Partial Thickness Rotator Cuff Tears

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Incidence

- Data from cadaveric and imaging studies
- Increasing incidence with age
- Partial tears ~ 2X’s full thickness tears
- Articular sided ~ 2-3 X’s more common than bursal surface

- Cadaveric study
- 7% full thickness
- 13% partial thickness
  - 18% bursal
  - 27% articular
  - 55% insubstance

- MRI of 96 asymptomatic shoulders
- Overall 20% prevalence of PT-RCT
- Age: 19-39 years
  - No full thickness tears
  - 4% partial thickness tears
- Age: >60 years
  - 28% full thickness tears
  - 26% partial thickness tears

Classification

- Ellman
  - Grade I: < 3 mm or < 25%
  - Grade II: < 6 mm or < 50%
  - Grade III: > 6 mm or > 50%

- Location
Anatomy

Microscopic Anatomy


- Rotator cuff coalescence of subscapularis, supraspinatus, infraspinatus and teres minor tendons
- 5 layer structure
- Layer 2 and 3 with tendinous fibers
- Vessel size increases from medial to lateral, more on bursal surface
- ? related to healing potential

Anatomic studies used as guidelines for average sized of footprint

Classic Anatomy


- 17 cadaveric shoulders
- Supraspinatus
  - Mean AP length: 25 mm (range: 19-27 mm)
Mean width: 12.1 mm (range: 9-15 mm)


- 20 cadaveric shoulders
- Supraspinatus tendon
  - Mean AP length: 23 mm (range: 18-33 mm)
  - Mean width: 16 mm (range: 12-20 mm)
  - Arthroscopic landmarks
    - Biceps to the bare area
    - Edge of articular surface to tuberosity.
- Infraspinatus
  - Mean AP length: 28 mm (range: 20-45 mm)
  - Mean width: 18 mm (range: 12-24 mm)
  - Wraps around posterior supraspinatus
  - Starts at bare area, framing it

Conclusions from above 2 studies

- General recommendations
  - Tear AP length can be measured by starting at posterior biceps
  - Thickness of tendon torn can be measured from edge of articular surface to intact fibers
  - Estimate 50% of tendon thickness ~ 6-8 mm of exposed bone

Recent Anatomic Studies


- Cadaveric study
- Supraspinatus tendon
  - Smaller triangular insertion
  - 21% of cases SST has lesser tuberosity insertion
- Infraspinatus tendon
  - Large, long, trapezoidal tendinous insertion
  - Occupies large portion of the superior facet of greater tuberosity
- Redefining anatomy and what 50% torn represents?
Lesser Known Study

Is The Partial Tear Even Tendon?


- Cadaveric study
- Dissection of capsular and tendinous insertion of rotator cuff
- Capsule occupies substantial portion of capsule/tendon insertion
- Capsule reinforces tendinous insertion?
- Thickest anteriorly and posterior (between infraspinatus/teres) minor \( \rightarrow \) corresponds to cable/crescent
- Thinnest 11 mm posterior to anterior supraspinatus \( \rightarrow ? \) Region of initial of PR-RCTs
**Pathogenesis**

**Intrinsic Factors**
- Age related changes (↓cellularity, fascicular thinning, fascicular disruption, granulation tissue formation, dystrophic calcification, hypovascular zone, metabolic & vascular changes → degeneration → differential shear stress)

**Extrinsic Factors**
- Subacromial impingement
- Glenohumeral instability
- Internal impingement
- Acute trauma
- Repetitive trauma

Certain factors predispose to different partial tears
- Older patients → age related degeneration → articular tear just posterior to biceps
• Young, overhead athletes → ? internal impingement → tensile fiber failure → posterior SST/anterior IST tear
• Likely lead to different prognosis and natural history

Diagnostic Imaging

Ultrasound
• Less expensive
• Noninvasive
• Operator dependent
• Little information on concomitant pathology


• U/S identified 13 of 19 PT-RCTs
• MRI identified 12 of 19 PT-RCTs

MRI
• More information on concomitant pathology
• Arthrogram may improve accuracy
• ABER view may improve accuracy


• 197 rotator cuff tears at arthroscopy
  • 92 FT-RCTs
  • 105 PT-RCTs
• FT-RCTs
  • Sensitivity = 96%
  • Specificity = 99%
  • Accuracy = 98%
• PT-RCTs
  • Sensitivity = 80%
  • Specificity = 97%
  • Accuracy = 95%
  • Most (78%) false negative and false positives were Ellman Grade I tears


• Recent meta-analysis of 65 studies
• Ultrasound similar sensitivity and specificity as MRI
• MRA more sensitive and specific than MRI and ultrasound

TREATMENT

NONOPERATIVE

• Activity modification
• Ice
• NSAIDS
• PT
• Injections

Non-Operative Treatment Results


• 76 consecutive patients, referred to tertiary referral centre
• non-operative treatment successful in ~ 50%
• 91% still satisfied 46 months after initial assessment
• Patients with atraumatic onset, non-dominant extremity, < 50% tendon torn more likely to have successful non-operative treatment.

Does Non-operative Treatment Lead to Progression of Tear Size?


• 1982-1992- 41 PT-RCT (articular surface) conservative treatment
• Mean age: 61 years
• Clinical F/U ~ 2 years
  • JOA Score 68 → 80
• F/U arthrography ~ 416 days post (1.1 years)
  • 11 (28%) progress to FT-RCT
  • 31 (53%) enlarged in size
  • 4 (10%) reduced in size
  • 4 (10%) tear disappeared
• Worse prognosis increasing age, larger tear size, atraumatic history

Lo et al. Non-operative treatment of partial thickness rotator cuff tears: Clinical and Anatomic Outcomes
• 37 patients, isolated PT-RCT
• Mean age 54 (36-75)
• Mean F/U 44 months (3.6 years)
• Clinical
  • ASES Score 84 (40-100)
  • SST 10 (5-12)
  • RC-QOL 81 (39-100)
• Anatomic F/U by MRI
  • 60% no significant change in size
  • 15% decrease in tear size
  • 25% progression of tear
  • NSD between MRI follow-up and outcome
• Prognosis not as bad as Yamanaka suggests
• No correlation between outcome and MRI
• Clinical and anatomic surveillance?

OPERATIVE

• Largely based on failure of non-operative treatment
• But also
  o size of tear and depth of tear
  o Patient age
  o Patient expectations
  o Assoc. pathology

Rationale for the 50% Rule

• In general
  o Patients with < 50% tendon thickness torn → debridement
  o Patients with >50% tendon thickness torn → repair
• Biomechanical rationale
  o Increased strain in residual RC with articular surface tears > 50%
  o Repair leads to restoration of normal state

Largely based on clinical study


• 65 patients with grade III PT-RCTs, 12% bursal, 88% articular
• Non-randomized based on preoperative consult
• 32 treated with debridement and acromioplasty
• 33 treated with mini-open repair
• F/U 2-7 years
Surgical Treatment

1. Debridement +/- decompression

- ~72%-86% good results (Snyder, Gartsman, Ryu, others)
- addition of decompression has not be shown to improve results
- Patients with bursal surface RCTs may have a higher failure rate (38%) (Cordasco)

Does debridement and decompression prevent tear progression?


- 33 patients Ellman grade II tears
- Mixed articular and bursal sided tears
- Surgery SAD and debridement
- F/U 101 months (8.4 years)
  - Operated side Constant score = 65 (15-98)
  - Non-operated side Constant score = 84 (15-96)
- Anatomic results
  - 26/33 patients underwent ultrasound
  - 9/26 → FT-RCT (lower Constant score (48 [15-97]) vs intact cuff 65 [45-98]) = NSD)


- 46 patients
- Mean age: 59.2 (33-76)
- Grade I and Grade II PT-RCT articular surface
- F/U 50.3 months (4.2 years)
  - ASES score = 37 → 86
  - Post-op Constant score = 87.6
- Anatomic results
  - Ultrasound
  - 6.5% (3 patients) progress to FT-RCT
  - Only 1 with poor result
2. Arthroscopic Rotator Cuff Repair

- multiple authors have published recent results
- current controversy is essentially
  - Conversion of tear to FT-RCT → repair
  - In-situ (e.g. trans-tendon) repair
- Advantages to conversion of tear to FT-RCT
  - Removal of all potential diseased tissue
  - Standard arthroscopic techniques for repair
- Advantages to in-situ repair
  - Maintain viable lateral tendon
  - Anatomic reconstruction of footprint
  - Improved time zero biomechanics

<table>
<thead>
<tr>
<th>Author</th>
<th># of Patients</th>
<th>Technique</th>
<th>Clinical Outcome</th>
<th>Anatomic Outcome</th>
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</thead>
<tbody>
<tr>
<td>Porat et al.</td>
<td>36</td>
<td>Conversion to FT-RCT</td>
<td>UCLA: 17.2 --&gt; 31.5</td>
<td>N/A</td>
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<tr>
<td>Deutsch et al.</td>
<td>41</td>
<td>Conversion to FT-RCT</td>
<td>ASES: 42 --&gt; 93</td>
<td>98%</td>
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<tr>
<td>Kamath et al.</td>
<td>42</td>
<td>Conversion to FT-RCT</td>
<td>ASES: 46.1 --&gt; 82.1</td>
<td>93% ultrasound 88% intact</td>
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<tr>
<td>Iyengar et al.</td>
<td>22</td>
<td>Conversion to FT-RCT</td>
<td>UCLA: 19.1 --&gt; 32.9</td>
<td>N/A MRI 82% intact</td>
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<tr>
<td>Waibl et al.</td>
<td>22</td>
<td>Trans-tendon</td>
<td>UCLA: 17.1 --&gt;31.2</td>
<td>91%</td>
</tr>
<tr>
<td>Ide et al.</td>
<td>17</td>
<td>Trans-tendon</td>
<td>UCLA: 17.3 --&gt;32.9</td>
<td>N/A</td>
</tr>
<tr>
<td>Castagna et al.</td>
<td>54</td>
<td>Trans-tendon</td>
<td>Constant: 45.3 --&gt; 90.6</td>
<td>98%</td>
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<tr>
<td>Castricini et al</td>
<td>31</td>
<td>Trans-tendon</td>
<td>Constant: 44.4 --&gt; 91.6</td>
<td>MRI 100% intact</td>
</tr>
<tr>
<td>Seo et al</td>
<td>24</td>
<td>Trans-tendon DRR</td>
<td>ASES: 38 --&gt; 89</td>
<td>92%</td>
</tr>
<tr>
<td>Tauber et al.</td>
<td>16</td>
<td>Trans-osseous</td>
<td>UCLA: 15.8 --&gt; 32.8</td>
<td>94%</td>
</tr>
<tr>
<td>Spencer</td>
<td>20</td>
<td>Intra-articular</td>
<td>Penn: 74 --&gt; 92</td>
<td>N/A</td>
</tr>
</tbody>
</table>


- 74 patients
- Randomized to transtendon versus conversion to FT-RCT
- F/U: minimum 2 years
- Trans-tendon
  - Constant score: 62.5 → 87.6
• Conversion
  o Constant score: 57.8 → 86.9
• NSD between groups
• Subgroup analysis greater strength improvement in conversion group
Bibliography


Codman EA. The Shoulder: Rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Boston, MA: Thomas Todd, 1934.


