Rehabilitation after Rotator Cuff Repair

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Disclosures:

- Shareholder Progressive Orthopedics and Upex
- No conflicts regarding the content of this presentation

What happens when we fix rotator cuff tears?

Improved:
- Pain
- Strength
- Function
- Satisfaction
- Quality of Life Years (QALYs)
- RCR is cost effective

Vitale JSES 2007
Re-tear/failure to heal
Stiffness
Recurrent tear - Major
Persistent pain
Dysfunction
Arthropathy
Stiffness - Challenge

Failure Rates: 12-94%

- Romeo Current Ortho 2001 MRI 100% Large Tear
- Harperman 1989 Lab - Nonsurgical tears 68% > Massive tears
- Caesar MD 2000 - 5%
- Segar 2006 - Repair MRI 70% Re-tear Rate
- Duliney MD 2007 JRC 100%
- Borise ME 2007 152 Small tears 60%
- Le et al AJSM 2014 25%
- Miller et al. AJSM 2011 Ultrasound 41% Recurrent tears
- Le et al AJSM 2014 US 25%
- 66% within 3 months
- 33% after 6 months
- Kliger Ultrasound 33%
- 74% within first 3 months
- Le et al. AJSM 2014 US 17% at 6 mo US
- 27% FT 5% PT tears

Focus on technical aspects of repair

Minimize tension
Restore footprint
Despite Technical Improvements—
No consistent reduction of failure rates:

- Kim AJSM 2017
- Massive 3 tendon tears (MRA)
- Michigan RC Registry - Matsen AJSM 2014
- 53% failure at 2-3 yrs
- Little evidence that RC results are improving
- Ianotti - Ultrasound ASES 2012
- 16.9%
- 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 - Ultrasound JSES 2015
- Lee AJSM 2017
- 7.2% (MRI)
- 4 weeks abduction pillow

Success vs Failure - Multifactorial

Traditional rehabilitation is based upon healing time

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

*10% per month
Humans (Variable tissue quality and healing capacity; deteriorate with age)

Normal Rotator Cuff

Tendon Healing

- Inflammatory
- Proliferative
  - Disorganized highly cellular and vascular tissue forms the initial scar tissue
  - Type III collagen
- Remodeling
  - Mature SCAF - the normal tendon to bone transition
  - Unmineralized to mineralized fibrocartilage recapitulated
  - Mechanical properties remain inferior
    - Elasticity and tensile strength
    - Type I collagen > Type III collagen

Curtis Arthroscopy 2006

Tendon Healing

Closer Look: Rotator cuff Healing

- Scar - Disorganized collagen transition
- Sub-optimal elasticity and tensile strength

Risk factors for re-tear:

- Age (>62)
- Smoking
- NSAID’s
- Corticosteroid injections
- Diabetes
- Osteoporosis
- Vitamin D deficiency
- Hyperlipidemia
- Genetics
- Chronic “stiff” tears
- Larger tears
- Fatty Infiltration
- Tendinosis
- Surgical technique
- Patient Compliance

Larger and Retracted:

- Patte Classification

Tears >2 cm retraction exposed to early ROM
- 1.4-1.9 x greater risk of failure
Fatty Infiltration- tear chronicity

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

• FI of SS and IS can be independent variable
  - See ASRM 2017

SS Atrophy & Fatty Infiltration of IS: preoperative predictors of failure

- 112 pts SR RC repair
- F/u at 9 mo
- 54.5% Healed
- 45.5% retear

Independent risk factors
- SS Atrophy – oct ratio < 43%
- IS Fatty Infiltration – grade 2

• Muscle quality may be more important than tendon
  - ASRM 46,7 2018

The influence of intraoperative factors and postoperative rehabilitation compliance on the integrity of the rotator cuff after arthroscopic repair

- Non-compliance- major risk factor
  - At 6 wks: 152 x risk of re-tear (shing)
  - At 12 wks: 7x
  - At 26 wks: 40x
  - Poor compliance most notable: 6-12 weeks

• Pts with better early functional outcomes at 12w < re-tear.
  - "False sense of security"
  - Ahmad S. JSES 2015

• Healing cuff actually more painful with movement (scar)
  - Andreas. JHJ 2015
“Failure in Continuity”

Major Determinants of Healing

- **BIOLOGY** - Tissue quality and healing capacity
- Compliance
- “Envelope of Function”
  - Boundaries of tolerable load and pain

- Our Role:
- Instruct and encourage compliance
- “Do NOT subject the healing tissue to more stress than it can tolerate”

The Relationship Between Shoulder Stiffness and Rotator Cuff Healing

- 1,533 Arthroscopic RCRs, by single surgeon
- US at 6mo
- Stiffer Shoulder at 6,12 weeks but not 24 wks had better RC Integrity at 6mo

Postoperative shoulder stiffness at 6 and 12 weeks is associated with a significantly higher rate of cuff healing

Stiffness reflects “More exuberant healing response”
**Immobilization vs Early mobilization**

Strict immobilization with graded rehabilitation shows improved healing rates without associated **long term stiffness vs early ROM**

**Factors Associated with Persistent Stiffness** (5-18%)

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

- In pts with ≥ 1 risk factor
- **Early addition of Table Slide (2 wks) effectively avoids detrimental stiffness**

**Beware of forceful manipulation of stiff shoulder**
Recalcitrant Stiffness Responds to Scope release

Incidence and Treatment of Postoperative Stiffness Following Arthroscopic Rotator Cuff Repair

- 489 arthroscopic rotator cuff repairs
- 24 patients (4.9%) developed stiffness
- 23 of 24 patients (95.8%) showed complete RC healing
- Arthroscopic release resulted in normal motion in all cases

**Healing Timeline**

- Phase 0-I: 0-2 and 2-4 wks
- Phase II: 0-12 weeks
- Phase III: 3-6 months
- Phase IV: 6-9+ months
- Phase V: 12+ Months

**Protection**

- < 15% vs EMG

**Cautious**

- 10% vs EMG

**Restore**

- Gentle Controlled Stress
- 10-30% EMG

**Progressive Strengthening and Functional Mobility**

- 30-50% EMG

**Functional Recovery**

- All Sports

**Envelope of function**

- 50%
- 10%+

Cryotherapy

- Decreased pain and opioid use
- Decreased swelling
- Improved sleep and tolerance for rehab
- Osbahr et al. Arthroscopy 2002
- Speer et al. JSES 1996
- Pneumatic compression enhances effectiveness
Slow Small Circle Pendulums: <20 cm

No Swinging or backward pulling motion!

EMG activity: guidelines for submaximal exercises within EOF: UHL/PANER 2020

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<thead>
<tr>
<th>Exercise</th>
<th>% Max</th>
<th>Supra</th>
<th>Infra</th>
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<tbody>
<tr>
<td>Supine PROM opposite arm</td>
<td>1%</td>
<td>4%</td>
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<tr>
<td>Table Slide/ Pendulums</td>
<td>5%</td>
<td>2%</td>
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<tr>
<td>Wash Cloth Press Up (AA)</td>
<td>3%</td>
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<td>Table Towel Slide (AA)</td>
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<td>Step up with Ball(A)</td>
<td>21%</td>
<td>18%</td>
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<td>Standing Press up (A)</td>
<td>29%</td>
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Supine Passive Salutes and Wand Exercises
Minimize Lever Arm & Muscle Activation Levels
Progressive Sub-maximal & Sub-painful Isometrics: for muscle tone and gradual strengthening

Scapular Stabilization: Wall Slides - help correct scapular dyskinesia

Maximal Medical Improvement at 1 year

- Meta analysis
- 19 studies
- 1370 pts
- Most re-tears occur by 6 months
- Clinically significant improvement in pt reported outcomes, ROM, strength was seen up to 1 year after surgery, but not beyond 1 year

AJSM 46:4.2018
Current and Future:
Biologic Augmentation: enhance healing

Key Principles:
- Healing is protracted – requires patience
- Rehab must be tailored to Biology (LOF) and surgical procedure
- Avoid temptation to initiate AROM & strengthening too soon
- Minimize "Failure in continuity"
- Non compliance = substantially greater risk of failure
- Re-tear is more critical problem than stiffness
- Initially stiff shoulders have higher healing rate
- Table Slides help minimize stiffness in at risk pts. without jeopardizing healing

"Decelerated" Rehabilitation:
- Preoperative Counseling: Protect repair, Control Stress, allow tendon to heal to bone
  - Sling 6-8 Weeks
  - AROM allows wrist, hand
  - Pendulums +/- table slides after 2 weeks
  - Avoid AROM of shoulder
- (Smaller < 1cm tears): sling 6-8 weeks:
  - Table Slides, Supine rotator
- Weeks 2-6 = gradually restore PROM
- Weeks 6-12 AA to AROM, Jt Mobilization
  - Minimize lever arm and gravity forces
- Gradual Strengthening
  - 6 wks: Sub-maximal and Sub-painful isometrics
  - 12 wks: Progression of strengthening exercises as healing, ROM and pain allow
Thank you

**Hyperlipidemia**

- Higher rates of RC disease
  - Lin et al.
  - Garcia et al.
- HL 45% re tear vs 11.3%
- 6 fold risk of re tear whether on or off Statins

**Tendinosis - Intrinsic degeneration**

- Arthroscopic Repair of Partial-Thickness and Small Full-Thickness Rotator Cuff Tears: Tendon Quality as a Prognostic Factor for Repair Integrity
  - Seok Won Chung AJSM, 2011, 2013
- Higher tendinosis Grade
- 7.64-times higher failure rate
Early AAROM vs Delayed ROM

- Randomized prospective Level 2
- 73 pts
- AAROM at 2-3 d pop
- Vs Delayed until 4-6w
- Small significant early improvement in WORC for early ROM
- No significant difference at 6mo
- Early 34% re-tear vs 31% delayed
- So Why risk early?
- Especially if concerned about compliance/ tissue quality

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.

- Independent Home Exercise Program v. Supervised PT
- 36% reduction of formal PT
- EQUAL OUTCOMES AT 1 YEAR
- NO EFFECT ON IMPAIRMENT OR DISABILITY RATES
- PT accounts for 74% of all postoperative costs
- Motivated pt. with proper instruction have same outcome as formal PT

Take Home Points

- Most significant problem is recurrent tear
- Give the cuff a chance to grow back to the bone
- Stiffness is natural phase of healing process
- Understand risk factors for failure – impact on healing potential
- Rehab protocol tailored to pt’s “Envelope of Function”
  - boundaries of safe tolerable physiologic load
- Do NOT subject the healing tissue to more stress than it can tolerate
- Encourage Compliance at every opportunity
- Avoid risky movements, positions, activities