Disclosures
- Institutional/Research Support:
  - Conmed/Linvatec
  - Arthrex
  - Ossur
  - DJO
  - Wright Medical
- Consultant
  - DJO
  - Arthrex
  - Conmed/Linvatec
  - Wright Medical
  - Acumed

Introduction
- Physical Exam
  - Imaging
  - Management Techniques
  - Repair
  - Transfer
  - Grafting
  - Arthroplasty
- Outcomes

Physical Exam for Cuff Tear

Small Rotator Cuff Tears
- Functional Pain
- Night Pain
- Overhead activities
- Deltoid distribution
- Provocative Signs:
  - Neer
  - Hawkins
• No Weakness

6 “Drop-Arm Sign”
• Weak abduction
• Can’t lift arm above head
• Can’t maintain arm in abduction

7 “Dropping Sign”
• Walch, JBJS-B (4), ’98
  • Infraspinatus
  • Stage 3 and 4 atrophy (Goutallier)
  • Irreparable Tear
    • 100% sensitive
    • 100% specific
  • Teres Minor hypertrophy

8 “Hornblower’s Sign”
• Walch, JBJS-B (4), ’98
  • Teres Minor
  • Stage 3 and 4 atrophy (Goutallier)
  • Irreparable Tear
    • 100% sensitive
    • 93% specific

9 Imaging

10 MRI
• Tendon Injury
  • Subscapularis
  • Biceps
  • Posterior Cuff

11 MRI
• Retraction
• Tendon Quality
• Muscle Quality

12 Rotator Cuff Healing- aRCR
• Small-Med Tears
  • SR: 43-85%
  • DR: 81-100%

13 Rotator Cuff Healing- aRCR

• Small-Med Tears
  • SR: 43-85%
  • DR: 81-100%

• Large-Massive Tears
  • SR: 6-24%
  • DR: 49-83%

14 Repair of Rotator Cuff Tear

15 My Algorithm

• <1cm: Triple-loaded anchor or knotless anchor

• 1-2 cm: Mattress fibertape with dual Swivelock

• >2cm: Knotless TOE

16 Technique

17 Single vs Double Row

• Most Biomechanical studies favor double row
  • Improved initial ultimate tensile strength and resistance to elongation
    • Ma et al JBJS 2006
  • Improved fixation strength
    • Meier and Meier Arthroscopy 2006
  • Greater resistance to gap formation and trend (P=.058) toward decreased failure with cyclic loading
    • Smith et al JBJS 2006
• No differences in *some* studies
  • No difference in failure with cyclic loading and gap formation despite improved footprint restoration with double row
    • Mazzoca et al AJSM 2005

### 18 TOE vs. Single/Double Row

• Cadaver study: Ultimate load to failure of 380 N with TOE compared with 280 N for double row technique
  • No difference in gap formation or initial stiffness
    • Siskoski *et al* 2007 AAOS presentation
  
  • Multiple studies show TOE superior to single-row techniques in ultimate load to failure, interface motion, restoring the footprint, and achieving the best contact forces
    • Cole *et al* Arthroscopy 2007

### 19 2009 Neer Award for Clinical Science

Gartsman, *et al* ASES Specialty Day 2010

• PRCT
  • Power Analysis
  • 50 patients per group
  • Blinded Radiologist
  • All SS tears <25mm
  • SR vs. TOE Suture Bridge

• 93% follow-up
  • 44/47 (94%) TOE Healed
  • 35/46 (80%) SR Healed
  • p=.046

### 20 Summary Case for DR RCRs:

• Double Row and TOE Repairs:
  • Biomechanically Superior
  • Anatomically Superior
  • Heal more dependably- in larger *and smaller* tears
  • Clinical results only improved in large tears
Re-Tear: When Do Repairs Fail?

- Murrell, AAOS, 2012
  - 19% torn at 6 mos
  - Correlated with tear size
- Peters, JBJS-A, 2012
  - <3cm
  - 10% at 6 months
  - 20% at 2 years
- Koh, JSES 2012
  - MRI at 6 and 20 mos post-op
  - No difference in re-tears

Most retears occur between 3-6 months post-op

- Re-tear rates generally stable after 6 months

Irreparable Tears

Tendon Transfer

Muscle/Tendon Transfers

- Deltoid
- Trapezius
- Pectoralis
- Triceps
- Teres Minor
- Latissimus

Latissimus Transfer

- Primary Indication: External Rotation Loss
  - “Dropping Sign”
  - “Hornblower’s Sign”
- Intact subscapularis
• Deltoid attachment?

27 Tendon Augmentation

28 Latissimus Transfer
• Anterior and posterior approach
• Lateral position
• Standard RC debridement and mobilization

29 Passing Tendon

30 Fixation

31 Rehabilitation
• Immobilization
  • 8 weeks- PROM
• Active Motion
  • Weeks 9-12
• Resistance
  • 12 weeks
  • Closed Chain
• Proprioception, Muscle re-training

32 Outcomes-
Latissimus Transfer
• Miniaci, JBJS(4),1999
  • Sig pain relief (p<.001)
  • Sig increased function
• UCLA 6.8 16.4
• Satisfaction 82%
• No infections or nn inj.
• Anterior deltid detachments no sig diff from those with intact deltid

33 Latissimus Transfer
• Gerber, CORR(275)
  • 33 month f/u
• Flexion 83
• Severe pain pre-op 13/16, no pain post op 13/16
• Conclusion: critical factor is competent subscapularis

34 Karas, Pearsall, et al- AAOS 2006
• N=12 1999-2004
• 10 had min 1 yr f/u
• Pain 9.1/3.6
• Constant 23/44
• ROM
  • FE= 27 degrees
  • ER= 16 degrees
  • G=4/S=4/P=2
• 3 Wound infections (2 fascia lata)

35 Lat Transfer- Conclusions
• Pain relief
• Results reproducible
  • But are they dependable?
• Modest improvements in ROM
• Extensive procedure
• Extensive rehab
• Is it a “long run for a short slide”?
  • Mean 24 deg forward elev.
  • Mean 11 deg ext rot improvement

36 Tendon Grafts

37 Grafts in Irreparable RCT
• Freeze Dried rotator cuff allografts
  • Neviaser et al JBJS 1978
• Synthetic materials
  • Polypropylene mesh
  • Post M, CORR 1986
• Biceps tendon autografts
  • Rhee AJSM 2008
• Fascia Lata allo- and autografts
  • McAdams KSSTA 2007
• Porcine Submucosa
  • Iannotti JBJS-A 2006
  • Murrell JBJS-A 2007

38  Methods
• Inclusion Criteria
  • Large/Massive Tear
  • Irreparable
  • <50% atrophy of the Tendon
  • Head concentric in glenoid
  • No or minimal OA
  • Non-smoker

39  Methods
• 14 patients
• Mean Age 54.6 yrs
• Previous surgery 4/10
• Ave tear size 13.0 cm²
• Ave f/u 16.4 mos (10-25)
• Prospective:
  • Pain
  • ROM
  • ASES scores
• MRI follow-up 12 mos post-op
• Paired 2-tailed Student's t-test

40  Technique
• Lateral approach
• Deltoid “off” laterally
• Full releases
• Full repair to anterior, medial, and posterior remnant tissue
• No “augmentations”
• “Double Row” repair laterally
• Avg Graft Size: 13.2cm²

41 Completed Repair

42 Rehabilitation
• Massive RCR Protocol

• Phase I: 8 weeks sling
  • Passive rom
  • No electrical stim

• Phase II: Active ROM
  • Isometrics

• Phase III: Resistance
  • Begins 3 months post-op

43 Results: ROM
• FF improved from 117° to 159°
  • $P = 0.017$

• ER decreased from 53° to 44°
  • $P = 0.047$

44 Results: Pain (VAS)
• VAS pain score improved from 6.2 to 0.56 postop
  • $P = 0.0001$

45 Results: ASES
• ASES improved from 38 to 82
  • $P = 0.037$
Results
- Complications: 1 adhesive capsulitis

- 14/14 patients satisfied with the procedure

- 14/14 pts would have the procedure again

Results: MRI

Second Look Arthroscopy

Keys to Good Outcome:
Patient Selection
- Narrow Therapeutic “niche”:
  - Concentric Head
  - Atrophy <50%
  - No pre-op pseudoparalysis
  - No/minimal arthritis
  - Non smoker

Expanded Indications:
Acute Pseudoparalysis

Rotator Cuff Arthropathy
(The Final Common Pathway of Irreparable RC Disease)

Cuff Arthropathy
- OA
- Motor impairment
- Instability
  - Escape
- Challenging Rx
  - TSA?
  - HHR?
Reverse Shoulder Prosthesis
- FDA Trial 2002-05
- 15 centers nationally

Humeral Preparation

Glenoid Technique

Multicenter Clinical Trial- Summary
- FDA Investigational Device Exemption
- Reverse™ Shoulder Prosthesis
- Encore Medical Corp. (Austin, Texas, USA)
- November 2002-Jan 2005
- \( n = 462 \) (SGK = 19)
- Primary: 327 (SGK = 10)
- Revision: 135 (SGK = 9)

Conclusions

NOT ALL RC TEARS THE SAME!