

Movement System Impairment Syndromes of the Scapula & Humerus

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Muscle Groups of the Shoulder

- ◆ Axioscapular Muscles
 - Must move the scapula correctly in order for the humerus to move correctly on the glenoid
- ◆ Scapulohumeral Muscles
 - Control the glenohumeral joint but attach to scapula
- ◆ Axiohumeral Muscles
 - Bypass the scapula (hamstrings of UE)

Background

- ◆ Based on the assumption that subtle deviations in the **precision** of shoulder movement are the **cause** of the tissue injury
- ◆ We developed a set of **movement-related diagnoses** for shoulder problems and a standard examination for assessing the patient's preferred alignment and movements.

Scapular and Humeral Diagnoses

- Diagnosis assigned based on
- ◆ Alignment and movement impairments noted throughout exam
 - ◆ The movement impairment that, when corrected, best alleviates the symptoms determines the diagnosis
 - ◆ Both a scapular & humeral diagnosis can be assigned, if appropriate

Scapular MSI Syndromes

Scapular internal rotation (AC joint)

- ◆ with anterior tilt (AC joint)
- ◆ with insufficient UR (SC and AC joint)
- ◆ with abduction (SC joint protraction)

Scapular depression (SC depression)

Scapular external rotation/adduction

(SC retraction; AC ER)

Scapular Winging (pathological) (AC joint)

Scapular elevation (SC elevation)

Scapulohumeral Timing

- ◆ The critical factor usually associated with impaired
 - alignment at initiation,
 - terminal position, and
 - return to starting position

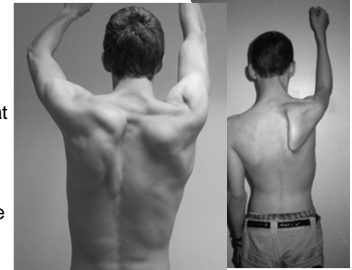


Definitions of Scapular Movements

- ◆ **Internal rotation:**
 - rotation of the scapula (about a vertical axis at the acromioclavicular joint)
 - » lateral border of the scapula moves anteromedially
 - » vertebral border of the scapula moves posterolaterally
 - » costal surface of the scapula faces more toward the midline of the body
 - ◆ **Muscles that Internally rotate the scapula**
 - Lateral rotators of glenohumeral joint
 - » Posterior deltoid
 - » Infraspinatus
 - » Teres minor
 - Teres major
- Ludewig PM et al. 2009
- ◆ **External rotation:**
 - Serratus, middle trap, rhomboids

Definition of Scapular Movements

- ◆ **Winging:**
 - abnormal movement of the scapula
 - about a vertical axis at the AC joint in which
 - the vertebral border moves in a posterior and lateral direction away from the ribcage
- (Hall, CM, Brody LT.)



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Scapulothoracic Motion

THE BIG THREE

- ◆ **Upward rotation:**
 - primarily from the SC joint via posterior axial rotation of the clavicle on the sternum
 - Secondly from the AC joint
 - Minimal from elevation at the SC joint
- ◆ **Posterior tilt:**
 - Primarily from the AC joint
- ◆ **External rotation:**
 - SC joint (clavicular retraction)
 - AC joint

Ludewig PM 2009

Normal Scapular Motion

- ◆ Scapula upwardly rotates and posteriorly tilts during arm elevation
 - Ludewig PM et. al., JOSPT 1996
 - Lukasiewicz AC et. al., JOSPT 1999
 - McClure PW et. al., J Shoulder Elbow Surg 2001
- ◆ Scapula externally rotates during arm elevation especially at the end ranges. Ludewig PM 2009
 - Scapula internally rotates until after ~125° and then starts to externally rotate Braman JP 2009
 - By the end of arm elevation the scapula ER so it is 10-20 degrees anterior to the frontal plane.

Ludewig P 2009

Normal Scapulothoracic Motion

Arm lowering

- ◆ Scapula had greater posterior tilting (2°) during arm lowering compared to arm raising Ludewig PM 2009
 - So...you shouldn't see *increased* anterior tilting during arm lowering
 - ◆ During functional reaching task the pattern of scapular movement during raising was mirrored during lowering regarding:
 - Scapular internal/external rotation
 - Scapular tilting
- Braman JP 2009

Normal Scapulothoracic Motion

Arm lowering

- ◆ During functional reach task there was relatively less scapular movement compared to GH movement during arm lowering compared to during arm elevation.
 - Arm elevation: .43° scapular: 1° GH
 - Arm lowering: .37° scapular: 1° GH
- Braman JP 2009
- Common impairment seen is 1'd scapular movement during arm lowering

Clinical Assessment: Criteria for Normal Scapular Motion

- ◆ Scapula should elevate but only slightly (6-10°) Ludewig PM 2009
- ◆ Vertebral border of scapula should remain in contact with thorax
- ◆ Normal GH:ST rhythm:
 - 2.1:1 for abduction; 2.4:1 for flexion; 2.2:1 for scapular plane abduction Ludewig PM 2009

Clinical Assessment: Criteria for Normal Scapular Motion

- ◆ By the end range of arm elevation:
 - Acromion should be aligned with C6-7
 - The vertebral border of the scapula should reach 55-60° (+ or - 5°).
 - Normal scapular abduction is 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)

Normal Resting Standing Alignment

- ◆ 19° SC joint clavicular retraction
- ◆ 6° SC clavicular elevation
- ◆ 41° scapular internal rotation
- ◆ 5° scapular upward rotation
- ◆ 13.5° scapular anterior tilt

12 subjects; mean age 29.3

Ludewig PM 2009

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**

Key Concept

For Most Effective Treatment:

- ◆ Identify the Principal Movement Impairment (PMI) that is consistently associated with the patient's symptoms throughout the examination (Diagnosis or Syndrome)
- ◆ Identify the impairments that contribute to the Principal Movement Impairment:
 - Muscle: (atrophy, strain, length-associated weakness, increased or decreased stiffness, changes in length)
 - Muscle recruitment: (timing, increased, decreased)
 - Biomechanical: (alterations in forces on the joints, bones, structural variations)
- ◆ Focus on modification of the Principal Movement Impairment via:
 - Patient education and practicing modifying the PMI during daily activities
 - HEP addressing the impairments that contribute to the PMI

Scapular Internal Rotation – insufficient Upward Rotation



Insufficient Scapular Posterior Tilt and External Rotation (end range)



Scapular Internal Rotation and Anterior Tilt

Due to a muscle activation problem:

◆ **Movement Impairment:**

- Excessive IR/anterior tilting during the return from flexion
 - » Criteria: not significant if the IR/tilting does not occur until the last 30-40 degrees of the return motion especially if the scapula is just resuming its starting alignment.
- Scapular IR/anterior tilting with the initiation of flexion especially with heavy arms - > post Deltoid

Scapular Internal Rotation and Anterior Tilt

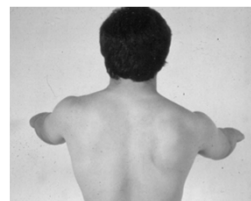
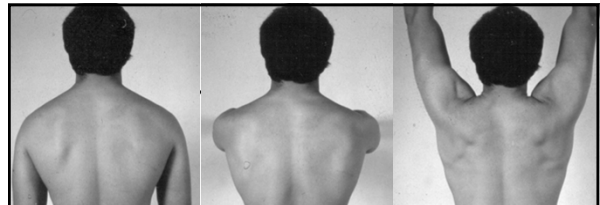
- ◆ **Movement Impairments when there is a muscle activation problem**
- These patients usually have a combination of IR and tilting



Scapular Internal Rotation and Anterior Tilt (Winging and Tilting)



Scapular motion controlled – elbow extended



Scapular IR and Tilting:
 ← return from Flexion (strength \geq 3/5 on MMT) (muscle activation problem)

Scapular Internal Rotation and Anterior Tilt



Insufficient Scapular Upward Rotation

Movement Impairment

◆ insufficient scapular upward rotation during flexion and abduction

- Criteria at the end range of shoulder flexion or abduction = 60° plus or minus 5° of scapular upward rotation
 - » normal SH rhythm is 60° of scapular upward rotation (Inman VT, 1934)
- scapula downwardly rotates during arm rotation or when a load is placed on the arm

Relative flexibility: The scapula does not move as readily as it should. The GH joint may move too much, not enough or the normal amount.

Insufficient Scapular Upward Rotation

◆ Movement Impairment

- insufficient scapular upward rotation may occur with excessive or insufficient scapular abduction

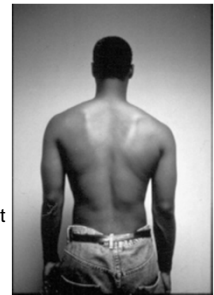
◆ Criteria:

- Scapular adduction = root of spine of scapula < 2.5 inches from vertebral spine at end range shoulder flexion
- Scapular abduction = root of spine of scapula > or = 3.5 inches from vertebral spine at end range shoulder flexion

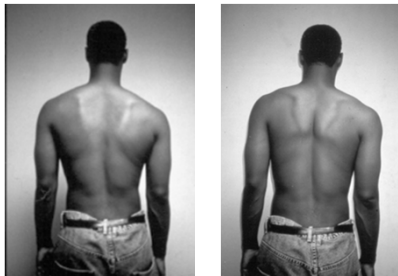
Insufficient Scapular Upward Rotation

◆ Alignment:

- increased slope of shoulders
- vertebral border of scapula not parallel to spine
- scapula may or may not be abducted
- humerus in abduction relative to scapula
- may have normal alignment at rest



Insufficient Scapular Upward Rotation



Intervention: Unsuccessful Correction of Alignment

Insufficient Scapular Upward Rotation

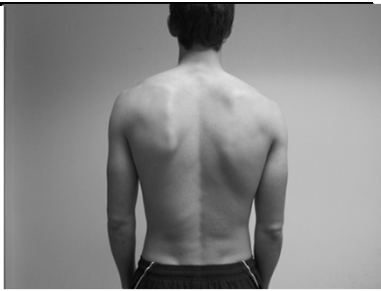


•Rhomboids more prominent than other scapular muscles = red flag

- Rhomboids more prominent on left
- SH muscles short on right

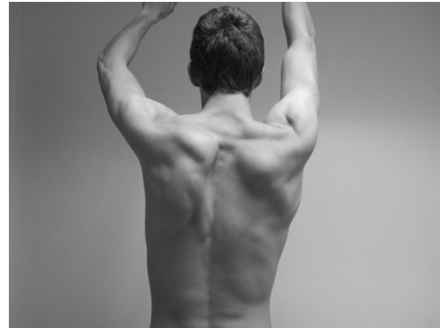


Left Side Involved

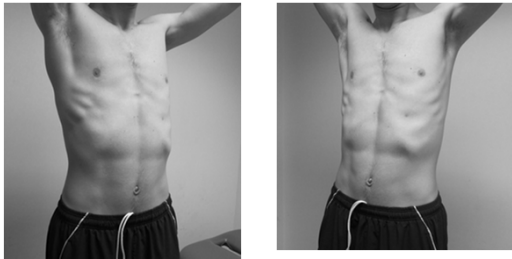


Onset after biking trip for several weeks with backpack on back; 20 y/o

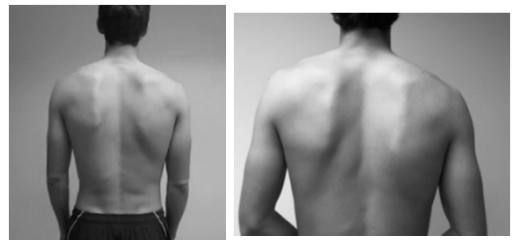
Pathokinesiological Problem



Serratus anterior absent



Recovery of SA function



Video: initial (left) and 6 weeks later (right)

Scapular Depression

◆ Movement Impairment:

- scapula fails to elevate sufficiently during abduction and flexion

» Criteria:

- ◆ at the end range of shoulder abduction or flexion the acromion should be aligned level with C6-7
- ◆ Clavicle elevates 6-10° Ludwig PM 2009
- ◆ The acromion depresses in the first 90 degrees of shoulder flexion or abduction or does not begin to elevate after about 30 degrees of arm elevation

- scapula depresses when a load is placed on the arm or during prone tests



Scapular Depression

Symptoms

- ◆ Pain can be located in upper trap area
- ◆ Headaches associated with neck pain

Activities

- ◆ Dancers especially ballet
- ◆ Gymnasts
- ◆ Same as Insufficient Scapular Upward Rotation

Scapular Depression



Shoulders not depressed at rest



Insufficient scapular elevation with movement

Scapular Depression



Scapular Depression



Scapular Depression

- ◆ Intervention: Function
 - support arms when sleeping, sitting and standing - KEY
 - correct height of desk and arm rests on chair
 - bra with straps that do not increase pressure on acromial area
 - scapular taping
 - driving position

Scapular Depression



Arm rests need to be closer to body and higher to adequately support shoulders at correct height.

Sometimes putting keyboard up on desk is better than keyboard tray for arm support.

External Rotation/Adduction Movement Impairment



External Rotation/Adduction



Scapular Diagnoses: Key Points

- ◆ Most often the impairment is *insufficient* scapular motion.
- ◆ Intervention must encourage the *correct motion* of the scapula versus *stability*
- ◆ Spinal alignment must also be considered
 - Erect sitting posture ↑ GHJ flexion in impingement subjects (Bullock MP, 2005)

Humeral Diagnoses

- ◆ Humeral Anterior Glide
- ◆ Humeral Superior Glide
- ◆ Shoulder Medial Rotation
- ◆ Glenohumeral Hypomobility
- ◆ Glenohumeral Multidirectional Accessory Hypermobility

Normal Humeral Movement

- ◆ The humerus laterally rotates relative to the scapula as the arm is elevated in all planes
 - GH LR should be about 60° by the end range of arm elevation
 - GH LR increases the volume of the subacromial space

Ludewig PM 2009

Normal Humeral Movement

- ◆ During shoulder LR
 - Movement should primarily be spinning with slight humeral anterior glide while maintaining humeral head alignment relative to the glenoid (Neumann DA 2002)
 - Humerus should spin on axis without horizontal abduction

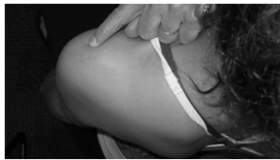
Humeral Anterior Glide



- ◆ Alignment:
 - forward shoulders
 - greater than 1/3rd of the humeral head anterior of the acromion
 - proximal humeral head anterior to the distal end of the humerus
 - indentation below acromion posteriorly

Humeral Anterior Glide

Resting Alignment: humeral head relative to anterolateral corner of acromion

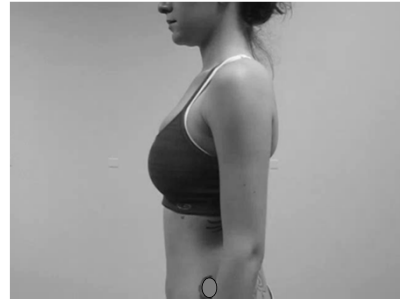


At rest



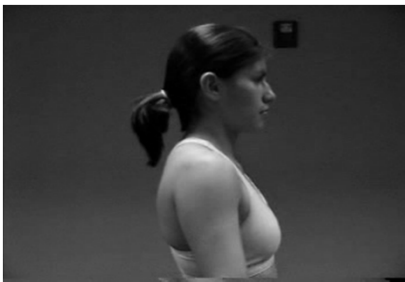
Abduction

Humeral Anterior Glide



video

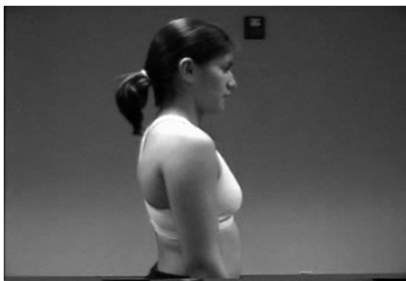
Humeral Anterior Glide: Abduction



Humeral Anterior Glide: correct



Humeral Anterior Glide: rotation



Humeral Anterior Glide



Humeral Anterior Glide

◆ Impairments (adaptations) in Muscle Activation, Strength, Stiffness, and Lengths:

- dominance of posterior deltoid over infraspinatus & teres minor during lateral rotation - resulting in
 - » GH extension or horizontal abduction during lateral rotation
 - » Associated with scapular internal rotation/anterior tilt
- dominance or shortness of pect major over rotator cuff muscles

Humeral Anterior/Inferior Glide Large Arc of Movement

Involved



Corrected



Normal

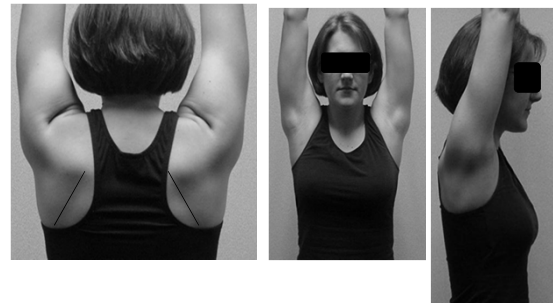


Humeral Anterior/Inferior Glide



Alignment

Humeral Anterior/Inferior Glide



Humeral Anterior Glide



◆ Intervention: Exercises

- ← - supine medial rotation - correct alignment and precision of movement lengthen lateral rotators/posterior capsule
- ← - prone medial rotation - correct alignment & precision of movement/strengthening at endrange for subscapularis

Humeral Anterior Glide



◆ Intervention Exercises:

- against the wall or supine - humeral horizontal adduction
 - » May be done with humeral MR or LR
- (McClure P et al JOSPT 2007)

Humeral Superior Glide

◆ Movement Impairment:

- insufficient inferior glide of the head of the humerus during shoulder flexion or abduction



Decreases volume of subacromial space.



Denervated rotator cuff

Humeral Superior Glide

•s/p comminuted fx right humeral head and neck



Age 76;
photos taken
10 months
post
injury



•full thickness tear of supraspinatus

•torn anterior and superior labrum

•moderate OA of AC with inferior spurring