Unraveling Muscle Imbalances in the Shoulder

with Rick Kaselj, MS

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My Story

Rick Kaselj

- Exercises and injuries
- BSc – 1997
- MS – 2008 / RC
- Work – physio, studio, gym, rec centre, rehab
- Courses – live, webinars, video presentations
- Writing – books, manuals
- Blog – ExercisesForInjuries.com

Rick Hiking 4300 km / 5 months from Mexico to Canada

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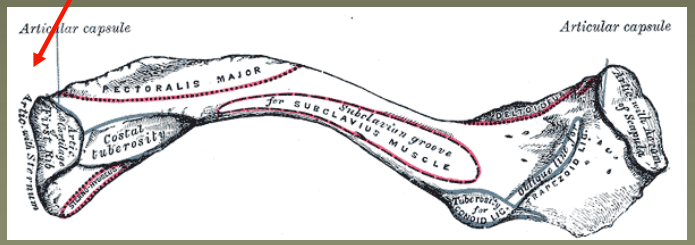
Objectives of the MIRU Video Presentation

- **Part 1** – Structure & Movement
  - Bones
  - Joints
  - Movement
- **Part 2** – Exercise for Muscle Imbalances in the Shoulder

Bones of the Shoulder (Osteology)

- Sternum
- Clavicle
- Ribs
- Scapula
- Humerus

Clavicle

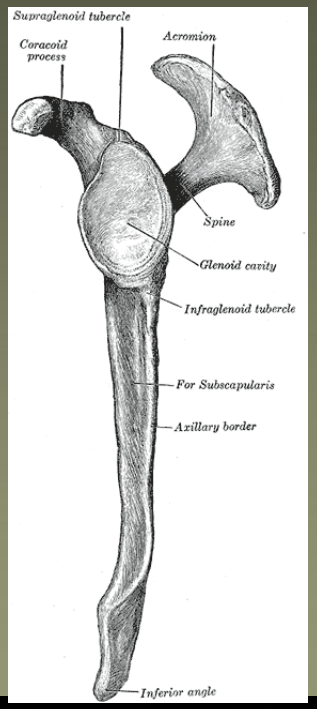


Left Anterior Clavicle Inferior View

- 20 degree angle posterior from the frontal plane
- Elevates
- Posterior rotation for full abduction like a crank

Scapula

- Glenoid Fossa – 5 degrees of upward rotation / not square on
- Scapular Plane – 35 degrees from the horizontal



Left Scapular
Lateral View

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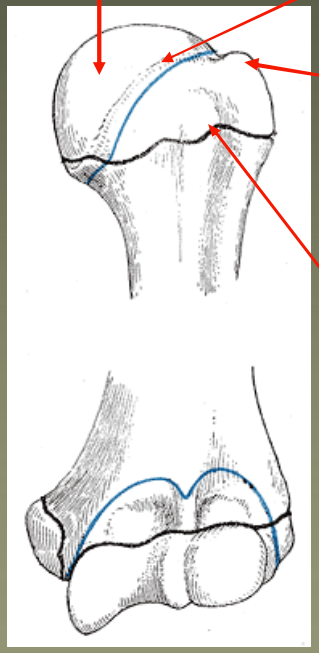
Humerus

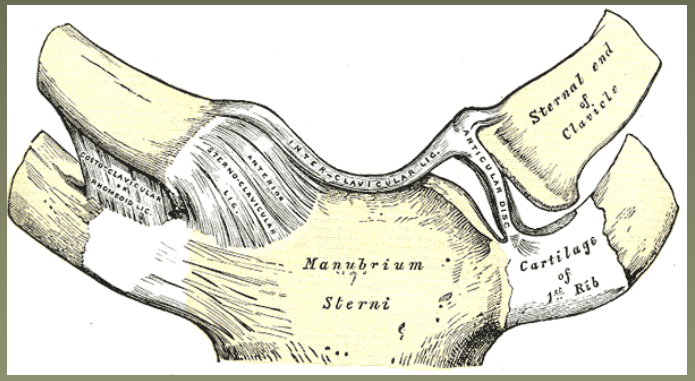


- Head of the Humerus **(1)**
  - contact with the glenoid fossa of the scapula to make of the glenohumeral joint
- Anatomical Neck **(2)**
  - separates the smooth head from the shaft of the humerus
- Lesser tubercle **3)**
  - where subscapularis inserts
- Greater tubercle **(4)**
  - supraspinatus, infraspinatus, teres minor insert

Joints of the Shoulder (Arthrology)

- Sternoclavicular
- Acromioclavicular
- Scapulothoracic
- Glenohumeral

Sternoclavicular Joint



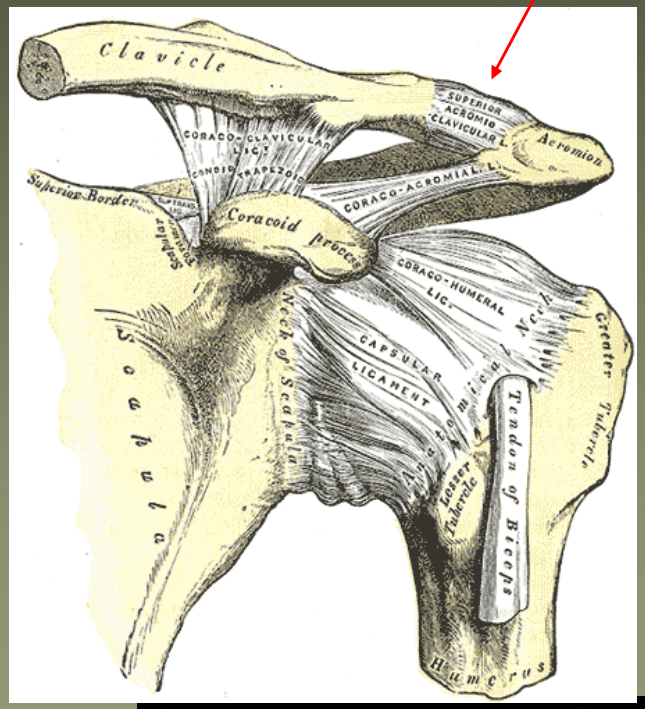
- Structures
  - Medial end of clavicle
  - Sternum
- Stabilized
  - Cartilage of first rib
  - ligaments
- Injuries
  - Arthritis is rare
  - Fracture of clavicle > SC dislocation

SC Joint

- **Movements Around the Joint**
  - Elevation (45 °) / Depression (10 °)
  - Protraction / Retraction
  - Axial rotation of clavicle (50 °)
  - Allows for lots of movement of scapula

Acromioclavicular Joint

- Structures
  - Lateral end of clavicle
  - Acromium of scapula
- Stabilized
  - capsule
  - ligaments
- Injuries
  - Degeneration is common
  - Susceptible to dislocation (falling or striking tip)



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AC Joint

- **Movement**
  - Upwards / Downward Rotation
  - Adjustment movement
    - Pivot (inferior angle side to side – horizontal/frontal)
    - Tilt (inferior angle forward or back - sagittal)
    - Fine tuning of scapula / Rotational adjustments
    - 10 ° to 30 °
  - Allows for subtle movements of scapula

Scapulothoracic Joint

- **Structures**
  - Scapula
  - Thorax
- **Movements**
  - Elevation / Depression
  - Protraction / Retraction
  - Upward / Downward Rotation

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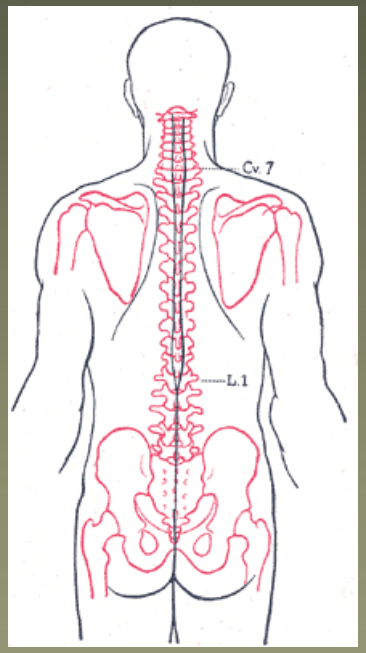
Scapulothoracic Joint



- Between 2nd (T2) and 7th rib (T7)
- 6 cm (2-3 inches / ~3 fingers) from medial border to spine

- **Spine of Scapula**
  - T3
- **Now You Do It!**

Movement at Scapula

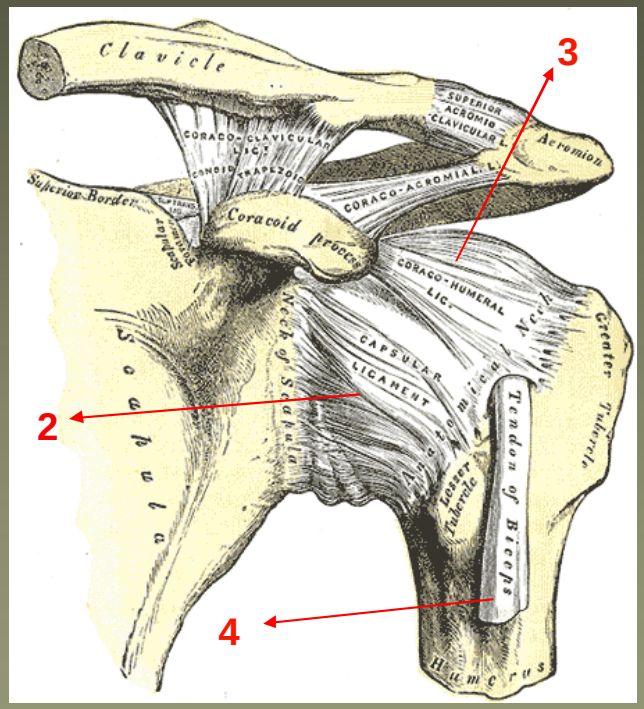
- **Elevation (Shoulder Shrug)**
  - Scapula follows path of clavicle at the SC joint
  - Downward rotation at AC joint to keep medial border of scapula vertical
  - Depression movement is the reverse

Movement of Scapula

- **Protraction**
  - Rotation at the SC joint
  - Horizontal adjustment at the AC joint
  - If issue at one joint the other can compensate
  - Retraction is the reverse
- **Upward Rotation**
  - Clavicular elevation at SC joint
  - Scapula upward rotation at AC joint
  - 60 ° of scapular rotation
  - Downward Rotation is the reverse

Glenohumeral Joint

- Structures
  - Convex head of humerus
  - Shallow concave glenoid fossa
  - Golf ball on a coin
- Stabilized
  1. RC muscles
  2. Capsular ligaments
  3. Coracohumeral ligament
  4. Long head of biceps
  5. Glenoid labrum



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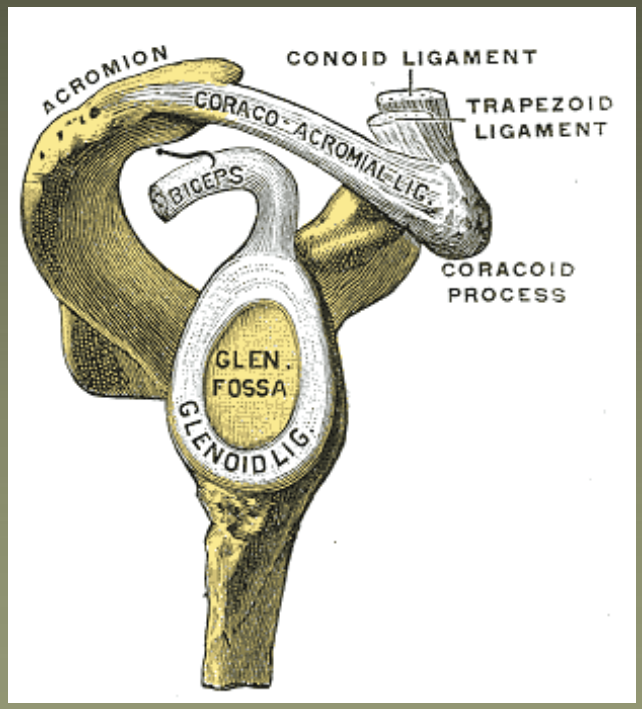
GH Joint

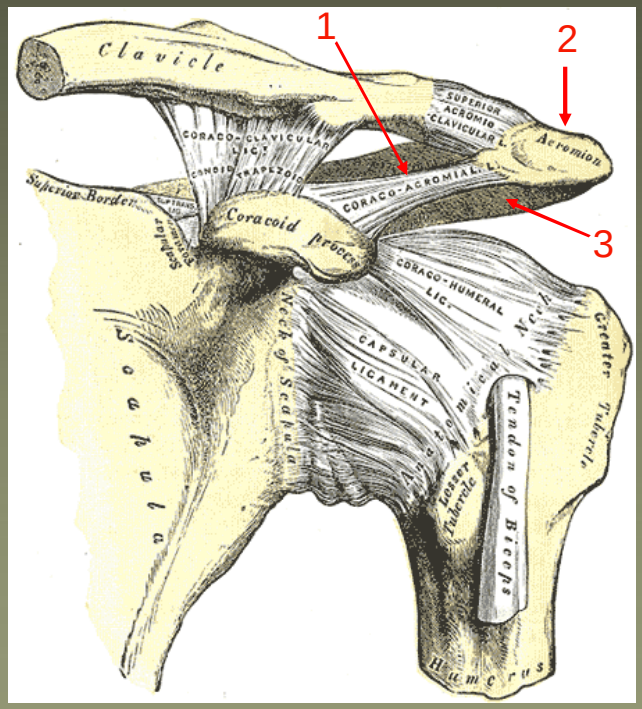


- **Glenoid Fossa**
  - Lined with hyaline cartilage
  - Glenoid labrum
    - Fibrocartilage ring
    - Long head of biceps originates here
    - Creates 50% of the depth

GH Joint

- Static Stability
  - Ligaments
  - Supraspinatus
  - Posterior deltoid
  - Negative intra-articular pressure of the capsule

Coracoacromial Arch



- = coracoacromial ligament (1) and acromion process of the scapula (2)
- Roof of the GH joint
- 1 cm gap btw arch and humerus
- Subacromial Space (3) – supraspinatus muscle & tendon, subacromial bursa, long head of biceps, superior capsule

GH Joint (Arthrokinematics)

- Movement
  - Abduction – 120 at GH / 60 upward rotation of scapula
  - Flexion – 120 at GH / 60 upward rotation of scapula
  - Extension – 45 to 55
  - IR 75 to 85 includes some scapular protraction / ER 60 to 70 includes some scapular retraction

Gluteus Maximus Circulation Exercise

- **Wall supported shoulder abduction ?**
- **Wall supported shoulder abduction in scapular plane (35 °)?**
- **Now You Do It!**

What Did You Find?

- Limited by greater tubercle of the humerus compression contents of the subacromial space against the low point of the coracoacromial arch.
- In order to complete abduction in the frontal plane need to externally rotate humerus
- If move into the scapular plane greater tubercle moves under the high point of the coracoacromial arch

Scapulohumeral Rhythm

- **2:1 ratio (Inman, 1944)**
- **3 degrees of shoulder abduction**
  - 2 degrees by GH joint abduction
  - 1 degrees occurs at scapulothoracic joint upward rotation

What About Under Load?

- **(McQuade, 1999).**
  - 1) arm completely unloaded and passively elevated - 7.9:1 to 2.1:1 (GH:Scap)
  - 2) light load consisting of active elevation against the weight of the limb - 3.1:1 to 4.3:1
  - 3) heavy loading against maximal resistance - 1.9:1 to 4.5:1

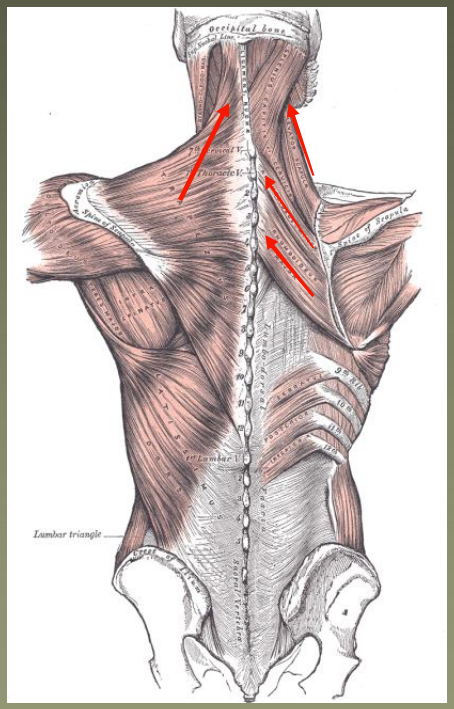
What About Under Fatigue?

- **(Szucs, 2009)**
  - Fatiguing out serratus anterior lead to:
    - Increase activation of upper trapezius
    - Altered serratus anterior and lower trapezius activation ratio
    - Could lead to shoulder pathology

Shoulder Kinematics

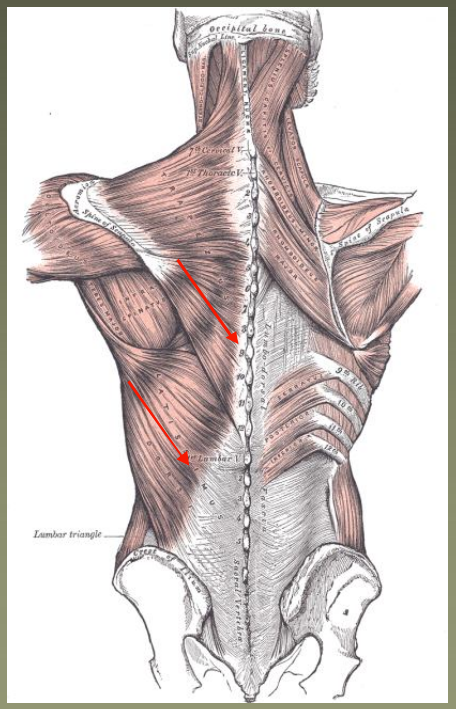
0 ° to 90 ° Abduction	90 ° to 180 ° Abduction
•**60 ° GH joint** • **30 ° scapulothoracic upward rotation** – 20 to 25 ° from clavicular elevation at SC joint –5 to 10 ° upward rotation at AC joint	•**60 ° GH joint** • **30 ° scapulothoracic upward rotation** – 5 ° from clavicular elevation at SC joint – 20 to 25 ° upward rotation at AC joint

Muscles of the Scapulothoracic Joint



- **Elevators**
  - Upper trapezius
  - Levator scapulae
  - Rhomboids (2 °)

Depressors of the Scapulothoracic Joint



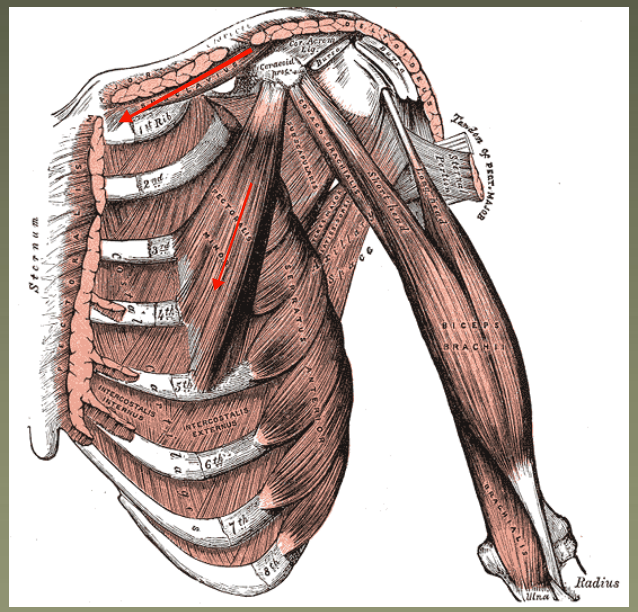
Lower trapezius

Latissimus dorsi

Pectoralis minor

Subclavius

Function can flip as in lifting seat of out wheelchair



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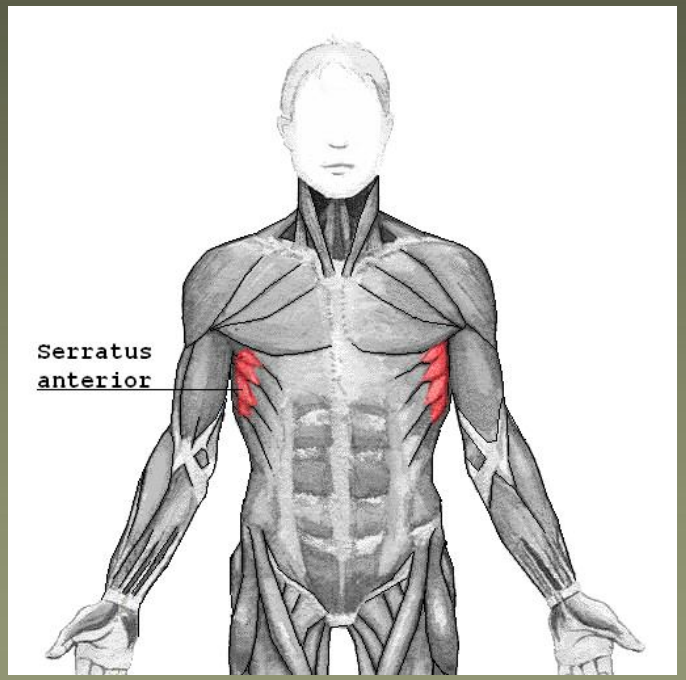
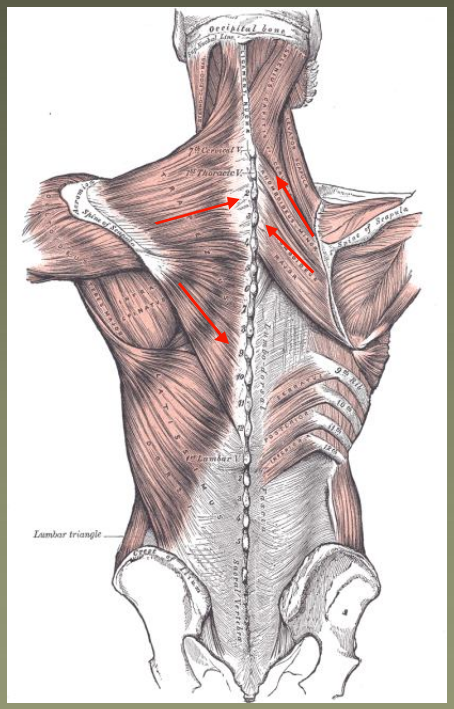
Protractors of the Scapulothoracic Joint

- **Serratus Anterior**



Retractors of the Scapulothoracic Joint



- Middle Trapezius
- Rhomboids (2 °)
- Lower Trapezius (2 °)

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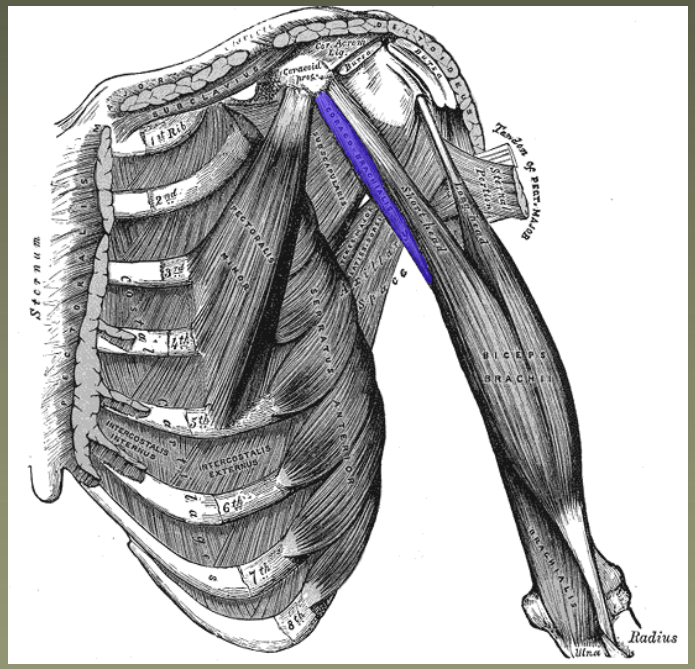
Full Arm Elevation
- Flexion -

- **GH Muscles**
  - Anterior Deltoid
  - Supraspinatus (2 °)
  - Coracobrachialis
  - Biceps (long head)
- **Scapulothoracic Joint Muscles**
  - Serratus Anterior
  - Trapezius
- **Rotator Cuff**



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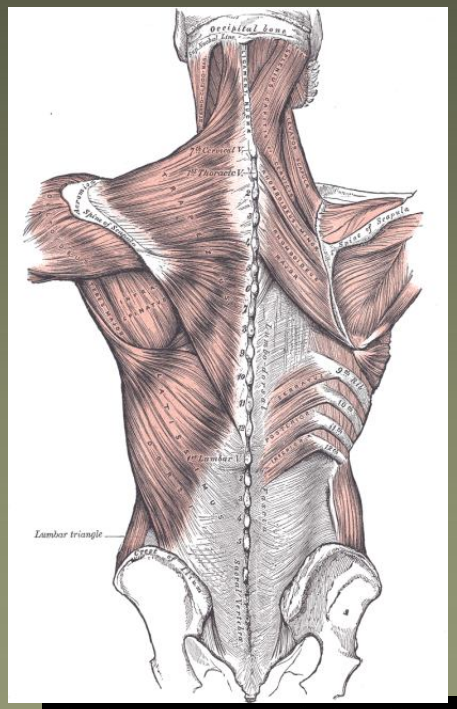
Full Arm Elevation
- Abduction -

- **GH Muscles**
  - Anterior Deltoid
  - Middle Deltoid
  - Supraspinatus
- **Scapulothoracic Joint Muscles**
  - Serratus Anterior
  - Trapezius
- **Rotator Cuff**

Supraspinatus & Deltoid

- Line of pull is same during abduction
- Most active until 90 °
- Create equal amounts of torque
- If Deltoid Paralyzed
  - Supraspinatus can fully ABD GH
- If Supraspinatus Paralyzed
  - ABD difficult
- Both
  - ABD not possible



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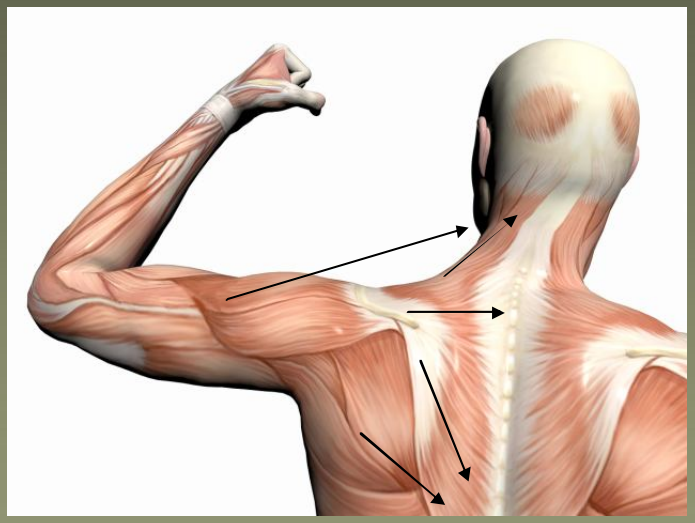
Upwards Rotators at the Scapulothoracic Joint

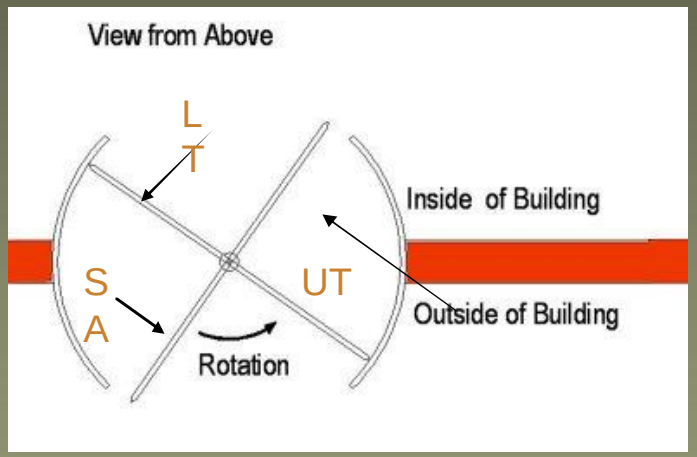


- **Proximal Stabilizers**
  - O @ spine, ribs, cranium -> I @ scap or clavicle
  - Serratus anterior
  - Trapezius
- **Distal Mobilizers**
  - O @ scap or clavicle -> I @ humerus or forearm
    - Deltoid
    - Supraspinatus

Upward Rotation Force Couple

- UT = Upper Trapezius
- LT = Lower Trapezius
  - Most Active Later Stage
- SA = Serratus Anterior
  - Protraction force is countered by MT & Rhomboids
  - If weak SA scap retracted
  - If MT weak scap protracted

Right Side Revolving Door

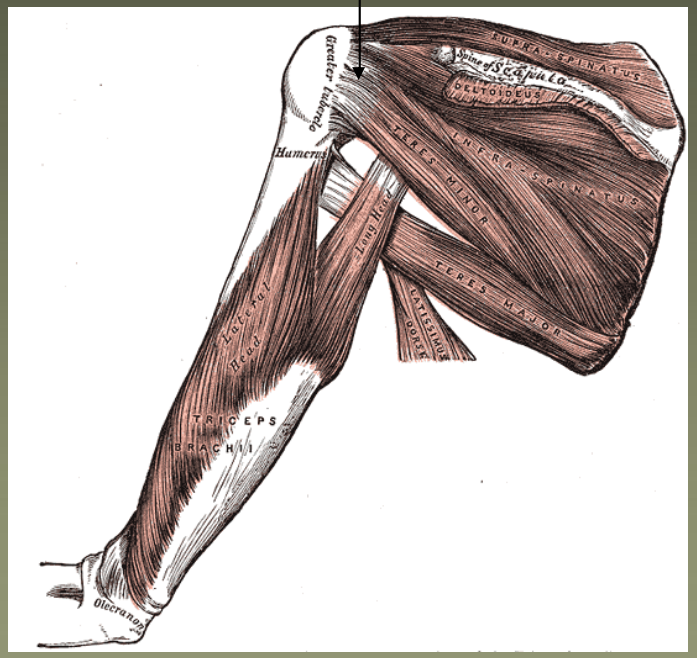


Paralysis

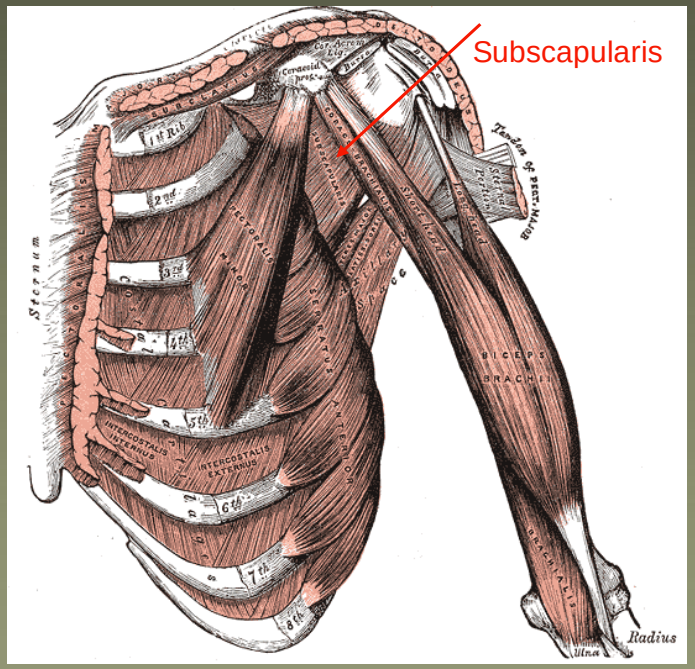
- **Trapezius**
  - Difficulty lifting arm
  - important for serratus to be active
  - Frontal plane abduction the worst due to lack of MT
- **Serratus Anterior**
  - Can't elevate over 90
  - With resistance scapula will wing & deltoid with downwardly rotate scap

Rotator Cuff

- **Supraspinatus**
- **Subscapularis**
- **Infraspinatus**
- **Teres Minor**
  - Rotator cuff muscles and capsular ligament blend into the fibrous capsule of the GH joint before attaching to Humerus

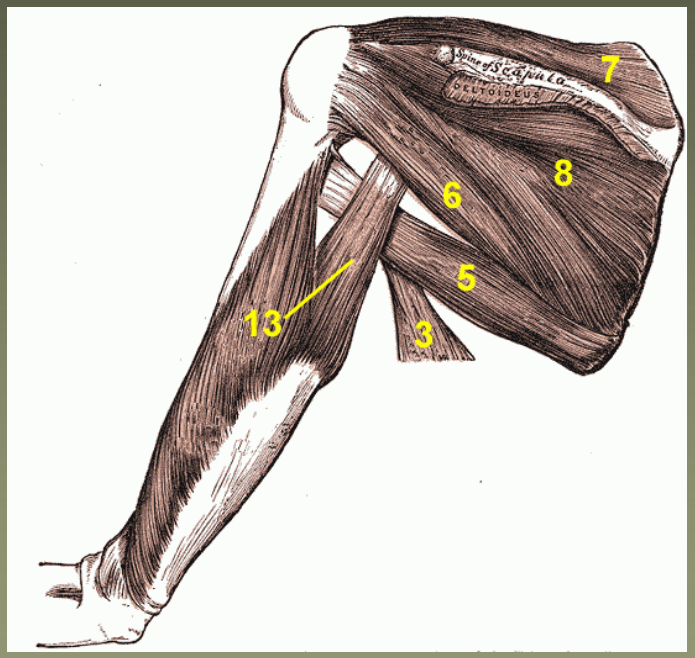


Rotator Cuff



- **Distal Mobilizer**
  - Supraspinatus – moves humerus
- **Dynamic Stabilizer**
  - Stabilizes and centralizes humeral head against glenoid fossa

Rotator Cuff



- Supraspinatus (7) produces a compression force into glenoid fossa which stabilizes humeral head
- Subscapularis, Infraspinatus (8), Teres Minor (6) produce inferior directed translation force on the humeral head
- Infraspinatus (8) & Teres Minor (6) external rotate humeral head & in frontal plane helps ER so greater tubercle cleared

Rotator Cuff

- **External Rotation**
  - Infraspinatus, teres minor and posterior deltoid
  - Supraspinatus – assists between neutral and full ER
- **RC**
  - Small percentage of total muscle mass in the shld
  - Creates smallest isometric force of all shld muscles
  - High-velocity concentric contractions
  - Eccentric activation decelerating internal rotation

Supraspinatus

- Most utilized muscle in shoulder
- Assists deltoid in ABD
- Dynamic stability
- Static stability (at times)
- Create 20 greater force than what is in the hand

Dysfunction

- **Supraspinatus**
  - Counters deltoid superior force
  - therefore humeral head jammed into coracoacromial arch
  - Decrease shoulder abduction
- **Subscapularis / Infraspinatus / Teres Minor**
  - Counters deltoid superior force
  - therefore humeral head jammed into coracoacromial arch
  - Decrease shoulder abduction

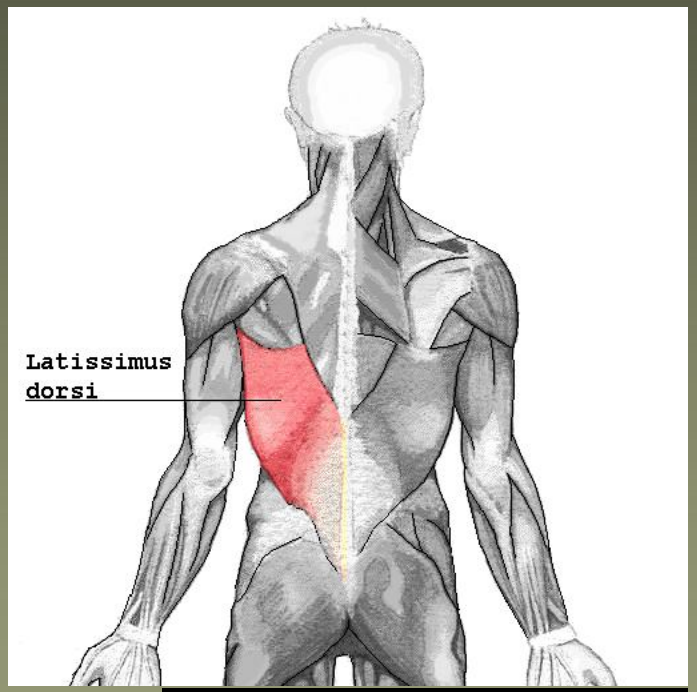
RC Exercises to Fatigue

- **(Ebaugh 2006)**
  - Performed RC exercises to fatigue
  - Less external rotation
  - Less posterior tilt of the scapula at the start of arm elevation
  - More scapular upward rotation and clavicular retraction in mid ranges of arm elevation

Adduction & Extension

- Latissimus Dorsi
- Pectoralis Major – sternocostal head
- Teres major
- Long head of triceps
- Posterior deltoid
- Teres minor

- **Rhomboids**
  - Main role is to stabilize scapula during ADD & Ext
- **Rotator Cuff**
  - Active during ADD & Ext



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Internal Rotation

- Subscapularis
- Anterior Deltoid

Also ADD & Ext

- Pectoralis Major
- Latissimus Doris
- Teres Major

- **IR > EX by 1.75 torque**

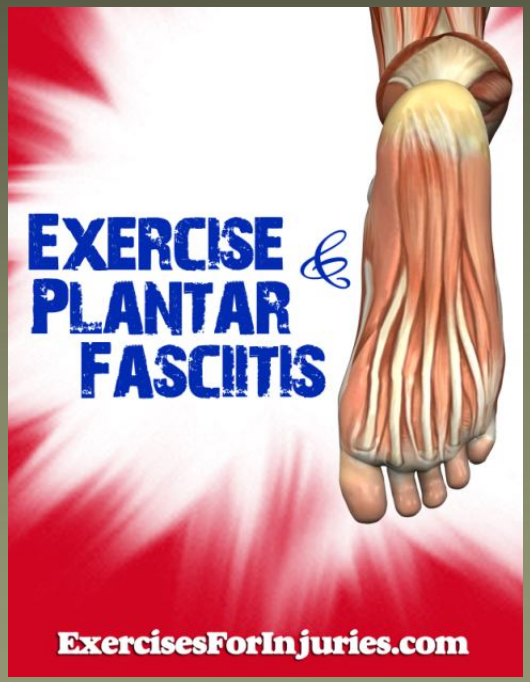
Horizontal Extension

- Primarily posterior deltoid
- Lower Trapezius needs to stabilize scapula

- **<u>Paralysis Deltoid</u>**
  - Difficulty combining shld ext and horizontal ext (arm into a jacket)

Other Exercises & Injuries

- Scapular Stabilization Exercises
- Plantar Fasciitis and Exercise
- The Most Effective Rotator Cuff Exercise Program
- Exercises for Prevention, Rehabilitation and Overcoming Knee Injuries
- Corrective Exercises for Running Injury-free
- Lumbar Spinal Fusion and Exercise



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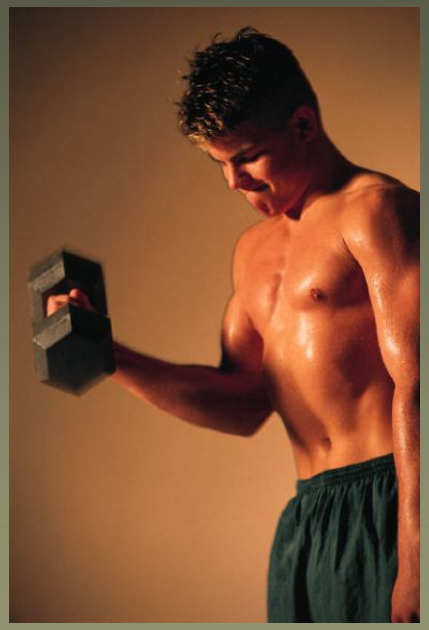

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Thank You

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