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Session 108: Glenohumeral Stabilization For True Upper Extremity Function
Terry Trundle, PTA, ATC, LAT

Today's Shoulder
• Shoulder dysfunction is the second most common musculoskeletal problem seen in physical therapy and affects 16% to 21% of the population.
• Prevalent in persons 65 years and older is 34%. Direct cost for treatment in the United States exceeds $7 billion annually.
• Shoulder Impingment Syndrome (SIS) is second only to lower back pain for people seeking treatment. (Am. Acad. Of Orthopedic Surgeons)
What are the Questions we Should be Asking?

1. What does stabilization really mean?
2. How do you describe function?
3. What are the three vital motion patterns to promote shoulder function?
4. What role do the modes of muscular contraction play in the missing link of exercise intervention?
5. What is the evidence that supports selective exercises for the aging patient

What does stabilization mean?

• Stability is the degree to which the musculoskeletal system can return to proper orientation of movement
• Instability is characterized by mobility that exceeds physiological limits with adequate control
• Essential concepts of stabilization may include:
  • Corrective or protective mobility
  • Selective exercises based on mode of muscular recruitment
  • Open Kinetic Chain challenge of tri-plane stabilization

Reference: McQuade KJ, Boniol J, de Oliveira, A S PTJ 2016

What does stabilization mean to a surgeon?

• CUT!!
• Surgery may be more indicated for the higher activity levels of patients
• Surgery for symptomatic instability
• Patients level of activity may be a risk factor for failure of operative stabilization

What are the Questions we Should be Asking?

1. Are all painful shoulders impinged?
2. Do all shoulder pathology recovery except for one depends on the function of the rotator cuff?
3. What is the missing link in shoulder rehabilitation?
4. What is the missing link in treating the elderly shoulder?
5. Is scapular stabilization the true core of the upper extremity?
6. What is the true function of the rotator cuff?
7. What are functional motion patterns?
8. Why there is no such thing as passive range of motion

FUNCTIONAL REHABILITATION OF THE SHOULDER

Open Kinetic Chain Rehabilitation Challenge

- Mobility – range of motion
- Recruitment – neuromuscular control
- Stabilization – tri-plane functionality
Three Phases of Rehabilitation

- Pre-functional – Mobility
- Return to Function – Recruitment
- Return to Activity – Tri-Plane Stabilization

Schmidt, DT; Harris, BA, Aimee, K, 2008.

Concepts of the Three P’s

- Pivoters – scapular stabilizers i.e. rhomboids, trapezius, pectoralis minor and serratus anterior
- Protectors – rotator cuff
- Positioners – deltoids, latissimus dorsi, pectoralis major

Reference: Ellen M, Rogers DP, Gilhoal JJ

True Function of the Rotator Cuff

- Dynamic decompression of the humeral head by providing balance of the upper pull of the deltoids and not allowing the scapula to overcome the G-H joint
- Steer and stabilize the humerus to the glenoid (Rockwood)
- Result = smooth rotational movement to allow shoulder elevation primarily in the transverse plane

Tate AR, et. al. JOSPT (40) 2010
• Scapulo-thoracic articulation – Not a true joint
  • Mobile structure stabilized by muscle
  • Scapula functions as a sesamoid reaction
  • True core of the Upper Kinetic Chain (T. Trundle/2011)

• Scapular positional movement
  • Normal position of the scapula is to be symmetrical mounted on the ribcage
  • Alteration of normal position or motion directly affect the glenohumeral joint and shoulder positioning is referred to as Scapular Dyskinesis

Scapular Dyskinesis

• Does this play a role as an indicator of instability?
• What does it really mean in the symptomatic shoulder?
• Scapular Dyskinesis may not be supported in current research as it is linked to pathology
• Systematic review of 10 studies linking scapular kinematics and impingement indicates there is no ideal scapular position that causes or contributes to impingement

References: Thomas et al. J. Sports Rehab 2013
Michener LA et al. JOSPT 2017 – Presentation at CSM

Scapula-thoracic – Static examination

• Anterior tilting – Inferior angle
  • Kibler Type I
• Internal rotation – Medial border
  • Kibler Type II
• Elevation – Superior glide
  • Kibler Type III

Reference: Ellenbecker, TS: Clinical Examination of the Shoulder, St. Louis,2004, Elsevier Sanders (A-R)
McQuade KJ, Burdett J, Shroot de Oliveira A, 2016 (PT)
Where are we on the mobility of the scapular-thoracic articulation?

Treatment should focus on preparation of mobility based on clinical findings
• Post-immobilization stiffness
• Loss of glide motion due to aging
• Prepare for retraction setting vs protraction preparation

Reference: Camargo PR, et al. JOSPT 2015
Trumble TL Orthopedic Management of the Shoulder 2016

Clinical Applications

• Greatest risk for shoulder impingement is when the scapula is internally rotated and anteriorly tilted
• Based on EMG studies, shoulder impingement is demonstrated by an increased EMG activity in the upper trapezius, but decreased activity in the serratus anterior muscles during elevation
• Restoration of normal scapulohumeral rhythm requires exercises that balance the trapezius and serratus anterior muscles
• Serratus anterior and trapezius weakness will reduce upward scapular rotation and increase the risk of rotator cuff and bicipital impingement

Passive Micro-Mobility
Preparation Glides

• Scapular Release with diagonals
  • Upper Trapezius Release
  • Lateral Glide
Video Clip:
Scapula D1/D2 diagonals
Four Levels – EMG Activity Based on Maximum Voluntary Isometric Contraction (MVIC)

- Level One: 20% of MVIC – Low
- Level Two: 21% to 40% of MVIC – Moderate
- Level Three: 41% to 60% of MVIC – High
- Level Four: More than 60% of MVIC – Very High

Precaution Concerning Rehabilitation

Therapeutic value of EMG Based Recruitment Pattern is a Dynamic Activity Level and Not a Measurement of Tendon Stress.

RECRUITMENT

Scapula Control

Retraction sets
Repositioning for Upper Core Stability
• Theraband Rows – Level 2
• Seated Rows with Weights – Machine or cable – Level 3
• Standing cable - double arm to single arm – Level 3
• Seated on ball - double arm to single arm – Level 3
• Prone Scapular Retraction – Level 3
• Prone Horizontal Abduction (Fly) with Retraction – Level 4

Reference: Ellenbecker TS, Sueyoshi T, et al. CSM Presentation 2017
Scapular Stabilization – Trapezius EMG Based Values

- Prone Extension and prone horizontal abduction with external rotation exercises promote early activation of the middle and lower Trapezius in relationship to the scapular and glenohumeral prime movers.
- SA → GH → Rotator cuff
- LA → ST → Scapular stabilization (advanced)


Protraction – Serratus Anterior Clinical Application Preparation for Elevation

- Press-up plus – ceiling punch – Level 3
- Standing scaption to 120° – Level 4
- Wall push-ups plus – Level 2
- Push-ups plus – floor – Level 4
- Dynamic hug – Level 3

Highest activity of the serratus anterior occurred at 55 degrees of elbow extension during the concentric phase of traditional push-up and not at the plus phase of the exercise.

Reference: San Juan JG, Suprak DN, Roach SM. BMC Musculoskeletal Disorder, 2015
Manual Exercises: The misunderstood component

• Questions we should be asking:
  • What are the three vital motion patterns?
  • The missing link in Glenohumeral motion is?
  • Do we need to reconsider how to design capsular mobility changes?
  • Does mobilization of the shoulder decrease pain?


Clinical Examination: Motion
“The Vital Three Motion Patterns”

Mobility:
• Short lever arm rotation
  • External rotation in modified scaption (1)
  • Internal rotation – spine level
• Long lever arm movement
  • Elevation – transverse plane (2) – distal marker: thumb-up
  • Horizontal abduction above 90° (2)
  • Abduction – modified scaption

• Clinical Concerns of Early Motion
  1. Gravity point concept
  2. Manual motion should begin in a scaption angle
  3. “Rotation before Elevation”
  4. Counter contraction decompression
Video Clip:

Three Vital Motion Patterns

Counter-contraction Decompression

Glenohumeral Preparation Glides

- Inferior Glide
- Rotational Glide
- Posterior glide
- Lateral glide
  - Anterior glide

Traditional Sleeper Stretch

Modified Sleeper Stretch
Quantifying Range of Motion Changes Across 4 Simulated Measurements of the Glenohumeral Joint Posterior Capsule: An Exploratory Cadaver Study

• Greatest ROM change was with flexion (elevation) and internal rotation
• Maximum reduction were observed at interior rotation at 40 and 60 degrees of flexion (elevation)
• Optimum test for assessment of the posterior capsule should consider internal rotation with elevation

Reference: Dashottar A, Borstad J. JOSPT Dec 2016

The Missing Link of Shoulder Rehabilitation

Modes of Contraction
• Isometric – static
• Concentric – shortening/acceleration
• Eccentric – lengthening/deceleration

Eccentric exercise - negative training:
• ↓O₂ – oxygen debt
• ↓ATP – energy challenges
• ↓EMG Activity – less active fibers
to dissipate load
• DOMS = Delayed Onset of Muscle Soreness
• Progressive Repetitive Protocol Needed
  • 2-3 sets of 5
  • 2 sets of 10
  • 3 set of 10

Muscle Work = recruitment x (+/-) ROM

Positional Recruitment

Evidence based – EMG Studies
• Sidelying External Rotation – Level 3
• Prone Extension to hip – Level 3
• Prone Horizontal Abduction with External Rotation – Level 4
• Prone 90/90 External Rotation – Level 3

Reference: Cricchio M, Frazer C. J. Hand Therapy (2011)
Muscle Type Composition of Rotator Cuff Muscles

- Type I – slow-twitch: resistant to fatigue
- Type II – fast-twitch: type II A, type II X

- Muscles disuse is associated with a type I to type II shift.
- Endurance exercise protocols may result in an increase of type I fibers.
- Losing muscle mass, strength, injured or post-operative muscles are likely to be more fatigable due to fiber changes with disuse atrophy.

**Clinical Concept:** Missing link is eccentric strengthening of external rotation.

Reference: Lovering, Russ. JOSPT 2008
• Prone extension: teres minor and deltoid (post) > 60% MVIC

Reference: Evans NA, Dressler EV, UN T – CSM Presentation JOSPT 2017
Positional Recruitment

- Scaption – neutral thumb-up position – Level 3
- Prone Scaption Series – Level 3

Prone Scaption Series

1. Scaption at 100°
2. Scaption at 120°
   • Short-arc ROM for rotator cuff recruitment
3. Long-arc ROM for advanced scapular stabilization with increase of activation of the lower trapezius, used in advanced stages of exercises
   • EMG Level 4

Non-Operative Intervention (exercises)

• Mobility – Scapula – R/O Scapular Dyskinesis
  • Inferior, Posterior & Lateral Glenohumeral glides
  • Anterior Capsule – Post Wall Re-lengthening
  • Posterior Capsule – Modified Sleeper Stretch
• Scapula Stabilization – Retraction/Protraction
• Rotator Cuff Strengthening
  • Prone Series
  • Scaption
  • SIDElying external rotations
• Wall Push-ups – closed kinetic chain
• Rhythmic Stabilization
  • Short lever arm vs. Long lever arm
• Elastic Resistance Exercises

Average Force (pounds) for Thera-band Elastic band

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Vital Five – Home Exercise Program

- Scapular retraction with resistance
- Press up plus protraction
- Prone extension to hip
- Scaption to 90°
- Side-lying external rotation to neutral
Healthy Cuff Program

• Mobility: Posterior and Anterior capsular length
• Positional Recruitment
  1. Sidelying External Rotation
  2. Standing Scaption thumb-up
  3. Prone Extension
  4. Prone Scaption – 100°
  5. Prone Scaption – 120°
  6. Prone Horizontal Abduction with rotation
• Stabilization means pain-free elevation

Ending Thought

• "How much to do without doing too little and avoiding doing too much and understanding the evidence of application between the two points."

TL Trundle 2017
Pre-retiring quotation of the future

Questions