Conservative and Postoperative Therapy for Rotator Cuff Tears

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OBJECTIVES

• Functional Anatomy and Biomechanics
• Pathophysiology of Rotator Cuff Disease
• Examination
• Nonoperative management
• Postoperative management

Shoulder Girdle Musculature

Rotator Cuff

Force Couples
• Subscapularis
• Posterior Cuff
  – Infraspinatus
  – Teres Minor
• Humeral Head Centralizer

Rotator Cuff Disease

Natural History

• One of the most prevalent musculoskeletal disorders
• Clinical presentation varies widely
• Some patients present with minimal impairments and functional limitations
• Others present with profound impairments and loss of function

Rotator Cuff Disease

Natural History

• Yamaguchi, JBJS, 2006
• Presence of rotator cuff disease highly correlated to age
• Average age:
  – No rotator cuff tear = 48.7 years
  – Unilateral rotator cuff tear = 58.7 years
  – Bilateral rotator cuff tear = 67.8 years
• 50% likelihood of bilateral tear after 66 years
Classification

- Rotator Cuff Disease
  - (aka: impingement, tendonitis, bursitis, tendinopathy)
  - Rotator Cuff – No Tear
- Rotator Cuff Tear (greatest diameter)
  - Partial tear
  - ≤ 1 cm = small tear
  - 1-3 cm = medium tear
  - 3-5 cm = large tear
  - > 5 cm = massive tear

MASSIVE ROTATOR CUFF TEAR

- Tear > 5 cm in diameter
  - Cofield 1985
- Detachment of at least two entire tendons from tuberosities
  - Patte, 1983 – Gerber, 2000

PARTIAL ROTATOR CUFF TEAR

CUFF TEAR SHAPE

Ellman and Gartsman, 1993
Lo & Burkart, AJSM, 2003

Rotator Cuff Disease

Natural History

- Rotator Cuff Tears in Asymptomatic Patients
  - Overall
    - Complete = 14%
    - Partial = 20%
  - Results by Age
    - >60 = 28% FT – 26% PT
    - 40-60 = 4% FT – 24% PT
    - <40 = 0% FT – 4% PT

Rotator Cuff Disease

Natural History

- How many tears are asymptomatic?
  - Yamamoto, JSES, 2011
  - 283 shoulders with full thickness cuff tear
    - 65.4% (185) asymptomatic
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Rotator Cuff Disease
Natural History

- Asymptomatic tears become symptomatic = 36 - 50%
  - Increase in pain common

- Tear Progression
  - 50% symptomatic patients
  - 22% asymptomatic patients

Rotator Cuff Disease
Natural History

- Unruh, JSES, 2014 (MOON Shoulder Group)
  - 450 patients – multi-center study
  - Duration of symptoms does not correlate with cuff tear severity

OUR JOB

SYMPTOMATIC CUFF TEARS

ASYMPTOMATIC CUFF TEARS

ROTATOR CUFF DISEASE
History

- Rotator Cuff Signs and Symptoms
  - > 40 years of age – not always symptoms
  - Pain – lateral shoulder to insertion of deltoid
  - Pain with reaching overhead and/or behind back
  - Pain at night
  - Weakness or decreased ER Strength
  - Decreased IR ROM

- Pre-existing RTC symptoms followed by acute trauma indicative of acute extension of degenerative RTC

CLINICAL SIGNS

Clinical presentation of large and massive rotator cuff tears
- Pain (especially at night)
- Trauma/Chronic
- Atrophy
- PROM > AROM
- Impingement sign
- Weakness of FF & ER
- ER lag sign

PHYSICAL EXAMINATION

- Neer
- Hawkins
- Supraspinatus
  - Empty can
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**PHYSICAL EXAMINATION**

- Lag signs
- External Rotation
  - $20^\circ$ abd.
  - $90^\circ$ abd. – isolates infraspinatus
- Subscapularis
  - Lift off
  - Belly press

**Shoulder Exam**

**Lift Off Test**

- Isolates subscapularis
- Useful in patients who lack IR ROM
- Place hand on belly and hold elbow away from body
- Positive if patient cannot maintain elbow or hand position

**Belly Press Test**

- Isolates subscapularis
- Useful in patients who lack IR ROM
- Place hand on belly and hold elbow away from body
- Positive if patient cannot maintain elbow or hand position

**RANGE OF MOTION**

- **American Shoulder and Elbow Surgeons**
  - Forward Elevation
  - External Rotation at 0
  - External Rotation at 90°
  - Internal Rotation up back
    - “IR at 90°”
  - JSES 1994

**Strength / Muscle Force**

- **Internal and External Rotation** with arm at side, elbow flexed to 90°
- **Forward elevation** in plane of the scapula at 45°, elbow flexed to 90°

Leggin, et al JSES 1996
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**PENN SHOULDER SCORE**

- 100-point questionnaire
  - 3 Pain items = 30 points
  - 1 Satisfaction item = 10 points
  - 20 Function items = 60 points

  JOSPT, March 2006

**Rehab Principles Based on Tear Size**

- Rotator Cuff – No Tear and Tears ≤ 3 cm
  - Impingement, tendonitis, bursitis
  - partial tear,
  - small tear (≤ 1 cm)
  - medium tear (1-3 cm)

- Rotator Cuff Tears > 3 cm
  - Large tear (3-5 cm)
  - Massive tears (> 5 cm or 2 full tendons)

**Rehab Principles**

- Rotator Cuff-No Tear and Tears ≤ 3 cm
  - pain relief with modalities
  - rest from painful activity
  - patient education
  - restore normal length of capsuloligamentous complex
  - Improve rotator cuff, deltoid, scapular muscle strength and coordination

**Clinical Implication**

- Pain relief and rest play a large role in managing rotator cuff disease

**WHAT DO WE NOT DO??**

- [Image of exercises crossed out]
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**SWISS BALL ROLL**

**MODALITIES**
- Heat / Ice
- Laser
- Kinesiology Tape
- NSAID’s
- Cortisone injection

**RESTORE TISSUE LENGTH**
Posterior Capsule
- Emphasize low load, repeated stretch
- 10 repetitions
- 10-20 second hold
- 3-4 times daily

**PHASE II ROM**
- Extension
- Internal rotation
- Cross body adduction

**STRETCHING**

**STRENGTHENING**
- Thera-band resistance
  - Yellow……2 lbs.
  - Red………3 lbs.
  - Green…….4 lbs.
  - Blue………5 lbs.
  - Black……..6 lbs.
  - Silver…….8 lbs.
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PHASE I STRENGTHENING

- External Rotation
- Internal Rotation
- Extension

PHASE I STRENGTHENING

- Internal Rotation

PHASE I SCAPULAR MUSCLE STRENGTHENING

- Extension

MANUAL RESISTANCE

*begin when at green for all Phase I exercises
- Forward elevation below shoulder level
- Abduction to 45°
- External rotation at 45° supported

PHASE II STRENGTHENING
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**PHASE II STRENGTHENING**

- Abduction to 45°

**MANUAL RESISTANCE**

ELEVATION and ER THROUGH RANGE

- Horizontal Abduction with ER & Scap retraction

**FOREHAND**

**BACKHAND**

**PHASE II STRENGTHENING**

- External rotation at 45° supported

**DYNAMIC HUG**

SERRATUS ANTERIOR
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PHASE III - IV STRENGTHENING


- Determine the effect of a 6-week exercise program on:
  - Impairments
    - ROM, strength, 3D scapular kinematics
  - Function/Disability
    - Penn Shoulder Score, SF-36
- Patients with shoulder impingement syndrome

McClure, et al

- N = 39
- Followed 1 time per week for 6 visits
- Improved:
  - Symptoms (pain, satisfaction)
  - Impairment (strength, ROM)
  - Function (shoulder score, SF-36)
    - PSS increased from 63 to 86
  - ? Scapular Kinematics (scap post tilt & ER)


- Randomized controlled trial
- Progressive resistance vs. no exercise
- Resistance group demonstrated improved pain and function vs. control group

Cummins, *JSES*, 2009

- 100 patients received injection and therapy
- ASES score improved from 56 to 95
- Pain decreased from 4.8 to 0.6
- 79% did not undergo surgery
- 30% of those who did not have surgery continued to have some pain

Holmgren, *BMJ*, 2012

- 102 patients
- Randomized to specific exercise vs. control – non-specific
- Specific exercise
  - > improvement in Constant Score
  - < patient chose surgery (20% vs. 63%)
# Rehabilitation Principles

Rotator Cuff Tears

- Rehabilitation of medium (>3cm) and large-massive cuff tears
  - Restore PROM
  - Initiate Cuff Strengthening (manual resistance)
  - Need to train remaining muscles to centralize humeral head to allow elevation
  - Emphasize subscapularis and deltoid

Large – Massive Rotator Cuff Tears

- Proximal humeral migration correlates with cuff tear size
  - Keener, *JBJS*, 2009

- Stable glenohumeral abduction without excessive humeral migration requires significantly greater forces of subscapularis
  - Hansen, *JBJS*, 2008

## Hawkes, JOR, 2012

- Compared healthy vs. massive rotator cuff patients
- Increased activity of latissimus dorsi and teres major

## Graichen, J of Biomechanics, 2005

- Adducting muscle activity led to significant increase of subacromial space
- No difference in scapulo-humeral rhythm between abducting and adducting muscle activity

## Rotator Cuff Tear Stage


- Set up testing system in cadavers
- Supraspinatus tear ↑d ER ROM ↑d and ↓d abd capability
- Adding half of infraspinatus changed humeral kinematics
- Pec major and lats kicked in as tear progressed

## Large-Massive Rotator Cuff Tears

- Kelly, *JSES*, 2005

- 18 subjects:
  - 6 normals
  - 6 symptomatic 2 tendon cuff tears
  - 6 asymptomatic cuff tears
- EMG activity of 12 muscles during 10 functional tasks
Kelly, *JSES*, 2005

- All cuff tear patients had increased muscle activation during all tasks vs. normals
- Asymptomatic patients > subscapularis and deltoid activity
- Symptomatic patients = increased activity of torn rotator cuff and upper trapezius

RESTORE PROM

- Many patients have limited FE and IR
- Phase I ROM
  - Supine FE & ER with stick
- Phase II ROM
  - Extension with stick
  - Cross body adduction
  - Internal rotation

PHASE II ROM

- Extension
- Internal rotation
- Cross body adduction

Rotator Cuff Strength

- Provide manual resistance to ER/IR

Rotator Cuff Strength

- Phase I
  - ER
  - IR
  - Extension

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Rotator Cuff Tears Rehabilitation Principles

- Initiate movement (ball/table slide)
- Emphasize internal rotation strength (subscap, pecs, lats, teres major)
- Work remaining posterior cuff (teres minor)
- Supervise active forward elevation
- Gradually introduce gravity
- Add weighted ball and/or elastic resistance

Supine Elevation Progression

*Restore the balance point
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SURGERY AND REHABILITATION OF
THE HAND: TRENDING TOPICS IN HAND TO SHOULDER THERAPY

SUPINE ELEVATION PROGRESSION

SUPINE ELEVATION

ELEVATION PROGRESSION

ELEVATION PROGRESSION

MANUAL RESISTANCE
ALTERNATING ISOMETRIC D2 and D1

Row and Lat Pull Down
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PHASE II STRENGTHENING

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CUFF REPAIR vs. PT?

- Kukkonen, Bone & Joint, 2014 & JBJS, 2015
- Compared 3 groups
  - PT
  - Acromioplasty & PT
  - Cuff repair, acromioplasty, & PT
- 1 & 2 years – operative treatment no better than conservative treatment

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Heerspink, JSES, 2015

“However, significant differences in pain and disabilities were observed in favor of surgical treatment.

The best outcomes in function and pain were seen in patients with an intact rotator cuff postoperatively”
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**CUFF REPAIR vs. PT?**

- Intact cuff (n = 5): Constant = 88.5
- Cuff retear (n = 14): Constant = 73.2 – 73.7% retear rate!
- PT (n = 25): Constant = 75.6

**Kuhn, et al JSES, 2013**

- Multi-center study
- 452 patients, 2 year follow-up
- <25% elected to undergo surgery
- Does that did, did so in first 6-12 weeks
- Nonoperative treatment successful in approximately 75% of patients at 2 years

**Rehab Following Rotator Cuff Repair**

- Fucentese, *JBJS*, 2012
- 24 patients with supra tears (52 yrs.)
- Declined surgery
- 42 month follow-up
- Shoulder score = 74% of normal
- Cuff size did not change
  - 2 = no longer present, 9 = smaller, 9 = no change, 6 = increased

**INTRODUCTION**

- Post-operative stiffness has been one of most dreaded complications following cuff repair
- Immediate passive range of motion

**INTRODUCTION**

- High incidence of failure of rotator cuff integrity following repair (6% - 84% intact)
- 60% intact open and arthroscopic
  - Bishop, 2006
- Higher rate of integrity in tears < 3 cm
- Better function and pain relief if cuff intact
- Many factors contribute to failure rates
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Healing Cuff in Rat Rotator Cuff Tendon

- Immobilization demonstrated superior structural, compositional and viscoelastic properties Thomopoulos 2003
- Immobilization improved tendon to bone healing Gimbel 2007
- Stiffness caused by immobilization was transient Sarver 2008

HOW MANY CUFF REPAIRS END UP STIFF?

- Transient stiffness responsive to nonoperative management = 10%
- Resistant stiffness, permanent or requiring capsular release = 3.3%

WHO IS AT RISK FOR STIFFNESS?

- Huberty, Arthroscopy, 2009
  – Calcific tendonitis
  – Adhesive capsulitis
  – Partial articular surface tendon avulsion (PASTA)
  – Concomitant labral repair
  – Workers’ compensation

SUMMARY OF BASIC SCIENCE and SYSTEMATIC REVIEWS

- Ideal rehabilitation protocol to prevent stiffness and encourage healing after cuff repair
  – Initial period of immobilization

Controversies

- When to start motion?
  – Healing rates
- How much therapy?
  – Home vs. supervised

STANDARD VS. DELAYED

<table>
<thead>
<tr>
<th>Time Since Surgery</th>
<th>Standard</th>
<th>Delayed</th>
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<tbody>
<tr>
<td>1-2 weeks</td>
<td>112.37</td>
<td>133.25</td>
</tr>
<tr>
<td>4-6 weeks</td>
<td>133.25</td>
<td>133.25</td>
</tr>
<tr>
<td>12 weeks</td>
<td>133.25</td>
<td>133.25</td>
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Current Principles

- Start of motion largely due to surgeon preference
- Some start motion 1-3 weeks post-op
- Some may immobilize for up to 6 weeks

Objective

- Progression of rotator cuff repair rehab no matter when you start

Must Know:

- Quality of tissue and ease of tendon mobilization
- Variations in surgical techniques
- Pre-surgery treatment
- Patient’s goals

Evaluation

- Modify according to stage of intervention
  - PROM FE & ER only in first 6 weeks
  - PROM & AROM FE, ER, & IR > 6-12 weeks
  - Muscle force > 12 weeks

Patient Education

- Positioning

Immobilization

- For first 6 to 8 weeks
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EARLY POST-OP EXERCISE
- Depends on surgeon’s assessment!
  - Size of tear
  - Quality of repair
- May stay immobilized until 6 weeks
- Pendulums
- Hand and elbow ROM

HOME vs. SUPERVISED
- Many patients can continue with home program
- Criteria:
  - Gain 10° FE in first session
  - Muscle guarding begins to subside
  - Able to demonstrate exercises independently

Why is motion restricted?
- True stiffness?
- Frightened and anxious?

Why are they frightened and anxious?
- Low pain tolerance
- Previous therapy experience
- Large or heavy extremity
- Muscle guarding (pain)

WHY ARE THEY IN PAIN??
THE SURGEON!!!
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INITIATE MOVEMENT

- Get patient to relax
- Gentle oscillations
- Passive movement of elbow

INITIATE MOVEMENT

- Start in plane of scapula
- Elbow bent to 90º
- Bring thumb to nose
- Take to point of tolerable stretch – Not Pain!!

UNWEIGHT THE ARM

- Patients having difficulty with muscle guarding
- Heavy extremity
- Chair stretch

UNWEIGHT THE ARM

- Dusting/Table Slide
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EFFECTIVENESS

  - Used Huberty risk factors
  - Immediate post-op table slides
  - No stiffness among 79 patients in this protocol
  - Historical rate of 7.8% in patients with risk factors

> 6 WEEKS POST-OP

- Add ROM exercises for posterior cuff and capsule

PHASE II ROM

- Extension
- Internal Rotation
- Cross Body Adduction

What If They’re Not There?

- Extend the PROM time period
- Change PROM FE to stick
- Add Pulley

Phase I Strengthening

- Small Tears
  - Add at 8-10 weeks post-op
  - ER, Ext, IR
- Tears > 3 cm
  - Add 12-16 weeks post-op
  - Assess function of cuff

Assess Function of Cuff

- Manually test ER
- Lag sign
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Avoid Overload

- Assess cuff performance
- Assess tolerance to exercise

SWISS BALL ROLL

Rotator Cuff Strength

- Phase I
  - ER
  - IR
  - Extension

STRENGTHENING

Manual Resistance

- Alternating isometrics and rhythmic stabilization
- Progress to multi-angles of elevation and rotation
- Supine or sidelying
- Gauge cuff contraction

SCAPULAR STRENGTHENING

12 Weeks Post-op

- Assess P/AROM (FE, ER @ 0 & 90, IR)
  - Gain last few degrees of motion
- Assess strength/muscle force
- Lag sign/posterior cuff function
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Signs of Trouble

- Shrug with FE
- ER weakness or lag
- Excessive ER ROM
- Persistent stiffness

12 - 16 Weeks Post-op

- Begin Phase II strengthening (when at green for all phase I Exercises)
- Manual Resistance in unsupported positions

PHASE II STRENGTHENING

- **SOME PATIENTS WILL NOT GET HERE!

Phase II Manual Resistance

- Progress to unsupported
- Assess reactivity
- Adjust position
- Grade resistance

16 weeks - Forever

- Encourage patients to continue with exercises
- Will show improvement for up to or > 1 year
- Gradual return to activities
- Work on general flexibility and strength

Summary

- Respect Healing Rates
- Recognize Who Needs Supervision
- Extend ROM period if criteria not met
- Use supine elevation progression to improve function

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Thank You!!

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