Dual Row Rotator Cuff Repair

Jeffrey Halbrecht, MD
Why Dual Row?

- Poor structural integrity on f/u studies of single row repair
- Restore anatomy (footprint)
- Stronger Repair?
- Faster rehab?
- Better results?
Advantages of Dual Row

- Restore footprint
- Minimize pop motion at repair site
- Limit synovial fluid migration into repair site
- Extended healing surface
- Improved biomechanical strength with multiple points of fixation
Dual Row Options

- Technique
  - Two separate rows
  - Suture spanning (suture bridge)
High Rate of “Recurrent Tears” after RTC Repair

- Harryman D: JBJS 1991
- Liu S: Arthroscopy 1994
- Gerber C: JBJS 2000
- Boileau P: ICSS 2004
- Galatz L: JBJS 2004
- Bishop J: AAOS/AOSSM Specialty Day 2004

20-80% residual defects
Footprint: Summary

- Normal Approximately 12-15mm
  - Nottage *Arthroscopy 2004*

- Single Row
  - 5-6 mm
Review literature on Dual Row:

- Biomechanical
  - Tensile strength
  - Gap formation
  - Motion at repair site
  - Contact surface
  - Contact pressure
- Clinical results
- Cuff integrity on f/u imaging
Meier: Dual Row Stronger to Cyclic Loading

2 row > TOS > single row
- (TOS) failure  75.3 cycles
- (SRSA) failure  798.3 cycles
- (DRSA) had no failures

5000 cycles : failure = 10mm or greater

Ma: Higher Ultimate Tensile Load

- Double Row mean UTL 287 ± 24 N
- 3 single-row repairs tested
  - simple suture 191 N;
  - MMA 212 N
  - massive cuff 250 N ($P < .05$).

In vivo studies of UTL in a goat rotator cuff model showed no significant biomechanical differences between single-row and double-row repairs at 4 and 8 weeks.

Kim: Less Gap Formation Higher Ultimate Tensile Load

- Less gap formation with cyclic loading with 2 row repair (p<.05)
- Double row 46% higher UTL (p<.05)

Meier S: Restores Footprint

- Dual row restores 100% footprint
- TOS restores 71%
- Single row restores 46%

Park: Improved Ultimate Load with Suture Bridge

- Transosseous equivalent (suture bridge)
  - 443.0 +/- 87.8 N
- Double-row technique
  - 299.2 +/- 52.5 N (P = .043).

- Gap formation the same...
- 30 cycles (10-180 N) then pullout
- Used interference screw laterally

J Shoulder Elbow Surg. 2007 Feb 21; [Epub ahead of print]
Part II: Biomechanical assessment for a footprint-restoring transosseous-equivalent rotator cuff repair technique compared with a double-row repair technique.

Park MC, Tibone JE, Elattrache NS, Ahmad CS, Jun BJ, Lee TQ.
Park: Improved Contact Pressure and Contact Area with Suture Bridge

- Increased contact area and contact pressure with 4 suture bridge technique
- Contact area
  - 4 suture bridge (criss-cross) 124 mm
  - 2 row (separate) 63.3 (p<.05)
- Contact Pressure
  - 4 suture bridge .27 Mpa
  - 2 row .19 M (p=.002)

Meier SW: Less Motion at Repair Site (submitted)
Sugaya: Improved Cuff Integrity

- 86 pts
- 31 months
- 2 row
- 83 % intact on fu MRI
  - 5% small- medium
  - 40% large- massive

*Sugaya H, Maeda K, Matsuki K, Moriishi J.*
J Bone Joint Surg Am. 2007 May;89(5):953-60
Huijsman: Ultra Sound Follow up

- Good strength and ROM..
- Good integrity by US 83% overall

Huijsmans PE, Pritchard MP, Berghs BM, van Rooyen KS, Wallace AL, de Beer JF.
Arthroscopic rotator cuff repair with double-row fixation.
Anderson: Excellent Clinical Results Low Re-tear Rate

- 52 shoulders
- 2 separate rows of suture anchors
- Fu min 2 years
- Exc clinical results
- 17% retear on f/u U/S

## Rate of intact RC repairs at final follow-up:

<table>
<thead>
<tr>
<th>Pre-op tear size:</th>
<th>Dual-row</th>
<th>Single-row</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Huijmans et al. (US)</td>
<td>~91%</td>
</tr>
<tr>
<td></td>
<td>Sugaya et al. (MRI)</td>
<td>95%</td>
</tr>
<tr>
<td>Medium</td>
<td>Liu et al. (Arthrogm)</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td>Bishop et al. (MRI)</td>
<td>30%</td>
</tr>
<tr>
<td>Large</td>
<td>Harryman et al. (US)</td>
<td>60%</td>
</tr>
<tr>
<td>Massive</td>
<td>Galatz et al. (US)</td>
<td>60%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>~91%</td>
<td>95%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Medium</td>
<td>~63%</td>
<td>60%</td>
<td>30%</td>
<td>18%</td>
<td>~48%</td>
<td>6%</td>
</tr>
<tr>
<td>Large</td>
<td>~63%</td>
<td>60%</td>
<td>30%</td>
<td>18%</td>
<td>~48%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Summary of Literature

- Dual row restores better footprint (100%)
- Dual Row Stronger
  - ultimate tensile load, cyclic loading
- Less gap formation
  - Cyclic loading
- Suture bridge better than two separate rows.
  - Ultimate Load, contact pressure, contact area
- Increased contact pressure and contact area
- Better structural integrity on post op imaging
Criticisms of Dual-Row Repair:

- Potential for over-tensioning.
- Increased surgical time.
- Increased technical difficulty
- Increase cost.
- Multiple prominent suture knots.
The Answer: Suture Spanning DR Technique with Versalok
Suture-Spanning DR Repair: Surgical Time

Meier et al. – *Submitted for publication 2007*

- 30 patients
  (15 SSDR/ 15 Standard DR)

SSDR ~20 minutes faster  (p<0.05)
Dual Row Suture Spanning

- Multiple knots
  - Knotless anchors
- Surgical Time
  - 20 minutes faster (p<.05) (Meier et al: submitted)
- Tension
  - Tensionable anchor
- Costs
  - Multiple load anchor
  - Faster technique
Low profile

Prominent knots eliminated...
The Versalok: Dual Row Suture Spanning

Advantages

- Arthroscopic
- Knotless
- Secure fixation
- Simple technique
- Nothing protruding into SA space
- Allow tensioning of repair
- Versatile technique
- Fast (save $- OR time)
- Accurate tensioning
- Versatile
Self locking anchor:
Locks suture within anchor after deployment
Versalok: Deployment

Expanding anchor locks sutures and fixes anchor to bone...

1. Tap inserter to laser line.
2. Tension Rotator Cuff w/tension wheel or manually
3. Deploy Anchor Lock suture by fully squeezing trigger
4. Unscrew & Remove anchor shaft by turning inserter counterclockwise.

Protect sutures

Ø4.9mm (Pre-Deployed OD)

Ø6.3mm (Post-Deployed OD)

Sub-cortical fixation
The Versalok: Tensioning Gun
Dual Row

- **Benefit:**
  - Maximizes compression onto tuberosity
  - Increasing fixation footprint
  - Decreased movement of cuff-bone interface during healing
  - Minimize synovial fluid infiltration

- **Technique**
  - Medial row:
    - Versalok: knotless mattress
    - Spiralok: standard mattress
  - Lateral row:
    - Suture spanning
    - Separate row
Dual Row: Crossover : Suture Spanning Technique

- One double loaded medial anchor
- Single large medial mattress
- Cross for footprint compression
- Two Double loaded medial anchors
- Tie Two medial mattress
- Criss-Cross for footprint compression

Single cross

Criss-cross
Dual Row: Criss-Cross
Dual Row:
Criss-Cross

Medial Row anchors - double loaded
Shuttle sutures through tissue
Dual Row: Criss Cross – cont.

Repeat Two Anchors
Dual Row: Criss Cross- cont.
Dual Row: Criss Cross - cont
Dual Row:
Criss Cross cont.
Dual Row: Criss –Cross- cont.
Dual Row: Criss Cross
Delamination

Superior (bursal) layer

Inferior (articular) layer
Delamination
Consider anatomic footprint reconstruction for …

\textit{delamination}

Dual-row, “dual-layer” fixation

Medial row \quad \rightarrow \quad \text{Lateral row}

Slide courtesy of Hiroyuki Sugaya, MD
Repair Scenarios

Delaminated tear

Dual-row, dual-layer fixation

Superficial layer to lateral row
"Anatomic Repair of Delaminated Rotator Cuff Tears - Dual-Row/Dual-Layer Fixation"

Meier et. al. – Submitted for publication 2007

~18 N
RTCT - Delamination

Dual-Row/
Dual-Layer
Avoid overtensioning. Do not fully lateralize tendon!

Incomplete coverage with DR can still more than with SR technique…
Rotator cuff surgery → high complication rate.

Rotator Cuff Repair - Improving Results

- Biology
- Surgical Technique & Fixation
- Post-op Stresses (Rehab.)
An anatomic repair is a LOW TENSION REPAIR

What determines tendon healing?

Factors we can control...

Surgical Technique

– Anatomic restoration
  • Recognize tear pattern and accurately re-approximate tear.
  • Restore musculotendinous length-tension orientation.
  • Address delamination.
  • Restore footprint anatomically.