Rotator Cuff Tears

"Keys to Universe"

- Many unknowns

The Unknowns
1. Symptom origin
2. Surgical vs conservative management
3. Subacromial decompression or not-acromioplasty?
4. Biceps tendon—what to do?
5. Tendon healing—large/massive tears

Rotator Cuff Tears

Symptom Origin
- Not everyone with a tear has symptoms, not everyone needs surgery
- ? Uncovered humeral head
- ? Biomechanical disturbance, disrupted force couples
- ? Inflammation
- ? Degenerative tissue, bursa, spurs
Treatment Principles

Based on theory of “impingement” (Neer)
Remove mechanical factors
Restore cuff continuity
Reestablish shoulder dynamics

Pathogenesis

- Studies challenge Neer’s hypothesis by demonstrating articular-side partial-thickness tears with normal acromion
  - Rockwood, C: The Shoulder 2009
- 20% of patients undergoing acromioplasty went on to develop RCT
  - Hyvonen: JBJS Br 1998
- Anterior acromial spur:
  - 7% < 50 years-old
  - 30% > 50 years-old
  - Nicholson: JSES 1996

Rotator Cuff Tears
Diagnostic and Treatment Dilemmas

Acromial Spur?
Acromioplasty

- Role of acromioplasty
- Systematic review and meta analysis Cochrane
- 4 trials 373 patients
- No difference with or without at intermediate follow up
- Chahal J. et al Arthroscopy May 2012
- MacDonald- prospective RCT-full thickness cuff +/- acromioplasty
  - No difference in short term outcomes
  - Higher reoperation rate in non acromioplasty group
- Macdonald P et al. JHKS Nov 2011

Acromioplasty- Summary

1. No evidence that it affects outcomes
2. Improves visualization and repair
3. Up to 20% have bursal tears and mechanical impingement
4. May have lower retear rates
5. Lower reoperation rates?
6. Acromioplasty may not be necessary but no harmful effects in repairs - be careful in massive irreparable tears resulting in superior escape

Biceps – What to do ?

- Cyclic thinking regarding the biceps
- Importance to the shoulder biomechanics
- Sacrifice (a la Francaise) vs. retention
- Tenotomy vs. tenodesis
Retrospective review
72 irreparable RCT w/ biceps pathology
   - 39 tenotomies
   - 33 tenodesis (extrarticular)
   - No subacromial decompression
   - No control group

Results:
   - 78% satisfied
   - No difference between tenotomy and tenodesis

Conclusions:

Contradictions:
Pseudoparalysis and RCT arthropathy → reverse TSA

5/8 failures

Biceps Pathology – What to do?

- Tenotomy – 16% cramping, 37% popeye
- Tenodesis - no cramping, 6% failure of tenodesis
  - Dele Rose et al Musculoskeletal Surg May 2012
  - Sienker et al Arthroscopy Apr 2012 - Level iv studies only no outcome difference, higher cosmetic deformity,
  - Koh et al prospective cohort popeye 9% tenodesis, 27% tenotomy

Biceps Tenodesis – What to do?

- Tenotomy results in higher incidence of cosmetic deformity, cramping
- Tenodesis -? location
- Above pec – Groove pain /continued tenosynovitis?
- Subpectoral - Better pain relief, Nerve injury, complications?
- NO or little data
Challenges in Treating Rotator Cuff Tears - Healing

Value of tendon repair

- RC- Holy Grail: Improved tendon to bone healing rate with minimal morbidity and maintenance of muscle belly health
- Restore strength
- Improve function
- Better pain relief
- Better function if stays repaired

Challenges in Treating Rotator Cuff Tears - Healing

1. Not all tears are reparable
   - Chronic, retracted tears
   - Recurrent tears
2. Reparable tears do not always heal
   - Recurrent tear rate following RCR: 25-94%, depending on tear size and other factors
     - At least 10% of small tears
     - 30-50% of larger tears

Challenges - Rotator Cuff Healing

- Re-tears occur early (3-6 months):

  Miller et al., AJSM 2011 (Figure 3)
  72 patients
  Large (>3cm) tears, arthroscopic repair
  41% re-tear rate, US imaging

  Iannotti et al., JBJS 2013 (Figure 1)
  132 patients
  1-4 cm tears, arthroscopic repair
  17% re-tear rate, MRI imaging
Challenges - Rotator Cuff Healing

- Failure-with-continuity (i.e., tendon retraction without a defect) may be a ubiquitous phenomenon:
  - Baring et al, JSES 2011
  - McCarron et al, AJSM 2013

Why do so many rotator cuff repairs fail to heal?

- Patient factors – Indicators of the adverse biology
  - Age
  - Comorbidities – Smoking, DM?
  - History of failed repair

- Adverse biology and mechanics
  - Muscle atrophy and fatty infiltration
  - Tendons tear through degenerative tissue
  - High tensile loads at the repair site
  - Type of repair - strength
  - Poor biology

Single vs. Double Row

- Multiple biomechanical studies have shown better results with “double row”
  - Decreased gap formation
  - Improved load to failure
  - Better footprint coverage
  - Increased surface area
6 studies included
- No significant difference in clinical or functional outcome

**Double row**
- Are we over treating?
- What do we do for revisions?
- Does anything really matter?
- Maybe it’s the biology that matters?

**Biologic Augmentation**
- Explosion of interest
- Improve healing response
- Improve mechanics

- Biologic Enhancement
- Gene Therapy
- Growth Factors
- Augmentation patches
- Marrow Stimulation
- Not a bridge or gap filler
- Augment or reinforce a tendon at risk
Where does the Healing Come From Locally?

- Tendon has minimal cellular activity
- Worse in larger tears
- Look at the Bone, Blood, and Marrow Cells
- How to Enhance!?
- “Crimson Duvet”
  - Stephen Snyder

Footprint Cannulation

- MicroFx vs NanoFracture Device
- 1mm x 9mm
- Defined size without creating fractures or cracks in surface
- Accesses marrow
- Reusable device
- Economical

Biologic Enhancement of the Footprint Endogenous

- Marrow stimulation, cannulation or channeling
- Promotes positive biology at tendon-bone junction
- Clearly improves RC healing

Milano Arthroscopy 2013
Jo AJSM 2013
Taniguchi JSES 2015
**External Biologic Options-Augmentation**

1. PRP
2. Stem cells- injections, amnion
3. Tissue patches augmentation - collagen, acellular dermis,
4. Synthetic options PLLA, polyester

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**PRP?**

- 6 different PRP preparations, how much? Where? When?
- Metaanalyses-8 RCT, high quality methodology
- Varying tear sizes and repair techniques
- No Significant difference in:
  1. Retear Rates
  2. Constant Scores
  3. UCLA score

Zhao Jia-Guo et al Arthroscopy Jan 2015

- Vavken et al, AJSM 2015: Meta-analysis & cost-effective analysis stratified by tear size
  - 13 studies included (Level I-II)
  - Re-tear rate not significantly different across all tears

- Significantly lower re-tear rate in tears < 3cm
- However, reduction not cost effective at current cost

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**Clinical Studies of PRP for Rotator Cuff Repair**

- Vavken et al, AJSM 2015: Meta-analysis & cost-effective analysis stratified by tear size
  - 13 studies included (Level I-II)
  - Re-tear rate not significantly different across all tears

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Stem Cells- Next Frontier?

- Auto/allo sources
- Very early clinical, basic science work
- 45/45 (100%) RC treated with MSC repairs healed at 6 months vs. 30/45 (67%) RCR with NO MSC
- At 10 years 39/45 (87%) MSC treated only 20/45 (44%) control
- ASC may produce a better response than MSC
- Hernigou et al Int Orth June 2014
- Peister et al Stem Cell Res July 2012

Are PRP and Stem cells enough? Cuff Patches/Augmentation

1. Biologic/ECM based scaffolds
   - Swine submucosa
   - Acellular dermal allograft
2. Biodegradable scaffolds
   - PLLA, PLGA, PCL, PDO
3. Synthetic non absorbable scaffolds
   - Polyester, polycarbonate, polyurethane

Commercial Augmentation Patches Available for Rotator Cuff Repair

Ricchetti et al, JSES 2012
Clinical Studies of Grafts for Rotator Cuff Repair

- Summarized outcomes of published data:
  - Porcine SIS (Restore) discontinued due to adverse events, poor outcomes (Iannotti et al)
  - Current ECM and synthetic grafts have not been associated with adverse events
  - Case series show improved outcomes from pre-op state
  - 2 comparative studies with promising results (Barber et al, Ciampi et al)

- Limited data to guide decision-making on use:
  - Small studies, short-term follow-up
  - Varying devices, surgical methods, and outcomes studied

Rotator Cuff Summary

Many unresolved issues
Clinical outcomes not affected by many factors
Not everyone needs surgery, those that do can do well with a variety of approaches

Certainly biologic enhancement and tissue engineering is an effort that is here to stay
With regard to RC repairs and healing:
Many options — Confusing
Cost vs. Benefit still not clear
Clear: Marrow Stimulation in large and massive tears significantly better healing rate
The goal is to have a healed tendon repair
More sutures/anchors is not the solution — Better Biology is.

You Are Here! Thank You