

# The Shoulder

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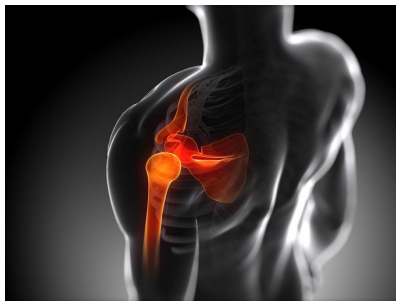
## Continuing Education

- Over the past 6-8 months
  - Multiple medbridge courses on shoulder
  - Kevin Wilks knee and shoulder course<sup>2</sup>
  - Mike Reinold Online shoulder seminar<sup>1</sup>
  - The shoulder complex - presented by Bryan Roming, The Network Seminars<sup>3</sup>
- I wanted to share all I've learned



## Overview

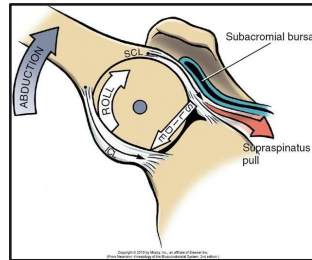
- Anatomy
- Clinical Examinations
- Treatments
- Manual therapy
- RTC - operative/non-operative
- Shoulder Instability
- The Stiff Shoulder
- Shoulder OA



## ANATOMY

## Shoulder Biomechanics

- Balance between stability and mobility
- Function of the rotator cuff is to center the glenohumeral head at the glenoid
  - Normal joint play = 4mm<sup>3</sup>
  - Actual translation during shoulder elevation = 0.3mm in a rotatory movement



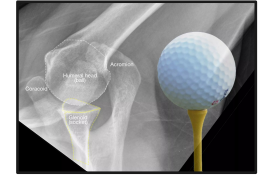
## Shoulder Biomechanics

### Static Stability

- Osseous configuration
  - Golf ball on tee
- Glenoid labrum
  - Increases the contact surface
- Capsuloligamentous
  - Loose and Redundant
- Interarticular pressure
  - Circle concept
- Joint cohesion

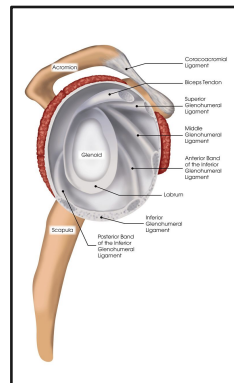
### Dynamic Stability

- Glenohumeral stability
  - supraspinatus, infraspinatus, subscapularis, teres minor
- Scapulohumeral stability
  - deltoid, levator, serratus anterior, middle trapezius, lower trapezius, upper trapezius, rhomboids, latissimus, pec major, pec minor



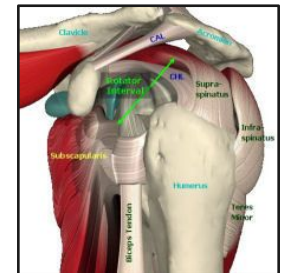
## Capsuloligamentous

- Ligaments of the capsule
  - Superior Glenohumeral ligament
  - Middle Glenohumeral ligament
  - Inferior Glenohumeral ligament
    - Anterior IGHL
    - Posterior IGHL
- Shirt Analogy
- Effects of increased tightness
  - Posteroinferior= elevation, IR of elevated arm, horizontal ADD
  - Posteroinferior= reaching up the back
  - Anterosuperior= ER at side
  - Anteriorinferior= elevation, ER of elevated arm, horizontal ABD



## Capsuloligamentous

- Rotator Interval
  - triangular space between the subscapularis and supraspinatus tendons covered by coracohumeral ligament, function is prevents inferior translation and excessive motion
    - Restriction→ limitations in ER and IR at 90 degrees,
      - if ligament restriction then limitation in ER in an adducted position, seen in frozen shoulder
    - Increased space→ increased GH mobility with possible instability inferiorly

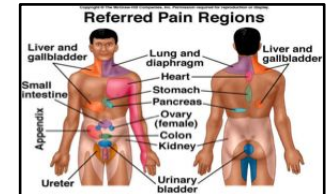


# Clinical Examination

## Don't forget RED FLAGS!



- Cancer: pancoast tumor
- Systemic diseases affecting organs can refer to shoulder
  - Cardiac
  - Lung/pleura
  - Diaphragm
  - Abdominal
  - Spine: cervical and thoracic
  - Breast
- Cardiovascular symptoms: MI, angina, pericarditis, AAA

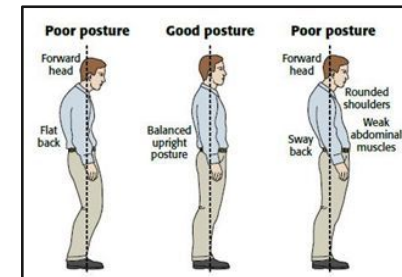


## Components of Clinical Examination

1. Subjective History
2. Clear cervical spine
3. Inspection/Observation
4. Active Range of Motion
5. Passive Range of Motion
6. Manual Muscle Testing
7. Accessory Motion Assessment
8. Laxity Testing
9. Special Test
10. Palpation
11. Neurovascular Assessment
12. Functional Assessments
13. Imaging Studies/radiographs

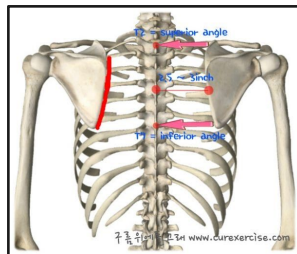
## Inspection/Observation

- Posture
  - Standing and Sitting



## Inspection/Observation

- Symmetry
  - T2 = superior spine
  - Distance from T4 to medial border
  - Outward slope to inferior angle
  - Hands on hips = scapular winging
  - Most common scapular dyskinesis
    - Increased anterior tilt
    - Decreased upward rotation
    - Increased scapular internal rotation

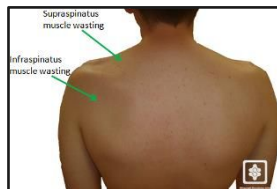


## Impaired Scapula Positions and Causes<sup>5,6</sup>

- Downward rotation: levator and rhomboid shortening and UT and SA lengthening (UT pain? Stretching is not indicated)
- Depressed: Pectoralis major and latissimus dorsi shortening and UT is lengthened
- Abducted: usually with upward rotation, SA and pec major shortening
- Anterior tilted: pec min shortening (inclinometer to measure angle, normal=20 degrees)
- Elevated: UT and/or levator short
- Winging/pseudo-winging: scapular internal rotation with minor anterior tilting,
  - True winging- long thoracic n. palsy

## Inspection/Observation

- Visual Deficits
- Atrophy



## Active ROM

- Functional shoulder ROM for activities of daily living
  - Flexion = 120°
  - Extension = 45°
  - Abduction = 130°
  - Horizontal Adduction = 115°
  - External Rotation = 60°
  - Internal Rotation = 100°

**Table 1** Activities of daily living from the Functional Assessment Section of the American Shoulder and Elbow Surgeons, Simple Shoulder Test, and University of Pennsylvania Shoulder Scores that were performed by the subjects

1.	Place a can of soup can on an overhead shelf without bending the elbow
2.	Reach the small of one's back to tuck in one's shirt with one's hand
3.	Wash the middle of one's back/unhook one's own bra (middle of back)
4.	Wash the back of the opposite shoulder
5.	Place hand behind one's head with the elbow held straight out to the side
6.	Comb hair
7.	Place a can of soup on a shelf at shoulder level without bending the elbow
8.	Place a 1-gallon container (8-10 lbs) on a shelf at shoulder level without bending the elbow
9.	Reach a shelf above one's head without bending the elbow
10.	Place a 1-gallon container on an overhead shelf without bending the elbow

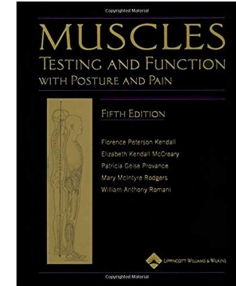
## Active ROM

- Scapular Dyskinesia
  - Scapular Dyskinesis Test (SDT)<sup>8</sup>
    - 3lbs or 5lbs weights; observe 5 reps shoulder flex and abd in 3 sec ascend/descend
    - Observe scapular movement and control



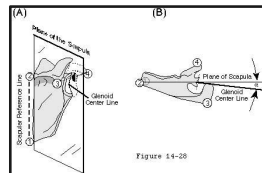
## Manual Muscle Testing

- Gross Shoulder strength
- Periscapular strength
  - Rhomboids
  - Middle Trapezius
  - Lower Trapezius
  - Serratus Anterior



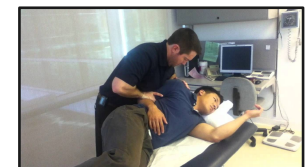
## Accessory Motion Testing

- Compare bilaterally
- Average upward tilt of 5°
- Average version is 5° of retroversion in relation to the axis of the scapular body



## Accessory Motion Testing

- Posterior capsule/cuff Testing
  - Patient in S/L or supine, pin down scapula ant distance between medial epicondyle to 90°, normal is to the horizontal or greater
- Rotator Interval Testing
  - Patient in S/L, stabilize scapula, patient places hands on hips, normal is elbow to the horizontal



## Special Test Cluster

- Scapular Dysfunction
  - Scapular Assistance Test:<sup>9</sup>
    - Assist the scapular retract and upwardly rotate as arm elevates
    - (+) pain diminished & range of motion increased
    - Indicates improving scapular motion may diminish symptoms
  - Scapular Retraction Test:<sup>10</sup>
    - Assess strength of deltoid and rotator cuff for provocative test
    - Patient retract scapula and manually provide scapular stability then retest strength
    - Improved symptoms indicates scapular muscular control is compromised
- Rotator Cuff Tear
  - Drop Arm
  - External Lag Test
  - Empty Can
  - Belly Press
- Impingement
  - Cross-Body Test
  - Hawkins-Kennedy Test
  - Neer Impingement Test

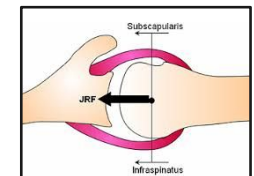
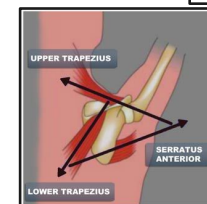
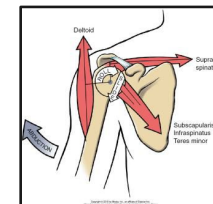
## Special Test Cluster

- SLAP lesion
  - Biceps Load I/II
  - Dynamic and Static Speeds
- AC Joint
  - Spring Test
  - Shear Test
- Thoracic Outlet
  - Roos Test
  - Allen's Test
  - Adson's Maneuver
- Instability Testing
  - Sulcus Sign
  - Load Shift
  - Anterior/Posterior Drawer

## Treatment of the Shoulder

## Force Couples

- Deltoid - Rotator Cuff
- Anterior - Posterior Rotator Cuff
- Trapezius - Serratus Anterior



## Exercise Program

- 4 Phase Approach
  - Proprioception and kinesthesia
    - Establish ability to process afferent sensory input
    - Promote baseline strength
    - Restore ROM
    - Minimize swelling and reduce pain
  - Dynamic stabilization
    - Maximize motor patterns; training muscular to dynamically stabilize
  - Neuromuscular Control
    - Coordinated motor output to sensory input
    - Maintaining stability with advance movements
  - Functional Movements and Skills/Sports-Specific Training
    - Gradual return to functional activities and sports, initiation of interval sports program, or work hardening program

## Proprioception and Kinesthesia, baseline dynamic stabilization

- Restore the PROM with IR/ER at 45°-90°, Abduction, Elevation in scapular plane
- Start scapular stabilization exercises immediately
- Alternative exercises
  - Active Repositioning: Patient has eyes closed, PT puts arm at certain joint angle and patient holds, then PT returns to neutral/starting position and patient much reproduce the angle
  - Rhythmic stabilizations: Alternating IR/ER isometric forces at varying degrees or at 10° H. ABD and 90° -100° flexion
  - Manual Contractions: manual/graded resistance which may include addition of rhythmic stabs for progression
    - Supine ROM, S/L ROM, PNF, Prone Rowing

## Proprioception and Kinesthesia, baseline dynamic stabilization

- Weightbearing and Closed Kinetic Chain exercises
  - Start with weight shifts forward=backwards, side=side
    - Progress to rocker board → add perturbations to arm, trunk, hips
  - Wall stabilization with towel performing circles
    - Progress to ball → add perturbations to arm, trunk, hips
  - Combine to circles on unstable surface (bosu) with 2 hands → 1 hand
    - Progress plank position → add perturbations to arm, trunk, hips
      - Progress plank to on unstable surface

## Dynamic Stabilization

- Utilized PNF with rhythmic stabilization at various points in pattern
- Begin Strengthening - posterior cuff emphasis
  - Start below 90° to avoid shrug
  - Utilize side-lying ensure active elevation of shoulder without shoulder shrug (Flex/ABD/ER)<sup>12</sup>
    - Progress with weight gradually
- Utilize Plyometrics for UE
  - 2 handed - chest pass, side-side throws, overhead throws
- Sustained Holds

## Neuromuscular Control

Advancement of current exercises

- Rhythmic stabilization advance to eyes closed
- Introduction of unstable surfaces, i.e. bosu or theraball
- Stabilize shoulder with LE patterns
  - Hold weighted ball with step ups
  - Ball elevation with step ups
- 1 Handed plyometrics
  - Ball flips = starting in side lying → prone horizontal ABD
  - 90/90 wall dribbles, deceleration catches

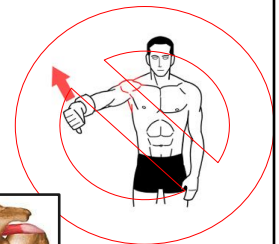
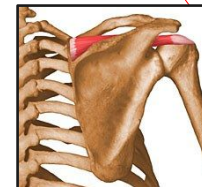
## Functional Movements and Sport-Specific

- Return to throwing
- Gradual introduction

## Exercise Selection for the Rotator Cuff and Periscapular Muscles<sup>11-15</sup>

### Supraspinatus

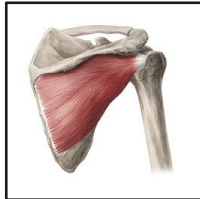
- Role: Compresses, abducts, small ER torque
- Minimize deltoideus activity
- 62-67% MVIC
- Exercises:
  - Full Can
  - Prone Full Can





## Infraspinatus and Teres Minor

- Role: compression, resist superior and anterior humeral head translation, glenohumeral ER
- Exercises
  - Side-lying ER (62%, 67% MVIC)
  - Prone ER at 90° abduction (50%, 48% MVIC)
  - ER with towel
    - Adds 20-25% more EMG activity



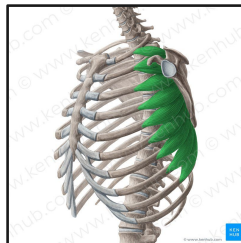
## Subscapularis

- Role: compression, glenohumeral IR, and anterior stability of shoulder
- Be aware of compensation of larger muscles including pectoralis major, latissimus dorsi, and teres major
- Similar EMG activity
- Exercises:
  - IR at 0° abduction - good for static stability
  - IR at 90° abduction - challenging position for shoulder stability
  - IR diagonal - effective strengthening in a functional movement pattern



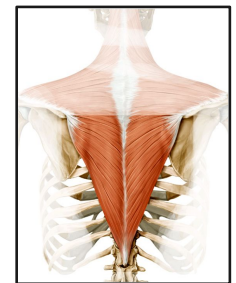
## Serratus Anterior

- Role: works with pectoralis minor to protract the scapula and with upper and lower trapezius to upwardly rotate scapula
- Exercises:
  - Push up with plus - provides resistance against protraction
  - Dynamic hug - good if patient has difficulty elevating arms or performing push up
  - Serratus Punch 120° - good dynamic activity to combine protraction and upward rotation functionally



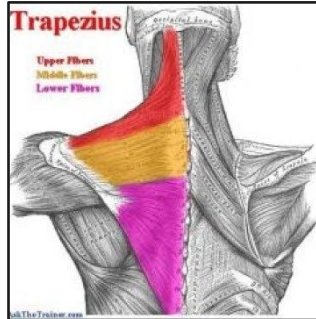
## Lower Trapezius

- Role: scapular upward rotation, external rotation, and posterior tilt
- Muscle activity lower at angles less than 90° elevation, then increases exponentially from 90°-180°
- Dual exercise with good infraspinatus/teres minor and middle trapezius activation
- Exercises:
  - Prone Full Can - properly align exercise with muscle fibers
  - Prone ER at 90° abduction
  - Prone horizontal abduction at 90° with ER - good UT/LT ration
  - Bilateral ER - good UT/LT ratio



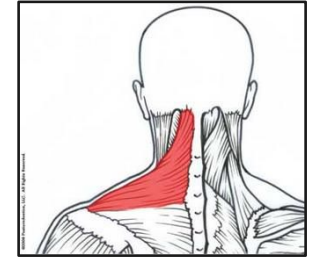
## Middle Trapezius

- Role: scapular retraction
- Exercises:
  - Prone Row - Good ratios for UT/MT/LT activity
  - Prone horizontal abduction at 90° with ER



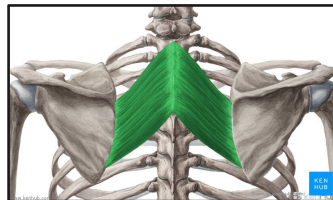
## Upper Trapezius

- Role: scapular elevation
- Beware of over compensation
- Exercises:
  - Shrug
  - Prone Row
  - Prone horizontal abduction at 90° with ER



## Rhomboid and levator scapulae

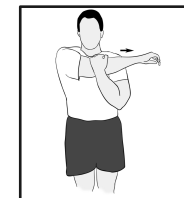
- Role: scapular retractors, downward rotators, and elevators
- Exercises:
  - Prone Row
  - Prone horizontal abduction at 90° with ER
  - Prone extension with ER - unique movement to enhance scapular control



## Posterior Cuff

### Sleeper vs Cross-body Stretch<sup>16</sup>

- 30 subjects (15 in each group)
- Measure IR at 90 and functional IR (thumb up the back)
- 5 sets of 30s holds
- Both increased IR with more compliance from cross-body stretch
- Cross-body stretch had significantly greater increased in IR and total rotation



# Manual Therapy

## Manual Therapy

### Uses:

- Address force couples
- Correct postural deficits
- Improve muscle imbalances
- Address fascial connections
- Improve ROM

### Techniques:

- Trigger point release
- IASTM
- MET
- Joint mobilizations
- Mobilization with movement
- Rhythmic stabilization
- Taping
- Etc.

## Joint Mobilizations

- Scapulothoracic: distraction, rotation, depression, retraction and protraction
  - Can be performed early in rehabilitation
  - Use of manual resistance for neuromuscular facilitation
  - Scapular Assist - increases posterior tilt, upward rotation, and increased AC distance<sup>19</sup>
- Glenohumeral: anterior, posterior, inferior, lateral distraction
  - Advanced mobilization at end range, in multiplanes, and with mobilization with movement
  - Inferior and posterior is most common
    - Posterior mobilization is more effective for ER deficits<sup>17</sup>
    - Posterior restrictions causes increased anterior translation<sup>18</sup>
    - Inferior restrictions causes increased superior translation

## Stretching and MET

### Posterior Cuff/Capsule

- Pain at end range elevation, decreased IR
- 5-second isometric contraction at approximately 25% maximal effort in the direction of horizontal abduction, followed by 30s active assisted stretch into horizontal adduction, repeat 3 times
- 6° increase in H. ADD and 4° increased in IR<sup>20</sup>

### Rotator Cuff Interval

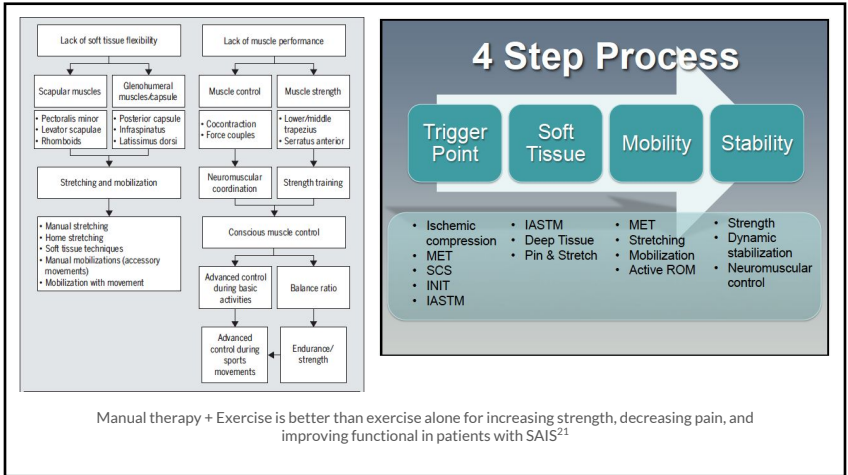
- Can be a gateway to address lost of functional IR
- Decreased anterior shoulder pain

### Latissimus Dorsi/Teres Major

- Improve overhead mobility

## Other Considerations

- After MT, follow up with strengthening, dynamic stabilization and/or repetitive motion in new range
- With loss of PROM
  - If accessory motion is loss- utilized joint mobs
  - If no accessory loss- utilize stretching and other soft tissue techniques
  - If no loss of PROM then address neuromuscular and strength deficits



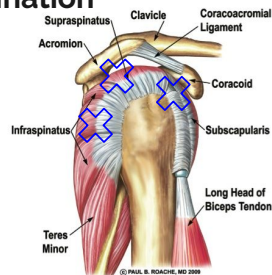
## Subacromial Impingement Syndrome

## Contributing Factors

- STRUCTURE GOVERNS FUNCTION
  - RTC dysfunction or scapular dyskinesia
    - Less posterior tilt<sup>22</sup> - increased irritation at subacromial and coracoacromial spaces
    - Less upward rotation<sup>23</sup> - earlier occurrence of subacromial narrowing
  - Increased thoracic kyphosis
  - Posterior capsule tightness
- Structural changes
  - Acromial changes
  - Thickening of coracoacromial ligament
  - Bursal fibrosis

## Differentiation of During Examination

- Subacromial
  - Pain location: greater tubercle
  - More pain with active IR and ER
- Internal impingement
  - Pain location: posteriosuperior of glenoid
  - More pain with horizontal ADD and ABD
- Anteroinferior impingement
  - Pain location: lesser tubercle
  - More involvement of subscapularis



## Keys to Treatment

"Balance the shoulder"

- Temporary avoidance of strenuous activities and aggravating activities
- Correct asymmetries in capsule
- Treat scapular control and position
- Normalize the motion and posture
- Re-establish muscle balance
- Improve dynamic stabilization



## Additional Considerations

- Backwards on UBE only for facilitation of upright posture
- Modifications of sleeper stretch and cross-body stretch to avoid impingement
- Behind the back stretch
  - Cue posture
  - Watch for increased lumbar lordosis
- Chest stretches
  - Cue posterior tilt of scapula

## Rotator Cuff Repair

## Factors that influence the Rehabilitation

- Type of Repair: open, mini-open, arthroscopic
- Tissue Quality: fatty infiltration, retracted, etc
- Size and type: number of tendons involved
  - Type I: small tear (<1cm with very good tissue quality)
  - Type II: medium tear (2-3cm with good tissue quality)
  - Type III: large tear (3-5cm with poor tissue quality)
  - Type IV: massive tears (>5cm with poor tissue quality)

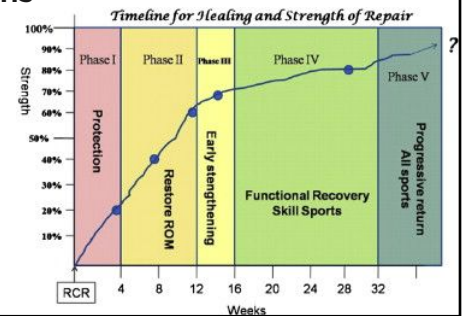
## REHAB MUST MATCH THE SURGICAL PROCEDURE

## Set the timeline for the patient:

- First 6 weeks: PROM and basic scapular control. Sleep modifications, Crucial time for healing as development of scar
- At 12 weeks: Functional modifications are still common. Particular reaching OH and BTB
- At 6 months: Full motion and control of motion. No functional limitations but still could be improving (especially multi-tendon). Begin activity and sport-specific training between 4-6 months
- 12+ months: Return of "power"

## Healing Considerations

- Research does not support GH training before 6 weeks and Shoulder proper strengthening at 12 weeks
- Soft tissue healing takes 12-15 weeks<sup>24-26</sup>

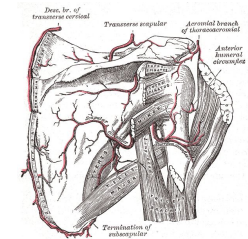


## Goal #1 - Maintain integrity of repaired rotator cuff

- Patient is in pillow sling all the time and icing frequently
- Rehab: addressing elbow and hand ROM, grip strength, thoracic and scapular mobility, PROM to tolerance or per protocol

## Goal #1 - Maintain integrity of repaired rotator cuff

- Sling = best friend for next 6 weeks; it improves healing rates and will not increase long term stiffness<sup>27</sup>
- Optimal shoulder immobilization postures:<sup>28</sup>
  - Supraspinatus: elevation in scapular plane with neutral rotation
  - Supra/Infraspinatus: elevation in the scapular/coronal plane
  - supraspinatus/subscapularis: elevation in scapular plane with IR
- “Critical Zone” of the shoulder near the repair site and relatively hypovascularized near supraspinatus, infraspinatus, and long head of biceps
  - Optimal blood flow at 30° ABD



## Goal #2: Reestablish full PROM as quickly and safely as possible

- Limit the strain on repaired tendon<sup>29-30</sup>
  - Significant less strain on tendons above 30° elevation and ER to 60°
  - IR significantly increased strain
- Limiting ER to 30° with reduce occurrence of gap formation and tendon strain
- Truly Passive<sup>31-32</sup> (<15% EMG activity of supraspinatus and infraspinatus)
  - Therapist assisted elevation and ER
  - Pendulums
    - Use small amplitudes less than 8-10 in diameter and circle outward to reduce activation<sup>34</sup>
- AAROM
  - Pulley
  - Wand
  - ER on wall vs ER with wand

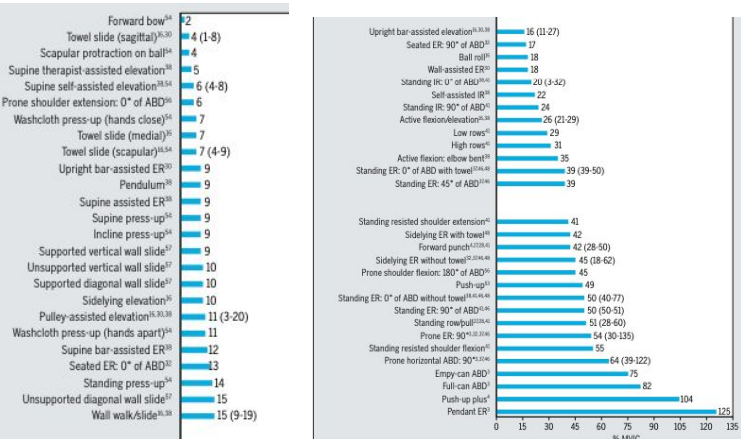


TABLE 4

SUMMARY AND SUGGESTED CONTINUUM OF REHABILITATION EXERCISES, BASED ON MUSCLE ACTIVATION (PERCENT MVIC) FOR THE SUPRASPINATUS AND INFRASPINATUS, FOR BOTH EARLY AND DELAYED POSTOPERATIVE MOTION PATHWAYS

	Time Point	Exercises
Phase 1: protection and early motion phase EMG activation: <15% MVIC	Early: weeks 2-6 Delayed: weeks 5-8	Passive ROM: flexion Forward box, supine therapist-assisted flexion, supine self-assisted flexion, sidelying flexion, towel slides, washcloth press-up Passive ROM: rotation (no IR, ER to 30°) Wall-assisted ER, supine bar-assisted ER, upright bar-assisted ER
Phase 2: active-assisted to active motion phase EMG activation: <20% MVIC	Early: weeks 7-9 Delayed: weeks 9-12	Active-assisted ROM: flexion Ball roll, upright bar-assisted flexion, supported wall walk/slide (progression into unsupported), pulley-assisted flexion Active ROM: flexion Supine active press-up, reclined active press-up Active-assisted ROM: rotation Continue ER exercises as above. Commence self-assisted IR, bar-assisted IR
Phase 3: strengthening phase EMG activation: 21%-50% MVIC	Early: week 10 Delayed: week 13	Active ROM: flexion Progress to standing press-up/active flexion (short lever, progressing to long lever), resisted active flexion Active ROM—strengthening: rotation Progress from seated to standing (in slight abduction to 45° of abduction) to sidelying (with and/or without pillow) Seated row exercises, progressing to standing row/pulls: forward/scapular punches
Phase 4: late strengthening phase EMG activation: >50% MVIC	Early: week 20 Delayed: week 20	Active flexion/abduction Prone horizontal abduction at 90° and 100° Strengthening: rotation Standing ER (in 90° of abduction) to prone (ER) in 90° of abduction Push-up/push-up plus, dynamic hugs

Abbreviations: EMG, electromyography; ER, external rotation; IR, internal rotation; MVIC, maximal voluntary isometric contraction; ROM, range of motion.

## Goal #3: Reestablish dynamic humeral head control

- Isometrics, rhythmic stabilizations, dynamic stabilization, progressing into full isotonic program
- Do not work through a shoulder shrug arc of motion
  - ER/IR ratio of >52% to raise arm without compensation
- Stabilization - supine ER/IR drills, supine Flex/Ext drills, progress to side-lying drills
  - Balance position: 100° flexion, 20° H. ABD (MAX compression forces)
- NMES to infraspinatus<sup>34-35</sup>
  - Patients with massive tears, retraction, or increased fatty infiltration can develop suprascapular neuropathy
  - Similar muscular inhibition after surgery due to pain stimulus and joint effusion

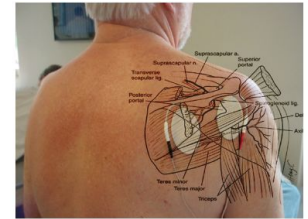


Figure 1. Pad placement along the muscle belly of the infraspinatus.

## Goal #4: Improve muscle balance with “posterior dominant shoulder”

- Use of joint mobilizations and STM
- Continue ROM/stretching exercises
- Progress strengthening program
  - Progress resistance 1#/week for gradually load the repair site
- Endurance drills (time, reps)
  - Sustained holds

## Goal #5: Emphasis HEP and continued stretching and strengthening program and RTS



## Rotator Cuff Summary

- Rehab program must match surgery
- Team approach: physician-therapist
  - When in doubt- communicate or go slow
- Adjust program to factors that affect rehab
  - Size of tear, retraction of the tear, tissue quality, chronicity of the tear, patient variables
- Restore PROM
- Reestablish dynamic stabilization
- Posterior dominant shoulder
- Do not overload healing tissue - gradual restoration of function

## Shoulder Instability

## Non-Operative Rehabilitation

### Acute Traumatic dislocation

- Presentation
  - Mm spasm, guarding, protective posturing, pain/inflammation, marked loss of ROM (anterior-loss of ABD, ER/ Posterior- loss of IR, H' ADD)
  - Goal: allow capsular healing
- Sling PRN, immobilized in ER for capsule healing
- Immediate ROM and isometrics, RS, control pain and inflammation
- Progress strength when ROM normalizes (dynamic stabilization, ER's, scapulothoracic)
- Progress proprioception, DS, NM control
  - CKC exercises

### Recurrent subluxation

- More successful than traumatic with 80% or better success rate
- Usually have excessive ROM
- Focus on DS, force couple efficiency
- Avoid aggressive stretching and mobilization

## Outcomes and Associated Injuries

- Not all acute dislocations will respond to conservative treatment
- Age and recurrence rate
  - <20 years old = 66-90%
  - 20-30 years old= 56-60%
  - 30-40 years old = 20%
- Associated injuries:
  - Bankhart lesion: detachment of IGHL and capsulolabral complex
  - Hill-Sachs lesion: depression of cortical surface of the posterior-superior humeral head
  - Brachial plexus stretch injury
  - Glenoid/proximal humeral fx
  - Axillary nerve/artery damage
  - Labral injury
  - RTC tear= patients>40years old

## Guidelines

1. Early Controlled Motion
  - a. Motion to tolerance
  - b. Neuromodulation of pain
  - c. **Do not stretch**
2. Reestablish Static/Dynamic Stability
  - a. Static - holds stationary positions, low level control drills
  - b. Dynamic stabs - ability to move through space, then stabilize
3. Restore proprioception
  - a. Joint awareness
  - b. EO/EC
4. Stable base of support
  - a. Scapular orientation
  - b. Scapular strength and mobility
5. Dynamic functional stability
  - a. ROM with stability
6. Perturbation training ( critical for RTS)
  - a. End range stability
  - b. postural /positional disturbance
7. Muscular endurance
  - a. Exercises time
8. Functional sport specific drills
  - a. Plyos etc

## The Stiff Shoulder

## Frozen Shoulder/Adhesive Capsulitis<sup>39</sup>

- Many definitions: an idiopathic global limitation of humeroscapular motion resulting from contracture and loss of compliance of the glenohumeral joint capsule
- Pathoanatomical Features: (adhesions vs collagen changes)
  - Hyperplastic fibroplasia to proximal portion of the capsuloligamentous complex and the subscapularis profoundly limits ER
  - At the rotator cuff interval the involvement of the superior glenohumeral ligament and coracohumeral ligament as it helps form the superior hammock which limits both ER and IR
  - Presence of multiregional synovitis, consistent with inflammation
  - Adherence of inferior capsule at axillary fold limits elevation
- Loss of passive motion in multiple planes, particularly ER in varying degrees of shoulder ABD is a significant finding
- Loss of motion due to: contracture of capsule, ligaments, or M-T unit, Adhesions along gliding surfaces of RTC or biceps tendons, Adhesions or contractures to scapulothoracic joint, or Combination of these factors

## Frozen Shoulder/Adhesive Capsulitis

### Risk Factors:

1. Patients with DM and thyroid disease
2. Individuals age between 40-65 years of age
3. Females>Males
4. Previous episode of adhesive capsulitis in the contralateral arm

### Diagnosis/Classification

- Global loss of both active and passive shoulder ROM
  - ROM loss >25% in at least 2 planes
  - Passive ER loss >50% of uninvolved shoulder or <30° of ER

## Frozen Shoulder/Adhesive Capsulitis

### Stage 1

- Last up to 3 months
- Sharp pain at end range and achy pain at rest
- Sleep disturbances
- Minimal to no ROM restrictions expect in ER
- SAIS often suspected

### Freezing Stage

- Last from 3 to 9 months
- Gradual loss of motion in all directions due to pain
- Aggressive synovitis/angiogenesis
- Treatment focus
  - Reduce inflammation and prevent capsular restrictions
  - Easy frequent light motion, NSAIDs, Modalities, sustained stretching-->prolonged stretches (light)
  - Example:
    - MHP, AAROM, pendulum, single plane mobs (1-3), STM, stretching, mid range submax iso, HEP (10-12x/day)

## Frozen Shoulder/Adhesive Capsulitis

### Frozen Stage

- Pain and loss of motion
- Last from 9 to 15 months
- Less synovitis/angiogenesis lessens but progressive capsuloligamentous fibrosis
- Treatment Focus
  - Inferior capsular stretches, LLLD stretches
  - Example:
    - Active WU, AAROM, single plane end range mobs (3-4), stretching, end range submax isometrics, self-capsular stretching, postural corrections, HEP (8-10x/day)

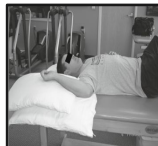
### Thawing Stage

- Pain begins to resolve but motion restrictions may persist
- Mild symptoms may persist for years
- Treatment focus
  - LLLD stretches
  - Example:
    - LLLD with heat, specific and unique joint mobs (multiplaner), NM training, active movements, HEP (4-6x/day)

## Frozen Shoulder/Adhesive Capsulitis

### Low Load Long Duration Stretching<sup>40-42</sup>

- Create deformation of the collagen tissue
- Perform 12-15 minutes bout for a total time of 60 minutes
- Heat to promote muscle relaxation



## Frozen Shoulder/Adhesive Capsulitis

### Why Physical Therapy?

- Even the most severe cases recover with or without treatment within two years but patients can remain symptomatic for 3-10 years
- 7 year follow up, 89% of patient had no functional deficits, but 50% continued to report mild pain or stiffness
- 89.5% of patients who received physical therapy, NSAIDs, corticosteroid injections, had symptoms resolved

## Post-Traumatic Stiff Shoulder

A limitation in humeroscapular motion presenting after an injury, low-level repetitive trauma, or part of an accompanying condition that results in a contracture of the structure participating in glenohumeral or humeroscapular motion interfaces (Harryman et al: The shoulder 1998)

- History of Significant trauma
  - Fracture, dislocation, RTC tear, fall or accident
- History of surgical procedure
  - Any type of surgery, stabilization & RTC repair surgeries
- History of prolonged immobilization

## Post-Traumatic Stiff Shoulder

### Clinical Examination

- Restricted ROM in specific planes
- Asymmetrical capsular tightness
  - Progression to global restrictions
  - Self-limiting
- Spasm or capsular end-feel

Phase 1: painful stage (change spasm to capsular end feel)

- Key:
  - Pt. Education (HEP 10-12x/day)
  - Do NOT push through spasm end feel
  - No aggressive stretching
- Address soft tissue restrictions

## Post-Traumatic Stiff Shoulder

### Phase I: Treatment

- MHP
- AAROM
- Gentle PROM
- Gr 1-2 single plane mobs
- Gentle PROM
- Pendulum
- Mid-range submax isometrics
- Repeat ROM and mobs

### Phase II: Transition phase

- Keys:
  - Pt. Education: HEP 10x/day
  - Progression based on end-feel
  - Gradual progression of ROM & mobs
  - May begin light isotonic late
  - Avoid DOMS
  - Avoid regression to a spasm end feel due to over aggression

## Post-Traumatic Stiff Shoulder

### Phase II: Treatment

1. Active Warm-up
2. AAROM
3. PROM
4. Single plane end range mobs: Gr. III-IV
5. Stretching
6. End-range submaximal isometrics
7. Gentle isotonic exercises
8. Self-capsular stretching
9. Repeated ROM & mobs

### Mobilizations:

- Mobilizations + ROM/Exercise = significantly more improvements than ROM/Exercise<sup>43</sup>
- Best mobilization are at end-range
- Average force a PT put on a joint: 39N
- Amount need 441-773 needed to load to failure<sup>44,45</sup>

## Post-Traumatic Stiff Shoulder

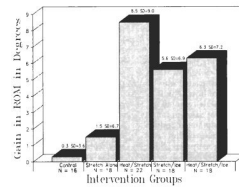
### Phase III: light phase

#### Keys:

- Pt. Education: HEP 4-6x/day
- Multiplane, multidirectional, and mobilization with motion
- Strengthening advanced - avoid DOMS

### Phase III: Treatment

1. Active-warm up
2. LLLD stretch with heat<sup>46</sup>
3. Single & multiple plane mobs
4. Stretching
5. Strengthening program
6. Repeat ROM & mobs



## Post-Traumatic Stiff Shoulder

### Phase IV: Maintenance Program

1. Continue stretching program 3-4x week
2. AAROM
3. Self-capsular stretches
4. RTC pgroom
5. Constant monitoring of ROM
6. Pt. Education
  - a. Compliance
  - b. Avoid immobilization
  - c. Avoid "over doing it"
  - d. Steady, gradual progression

## Shoulder Osteoarthritis

## Overview

- Becoming more prevalent at younger ages
- Osteoarthritis = uneven wear and tear
- Typical clinical finds:
  - Glenoid flattening leading to humeral subluxation (posterior)
  - Humeral head changes with osteophyte formation limiting ROM
  - Hard end feel with crepitus

## Keys to Working with Arthritic Shoulder

# BALANCE, BALANCE, BALANCE

- Alignment
- Joint mobility
- Soft tissue mobility
- Dynamic stability

## Balance

### Centration of Glenohumeral Joint

- Static - imbalance of capsule resulting in static rub at posterior rim
- Dynamic - uneven distribution of dynamic stabilization factors

### Balance Alignment

- Consider thorax position, thoracic spine mobility and lumbopelvic alignment
- Start at GH/scapulothoracic joint → thoracic kyphosis influenced by lumbopelvic joint

## Balance

### Balance Joint Mobility

- Mobility before soft tissue
- Loss of inferior mobility is most common
  - Development of adhesions due to inflammation
  - (+) shrug sign
  - Aggressive strengthening could increase irritation due to mal-alignment

### Balance Soft Tissue Mobility

- Compensatory soft tissue restrictions with chronic adaptations due to movement restrictions
  - Can address in conjunction with joint mobility but not before address joint mobility
  - Focus on Lats, Teres Major, Posterior Cuff, and Subscapularis

## Balance

### Balance Dynamic Stability

- Address once mobility is restored
- Baseline rotator cuff and scapular strengthening
  - Low load and low reps
  - Working within available range
  - Avoid working through compensations, pain, crepitation
  - Emphasis on dynamic stability working with force couples at shoulder
  - Create a more posterior dominant shoulder
  - Use CKC to help RTC provide compressive force, better in scapular plane, reduce if causes increased symptoms

### Key Summary:

- Alignment, joint mobility, soft tissue, dynamic stability
- Alignment before mobility before stability



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TABLE

RECOMMENDED EXERCISES FOR GLENOHUMERAL AND SCAPULOTHORACIC MUSCLES  
BASED ON ANATOMICAL, BIOMECHANICAL, AND CLINICAL IMPLICATIONS

Muscle	Exercise	Anatomical Implications	Biomechanical Implications	Clinical Implications
Supraspinatus	1. Full can	1. Enhances scapular position and subacromial space	1. Decreased deltoid involvement compared to empty can	1. Minimizes chance of superior humeral head migration by deltoid overpowering supraspinatus
	2. Prone full can	2. Enhances scapular position and subacromial space	2. High posterior deltoid activity with similar supraspinatus activity	2. High supraspinatus activity and also good exercise for lower trapezius
Infraspinatus and teres minor	1. Side-lying ER	1. Position of shoulder stability, minimal capsular strain	1. Increased moment arm of muscle at 0° abduction. Greatest EMG activity	1. Most effective exercise in recruiting infraspinatus activity. Good when cautious with static stability
	2. Prone ER at 90° abduction	2. Challenging position for stability, higher capsular strain	2. High EMG activity	2. Strengthens in a challenging position for shoulder stability. Also good exercise for lower trapezius
	3. ER with towel roll	3. Allows for proper form without compensation	3. Increased EMG activity with addition of towel, also incorporates adductors	3. Enhances muscle recruitment and synergy with adductors
Subscapularis	1. IR at 0° abduction	1. Position of shoulder stability	1. Similar subscapularis activity between 0° and 90° abduction	1. Effective exercise, good when cautious with static stability
	2. IR at 90° abduction	2. Position of shoulder instability	2. Enhances scapular position and subacromial space. Less pectoralis activity	2. Strengthens in a challenging position for shoulder stability
	3. IR diagonal exercise	3. Replicates more functional activity	3. High EMG activity	3. Effective strengthening in a functional movement pattern
Serratus anterior	1. Push-up with plus	1. Easy position to produce resistance against protraction	1. High EMG activity	1. Effective exercise to provide resistance against protraction, also good exercise for subscapularis
	2. Dynamic hug	2. Performed below 90° abduction	2. High EMG activity	2. Easily perform in patients with difficulty elevating arms or performing push-up. Also good exercise for subscapularis
	3. Serratus punch 120°	3. Combines protraction with upward rotation	3. High EMG activity	3. Good dynamic activity to combine upward rotation and protraction function
Lower trapezius	1. Prone full can	1. Can properly align exercise with muscle fibers	1. High EMG activity	1. Effective exercise, also good exercise for supraspinatus
	2. Prone ER at 90° abduction	2. Prone exercise below 90° abduction	2. High EMG activity	2. Effective exercise, also good exercise for infraspinatus and teres minor
	3. Prone horizontal abduction at 90° abduction with ER	3. Prone exercise below 90° abduction	3. Good ratio of lower to upper trapezius activity	3. Effective exercise, also good exercise for middle trapezius
	4. Bilateral ER	4. Scapular control without arm elevation	4. Good ratio of lower to upper trapezius activity	4. Effective exercise, also good for infraspinatus and teres minor
Middle trapezius	1. Prone row	1. Prone exercise below 90° abduction	1. High EMG activity	1. Effective exercise, good ratios of upper, middle, and lower trapezius activity
	2. Prone horizontal abduction at 90° abduction with ER	2. Prone exercise below 90° abduction	2. High EMG activity	2. Effective exercise, also good exercise for lower trapezius
Upper trapezius	1. Shrug	1. Scapular control without arm elevation	1. High EMG activity	1. Effective exercise
	2. Prone row	2. Prone exercise below 90° abduction	2. High EMG activity	2. Good ratios of upper, middle, and lower trapezius activity
	3. Prone horizontal abduction at 90° abduction with ER	3. Prone exercise below 90° abduction	3. High EMG activity	3. Effective exercise, also good exercise for lower trapezius
Rhomboids and levator scapulae	1. Prone row	1. Prone exercise below 90° abduction	1. High EMG activity	1. Effective exercise, good ratios of upper, middle, and lower trapezius activity
	2. Prone horizontal abduction at 90° abduction with ER	2. Prone exercise below 90° abduction	2. High EMG activity	2. Effective exercise, also good for lower and middle trapezius
	3. Prone extension with ER	3. Prone exercise below 90° abduction	3. High EMG activity	3. Effective exercise, unique movement to enhance scapular control

Abbreviations: EMG, electromyography; ER, external rotation; IR, internal rotation.