Rehabilitation after Rotator Cuff Repair
Jeffrey D Stone, M.D.
Florida Orthopaedic Institute

Disclosures:
• Shareholder Progressive Orthopedics and Upex
• No conflicts regarding the content of this presentation

What happens when we fix rotator cuff tears?
• Healed RCR
Significantly improved Quality of Life Years (QALYs), function, pt. satisfaction and RCR is cost effective
  - Vitale JSES 2007
What’s the problem?
- Recurrent tear
- Stiffness

Failure Rates: 12-94%

- Romeo Current Ortho 2001 MRI 50% (33% Large Tears)
- Harmeyer 2013 MRI 12.5% (46% were failure tears MRI, 10% failure tears)
- Greens MR 2004 10%
- Supina & Braverman 2005 15% (30% were recurrent tears MRI)
- Dernek MRI 2005 10%
- Ehrlich MRI 2005 11%
- Labrosse et al. 2006 17%
- Et et al. 2006 MRI 14.2%
- Hunder et al. 2007 MRI 21.5%
- Bogli et al. 2007 MRI 20%
- Suhara et al. 2006 62.9%
- Sugaya et al. 2005 40% large to massive size tears MRI
- Debeer et al. 2007 US 17%
- Boileau et al. 2005 29% small tears 57% if > 65 yrs
- Lafosse et al. 2008 CT 12%
- Nho et al. 2008 US 25%
- Miller et al. AJSM 2011 Ultrasound 41% recurrent tears Ultrasound
- MRI within 3 months
- MRI after 3 months
- Yager - Ultrasonography
- Le et al. AJSM 2014 17% at 6mo US
- 27% FT, 5% PT tears

Massive RC tear: Technically Good Repair

- Restore sarcomere length and tension
- Optimize fixation of tendon to bone
- Restore footprint

Success or Failure?
Technical Improvements—No consistent reduction of failure rates

- Kim AJSM 2017
- Massive 3 tendon tears (MRA)
- Michigan RC Registry - Mclveny/Matsen AJSM 2014
  - 53%
- Re-ripping at 2-3 days
  - MRI/MRAC/US evidence that RC results are improving
- Ianotti - Ultrasound ASES 2012
  - Linear increase in re-tear rate first 6 months
  - Risk for re-tear up to 6-9+ months postoperatively, “longer race”
  - Healing is protracted
  - Ahmad JSES 2015
  - Lee AJSM 2017
  - 7.2% (MRI)
  - 4 weeks abduction pillow

Biology and Rehabilitation

Normal Rotator Cuff

- Curtis Arthroscopy 2006
Traditional rehabilitation is based upon healing time

Load to failure/ Tensile Strength:
- 6-12 wks  30%
- 3-5 months  50%
- 6 months     80%

- Trudel et al J Orthop Res 2010
- Koike et al J Orthop Res 2005
- Gerber 1999 JBJS Sheep
- Sonnabend et al JBI Bullet

Humans (Different Anatomy/ Biology)

Tendon Healing

- I-Inflammatory
- II Proliferative
  - Disorganized highly cellular and vascular tissue forms the initial scar tissue
  - Type III collagen.
- III Remodeling
  - Mature scar
  - Mechanical properties remain inferior
  - Type I collagen > Type III collagen
Closer Look: Rotator cuff Healing

- Disorganized scar
- Sub-optimal elasticity and tensile strength

Risk factors for re-tear of rotator cuff repair:

- Age (>62)
- Patient Compliance
- Smoking
- NSAID's
- Corticosteroid Injections
- Diabetes
- Osteoporosis
- Hypercholesterolemia
- Vitamin D deficiency
- Genetics
- Larger tear size
- Fatty Infiltration
- Tendinosis

Larger Size and Retraction:

- Patte Classification

Tears >2 cm retraction exposed to early ROM
- 1.4-1.9 x greater risk of failure
Tendinosis - Intrinsic degeneration

- Arthroscopic Repair of Partial-Thickness and Small Full-Thickness Rotator Cuff Tears: Tendon Quality as a Prognostic Factor for Repair Integrity
- Higher tendinosis Grade
- 7.64-times higher failure rate

Fatty Infiltration - tear chronicity

- Stage 0: No Fatty Infiltration
- Stage 1: Some Fatty Infiltration
- Stage 2: Fat < Muscle
- Stage 3: Fat = Muscle
- Stage 4: More Fat than Muscle

- FI of SS and IS can be independent variable

Benefits of Early Mobilization

- Improved collagen orientation, biomechanical properties
- Decreased joint swelling, pain, and stiffness
  - Kim et al, 2009
- Overloading is detrimental
  - RC: PROM and ARROM

- Flexor/Extensor tendons
  - Controlled motion protocols
Healing vs Stiffness: Balance between protection and mobility

**Lengthy immobilization**

**Early motion**

Immediate early mobilization has a paradoxical effect

- Greater risk of re-tear from early motion in chronic (stiff) tears
- Immediate Passive ROM 0-2wks
- Greater joint stiffness at 2+ weeks
- No beneficial effect on mechanical properties of the tendon

Impact of Post Operative Immobilization on Stiffness

- 56 pts
- 23% Stiff after 6-12 weeks
- No difference ROM measures at 1 year
### Early Mobilization vs Immobilization

Strict immobilization with graded rehabilitation shows improved rates of anatomic healing without associated stiffness when compared with early ROM.

### The Relationship Between Shoulder Stiffness and Rotator Cuff Healing

A study of 1,533 consecutive arthroscopic rotator cuff repairs

- Stiff shoulders at 6 and 12 weeks were less likely to re-tear at 6 months
- Postoperative shoulder stiffness was associated with a higher rate of cuff healing
  - "More exuberant healing response"

**At 6 wks:**
- If ER< 20 - 7% Re-tear
- If ER > 20 - 15% Re-tear

### Factors Associated with Persistent Stiffness (5-19%)

- Calcific Tendonitis
- Pre-op adhesive capsulitis
- Repair of partial thickness tears (PASTA)
- Small, acute single tendon tears
- Concomitant labral, slap repair
- Age < 50
- Worker's compensation

- In pts with ≥ 1 risk factor
- Table Slide (low level of EMG activity) effectively avoided detrimental stiffness
Stiffness and Scope release

Incidence and Treatment of Postoperative Stiffness Following Arthroscopic Rotator Cuff Repair

- 489 arthroscopic rotator cuff repairs
- 24 patients (4.9%) developed stiffness

Risk factors:
- calcific tendinitis, adhesive capsulitis, single-tendon cuff repair, PASTA repair, under 50 years of age, Workers’ Compensation.
- 23 of 24 patients (95.8%) showed complete RC healing
- Arthroscopic release resulted in normal motion in all cases

Beware of forceful manipulation of stiff shoulder

RCR Rehab Program

- Pre-operative counseling
- Healing cuff is fragile

- Goal
  - Tendon healing
  - Pain-free function, mobility and strength
  - Quality of life

- Non-compliance
  - At 6wk: 15% risk of re-tear
  - At 12 wks: 7%
  - At 26 wks: 40%

Ahmad S. JSES 2015
**EMG activity: guide for submaximal stress on RCR:**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>% Max Infra</th>
<th>% Max Supra</th>
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<tbody>
<tr>
<td>Supine PROM opposite arm</td>
<td>1% 4%</td>
<td>1% 4%</td>
</tr>
<tr>
<td>Table Slide/ Forward Bow</td>
<td>5% 2%</td>
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<tr>
<td>Wash Cloth Press Up (AA)</td>
<td>3% 7%</td>
<td>3% 7%</td>
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<tr>
<td>Table Towel Slide (AA)</td>
<td>7% 4%</td>
<td>7% 4%</td>
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<tr>
<td>Step up with Ball(A)</td>
<td>21% 18%</td>
<td>21% 18%</td>
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<tr>
<td>Standing Press up (A)</td>
<td>29% 14%</td>
<td>29% 14%</td>
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**Timeline for Healing**

- **Strength**
  - 0-2 and 2-4 wks: 10%
  - 6-12 weeks: 50%
  - 3-6 months: 75%
  - 6-9+ months: 90%
  - 12+ Months: 100%

- **Protection**
  - < 15% ssEMG

- **Restore ROM**
  - 15-30% EMG

- **Controlled Stress**
  - 15-39% EMG

- **Cautious Progressive Strengthening**
  - 35-50% EMG

- **Functional Recovery – Skill Sports**
  - 35-50% EMG

- **Progressive Recovery – All Sports**
  - > 50% EMG

**Slow Small Circle Pendulums:** <20 cm

- No Swinging or backward pulling motion!
Minimize Lever Arm & Muscle Activation Levels:
Supine Salutes and Wand Exercises

Progressive Sub-maximal & Sub-painful Isometrics

Scapular Stabilization: Wall Slides
Scapular Stabilization

Core Stabilization

Key Principles:

- Healing is protracted and NOT linear.
- Temptation to initiate AROM & strengthening too early
- Re-tear is more critical problem then stiffness
- Decelerated rehab does not lead to stiffness
- Table Slides help minimize stiffness in at risk pts. without jeopardizing healing
- Initially stiff shoulders have higher healing rate
- Stiffness usually resolves with time
  - Responds to surgical release if recalcitrant.
- Phase progression is goal based not just time.
Decelerated Rehabilitation:

- Protect repair, Control stress, allow tendon to heal to bone
- Sling to 6-8 Weeks
  - AROM elbow, wrist, hand
  - Pendulums
  - Avoid AROM of shoulder
- "Fast Rehab" (smaller < 1cm tears) sling 4-6 weeks add Table Slides
- Weeks 2-6 + gradually restore PROM
  - Minimize lever arm and gravity forces
- Gradual Strengthening
  - Sub-maximal and Sub-painful isometrics
  - Progression of strengthening exercises as healing, ROM and pain allow

The End

Cryotherapy

- Decreased opioid use
- Decreased swelling
- Improved sleep and tolerance for rehab
  - Speer et al, JSES 1996
- Pneumatic compression
  - Enhanced effectiveness

Osbarth et al, Arthroscopy 2002
Position of Immobilization- Does it Matter?

- SS strain less at 35-45 Deg
- Sign increase in strain from 30-15 & 15-0 deg.
- Hatkeyama AJSM 2001
- 34 N reduction in repair load from 0-30 Abd
- 34 N load x 24 hrs resulted in 9 mm Gap
- Reilly JSES 2004
- Slight abduction might improve vascularity and minimize tension on Cuff
- Rathburn JBJS Br 1970
- Footprint contact
- Park at AISM 2009

No General Consensus- Avoid Undue Tension on Repair

Beware Shrug Sign

- Do Not Exercise through Shrug Sign
- Poor mechanics
- Scapular dyskinesis

Limited physical therapy utilization protocol does not affect impairment and disability in Workers' Compensation patients after rotator cuff repair: a short term follow-up study.

- 36% reduction of formal PT through an independent exercise program had NO EFFECT ON IMPAIRMENT OR DISABILITY RATES
- Supervised PT vs Independent Home
  - Exercise Program
  - EQUAL OUTCOMES AT 1 YEAR

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