Management of Rotator Cuff Tears: Evidence Based Approach  
Chair: Robert Marx  

Eric McCarty: Evidence for surgery: when should we operate on rotator cuff tears?  
Mario Larrain: Evidence for cuff fixation: one or two rows?  
Teruhisa Mihata: Evidence for cuff healing: effect of physical therapy and biological agents  
Russell Warren: Evidence for repair or reverse TSA in massive cuff tears
Evidence for surgery: when should we operate on rotator cuff tears?

Eric McCarty, MD
Associate Professor
Chief Sports Medicine & Shoulder Surgery
Department of Orthopaedics
University of Colorado School of Medicine

Speaker Disclosure

Disclosure Information
The following relationships exist:

- Stryker, Smith Nephew - Institutional Support
- Biomet Sports Medicine - Consultant
- Elsevier - Book Royalties
- DJO - Royalties for Sling

• Thanks to Jed Kuhn, MD at Vanderbilt Univ. in Nashville Tennessee for many of the Slides and thoughts on this topic

Rotator Cuff Treatment

• Do we really know what works best?
• We think we know what works best?
• Why do we do what we do?

Dogma

• How Medicine was Practiced from Hippocrates until now
• Apprenticeship

• Why do I practice the way I do?
  - Because Hawkins did it
  - Because Neer did it
  - Because Codman did it...

Bloodletting

• One of the most enduring and popular medical practices in history.
• Originated by Greeks used until 19th century
• Four Humours: Blood, Phlegm, Yellow Bile, Black Bile get out of balance
• Contributed to Death of George Washington
Evidence Based Medicine

- Use DATA, not DOGMA
- Empowers young physicians
- Implies we should:
  - Question the things we do and find data to support our practice patterns
  - Avoid adopting new technologies until there is data to support their use.

Case Scenario

- 72 yo female with Painful Shoulder
  - No history of injury
  - Night pain
  - Crepitus
  - Limits Gardening, Swimming
  - Exam Full Painful ROM
  - MRI

What would you do and why?

- How many would:
  - Offer Surgery?
  - Offer Physical Therapy?
  - Offer Injection?

- IS THERE DATA ON THE BEST APPROACH?
- Is there a consensus on the best approach?

Geographic Variation

- Geographic Variation is great for Cuff Repairs in USA
  - Mississippi 9/100,000 Medicare pts
  - Idaho 65/100,000 Medicare pts
  - Michigan 27/100,000 Medicare pts

Vitale et al. Geographic variations in the rates of operative procedures involving the shoulder, including total shoulder replacement, humeral head replacement and rotator cuff repair. JBJS. 1999;81-A(5):762-771

Do Surgeons Agree on Approach?

- Survey of AAOS with 49% response rate
- Four Hypothetical Cases
- Significant variation in decision making and lack of clinical agreement regarding role of surgery vs nonoperative care and effectiveness of treatments

Dunn et al. Variation in orthopaedic surgeons’ perceptions about the indications for rotator cuff surgery. JBJS.2005;87-A(9):1978-84

Systematic Reviews

Indications for Surgery

Hypothesis: indications for surgery in literature are poorly described

- 86 Papers Reviewed
- Patient Characteristics and Indications not described in most
  - Limitations in ADL (31%)
  - Failure of Nonoperative Tx (52%)
  - Duration of Nonoperative Tx (26%)
  - Night Pain (16%)


Eric McCarty, MD
Systematic Reviews
Indications For Surgery
• Level IV Review
• Results
  – Age and Gender should not impact decision
  – Acute tears may benefit from early surgery
  – Weakness or Functional Disability may have worse outcomes with nonoperative treatment

The Best Evidence Suggests
• Acute Tears Should be Repaired
• Weakness is an Indication for Rotator Cuff Repair

Question
• What is the Best Way to Treat the Patient WITHOUT AN INJURY Who:
  – Has Pain
  – Has an MRI with a Cuff Tear

The Cuff Tear is NOT the Issue!

The Cuff is Not the Issue
• Patient Complaints?
  – Pain
  – Trouble Sleeping
  – Function (pain)
  – Weakness (pain)
• Subjective
  Does SUBJECTIVE = OBJECTIVE?

The Cuff is NOT the Issue
• Assumption #1:
  “The patients subjective complaints are directly related to my objective findings.”
• Surgeon Bias
• This is likely NOT the case
The Cuff is NOT the Issue

- Pain is Slippery
- Surgeons have been misled tying pain to objective data before...
  - Black Disk
  - Acromion
  - TFCC Tears
  - FAI?

The Cuff is NOT the Issue

- Is it possible that the patients complaints of PAIN are not originating from the easily seen objective findings of an MRI documented cuff tear?
- Let's look at DATA!

The Cuff is NOT the Issue

Prevalence Data

- US Population 2010 = 308.4 million
- Over Age 60 = 57 million

Prevalence Data

- What proportion of people over age 60 have full thickness cuff tears?


Prevalence Data

- Let’s be as conservative as possible
- Let’s say 10% of U.S. Population over 60 have full thickness cuff tears (real number is likely more...)
- What does this mean?

Prevalence Data

<table>
<thead>
<tr>
<th>Group</th>
<th>Total</th>
<th>Mean age (years)</th>
<th>PTH prevalence (%)</th>
<th>PTH prevalence (%)</th>
<th>Total prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total shoulders</td>
<td>4629</td>
<td>69.3</td>
<td>12.7</td>
<td>10.4</td>
<td>23.1</td>
</tr>
<tr>
<td>Full thickness shoulders</td>
<td>2020</td>
<td>70.1</td>
<td>15.9</td>
<td>19.1</td>
<td>50.0</td>
</tr>
<tr>
<td>Ultrasound asymptomatic</td>
<td>509</td>
<td>68.7</td>
<td>21.7</td>
<td>17.1</td>
<td>50.0</td>
</tr>
<tr>
<td>Ultrasound symptomatic</td>
<td>1030</td>
<td>68.4</td>
<td>28.5</td>
<td>21.7</td>
<td>45.3</td>
</tr>
<tr>
<td>MRI asymptomatic</td>
<td>271</td>
<td>66.1</td>
<td>19.4</td>
<td>16.3</td>
<td>25.2</td>
</tr>
<tr>
<td>MRI symptomatic</td>
<td>450</td>
<td>43.6</td>
<td>48.6</td>
<td>5.5</td>
<td>48.4</td>
</tr>
</tbody>
</table>

The Cuff is NOT the Issue

- 10% of 57 million is 5.7 million
- So at minimum, 5.7 million of the U.S. populations have full thickness cuff tears.
- That is a lot of people...
### The Cuff is NOT the Issue

**Prevalence Data**
- What proportion of patients with full thickness cuff tears get surgery each year?
  - 250,000 surgeries / 5,700,000 with tears

### The Cuff is NOT the Issue

**Prevalence Data**
- Number of Rotator Cuff Surgeries in USA each Year
  - Industry Estimates
    - 100,000-250,000/year
    - Includes Decompressions, Transfers, Debridements etc
  - Number of Rotator Cuff Repairs is a portion of this number
  - Let’s be Generous and say 250,000 cuff repairs performed in USA/year

### Is the Cuff Tear Responsible for our Patient’s Symptoms?

<table>
<thead>
<tr>
<th>Author</th>
<th>Citation</th>
<th>N</th>
<th>% Healed</th>
<th>% Success</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeFranco</td>
<td>JBJS 2007</td>
<td>85 small/ medium</td>
<td>60%</td>
<td>60%</td>
<td>FBPI Satisfaction Score not significantly different between failed and healed groups</td>
</tr>
<tr>
<td>Galatz</td>
<td>JBJS 2004</td>
<td>18 Large/ Massive</td>
<td>0%</td>
<td>100%</td>
<td>All patients satisfied with surgery</td>
</tr>
<tr>
<td>Harryman</td>
<td>JBJS 1991</td>
<td>105</td>
<td>65%</td>
<td>100%</td>
<td>All patients satisfied with surgery</td>
</tr>
<tr>
<td>Kleppe</td>
<td>AOSSM 2009</td>
<td>222 patients followed</td>
<td>65%</td>
<td>No difference in ASES, UC, or Constant scores comparing failures to healed</td>
<td></td>
</tr>
<tr>
<td>Oh</td>
<td>Arthrosc 2009</td>
<td>78</td>
<td>39%</td>
<td>No difference in ASES, Constant, SST, VAS, or Satisfaction comparing failures to healed</td>
<td></td>
</tr>
<tr>
<td>Jost</td>
<td>JBJS 2000</td>
<td>65</td>
<td>69%</td>
<td>Of those that failed, 65% were satisfied</td>
<td></td>
</tr>
</tbody>
</table>

- Objective Outcomes do not Correlate with Subjective Outcomes....
Systematic Review
Does the Literature Confirm Superior Clinical Results in Radiographically Healed Rotator Cuff After Rotator Cuff Repair?
Mark A. Malanga, MD, Stuart S. Hui, MD, M.B., Robert C. Guman, B.S., Zrett J. Allen, M.D., Stuart S. Hui, M.B., Ronald S. Hansen, B.S., Anthony A. Di Biase, B.S., and Miles P. Venes, M.D.

• Systematic Review Comparing Outcomes of Successful Repairs to Failed Repairs
  – Strength
  – Patient Reported Outcome

Patient Reported Outcomes

Summary Comparing Outcomes Healed vs Failed Repairs
• Strength is Probably Better when the Repair Heals
• Constant Score (25% strength) may be better when repair heals
• Other Outcomes NO DIFFERENCE!

MOON Shoulder Group
• Multiple Sites/Surgeons
• Full Thickness Rotator Cuff Tears
• Prospective Cohort Study on Nonoperative Treatment

MOON DATA
• Collecting Data on
  – History
  – Patient Related Outcomes
    • SANE
    • ASES
    • SF-12
    • WORC
  – Physical Exam
  – Imaging
Do Symptoms Correlate with Rotator Cuff Tear Severity?

- Many cuff tears are asymptomatic
- Most orthopaedic disease states have increased symptoms with increased severity of disease (e.g. osteoarthritis, GH instability, AC instability, etc.)
- Does pain correlate with rotator cuff tear severity?

Symptoms of Pain Do Not Correlate with Rotator Cuff Tear Severity

- 396 Patients Enrolled
- Data at Time=0
- Cuff Tear Severity on MRI:
  - Amount of Retraction in Coronal Plane
  - Number of Tendons Involved
  - Symptom Duration
  - Rotator Cuff Muscle Atrophy
  - Superior Migration of Humeral Head

Symptoms of Pain Do Not Correlate with Rotator Cuff Tear Severity

- Pain
  - Visual Analog Scale
    - 10cm scale
    - How much pain are you having in your shoulder today?
  - WORC Symptom Domain
    - 5 Questions regarding nature and severity of pain
  - Correlation determined using linear regression model which adjusts for other patient characteristics

OUTCOME OF NONOPERATIVE TREATMENT OF SYMPTOMATIC ROTATOR CUFF TEARS MONITORED BY MAGNETIC RESONANCE IMAGING

- 59 shoulders
- Mean age 59 yrs
- Mean f/u 20 months (7 – 58 mos)

FACTORS ASSOC. WITH PROGRESSION OF TEAR:

1. Age > 60 (17% of shoulders younger than 60 vs 54% of those older than 60)
2. Full thickness tear (vs. partial thickness)
3. Fatty infiltration of cuff
Factors related to successful outcome of conservative treatment for rotator cuff tears

1. Intact intramuscular tendon of the supraspinatus
2. Little or no atrophy of the supraspinatus muscle
3. Negative impingement signs
4. Preserved motion in external rotation

- Patients with these 4 factors are more likely to have a successful outcome following conservative treatment than those without these four factors.

Success of Non-op Cuff Tear Tx

- Prospective cohort study
- 50 patients
- Avg age 60 (40-85)
- Mean duration of symptoms 2 years
- Standardized home-based physiotherapy x 3 mos
- 76% success rate (38/50 declined surgery at 3 mos)
- Rotator Quality of Life score most sig. predictor

Is Nonoperative Treatment Effective?

Effectiveness of Physical Therapy in Treating Atraumatic Full Thickness Rotator Cuff Tears. A Multi-Center Prospective Cohort Study

John E. Kuhn, MD, MS, Warren Dunn MD, MPH

Moon Shoulder Group:
Baumgarten MD, Julie Bishop MD, James Carey MD, Charles Cox MD, Brian Holloway MD, Grant Jones MD, Benjamin Ma MD, Robert Marx MD MSc, Eric McCarty MD, Matthew Smith MD, Edwin Spencer MD, Armando Vidal, MD, Brian Wolf MD MS, Wright MD

Is Nonoperative Treatment Effective?

- Multicenter Prospective Cohort
- 400 patients
- Avg. age 62 years
- Atraumatic Full Thickness Rotator Cuff Tears
- Treated with EBM Physical Therapy Program
- Followed at 6, 12 weeks and 1, 2 years

Factors related to successful outcome of conservative treatment for rotator cuff tears

• 123 shoulders treated conservatively for > 3 months
• Clinical improvement in 65 shoulder
• No improvement or worse in 58 shoulders (all went on to surgery)
General Follow-up Protocol

- At follow up points (6 and 12 weeks) patients are asked:
  - Are you cured?
    - Future follow up by telephone and mail
    - Return if symptoms worsen
  - Are you better?
    - Continue PT to 12 weeks, then HEP and follow up by phone and mail
    - Return if symptoms worsen
  - Are you no better?
    - Arthroscopic RCR

Methods

Patient Data Collection

- T=0, 6 weeks, 12 Weeks, 1 Year, 2 years
- Demographic and Co-morbidities
- Outcome Scores
  - SF-12
  - ASES
  - WORC
  - SANE
  - Marx Activity Scale

Physician Data Collection

- T=0, 6 weeks, 12 weeks
- Physical Exam Data
  - ROM, Strength, Provocative Tests
- Imaging Data
  - Xrays
  - MRI Descriptors of Rotator Cuff

Results

Outcome of Treatment

<table>
<thead>
<tr>
<th>Total/Outcome</th>
<th>6 weeks</th>
<th>12 weeks</th>
<th>1 year</th>
<th>2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Data</td>
<td>16 (4%)</td>
<td>23 (7%)</td>
<td>2 (1%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>No Surgery</td>
<td>325 (86%)</td>
<td>293 (87%)</td>
<td>236 (93%)</td>
<td>133 (98%)</td>
</tr>
<tr>
<td>Surgery</td>
<td>36 (10%)</td>
<td>20 (6%)</td>
<td>16 (6%)</td>
<td>3 (2%)</td>
</tr>
</tbody>
</table>

Nonoperative Treatment of Rotator Cuff Tears

- Fewer than 10% of patients failed and went to surgery
- Most who went to surgery did so in first 6 weeks
- Results do not seem to worsen with time

Patient Outcome Measures After Nonoperative

<table>
<thead>
<tr>
<th>SF-12 MCS</th>
<th>Baseline</th>
<th>6 Weeks</th>
<th>p-values</th>
<th>12 Weeks</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40.3</td>
<td>40.6</td>
<td>0.29</td>
<td>40.9</td>
<td>0.79</td>
</tr>
<tr>
<td>SF-12 PCS</td>
<td>35.3</td>
<td>35.6</td>
<td>&lt;0.0001</td>
<td>36.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>ASES</td>
<td>54.4</td>
<td>69.1</td>
<td>&lt;0.0001</td>
<td>75.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>WORC</td>
<td>47.0</td>
<td>62.5</td>
<td>&lt;0.0001</td>
<td>69.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>SANE</td>
<td>46.6</td>
<td>62.7</td>
<td>&lt;0.0001</td>
<td>70.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Marx Activity Scale</td>
<td>9.9</td>
<td>10.1</td>
<td>0.095</td>
<td>10.0</td>
<td>0.44</td>
</tr>
</tbody>
</table>
The Evidence for Rotator Cuff Surgery

May 15, 2011

Eric McCarty, MD

Patient Outcome Measures After Nonoperative Treatment

<table>
<thead>
<tr>
<th>Assessment Tool</th>
<th>Baseline Scores</th>
<th>6 weeks</th>
<th>12 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-12 MCS</td>
<td>40.26</td>
<td>40.57</td>
<td>40.84</td>
</tr>
<tr>
<td>SF-12 PCS</td>
<td>35.34</td>
<td>35.64</td>
<td>36.05</td>
</tr>
<tr>
<td>ASES Score</td>
<td>54.47</td>
<td>77.98</td>
<td>83.67</td>
</tr>
<tr>
<td>WORC Score</td>
<td>47.16</td>
<td>62.52</td>
<td>69.67</td>
</tr>
<tr>
<td>SANE Score</td>
<td>46.6</td>
<td>62.73</td>
<td>70.27</td>
</tr>
</tbody>
</table>

Nonoperative Treatment is Effective in this Group

• How does it compare to surgery?

Randomized Controlled Trial

Operative vs Nonoperative Treatment of Rotator Cuff Tears

• 103 patients
• <3cm size
• Traumatic and atraumatic tears on MRI

Groups

• Nonoperative (N=52)
  – Protocol developed by authors
  – Applied in non-standard manner according to clinical findings and progress
  – 40 min 2x/week increasing intervals 6-12 weeks

• Operative (N=51)
  – Open (42 patients) or Mini-open (9 patients) Repairs
  – Tenodesis in 18 patients (35%)*

Outcomes

• Primary Outcome Measure
  – Constant Score

• Secondary Outcome Measures
  – ASES
  – Pain free abduction
  – VAS

Results

Constant and ASES Score

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Surgery group (n=52)</th>
<th>Nonoperative group (n=51)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant score (range 0 to 100)</td>
<td>22.2 (20-40)</td>
<td>26.6 (25-42)</td>
</tr>
<tr>
<td>6 months</td>
<td>64.8 (56-78)</td>
<td>66.1 (58.5-81.7)</td>
</tr>
<tr>
<td>1 year</td>
<td>76.9 (72.6-86.6)</td>
<td>66.8 (60.8-82.4)</td>
</tr>
<tr>
<td>ASES (range 0 to 100)</td>
<td>45.2 (41.0-49.8)</td>
<td>46.6 (44.1-52.2)</td>
</tr>
<tr>
<td>6 months</td>
<td>84.0 (78.0-88.4)</td>
<td>79.8 (74.2-81.1)</td>
</tr>
<tr>
<td>1 year</td>
<td>82.4 (78.4-86.6)</td>
<td>79.2 (73.7-89.1)</td>
</tr>
</tbody>
</table>

Constant Score Difference = 10.9, p=0.002, MCID = NR
ASES Score Difference = 13.4, p=0.0005, MCID = 6.4*
The Evidence for Rotator Cuff Surgery

May 15, 2011

Eric McCarty, MD

---

**Constant Score over Time**

![Graph showing change in Constant Score over time](image)

**Pain VAS**

<table>
<thead>
<tr>
<th>Time</th>
<th>Surgery Group</th>
<th>Physiotherapy Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>9.8 (6.0 to 8.1)</td>
<td>9.4 (5.5 to 9.6)</td>
</tr>
<tr>
<td>8 months</td>
<td>6.4 (7.0 to 6.8)</td>
<td>7.4 (6.2 to 8.4)</td>
</tr>
<tr>
<td>12 months</td>
<td>6.9 (6.2 to 7.0)</td>
<td>7.1 (6.1 to 7.0)</td>
</tr>
</tbody>
</table>

Difference = 1.5, p=0.005, MCID VAS=2.0

---

**Success with Surgery**

- MRI Follow up on 50 of 51 Randomized to Surgery and all (9) Cross Over Patients
- Intact Cuff Repairs were seen in 76% of Patients, Partial Tears in 12%, Full Tears in 8%.

---

**Failures of Nonoperative Treatment**

- 9 of 53 (18%) failed nonoperative treatment and moved to surgery
  - 3 before 6 months
  - 6 after 6 months

---

**Comments on Design**

- Design—not a true intention to treat analysis
  - A patient who crossed over to their final score pre-operatively was the best estimate for the final result from physiotherapy. Following these patients without further treatment would have been unethical, and elimination of their results from analysis would have led to an overestimation of the effect of physiotherapy.
  - Not Unethical (display of bias)
  - Should have used 12 month data in intent to treat analysis.

---

**Comments**

- Constant Score is 25% Strength
- Biceps Tenodesis in 35% may be Performance Bias
- Pain and Constant Scores below MCID Threshold
  - Only 18% of patients crossed over....
Indications for Surgery

- The 18% Crossovers are the Interesting Group
- Why did more not cross over?
- Why did the ones who failed, fail?

What do we Make of This?

1.) The Cuff is NOT the Issue
- We repair less than 5% of all cuff Tears
- Results are Great in the Face of Surgical Failure
- There is NO correlation between severity of disease and pain

2.) Understand Your Bias
- Surgeons acknowledge pain, but look for OBJECTIVE sources because we fix anatomy
- With Cuff Tears, Patient Symptoms may have little to do with the Obvious Objective Finding.

3.) Don’t Make Claims without DATA!
- “Small Tears Get Bigger—Surgery can Prevent this!”
- “If we Don’t Fix this you may need a Reverse Shoulder Arthroplasty!”
- “Fatty Infiltration is Really Bad!”

4.) Patient Perception Rules OR
- You Can Sell Your Patients Anything.....
Thank You
Evidence for rotator cuff repair and patch graft

Teruhisa Mihata MD, PhD
Department of Orthopedic Surgery
Osaka Medical College

Arthroscopic rotator cuff repair has become more popular than open repair.

Yamaguchi K, Instr Course Lect 2003

Re-tear Rate after Rotator Cuff Repair
Large and Massive tear

<table>
<thead>
<tr>
<th></th>
<th>Open</th>
<th>Arthroscopic Single-row</th>
<th>Arthroscopic Double-row</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>55%</td>
<td>94%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>54%</td>
<td>48%</td>
<td>36%</td>
</tr>
</tbody>
</table>

Gazielly DF, CORR 1994
Galatz LM, JBJS Am 2004
Sugaya H, JBJS Am 2007
Boileau P, JBJS Am 2005
Huijsmans PE, JBJS Am 2007

Contributing factors in the re-tear of repaired tendon
• Biomechanical properties of repaired tendon
• Tear size
• Muscle atrophy and fatty infiltration
• Age

Millar NL, CORR, 2009
Sugaya H, JBJS Am, 2007
Huijsmans PE, JBJS Am, 2007
Nho SJ, AJSM, 2008
Goutallier D, JSES, 2003

Re-tear and Functional Outcome

Postoperative re-tear cases had significantly inferior functional outcomes.

Gazielly DF, CORR, 1994
Sugaya H, JBJS Am, 2007
Huijsmans PE, JBJS Am, 2007

Biomechanical Properties of Repaired Tendon
Cadaveric study
• Double-row repair improved initial strength and stiffness and decreased gap formation and strain over the footprint when compared with a single-row repair

Kim DH, AJSM 2006
Biomechanical Properties of Repaired Tendon

- A suture-bridge repair provides a stronger repair than the double-row technique, which may help optimize healing biology.

  *Park MC, AJSM 2008*

![Double-row Suture Bridge](image)

Tear Size and Re-tear Rate

- The retear rate was 5% for small-to-medium tears, while it was 40% for large and massive tears.

  *Sugaya H et al, JBJS 2007*

- 12% of small tear, 7% of medium tear, 22% of large tear, and 55% of massive tear had re-tear after double-row repair

  *Huijsmans PE et al, JBJS 2007*

Muscle atrophy and fatty infiltration

<table>
<thead>
<tr>
<th>Goutallier Classification</th>
<th>Reparable</th>
<th>Irreparable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Goutallier stage 3 and 4, it is relatively difficult to bring the torn tendon end back to the original footprint; therefore, these shoulders are not suitable for primary repair.

*Huijsmans PE et al, JBJS 2007*

Age and Clinical Outcome

- Recurrent tears appear to be linked to age-related degeneration.

  *Levy O, JBJS Br 2008*

- Female or old age statistically correlated with the score of SST, and the size of the tear correlated with the ASES score.

- The retear was influenced by age, fatty degeneration of the cuff muscles, and the size of tear.

  *Oh JH, Arthroscopy 2009*

Age and Clinical Outcome

- There was a significant negative correlation with size of cuff tear, age of the patient and Constant-Murley score.

  *Prasad N, Acta Orthop Belg 2005*

- Women had a negative, statistically significant relationship between age and shoulder scoring scales.

  *Romeo AA, CORR 1999*

Absolute Indication for ARCR

- Small to medium size tear
- Goutallier Stage 0-2
- 40-60 years old

For large to massive tear with Goutallier Stage 3 or 4, is ARCR the best surgical procedure?
Irreparable RCT

- Debridement and subacromial decompression
- Partial repair
- Transposition of the subscapularis tendon
- Transplantation of teres major muscle
- Supraspinatus muscle advancement
- Deltoit flap reconstruction
- Latissimus dorsi transfer
- Pectoralis major transfer
- Closure with allografts, autografts, and synthetic graft materials
- Reverse TSH

Patch Graft Surgery for Irreparable RCT

- Neviaser JS, JBJS Am 1978: Freeze-dried rotator cuff,
- Neviaser JS, Orthop Clin North Am 1980: Fascia Latae or Biceps tendon
- Ozaki J, CORR 1984: Teflon felt
- Post M, CORR 1985: Carbon filament
- Naska RJ, CORR 1988: Freeze-dried allografts
- Schlepckow P, AOTS 2001: Triceps tendon or CA lig
- Koh JL, AISM 2002: Polytetrafluoeroethylene (PTFE) felt
- Kimura A, JBJS Br, 2003: Porcine small intestinal submucosa
- Schlamberg SG, JSES 2004: Allografts
- Moore DR, AISM 2006: Porcine dermal collagen
- Soler JA, Acta Orthop Belg 2007: Teflon felt
- Sugaya Katakansetsu 2009: Fascia Latae or Hamstrings
- Shimokawa, Katakansetsu 2009: Biceps tendon
- Sano, Katakansetsu 2009: Polyglycol acid (PGA) sheet
- Mochizuki, Katakansetsu 2009: Polyglycol acid (PGA) sheet

Retear rate after patch graft to RC tendon

- Porcine small intestinal submucosa: 10/11 (91%) - Schlamberg SG, JSES 2004
- Allograft: 15/15 (100%) - Moore DR, AISM 2006
- Porcine dermal collagen: 4/4 (100%) - Soler JA, Acta Orthop Belg 2007

Very high re-tear rate!

Patch graft seems to be abraded by subacromial impingement due to lack of superior stability even after surgery

How can we restore superior stability without RCR?

Irreparable rotator cuff tear
Defect of the superior capsule as well as the rotator cuff tendon
We hypothesized that reconstruction of the superior shoulder capsule may be useful to prevent superior migration of the humeral head and subacromial impingement for irreparable rotator cuff tear.

**Biomechanical study**

**Superior Translation**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Superior Translation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact</td>
<td>0</td>
</tr>
<tr>
<td>SS Cut</td>
<td>2</td>
</tr>
<tr>
<td>SS Patch</td>
<td>4</td>
</tr>
<tr>
<td>SC Patch</td>
<td>6</td>
</tr>
</tbody>
</table>

**Clinical study**

**Healing rate**

- Rotator Cuff Repair: 82.4% (14/17 shoulders)
- Superior Capsular Reconstruction: 100% (10/10 shoulders)

**Active Shoulder Elevation**

- Healed repair: 14 shoulders
- Failed repair: 3 shoulders
- Superior Capsular Reconstruction: 10 shoulders

**Summary**

- Small to medium size RCT with Goutallier stage 0-2 are good indication for ARCR
- While conventional patch graft has high re-tear rate after surgery, ASCR had high survival rate
- Arthroscopic superior capsular reconstruction has comparable outcome to ARCR without re-tear
- Arthroscopic superior capsular reconstruction can be an effective option for irreparable rotator cuff tear
MANAGEMENT OF ROTATOR CUFF TEAR. EVIDENCE BASED APPROACH

Evidence for cuff fixation: one or two rows?

Dr. Mario V. Larrain y col.

Surgical Technique

“Footprint” Repair
- Single Row 67%
- Transosseous Suture 85%
  Apreleva y col, Arthroscopy 2002
- Double Row Technique ~ 100%

Surgical Technique

“Footprint” Repair
- Double Row ~ 100%

Fallas
- Different authors (Walton, Boileau) with different images studies (US, MRI, Arthro CT scanner) showed a loss of healing of rotator cuff between 20-68%, depending on the age, size of lesion and tissue quality.
- Romeo: high incidence asymptomatic healing defects of the rotator cuff after arthroscopic SR repairs.

Fealy et al. Arthroscopy 2002
Lo et al. Arthroscopy 2003
Covering / Contact Pressure

Transosseous Equivalent vs Double-Row Repair

Bigger Contact and Pressure Area

23% < Strength

Significantly higher ultimate load to failure and energy absorbed to failure

Park M, ElAttrache NS, Tibone JE et al.
J Shoulder Elbow Surg. 2007:16
**Double-Row Indication**

- “Any tear that initially or after their release mobilization comes to cover the extension of the footprint of the cuff without excessive tension on the repair”

**Movilization of the Rotator Cuff: Rotator Interval Release**

**SA release**

**GR release**

**Technique**

- Recognize tear pattern
- Debride tendon edges
- Liberate-Mobilize cuff.
  (Release/ interval slide)
- Margin Convergence
- Prepare Bone Bed
- Anchor placement
- Suture Knots

**“Suture Bridge System”**

**Key of Success**

- Recognize tear pattern
- Apropriate Liberation
- Secure fixation with minimal tension
- Good “footprint” restore with adequate contact pressure
- Good rehabilitation

**Discussion**

- DR rotator cuff repair provides secure nature anchor tendon fixation to bone and re-establishes the normal rotator cuff footprint.
  Ian K. L. Lo and Stephen S. Burkhart, Arthroscopy November 2003

- The DR technique was similar to the DR techniques in load to failure, cyclic displacement, and gap formation.

- Small to medium rotator cuff tears should be repair with the SR method, and large to massive tears should be repair with the DR method.
Discussion

**Biomechanical Comparison of a Single-Row Versus Double-Row Suture Anchor Technique for Rotator Cuff Repair**

David H. Kim, MD, Neel D. Dhadike, MD, Joseph M. Thoresen, MD, Kang-Joo Jun, MD, and Jose T. Linscheid, MD


- The DR repair improve initial strength and stiffness while decreasing gap formation and strain over the footprint compared with SR.

---

Discussion

**Can a Double-Row Anchorage Technique Improve Tendon Healing in Arthroscopic Rotator Cuff Repair?**


- Comparing DR and SR they found no significant difference in clinical results, but tendon healing rates were better for DR.
- Improvements in the DR technique might lead to better clinical and tendon healing results.

---

Discussion

**The Effect of Dynamic External Rotation Comparing 2 Footprint Restoring Rotator Cuff Repair Techniques**


- Comparative study with fresh frozen human cadaveric shoulders DR vs. Suture Bridge
- The tendon suture-bridging rotator cuff repair has a yield load that is higher than the DR repair when allowing for external rotation during load testing.
- An interconnected construct such as the suture bridging repair may share load better than a DR repair that has 4 separate fixation points.

---

Discussion

**Arthroscopic Rotator Cuff Repair:**

- Single Road Repair are least successful in restoring the footprint of the Rotator Cuff and most susceptible to Gap formation.
- Double repair have an improved load to failure and minimal Gap formation.
- Tensile strength equivalent repairs have the highest ultimate load and resistance to shear and rotational forces and the lowest gap formation.
**Advantages**

- Restoring of a larger footprint increases the area of contact for healing.
- Some biomechanical studies in cadaver showed superior fixation of tendon to bone with transosseous equivalent repair when compared to double and single row fixation.
- May potentially improve the healing and mechanical strength of repair.

**Disadvantages**

- The procedure is more time consuming.
- The need of more implants is obvious, making the procedure more expensive.
- Major surgical training.
- Associated injury.

**Conclusions**

- Each case “made to measure” depending tear configuration, mobilization and tissue quality.
- Double Row fixation has a biomechanical rationale.
- Although there is no clinical evidence that is better than Single Row fixation yet, it better reconstructs the footprint anatomy.
- Double Row suture anchor technique may provide a better environment for tendon healing when possible.
- The figure eight technique avoiding the passage of 2 or 4 sutures decrease the surgical time and restore a better footprint with more uniform contact pressure.
Complications after reverse total shoulder arthroplasty
Wall B. et al Include dislocation 7.5%, infection 4%, revision surgery 2x primary
Wall B. et al JBJS, 2007; 89 p1476

In conclusion:

Repair of a massive tear is optional for most structures if sufficient tissue is available. In elderly patients with many co morbidities, a debridement or partial repair may be of value. In young patients < 50 without arthritis, a tendon transfer, latissimus dorsi may help in patients with a good subscapularis. In older patients with cuff tear arthropathy, a reverse prosthesis is of value with complications becoming less frequent. In a cuff tear that is massive and non repairable or in whom a prior repair failed yet arthritis is not present, a RTSA can be of value despite the risks that are present.
Nho S. AJSM, Vol X, P1
Bedi A. JBJS, Current Concepts, 2010; 92; 1894-1908
Role for Latissimus Dorsi transfer in younger patients without arthritis and an intact subscapularis.

**Gerber et al, CORR, 1992 P152**
Women did more poorly with Lat transfer

**Iannotti J., JBJS; 2006 88 P342**

Role of hemiarthroplasty for individual with cuff tear arthropathy if they have good elevation and no prior surgery or anterior superior escape vs RTSA

**Fields L, et al. JSES,**

Reverse shoulder replacement for cuff tear arthropathy
- If arthritis is present, a standard TSR may lead to loosening of the glenoid.


Constrained design in the 80's lead to failure.

**Bostrom LA, CORR; 1992 P155-160**

Grammont – altered the designed and improved the efficiency of the deltoid.
1. Medialized the center of rotation to decrease forces on the glenoid
2. Lengthened the deltoid by changing the angle on the humeral cut

**Boileau et al, JSES, 2005; 1475-61**

The results while encouraging clinically have noted a high complication rate.

**Guery J. et al- 80 prosthesis in 78 patients at 2 year- elevations increase 78° to 138°**

Prosthetic survival at 5 years = 91%  
at 7 years = 75%  
at 8 years = 30%

**Guery J. et al JBJS, 2006; 88 P1742**

**Werner JP- RTSA for CTA**
- Constant score 29 → 64
- Complications 50%
- Revisions 33%

**Werner JP, JBJS, 2005; 87 P1476-86**

**Frankle M, JBJS 2005; 87, P1697**
- 60 Patients at 33 months (ave) for CTA
- 33 Primary 23 after failed cuff repair
- ASES score – 34 →68:
  Complication rate 17%
  Revision rate 12%
These forces are acting through the remaining cuff, this can lead to increased size or repair failure.

**Hensen et al, JBJS 2008, 90 P316-325**

Levy exercises may convert some individuals to become a coper with elevation and minimal pain.

**Levy O. JSES, 2008, 17 P863-70.**

Cuff repair is considered if some tissue remains with grade 3 fatty replacement. MRI factors associated with reparability include:
- Tear size > 40mm length and width
- Supraspinatus thickness <5mm glenoid

**Sagihara T., JSES 2003; 12 P22**

Poorer results noted with fatty replacement

**Open repair of massive tear**
- 1. Hard to tell degree of soft tissue flexibility on MRI
- 2. Actually easier to repair large tears with arthroscope

Defects are common after repair.

Defect rates do not correlate with clinical outcome

**Harrigan et al**

Strength is correlated with defect rate

Results vary:
- Cofield et al repair- 11 massive tears no significant difference in past operative active abduction or external rotation.

**Cofield R., JBJS, 2001, 83 P71**

**Arthroscopic Repair**
- Galatz L. noted improved scores at 1 year that decreased at 2 years
- Galatz L. noted high re-tear rates (94% massive tears)
- Verma noted 50% in massive repair vs. 19% for tears <3cm,

**Arthroscopy, 2006; 22 P507**
- Sugaza noted a 40% re-tear rate for large and massive with decreased scores and strength for failed repair.

**Sugaza et al, JBJS, 2007; 89 P953**

**Margin Convergence:** as noted by Burkart S.:
- Found in 59 patients no difference in scores of those treated by margin convergence vs. direct tendon to bone repair.

**Burkart s., Arthroscopy, 2001; 17 P905-912**
EVIDENCE FOR REPAIR ON REVERSE SHOULDER REPLACEMENT FOR MASSIVE ROTATOR CUFF TEARS

Definition of massive rotator cuff tears
- De Orio and Cofield- Defined massive cuff tears as the length of the greatest diameter as more than 5cm- JBJS 1984: 66(4) P 563-567
- Some define it as > or equal to 2 tendon tears,
Gerber C. JBJS 2000, 82(4) P505

Result of arthroscopic repair of massive tears will demonstrate a high level of defects (17 of 18) Galatz LM, JBJS 2004: 86 P219-224

Massive tears have a high level of fatty replacements that will affect the ultimate power and function of the shoulder.
Goutallier D. JSES, 2003; 12 P 550-554

Cuff defects over time leads to tissue retraction, loss of contractile strength and decreased compliance as well as fat atrophy of the muscle.
Coleman S. et al, JBJS

In treating massive tears the important issues are:
1. Age and co-morbidity
2. Painful
3. Weakness
4. Presence of superior migration
5. Arthritis
6. Degree of fatty replacement

Some massive tears are pain free with reasonable motion. If arthritis is minimal the potential treatments include:
1. Observation/Rehab
2. Cuff debridement/tuberosity
3. Margin convergence/augmentation
4. Reverse prosthesis
Fenlin J., JSES, 2002; 11: 136-142

If arthritis is present, the issue of function/pain are critical. If he has pain but good function, a hemiarthroplasty vs. a reverse prosthesis may be considered.

Massive tear without arthritis
1. Rehabilitation
   - Hensen et al – remaining cuff can develop sufficient force to counteract the deltoid:
     6-7cm tear- remaining cuff had< 50% increased force requirement
     8cm tear- remaining cuff had to generate > 80% force of normal state.