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
Concepts of the Three P’s

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


True Function of the Rotator Cuff

- Dynamic decompression of the humeral head by providing balance of the upper pull of the deltoids
- Steer and stabilize the humerus to the glenoid
- Result = smooth rotational movement to allow shoulder elevation

CKC vs. OKC Exercises: Shoulder

- Moveable – No Load (MNL) = passive
- Moveable – External Load (MEL) = OKC
  - Concentric – Acceleration $W=F(+D)$
  - Eccentric – Deceleration $W=F(-D)$
- Fixed – External Load (FEL) = CKC

Clinical Examination Motion

Mobility:
• Short lever arm rotation
  – External rotation in modified scaption
  – Internal rotation – spine level
• Long lever arm movement
  – Elevation – transverse plane
  – Horizontal abduction at 90°
  – Abduction – modified scaption

Early Motion Concerns

- Why pendulum exercises need to be reconsidered
- Self-ROM with cane/wand is usually performed incorrectly
- Manual motion should begin in scaption
- Rotation before elevation

Passive Micro-Mobility – Primary

- Scapular Release with diagonals
  - Lateral Glide and Tilt
- Glenohumeral Inferior Glide
  - Over the top
  - Finger mobility with passive rotational shift
- Glenohumeral posterior glide

Passive Micro-Mobility – Secondary

- AC and SC joints A-P micro-mobility
- Glenohumeral lateral glide
Four Levels – EMG Activity Based on 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 is a Dynamic Activity Level and Not a Measurement of Tendon Stress.


Positional Recruitment

Evidence based – EMG Studies

- Sidelying External Rotation
- Prone Extension to hip
- Prone Horizontal Abduction with External Rotation
- Prone 90/90 External Rotation
Positional Recruitment

- Scaption – thumb-down internal rotation
- Scaption – neutral thumb-up position – Flexion
- Bench Press
- Press-up (chair dips)

References:
Manske RC. Electromyographically Assessed Exercises For The Scapular Muscle. ATJ 2008 11(5) 19-23
Modified Super Eight
Therapeutic Value

• Sidelying external rotation
• Scaption – Standing to 90°, 120°
• Prone extension to hip
• Prone scaption - 100°, 120°
• Prone horizontal abduction with rotation
• Prone external rotation 90/90 position
• Push-ups
• Chair-dips (press-ups)


Levels of EMG Based Exercises for the Shoulder

• Level One – Low EMG
  – Clinician Assisted Forward Elevation
  – Pendulum (Codman)
  – Weight Shifts on Table (CKC)
  – Gravity Eliminated Forward Elevation
    • UE Ranger™
Levels of EMG Based Exercises for the Shoulder

• Level Two – Moderate EMG
  – Wall Push-ups
  – Thera-Band® - Short Arc Rotation – Low Color (yellow)
  – Sidelying Internal Rotation

Levels of EMG Based Exercises for the Shoulder

• Level Three – High EMG
  – Sidelying External Rotation
  – Scaption – Thumb-up Elevation
  – Thera-Band® Standing Rotation (Red-Green)
  – Prone Extension to Hip
  – Prone Scaption

• Level Four – Very High EMG
  – Scaption to 120° and Higher
  – Press-up – Chair Dips
  – Bench Press
CLOSED KINETIC CHAIN RECRUITMENT

- Ball on the Wall – Not true CKC
  Muscle Re-education
  Ball on the table – geriatric perspective

- Wall push-ups
  - Sagittal plane
  - Transverse plane
  - Modified frontal plane
- Wall push-up plus add resistance

University of Kentucky Studies

- Electromyographical Differences between slow and fast closed and open chain shoulder exercises
  - Fast speed OKC > CKC
  - CKC produced less EMG Activity than OKC
  - Supraspinatus Activity > in OKC than CKC

Reference: Uhl TL, Wise MB, Mattacola CG, Nitz AJ: Division of Athletic Training

MODIFIED CLOSED KINETIC CHAIN RECRUITMENT

- Push-up on uneven surface – ball on the wall
- Wall push-ups while standing on uneven surface – balance pad or BOSU
- Hands on Stepper – straight/flexed elbow

References:
ROTATOR CUFF REPAIR

1. Small to medium sized tears
   Partial thickness lesions (1cm – 3cm)

2. Large to massive tears
   Full thickness > 4cm – 5cm
   Complete rupture

Arthroscopic vs. Mini-Open Repairs

Factors used to determine type of surgery
- Tear size
- Mobility of the tissue
- Tissue quality
- Age and activity level

Survey Conducted by Wilk, 2003
Arthroscopic vs. Mini-Open Repairs

- Less deltoid injury
- Visualization of tear
- Secondary pathology
- Less post-op pain
- Improved motion

Mini-Open

- More deltoid injury
- Possible too much SAD
- Nerve damage (Axillary Nerve?)
### Rotator Cuff Repair

#### Partial thickness Lesions – small to medium tears

**Phase I Pre-functional – 1-3 weeks**
- Immobilization as needed abduction pillow brace in scaption plane
- Manual control range of motion
  - ER 45° at 45° of abduction
  - Positional internal rotation
  - Elevation – short to long lever arm motion
- Scapular retraction sets
- Wrist and grip exercises
- Biceps and Triceps curls – neutral humerus - begin with isometrics
- Ball on the wall/table – early closed kinetic chain
- Sub-max isometrics – week 3

*Manske RC. Post Surgical Orthopedic Sports Rehabilitation Knee and Shoulder. Chapter 33. 2006 St. Louis. Mosby-Elevier*

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### Rotator Cuff Repair

#### Full-thickness Tears – Large (massive)

**Pre-functional phase 1-4 weeks**
- Immobilization – abduction brace at 30° modified scaption
- Manual control ROM
- Gripping exercises
- Scapular retraction sets
- Elbow ROM with neutral Humerus – light strengthening at 3 to 4 weeks
  - Begin Isometrics
- Sub-max Isometrics – end of week three/four

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### Rotator Cuff Repair

#### Full-thickness Tears – Large (massive)

**Early Post-op R.O.M.**
- External rotation in scapular plane 30° - 60°
  - Less tension on repair
- Repaired supraspinatus increased tension in 30° to 60° of internal rotation
- Elevation in scapular plane
  - Neutral Humeral position with progressive external rotation
- Positional internal rotation to hip

*Ref: Manske, R. 2009*
Rotator Cuff Repair

Partial thickness Lesions – small to medium tears
Pre-Functional Phase 4 – 6 weeks
• Manual control range of motion
  – ER – progressive to 90° at 45° abduction to 90° abduction
  – Positional internal rotation to spine level
  – Elevation 140° to WNL
• Standing Extension to hip
• Resistive strengthening – scapular retraction
  – Add protraction when ready
• Manual exercises – rhythmic stabilization – short lever arm
• Wall push-ups (double arm) – closed kinetic chain exercises
• UBE when ready
• Begin prone series with prone extension to hip
• Thera-band® short-arc rotation

Rotator Cuff Repairs

Full-thickness Tears – Large (massive)
Pre-functional phase 4-8 weeks
• Manual control ROM progress with elevation
• Isometrics – deltoids and rotators – sub-max – 4+ weeks
• Scapular stabilization – retraction – Thera-band®
• Elbow strengthening – biceps/triceps PRE – Neutral Humerus
• Rhythmic stabilization – short lever arm – 6+ weeks
• UBE – 6 weeks
• Thera-band® rotation short-arc at end of this phase
• Standing extension to hip – 3+ weeks
• Prone extension to hip – 5+ weeks
• Closed kinetic chain – ball on the wall – progress to
double arm push-ups
Rotator Cuff Repair

Partial thickness Lesions – small to medium tears
Return to function Phase
• Isotonic strengthening with positional recruitment
  – Prone series – prone extension to hip, prone scaption 100°, prone scaption 120°, prone horizontal ABD – ER
  – Scaption to 70° then to 90° - (Full Can)
  – Sidelying external rotation to neutral
• Elevation strengthening – Supine position
• Protraction PRE – manual applied force distally (CKC)
• Single arm wall push-ups
• Placement eccentrics
• Advanced scapular stabilization
• Rhythmic stabilization (perturbation – long lever arm)
Rotator Cuff Repairs

Full-thickness Tears – Large (massive)
Return to Function Phase
• Continue manual ROM
• Advanced scapular stabilization
• Delayed positional recruitment – sidelying external rotation – prone scaption – standing scaption
• Closed Kinetic Chain exercises – double arm progress to single arm

Interactive Outcomes

• Pain report
• Mobility needs – ROM goals met
• Elevation control – muscle recruitment
• ADL dysfunction
Placement Eccentrics

- Scaption
- Sidelying External Rotation
- Prone Scaption

Recommended exercise progression
- 2 sets of 5
- 3 sets of 5
- 2 sets of 10

Guard against overload

Muscle Recruitment

- Isometric muscle recruitment assist with synergistic recruitment
  - Rhythmic stabilization is an effective means of functional based strengthening
- Placement Eccentric
  - Isometric to eccentric isotonic activity is more likely to create functional carryover
  - Holding isometric to muscle lengthening (Eccentric) leads to controlled mobility
  - The goal for the patient is to develop automatic controlled mobility during functional performance

Rotator Cuff Repairs

Return to function Phase

• Closed kinetic chain exercises – wall push-ups
  – Three planes – single arm – uneven surface
• Manual PNF exercises
• Plyo-toss – double arm – plyometrics
• BodyBlade® – three planes – oscillation training

Delayed for large tears – based on clinical interactive outcomes.
Rotator Cuff Repairs

Return to activity Phase
  • Advanced strengthening – vital five program – updated home program
  • Endurance training i.e. bodyblade® – impulse training
  • Plyo-toss – plyometrics – single arm
  • Progress to single leg balance
  • Sports or job specific training
  • Interval throwing (if needed)

Delayed for large tears based on clinical interactive outcomes
Rotator Cuff Repairs

- Vital Five Exercises – Home Program
  - Scapula Stabilization
  - Single arm wall push-up
  - Prone series
  - Scaption strengthening
  - Sidelying external rotation

Rehabilitation Summary

- Tri-Planar Stabilization – end product of function
- Positional Recruitment
  - Vital Five – Based on Therapeutic Value
  
  **Strengthening**
  - Scapula-cuff stabilization using the three “p’s”
    - Pivotors – scapular stabilizers, i.e., rhomboids & trapezius – serratus anterior
    - Protectors – rotator cuff → decompression
    - Positionors – deltoids, latissimus dorsi, pectoralis major → controlled elevation
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Designing Rehabilitation Programs for the Shoulder
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