scapula not parallel to spine
- Humerus in abduction relative to scapula

Unsuccessful Correction of Alignment Using Rhomboids

Depression with Insufficient Scapular Upward Rotation

SCAPULAR DEPRESSION WITH INSUFFICIENT UPWARD ROTATION

Criteria For Normal Motion During Arm Elevation
- Acromion should be aligned level with C6 -7 at end range
- Clavicle elevates 6-10° when the arm is elevated 120°

Ludewig PM 2009

Movement Impairment - Insufficient elevation
- Acromion depresses in the first 90 degrees of shoulder flexion or abduction
- Acromion does not begin to elevate after about 30 degrees of arm elevation
- Acromion below C6 -7 at end range

Dissociating GH from ST Motion

video
Scapular Depression With Insufficient Upward Rotation

Preferred

Corrected

Scapular Depression
With Insufficient Upward Rotation

Neck Pain with Scapular Depression and Cervical Flexion

Pilates Instructor

SCAPULAR EXTERNAL
ROTATION/ADDUCTION

External Rotation/Adduction
With Insufficient Upward Rotation

Criteria For Normal Motion At End Range Arm Elevation

- Root of spine of scapula 3 inches (7.5 cm) from vertebral spine

- Scapula should be about 10-20° anterior to the frontal plane

- The vertebral border should be 55-60° relative to the vertical.

External Rotation/Adduction
With Insufficient Upward Rotation

Movement Impairment
External Rotation/Adduction
With Insufficient Upward Rotation

- Scapula less visible from sideview compared to person with scapular IR
- Associated with flat thoracic spine.

External Rotation/Adduction
With Insufficient Upward Rotation

SCAPULAR WINGING
SCAPULAR ELEVATION

Scapular Winging
Movement Impairment
- Scapular winging during flexion and during the return from flexion
- May have associated scapular depression
- History of long thoracic nerve injury more often than spinal accessory nerve injury.

Scapular Winging
Strength of serratus anterior on MMT is < 3/5

Scapular winging - long thoracic nerve injury

Left Side Involved
Onset after biking trip for several weeks with backpack on back; 20 y/o
Video: initial (left) and 6 weeks later (right)

Caution
Flat thoracic spine may result in prominence of entire vertebral border but the patient may not demonstrate the movement impairment of scapular winging.

Kendall

Scapular Elevation

Movement Impairment
- Excessive scapular elevation is usually identified early in the range and continues throughout arm elevation.
- The primary problem is typically limited glenohumeral motion and not poor muscle performance.

Scapular Elevation

Primary Focus of Intervention:
- If GH hypomobility is present - increase GH mobility.
- If rotator cuff function is deficient but expected to return focus is on restoring precise GH without scapular elevation.
- If rotator cuff function is deficient and not expected to improve then scapular elevation as a compensatory technique may be necessary.
SHOULDER MOVEMENT EXAMINATION

For each exam item, observe the patient’s preferred alignment or movement strategy and obtain symptom response from the patient. If an impairment of alignment or movement is observed, repeat the exam item with the appropriate correction/modification and again obtain the patient’s symptom response.

A. STANDING
   1. Appearance – height, weight, age, frail, fit, body proportions
   2. Alignment: thorax – kyphosis = scap ant tilt; barrel chest = scap internal rotation
      Shoulders – low = scap depression; forward = ant tilt, abd; internal rot
      Scapula – add = add/ext rot; downward rot = insuff upward rot; prominent inf angle = ant tilt;
      Humerus – head forward of acromion = ant glide; medially rotation = GH medial rotation; abducted – sup glide
   3. Shoulder flexion and return (bilateral & unilateral)
   4. Shoulder abduction and return (bilateral & unilateral)
   5. Shoulder lateral rotation with arm at side and elbow flexed

B. SUPINE
   1. Shoulder alignment – forward = anterior tilt
   2. Shoulder flexion
      • Limited range, with or without medial rotation
      • Movement of humeral head = hypermobility
   3. Shoulder medial rotation from 70 - 80 deg of abduction
      a. Humeral anterior glide
      b. Scapular anterior tilt
      c. Anterior-medial rotation off axis
   4. Shoulder lateral rotation from 70 – 80 deg of abduction
      a. Humeral anterior glide
      b. Limited range of motion
   5. Horizontal adduction
      • Limited range
      • Scapular internal rotation

C. PRONE
   1. Shoulder in 145 deg of abduction – hold performance
      a. Glenohumeral excessive motion
      b. Scapular anterior tilt
      c. Scapular elevation
   2. Shoulder lateral rotation from 80 deg of abduction – on edge of plinth
      a. Scapular internal rotation
      b. Limited ROM
      c. GH - extension
   3. Shoulder medial rotation
      a. Humeral anterior glide
      b. Limited ROM
      c. Poor muscle performance

D. QUADRUPED
   1. Alignment: head, neck, thorax, shoulders, scapula, humerus (UQ)
   2. Rocking backward
      a. Scapular internal rotation
      b. Scapular abduction/internal rotation
      c. Scapular excessive elevation
      d. Scapular depression
      e. Humeral anterior glide
E. FUNCTIONAL ACTIVITIES (UQ)
   1. Sitting alignment
      ▪ Arm support
   2. Sleeping position
   3. Work station
      ▪ Phone use
      ▪ Filing
      ▪ Computer/monitor location
   4. Sporting/Fitness activities
   5. Reading position
      ▪ Bifocals
      ▪ Driving