If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

No part of the materials available through the continued.com site may be copied, photocopied, reproduced, translated or reduced to any electronic medium or machine-readable form, in whole or in part, without prior written consent of continued.com, LLC. Any other reproduction in any form without such written permission is prohibited. All materials contained on this site are protected by United States copyright law and may not be reproduced, distributed, transmitted, displayed, published or broadcast without the prior written permission of continued.com, LLC. Users must not access or use for any commercial purposes any part of the site or any services or materials available through the site.
Technical issues with the Recording?

- Clear browser cache using [these instructions](#)
- Switch to another browser
- Use a hardwired Internet connection
- Restart your computer/device

Still having issues?

- Call 866-782-6258 (M-F, 8 AM-8 PM ET)
- Email [customerservice@PhysicalTherapy.com](mailto:customerservice@PhysicalTherapy.com)
ROTATOR CUFF LESIONS
Conservative & Post-Operative Management

David Nolan, PT, DPT, MS, OCS, SCS, CSCS

Learner Outcomes
After this course, participants will be able to:

- List at least three predisposing factors related to rotator cuff pathology.
- Identify at least two appropriate rehabilitation interventions for each stage of healing following rotator cuff surgical interventions.
- Develop an evidence-based therapeutic plan of care targeting rotator cuff and scapular region musculature.
Biomechanics

- Scapulohumeral rhythm
  - 2° of GH motion for every 1° of ST motion
  - 180° shoulder elevation
    - 120° humeral elevation
    - 60° scapular rotation

Force Couples

- Deltoid – Rotator Cuff Force Couple
  - Unopposed deltoid = superior migration
Force Couples

- Anterior-Posterior Rotator Cuff Force Couple
  - Anterior: Subscapularis
  - Posterior: Infraspinatus & Teres Minor

Force Couples

- Upper Trapezius-Serratus Anterior Force Couple
  - Shoulder elevation
  - Upward rotation of scapula
  - Functions
    1. Optimal position of glenoid
    2. Deltoid length-tension
    3. Prevents impingement
    4. Stable base to recruit scapular musculature
Rotator Cuff

- Provides dynamic stabilization by compressing humeral head into glenoid

Rotator Cuff

- RC muscles blend with capsule & create dynamic ligament tension
Rotator Cuff Lesions

- Wide spectrum of severity
  - Mild impingement → Full thickness tear
- Progressive failure

Progressive Process

- Tendonitis
  - Inflammation of the tendon
  - Most often tendon sheath
- Bursitis
  - Inflammation of the subacromial bursa
- Tendonosis
  - Intrasubstance degeneration or tearing
Subacromial Impingement

- Subacromial Space
  - 11mm @ 0°
  - 5.7mm @ 90°
- Tendons of rotator cuff
- LHB tendon
- Subacromial bursa
- Superior capsule

Etiology

- Humeral head depressor weakness / fatigue
- GH instability
- Posterior capsule tightness
- Scapular muscle weakness / Dyskinesia
- Subacromial crowding
Pathology

Inflammation
\[ \downarrow \]
Tendinitis
\[ \downarrow \]
Fibrotic scar tissue / tendinosis
\[ \downarrow \]
Bone Spur
\[ \downarrow \]
Partial thickness tear
\[ \downarrow \]
Full thickness tear

Mechanism of Injury

- Acute is rare
- Chronic
  - Repetitive microtrauma
  - Throwing sports
  - Vocational demands
Patient Presentation

- Pain & decreased ROM
- Painful Arc 60° - 120°
- Muscle dysfunction
- Tendon & bursal thickening

Neer Classification

- Stage I
  - Edema and hemorrhage
  - <25 y/o
  - Tenderness @ greater tuberosity & anterior acromion
  - Reversible pathology
  - Treatment = PT
Neer Classification

- Stage II
  - Fibrosis of capsule and bursa
  - Tendinitis of rotator cuff
  - 25-40 y/o
  - Loss of motion evident
  - Recurrent pain with increased activity
  - Treatment = PT & possibly surgery
    - Sub-acromial decompression

- Stage III
  - Tendinosis / cuff failure
  - Bone spurs & tendon rupture
  - >40 y/o
  - Limited AROM
  - Atrophy of posterior RC
  - Progressive disability
  - Treatment = surgery
    - Sub-acromial decompression & RC repair
Predisposing Factors

- AC joint
  - Degenerative spurs
- Bursa
  - Chronic Thickening
- Capsule / Ligaments
  - Hypermobility
  - Hypomobility

Predisposing Factors

- Scapula
  - Abnormal position / rhythm
    - Winging
    - Anterior tilt
Predisposing Factors

- **Acromion**
  - Degenerative spurs
  - Malunion / Fracture
  - Shape
    - Type I: Flat
    - Type II: Curved
    - Type III: Hooked

- **Rotator Cuff**
  - Thickening / Scarring
  - Posterior cuff weakness
  - Deltoid allowed to fire unopposed resulting in superior migration
  - Hypovascular zone?
    - Blood flow decreases with age

---

Article authors: Guo, Xiaoguang; Ou, Min; Yi, Gang; Qin, Bo; Wang, Guoyou; Fu, Shijie; Zhang, Lei [CC BY 4.0 (https://creativecommons.org/licenses/by/4.0)]
Primary Impingement

- **Characteristics**
  - Hypomobile
  - > 40 yo
  - Etiology
    - Disruption of normal mechanics

**Treatment**
- Decrease pain / inflammation
- Normalize motion
  - Capsular tightness
    - Inferior and posterior
  - Soft tissue adaptive changes
    - Pectoralis minor
Primary Impingement

- **Treatment**
  - Improve dynamic stability / endurance
    - Posterior cuff
    - Scapular muscles
  - Postural correction
  - Patient education / activity modification

Secondary Impingement

- **Characteristics**
  - Hypermobility of static stabilizers
  - Overuse leads to loss of dynamic stability provided by rotator cuff
  - 15 – 40 yo
Secondary Impingement

Static Stabilizers stretched ↓
Increased GH translation ↓
RC fatigues ↓
Overuse tendinitis ↓
Tendon fibers fail ↓
RC unable to control HOH during elevation ↓

Superior migration occurs ↓
Muscle dysfunction leads to decreased scapular rotation ↓
Elevation limited by acromion ↓
Impingement syndrome is secondary/resulting pathology

Superior Migration
Secondary Impingement

- Treatment
  - Cuff strengthening
    - Focus posterior
  - Scapular stabilization
    - Retraction
    - Protraction
    - Depression
  - Neuromuscular influences
  - Avoid repetitive microtrauma

Impingement

- Primary vs Secondary
  - Jobe Subluxation / Relocation
    - Primary: No change in symptoms
    - Secondary: Decreased symptoms with ↑ ER
Internal Impingement

**Mechanism**
- Abduction and ER (late cocking phase)
- Normal shoulder translates posterior
  - Overhead throwing athletes have excessive anterior translation and GH ER
- Compressive force between greater tuberosity and posterior/superior labrum
- Undersurface of supraspinatus and infraspinatus implicated

**Presentation**
- Pain with excessive ER at 90° Abd
- Symptoms with overhead activities
- History of recurrent symptoms
- Loss of control and velocity
Internal Impingement

- Exam
  - Posterior pain on palpation
    - Infraspinatus tendon
  - Anterior capsule laxity
  - Posterior shoulder tightness \( (p=.03) \)
    - Myers et al. AJSM 2006
  - Normal ROM
    - ↑ ER and ↓ IR
    - GIRD \( (p=.03) \)
    - Myers et al. AJSM 2006
  - Weak external rotators
  - Weak scapular muscles
  - (+) Jobe Subluxation/relocation

Internal Impingement

- Treatment
  - Decrease pain / inflammation
    - Avoid irritating motions/activities
  - Dynamic stability of RC
    - Rhythmic stabilization
    - Closed chain drills
  - Scapular muscle training
    - Emphasize retraction & depression
  - Neuromuscular training
    - Perturbation
  - Proper throwing mechanics
Special Testing of the Shoulder Complex

SPECIAL TESTING

Sensitivity
Percentage of patients with a particular pathology / diagnosis that are correctly identified by a (+) test.
SnNout: High sensitivity tests with (-) results help rule out a disorder

Specificity
Percentage of patients without a particular pathology / diagnosis that are correctly identified by a (-) test.
SpPin: High specificity tests with (+) results help rule in a disorder
SPECIAL TESTING

Positive Likelihood Ratio (LR+)
Shift in probability that favors the *existence* of the disorder

Negative Likelihood Ratio (LR-)
Shift in probability that favors the *absence* of the disorder

<table>
<thead>
<tr>
<th>LR +</th>
<th>Explanation</th>
<th>LR -</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2</td>
<td>Alters posttest probability of a diagnosis to a minimal degree</td>
<td>.5 to 1</td>
</tr>
<tr>
<td>2 to 5</td>
<td>Alters posttest probability of a diagnosis to a small degree</td>
<td>.2 to .5</td>
</tr>
<tr>
<td>5 to 10</td>
<td>Alters posttest probability of a diagnosis to a moderate degree</td>
<td>.1 to .2</td>
</tr>
<tr>
<td>&gt;10</td>
<td>Alters posttest probability of a diagnosis significantly and almost conclusively</td>
<td>&lt; .1</td>
</tr>
</tbody>
</table>
Impingement Syndrome & Rotator Cuff Tests

**IMPINGEMENT TESTING**

- Speed’s Test
  - SLAP (Deep)
  - LHB (Anterior)

- Calis et al (SAI)
  - Sensitivity = 69%
  - Specificity = 56%
  - (+) LR = 1.57 (minimal)
  - (-) LR = 0.55 (minimal)
IMPINGEMENT TESTING

- Yergason's
  - LHB & THL

  - Sensitivity = 37%
  - Specificity = 86%
  - (+) LR = 2.7 (small)
  - (-) LR = .73 (minimal)

- Neer Test
  - Supraspinatus & LHB

- MacDonald et al. JSES 2000
  - Sensitivity = 75%
  - Specificity = 48%
  - (+) LR = 1.44 (minimal)
  - (-) LR = .52 (minimal)

- Bak et al. AJSM 1997
  - Sensitivity = 39%
  - Specificity = 100%
  - (+) LR = NA
  - (-) LR = .61 (minimal)

  - Sensitivity = 89%
  - Specificity = 31%
  - (+) LR = 1.29 (minimal)
  - (-) LR = .35 (small)
IMPINGEMENT TESTING

- Hawkins-Kennedy
  - Supraspinatus

- MacDonald et al. JSES 2000
  - Sensitivity = 92%
  - Specificity = 44%
  - (+) LR = 1.64 (minimal)
  - (-) LR = .18 (moderate)

- Bak et al. AJSM 1997
  - Sensitivity = 80%
  - Specificity = 76%
  - (+) LR = 3.33 (small)
  - (-) LR = .26 (small)

  - Sensitivity = 78%
  - Specificity = 100%
  - (+) LR = NA
  - (-) LR = .21 (small)

  - Sensitivity = 92%
  - Specificity = 25%
  - (+) LR = 1.23 (minimal)
  - (-) LR = .32 (small)
IMPINGEMENT TESTING

- Supraspinatus Test / Jobe-Yocum

Holtby et al: 3 groups
- (1) Supraspinatus tendinitis partial thickness tear
- (2) Full thickness tear
- (3) Large to massive tear
- Sensitivity = 62%, 41%, 88%
- Specificity = 54%, 70%, 70%

IMPINGEMENT TESTING

- Internal Rotation Resistance Strength Test
  - Compare IR and ER strength
  - (+) IRRST = ER > IR
    - (+) IRRST: intra-articular
      - ER stronger
    - (-) IRRST: outlet impingement
      - ER weaker
  - Zaslav et al. JSES 2001
    - Sensitivity: 88%
    - Specificity: 96%
    - (+) LR: 22.0 (conclusive)
    - (-) LR: .13 (moderate)
ROTATOR CUFF INTEGRITY

- Lag Signs
  - ERLS
    - Infraspinatus
    - Supraspinatus
  - Hertel et al
    - Sensitivity = 70%
    - Specificity = 100%
    - (+) LR = NA
    - (-) LR = .30 (small)

- Lag Signs
  - 90/90 lag sign
    - Infraspinatus
    - Supraspinatus
  - Hertel et al
    - Sensitivity = 36%
    - Specificity = 100%
ROTATOR CUFF INTEGRITY

**Lift-Off Test**
- Subscapularis
- Gerber C & Krushnell RJ JBJS (Br) 1991
- Barth JRH et. al. *Arthroscopy* 2006
  - Sensitivity: 17.6%
  - Specificity: 100%
  - PPV: 100%
  - NPV: 76.7%
- Tokish JM. at. al. *JSES* 2003
  - Lower fibers via EMG

**Lag Signs**
- IRLS
  - Subscapularis
- Hertel et al. *JSES* 1996
  - Sensitivity = 97%
  - Specificity = 96%
  - (+) LR = 24.3 (conclusive)
  - (-) LR = .03 (conclusive)
ROTATOR CUFF INTEGRITY

- Belly Press Test
  - Subscapularis
  - Gerber C et al. *JBJS (Am)* 1996
  - Barth JRH et. al. *Arthroscopy* 2006
    - Sensitivity: 40%
    - Specificity: 97.9%
    - PPV: 88.9%
    - NPV: 79.7%
  - Tokish JM. et. al. *JSES*. 2003
    - Upper fibers via EMG

- Napoleon Test
  - Subscapularis
    - Variation of Belly-Press Test
  - Barth JRH et. al. *Arthroscopy* 2006
    - Sensitivity: 25%
    - Specificity: 97.9%
    - PPV: 83.3%
    - NPV: 75.8%
ROTATOR CUFF INTEGRITY

- Bear-Hug Test
  - Subscapularis
  - Barth JRH et al. *Arthroscopy* 2006
    - Sensitivity: 60%
    - Specificity: 91.7%
    - PPV: 75%
    - NPV: 84.6%

Subscapularis
- (+) Bear Hug & Belly Press
  - Upper 1/3 tears
  - 50% tear needed
- (+) Napoleon
  - 75% tear needed
- (+) Lift-Off
  - 40% tears missed clinically
Barth JRH et al. *Arthroscopy* 2006
ROTATOR CUFF INTEGRITY

- Hornblower’s Sign
  - (+) patient unable to ER

- Walch et al. *JBJS (Br)* 1998
  - Sensitivity: 100%
  - Specificity: 93%
  - (+) LR: 14.29 (conclusive)
  - (-) LR: 0.0 (conclusive)

- Dropping Sign
  - (+) patient unable to maintain position of ER

- Walch et al. *JBJS (Br)* 1998
  - Sensitivity: 100%
  - Specificity: 100%
  - (+) LR: NA
  - (-) LR: 0.0 (conclusive)
SUMMARY

- Impingement Testing
  - Literature is mixed for Neer and Hawkins-Kennedy tests
  - IRRST is helpful differentiating intra-articular dysfunction from outlet impingement
  - Utilizing a diagnostic cluster likely the best approach

- Rotator Cuff Integrity Testing
  - Dropping Sign is sensitive & specific for infraspinatus tears
  - Hornblower sign is sensitive & specific for teres minor tears

ROTATOR CUFF LESIONS

Surgical Interventions & Rehabilitation
Influencing Factors

- Bishop J et al. JSES 2006
  - Age (healing)
  - Activity level
  - Type of repair
    - Open (deltoid taken down)
    - Mini-Open (deltoid split)
    - Arthroscopic
  - Tissue quality
    - Soft tissue integrity
      - Repair and surrounding tissue
    - Osseous integrity
      - Fixation strength

- Size of tear
  - Bishop J et al. JSES 2006
    - Small: <1cm
    - Medium: 1-3cm
    - Large: 3-5cm
    - Massive: >5cm
Influencing Factors

- Location of tear
  - Isolated supraspinatus
  - Supraspinatus and Infraspinatus
  - Subscapularis

Positive Outcome

Prognostic Factors for Successful Recovery After Arthroscopic Rotator Cuff Repair: A Systematic Literature Review

  - Demographic Factors
    - Younger age, male gender
  - Clinical Factors
    - Higher BMD, (-) DM, (-) obesity, ↑ pre-op ROM, ↑ sports activity
Positive Outcome

  - Cuff Integrity
    - Smaller sagittal size, less retraction, less fatty infiltrate, (-)
      multiple tendon involvement
  - Surgical Procedure
    - (-) concomitant biceps or AC procedures

Surgical Interventions

- Impinging Lesions
  - Arthroscopic Acromioplasty
    - Acromial spur removed
    - Coracoacromial ligament released
    - AC joint osteophytes excised
Surgical Interventions

- Full Thickness Rotator Cuff Tear
  - Open repair
    - Pros
      - Exposes all involved anatomy
      - Allows for mobilization of tendons
    - Cons
      - Release of deltoid
      - Hospital stay
      - Longer rehab
      - Unable to examine GH joint and subacromial space
      - Decreases cosmesis

- Arthroscopically Assisted Mini-Open Repair
  - Pros
    - Visualization of cuff tear (open)
    - No deltoid release (arthroscopy)
    - Possibly better fixation
Mini-Open Surgical Technique

- Visualization of Supraspinatus tear
- Retraction from footprint

Mini-Open Surgical Technique

- Sutures through bone tunnel
- Suture Anchors
Mini-Open Surgical Technique

- Tear is brought back to footprint
- Bony notch to improve healing

Surgical Interventions

- Full Thickness Rotator Cuff Tear
  - Arthroscopic Rotator Cuff Repair
    - Pros
      - No deltoid release
      - Limited morbidity
      - Accelerated rehab
      - Improved cosmesis
    - Cons
      - Technically demanding
Platelet-Rich Plasma

  - RCT: 25 patients (12 PRP; 13 saline)
    - 1 injection intra-op & 1 @ 4-weeks post-op
    - 6-week F/U; No statistical difference in outcomes
      - VAS, EQ-5D, WORC, DASH

  - RCT: 51 patients (26 PRP; 25 control)
  - 5 year F/U; No difference in outcomes
    - UCLA, Constant, VAS
Failure

- Integrity of Repair
  - 22% had recurrent tears on MRI at 2 Yr F/U
    - Cole BJ et al. JSES 2007
  - 40% of tendons not healed
    - DeFranco MJ et al. JSES 2007
  - 88% (15/17) showed leakage with MR Arthrography
    - Meyer M et al. JSES 2012

- Anatomic Integrity does not correlate with functional outcomes or patient satisfaction

Delayed Mobility?

**Does Slower Rehabilitation After Arthroscopic Rotator Cuff Repair Lead to Long-term Stiffness?**

  - Sling immobilization for 6 weeks post-op
    - Did not result in long term stiffness (1 yr)
    - May improve rate of tendon healing (less re-tears)
Rehabilitation

A Comparison of Rehabilitation Methods After Arthroscopic Rotator Cuff Repair: A Systematic Review

- No significant difference between early versus late mobilization approaches

Post-Operative Rehabilitation
- Phase I (0-6 weeks)
  - Passive exercises
  - Minimize load across repair
- Phase II (6-10 weeks)
  - Active exercises
  - Gradual load repair
- Phase III (10-12 weeks)
  - Resistive exercises
  - Restore force production of cuff
- Phase IV (16-24 weeks)
  - Restore maximum strength, power, endurance
### Range of Motion Goals

<table>
<thead>
<tr>
<th></th>
<th>Passive Scaption</th>
<th>Passive ER 20° Abd</th>
<th>Passive ER 90° Abd</th>
<th>Active Scaption</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD 1</td>
<td>60°– 90°</td>
<td>0°– 15°</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>POW 1</td>
<td>60°– 90°</td>
<td>0°– 20°</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>POW 3</td>
<td>90°– 100°</td>
<td>15°– 30°</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>POW 6</td>
<td>90°– 120°</td>
<td>20°– 45°</td>
<td>40°– 60°</td>
<td>NA</td>
</tr>
<tr>
<td>POW 9</td>
<td>130°– 155°</td>
<td>30°– 60°</td>
<td>50°– 75°</td>
<td>80°– 120°</td>
</tr>
</tbody>
</table>

### Rehabilitation

- **Phase I (0-6 weeks): Protect Repair**
  - Immobilization in Abduction sling
    - Prevent “wringing out”
    - ↓ tension on repair
  - PROM
    - May assist with proper orientation of type 1 collagen
    - Assist with proper tendon gliding
  - “Stretching” should be avoided
  - Establish voluntary muscle control
Rehabilitation

- Phase I interventions
  - Patient education key
  - Sling 4-6 weeks (per MD)
  - Immediate PROM
    - Elbow wrist and hand (modify with biceps involvement)
    - Achieve staged ROM goals
    - Scapular plane
    - Caution excessive Abd & IR
    - Avoid pulleys
      - EMG shows RC is active (Burkhart SS et al. Arthroscopy. 1997)
  - Manual scapular strength
  - Cryotherapy
    - Control post-op pain
    - ↓ swelling & muscle spasm

Rehabilitation

- Milestones to Progress to Phase II
  - Appropriate healing
    - Compliant with immobilization
    - Compliant with precautions
  - Staged ROM goals on target
    - Scaption (90° – 120°)
    - ER 20° Abd (20° – 45°)
    - ER 45° Abd (40° – 60°)
  - Minimal pain with ROM
    - ≈ 2/10
Rehabilitation

- Phase II (6-12 weeks)
  - D/C Sling
    - Consider pain and compliance
  - Progress to full PROM
  - Initiate self-assisted & AAROM → AROM
    - Focus on good mechanics
  - Strengthening
    - No resisted RC exercise
  - Scapulothoracic focus
    - Dynamic stability
  - Independent with ADLs (Week 12)

- Phase II interventions
  - Continue P-A-AAROM
    - Pec minor
  - Continue rhythmic stabilization
    - Middle and lower trapezius
  - Strength (10-12 weeks)
    - Isometrics
    - Scaption with ER (Full Can)
    - Sidelying Abduction to 45°
      - ↑ Supraspinatus with ↓ risk of impingement
    - Avoid painful exercises
  - Initiate low level functional activities
Rehabilitation

- Milestones to Progress to Phase III
  - Staged AROM achieved
    - 0-2/10 pain
    - Without compensation
  - Strengthening Activities progressing
    - 0-2/10 pain
  - Normal scapular position
    - Static and dynamic

- Phase III (12 - 24 weeks)
  - Goals
    - Full P / AROM
    - Dynamic shoulder stability
    - Shoulder strength & endurance
    - CKC activities
    - Neuromuscular Re-Ed
      - Joint reposition
    - Return to work activities
    - Initiate modified recreational activities
Rehabilitation

- **Phase III Interventions**
  - Scapular plane initially
  - No compensatory patterns
  - High repetition focus

---

Rehabilitation

- **Milestones to Progress to Phase IV**
  - Adequate strength & dynamic stability for progression to work / sport activity
  - Normal scapular position
    - Static and dynamic
Rehabilitation

- Phase IV
  - Replicate demands of ADL and work activity
  - Plyometric program
  - Initiate interval sport program

Massive Rotator Cuff Tears

- 40% of all RC tears (Greenspoon JA et al. JSES. 2015)
  - Atrophy & fatty infiltrate
  - Management of irreparable tears
    - Non-Operative
      - Low demand patients; OA over time
    - Partial Repair & Debridement
      - Good results; limited long-term data
    - Reverse TSA
      - Elderly patients with advanced OA
  - Latissimus Dorsi Transfer (Namdari S et al. JBJS Am. 2012)
    - Younger patients with posterosuperior tears
    - High complication rates
Massive Rotator Cuff Tears

- Superior Capsule Reconstruction
  - Mihata T et al. AJSM. 2012
    - Technique
      - Fascia Lata autograft
      - Dermal allograft
    - Prevents superior migration
    - Functioning deltoid & subscapularis.

Superior Capsule Reconstruction for Massive Rotator Cuff Tears-Key Considerations for Rehabilitation

- Post-Operative Rehabilitation
  - Pogorzelski J et al. IJSPT. 2017
Phase 1: Maximal Protection

- Goals:
  - Protect repair
  - Minimize pain/inflammation
  - Maintain mobility accessory joints
  - Patient education

- Interventions:
  - Immobilized in abduction sling x6 weeks
  - Cryotherapy
  - AROM cervical spine
  - AROM elbow, wrist, hand out of sling
  - Ball squeezes
  - Scapular retraction/depression

Phase 2: ROM & Endurance

- Goals:
  - Restore ROM
  - ↑ RC endurance
  - Restore scapulohumeral rhythm
  - Initiate light ADLs
  - Ween sling

- Interventions:
  - PROM / AROM to tolerance
  - Deltoid activation
  - ER function (dependent on tissue quality)
  - Scapular & GH isometrics
Phase 2: ROM & Endurance

- SL Abduction

- SL H-Abduction

---

Phase 3: Strength

- Goals:
  - Advanced strength
  - Restore functional ROM
  - Resume higher level functional activities

- Interventions:
  - Progressive resisted ROM
  - Initiate CKC exercises
  - **Normal scapulohumeral rhythm**
Phase 4: Advanced Strength / Return to Activity

- As appropriate

- Interventions:
  - **Endurance**
  - Overhead strength
  - Advanced CKC
  - Plyometrics

Keys to Success

- Establish PROM
- Restore ER strength
- Establish shoulder balance
- Improve scapular position & movement
- Gradually increase loads
- Avoid aggressive activities early on
- Gradual return to functional activities
Therapeutic Exercise Considerations

Shoulder Complex Function

- Goals:
  - Joint compression
  - Dynamic ligament tension
  - Neuromuscular control
  - Scapulothoracic Control

- Mobility → Stability → Controlled Mobility → Skill
Force Couples

- Deltoid – Rotator Cuff
  - Unopposed deltoid = superior migration

- Anterior-Posterior Rotator Cuff
  - Anterior:
    - Subscapularis
  - Posterior:
    - Infraspinatus & Teres Minor

Force Couples

- Upper Trapezius-Serratus Anterior
  - Shoulder elevation
  - Upward rotation of scapula
  - Functions
    - Optimal position of glenoid
    - Deltoid length-tension
    - Prevents impingement
    - Stable base to recruit scapular musculature
No Cook Books

- Emphasis should be an individualized approach
  - Consider specific deficits and demands
  - Respect the surrounding tissues and stage of healing
    - Control Pain & Inflammation

EMG Considerations

- Surface vs. fine wire EMG
  - “Cross Talk”

- Isometric contractions vs. dynamic movement

- Healthy subjects vs. patients with shoulder pathology

- Subject demographics
Glenohumeral Muscles

- Townsend et al. AJSM 1991
  - “Best” exercises
    - Scaption in IR “Empty Can”
      - 74% MVIC Supraspinatus
    - Scaption in ER = 64%
    - 62% MVIC Subscapularis
    - Flexion
      - 67% MVIC Supraspinatus
    - Horizontal Abd with ER
      - 88% MVIC Infraspinatus
      - 74% MVIC Teres Minor
    - Press-up

Empty Can?

- Townsend et al. AJSM 1991
  - Highest Anterior Deltoid (72% MVIC) & Middle Deltoid (83% MVIC)
- Flatow EL et al. AJSM, 1994
  - May be painful 2° impingement position
  - ↑ superior migration of humeral head
- Kelly et al. AJSM, 1996
  - 11 subjects; Non-dominant shoulders
  - Supraspinatus isolation best achieved: Scaption with ER
  - Less deltoid in “full can” position
- Itoi et al. AJSM, 1999
  - EMG activity similar between thumb up and down positions
  - Thumb up was more comfortable
- Thigpen et al. AJSM, 2006
  - ↑ Anterior tipping & IR of scapula in “Empty Can” position = ↓ Subacromial space
  - Less deltoid with full can
    - 84% full can; 124% empty can
Force Couples

- Deltoid – Rotator Cuff Force Couple
  - Unopposed deltoid = superior migration
    - Full Can at lower loads = best supraspinatus to deltoid rat
    - Isometric ER @10-40% MVIC maximized infraspinatus and minimized deltoid

Rotator Cuff

Scapulothoracic and Scapulohumeral Exercises: A Narrative Review of Electromyographic Studies

- Cricchio M & Frazer C. J Hand Ther. 2011
  - Reviewed 22 EMG studies; Highest activation

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Primary Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isometric ER</td>
<td>Infraspinatus</td>
</tr>
<tr>
<td>Sidelying ER</td>
<td>Infraspinatus, Teres Minor</td>
</tr>
<tr>
<td>Full Can</td>
<td>Supraspinatus</td>
</tr>
<tr>
<td>Prone H-Abd @100°full ER</td>
<td>Supraspinatus</td>
</tr>
<tr>
<td>Push-Up Plus</td>
<td>Subscapularis</td>
</tr>
<tr>
<td>Diagonal D2 Extension</td>
<td>Subscapularis</td>
</tr>
</tbody>
</table>
External Rotation

- Reinold MM et al. *JOSPT* 2004
  - Sidelying ER = Greatest EMG
    - Infraspinatus: 62% MVIC
    - Teres Minor: 67% MVIC
  - Towel Roll
    - ↑ infraspinatus muscle activity: 10% ↑ in EMG
    - Improved form: keep arm at side

- ER at 90° Abduction
  - Functional position for overhead athletes/workers
  - Caution: ↑ strain on capsule in 90°-90° position
  - Avoid in early rehab

- Manual Therapy
  - Manual resistance
  - Incorporate concentric & eccentric contractions
Subscapularis

- Decker et al. AJSM, 2003
  - 15 healthy subjects
  - Upper and lower fibers of subscapularis act independently
  - Greatest subscapularis activity:
    - Push-up plus
    - Diagonal exercise (tennis forehand)

- IR at 0° not ideal due to co-contraction of
  - Anterior deltoid
  - Pectoralis major
  - Latissimus dorsi

Scapular Dysfunction

<table>
<thead>
<tr>
<th>Impairment / Biomechanical Cause</th>
<th>Faulty Scapular Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ Serratus Anterior strength</td>
<td>↓ Scapular upward rotation &amp; posterior tilt</td>
</tr>
<tr>
<td>↓ Pec Minor length</td>
<td>↑ Scapular IR &amp; anterior tilt</td>
</tr>
<tr>
<td></td>
<td>↓ Scapular upward rotation &amp; posterior tilt</td>
</tr>
<tr>
<td>↑ Thoracic kyphosis / flexed posture</td>
<td>↑ Scapular IR &amp; anterior tilt</td>
</tr>
<tr>
<td></td>
<td>↓ Scapular upward rotation &amp; posterior tilt</td>
</tr>
<tr>
<td>↓ Posterior GHJ Soft tissue length</td>
<td>↑ Scapular anterior tilt</td>
</tr>
</tbody>
</table>

Mobility

- Pec Minor
  - Muscle tightness may lead to reciprocal inhibition
    - Weakness of antagonist
  - Borstad JD et al. JSES 2006
    - Doorway stretch
      - (+ 2.24 cm)
    - Supine manual stretch
      - (+ 1.69 cm)
    - Seated manual stretch
      - (+ 0.77 cm)
    - Shoulder retraction in 30° fwd flex

- Thoracic Spine

Scapular Stabilizers

  - “Best” exercises
    - Scaption
    - Rowing
    - Push Up Plus
    - Press Up
Scapular Stabilizers

Scapulothoracic and Scapulohumeral Exercises: A Narrative Review of Electromyographic Studies

- Cricchio M & Frazer C. *J Hand Ther*. 2011
- Reviewed 22 EMG studies; Highest activation

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Primary Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prone Extension</td>
<td>Middle Trapezius</td>
</tr>
<tr>
<td>Prone T</td>
<td>Middle &amp; Lower Trapezius</td>
</tr>
<tr>
<td>Prone Y</td>
<td>Middle &amp; Lower Trapezius</td>
</tr>
<tr>
<td>Inferior Glide</td>
<td>Serratus Anterior, Lower Trapezius</td>
</tr>
<tr>
<td>Isometric Low Row</td>
<td>Serratus Anterior, Lower Trapezius</td>
</tr>
<tr>
<td>Lawnmower</td>
<td>Serratus Anterior, Lower Trapezius</td>
</tr>
<tr>
<td>Push-Up Plus</td>
<td>Serratus Anterior, Lower Trapezius</td>
</tr>
<tr>
<td>Wall Slide</td>
<td>Serratus Anterior</td>
</tr>
<tr>
<td>Dynamic Hug</td>
<td>Serratus Anterior</td>
</tr>
</tbody>
</table>
Trapezius

- Ekstrom RA. et. al. JOSPT 2003
  - Surface EMG 30 healthy subjects
    - Upper Trapezius
      - Unilateral shrug (%MVIC 119 ± 23)
    - Middle Trapezius
      - Prone elevation (%MVIC 101 ± 32)
      - Prone Horizontal Ext (%MVIC 87 ± 20)
    - Lower Trapezius
      - Prone Elevation (%MVIC 97 ± 16)

- McCabe RA. et. al. NAJSPT 2007
  - Lower Trapezius below 90°
    - Seated press up
    - Unilateral scapular retraction

<table>
<thead>
<tr>
<th>Exercise</th>
<th>UT %MVIC</th>
<th>MT % MVIC</th>
<th>LT % MVIC</th>
<th>SA % MVIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press Up</td>
<td>27</td>
<td>32</td>
<td>56</td>
<td>44</td>
</tr>
<tr>
<td>Scap Retraction</td>
<td>62</td>
<td>50</td>
<td>51</td>
<td>26</td>
</tr>
<tr>
<td>B Shoulder ER</td>
<td>17</td>
<td>37</td>
<td>40</td>
<td>29</td>
</tr>
<tr>
<td>Scap Depression</td>
<td>20</td>
<td>19</td>
<td>21</td>
<td>41</td>
</tr>
</tbody>
</table>
Trapezius

- Cools AM. et al. AJSM 2007
  - 45 healthy subjects
    - Mean age = 20.7 ± 1.7
    - Surface EMG
      - Upper, Middle, Lower trapezius
      - Serratus Anterior
  - Examined 12 exercises
    - UT/LT
      - SL flexion, SL ER, Prone H-Abd in ER
    - UT/MT
      - SL flexion, SL ER, Prone Ext

- De Mey K. et al. AJSM 2012
  - OH Athletes with Mild Impingement; 6-week exercise program
  - Prone H-Abd with ER, Sidelying Flexion, Sidelying ER, Prone Extension
  - SPAD I scores improved
    - 29.86 ± 17.03 to 11.7 ± 13.78 (P<.001)
    - Improved pain and function
  - Increased MVIC of trapezius muscles
  - Earlier activation of LT compared to UT and MT (P<.001)
  - Earlier activation of SA compared to UT & MT (P<.001) and LT (P<.046)
• Kibler et al. AJSM 2008
  • 39 subjects
  • Mean age of 29.62 yrs
  • Asymptomatic
    • 9 male / 9 female
  • Symptomatic
    • 13 male / 8 female
    • Dx of impingement (9), labral pathology (5) or RC tendinopathy (7)
    • Demonstrated scapular dyskinesis
  • Surface EMG
    • Serratus Anterior
    • Upper and Lower Trapezius
    • Anterior and Posterior Deltoid

• 4 Exercises
  • Inferior Glide
  • Low Row
  • Lawnmower
  • Robbery
**Early Rehabilitation**

- **Kibler et al. AJSM 2008**
  - No difference among groups
  - Serratus Anterior activated 1st in inferior glide and low row
  - Serratus Anterior activated last in lawnmower and robbery
  - Key is position of scapular retraction

---

**Serratus Anterior**

- **Ludewig PM et. al. AJSM 2004**
  - Healthy & mild dysfunction groups
  - Surface EMG of SA and UT
  - Low UT/SA ratio
    - Standard Push-Up Plus was optimal
  - Wall Push-Up Plus
    - Highest UT activation of all positions tested
Serratus Anterior

Serratus Anterior or Pectoralis Minor: Which Muscle Has the Upper Hand During Protraction Exercises?

- Castelein R t al. Man Ther. 2016
  - SA Punch with pulley resistance
  - Max Serratus Anterior with Min Pec Minor

- Ekstrom RA. et. al. JOSPT 2003
  - Surface EMG 30 healthy subjects

  - Serratus Anterior
    - Diagonal exercise
      - Flexion, horiz flexion, ER
      - %MVIC 100 ±
    - Scaption above 120°
      - %MVIC 96 ± 24
Serratus Anterior

- Hardwick et al. JOSPT, 2006
  - 20 healthy subjects performed:
    - Wall Slide
    - Push-Up (+)
    - Scaption

  - Serratus Anterior activity was similar for all 3 exercises

  - Wall slide activates Serratus Anterior above 90° of elevation

---

Serratus Anterior

  - 16 healthy, active volunteers
  - Surface EMG
    - Lower SA
    - Middle SA
    - Upper Trapezius
  - Scapula protraction key

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Elevation</th>
<th>Diagonal Elevation</th>
<th>Dynamic Hug</th>
<th>Dynamic Hug (+)</th>
<th>Push-Up (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA</td>
<td>48.2</td>
<td>63.6</td>
<td>45</td>
<td>85.1</td>
<td>54.6</td>
</tr>
<tr>
<td>ISA</td>
<td>41.6</td>
<td>62.7</td>
<td>35</td>
<td>67.7</td>
<td>65.6</td>
</tr>
<tr>
<td>UT</td>
<td>49</td>
<td>36.3</td>
<td>7.7</td>
<td>4.3</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Scapular Musculature

Superficial and Deep Scapulothoracic Muscle Electromyographic Activity During Elevation Exercises in the Scapular Plane

Castelein B et al. JOSPT 2016

- 21 Healthy subjects
- Fine wire and surface EMG
- Weighted and non-weighted
  - Elevation in scapular plane
  - Towel wall slide
  - Elevation with ER & Tband

- Upper Trap: ↑ Activation with Scaption 😞
- Middle & Lower Trap: ↑ Activation with Elevation & ER 😊
- Serratus Anterior: ↑ Activation with all 3 exercises 😊
- Pec Minor: ↑ Activation with Wall Slide 😞

Castelein B et al. JOSPT 2016
A Systematic Review of the Exercises That Produce Optimal Muscle Ratios of the Scapula Stabilizers in Normal Shoulders


- Upper trapezius had the **GREATEST** activity during standing exercises
  - Highest during 60°-120°

- Upper trapezius had the **LEAST** activity during exercises in prone, side-lying and supine

---

**Summary**

Optimal Exercise Prescription is Multi-Factorial

- Individualized to address deficits of dynamic stability
- Specific demands of the patient
- Stage of healing
- Pain level
- Concomitant injury
Thank You