Massive Rotator Cuff Tears: the Transfer for New Ideas

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Assistant Professor

Pan Am Clinic

- Disclosures
  - None

Massive Rotator Cuff Tears

Challenges and Controversies in Treating Massive Rotator Cuff Tears

Stephen S. Burkhart, MD
Eric T. Ricchetti, MD
William N. Levine, MD
Leesa M. Galatz, MD

Observation?

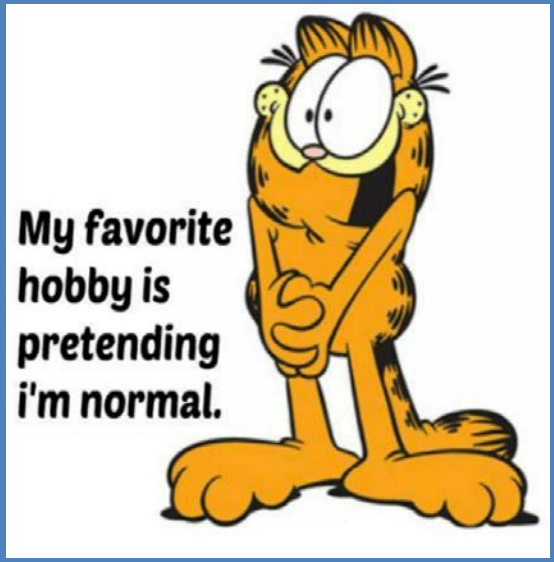
Massive Rotator Cuff Tears: Trends in Surgical Management

ROBERT THORSNESS, MD; ANTHONY ROMEO, MD

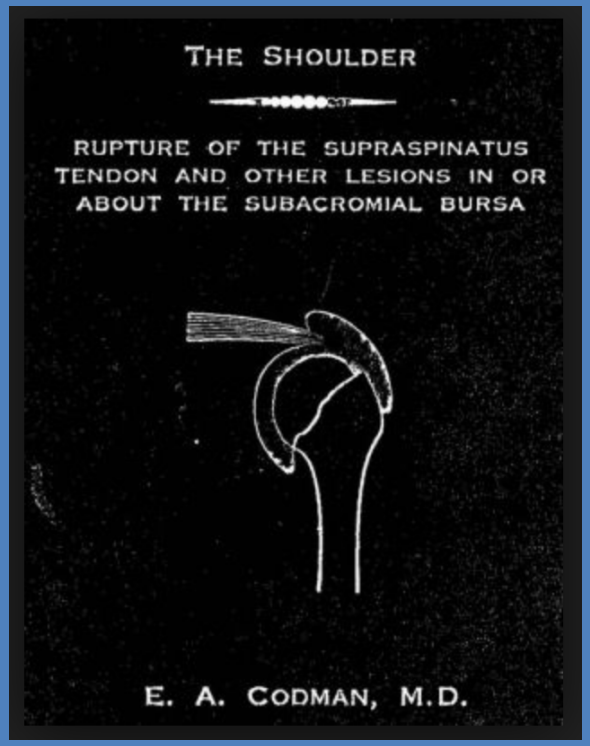
Superior Capsular Reconstruction?

Tendon Transfers?

Re-tear Rates 25-94%



The Goal: **Quality** (Cost / Outcome)



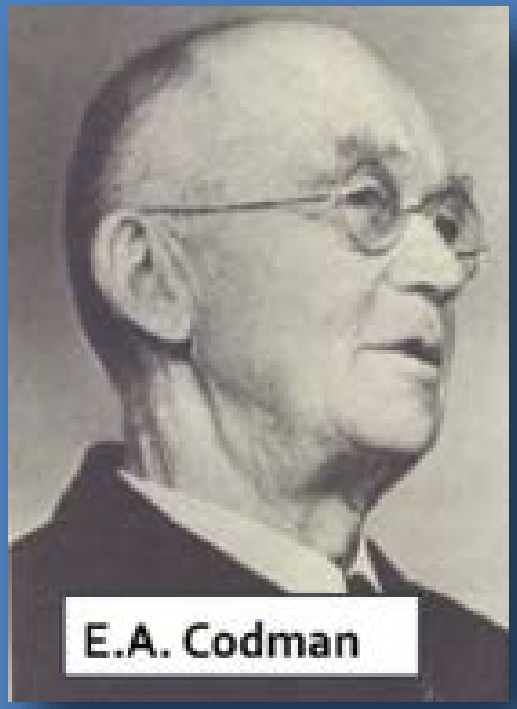
1986 - 1940

"rotator cuff tears occur in predictable patterns and we must recognize these patterns to allow improved outcomes"

Societal Impact

Quality = (**Cost** / Outcome)

Failed Surgery = Increased Cost



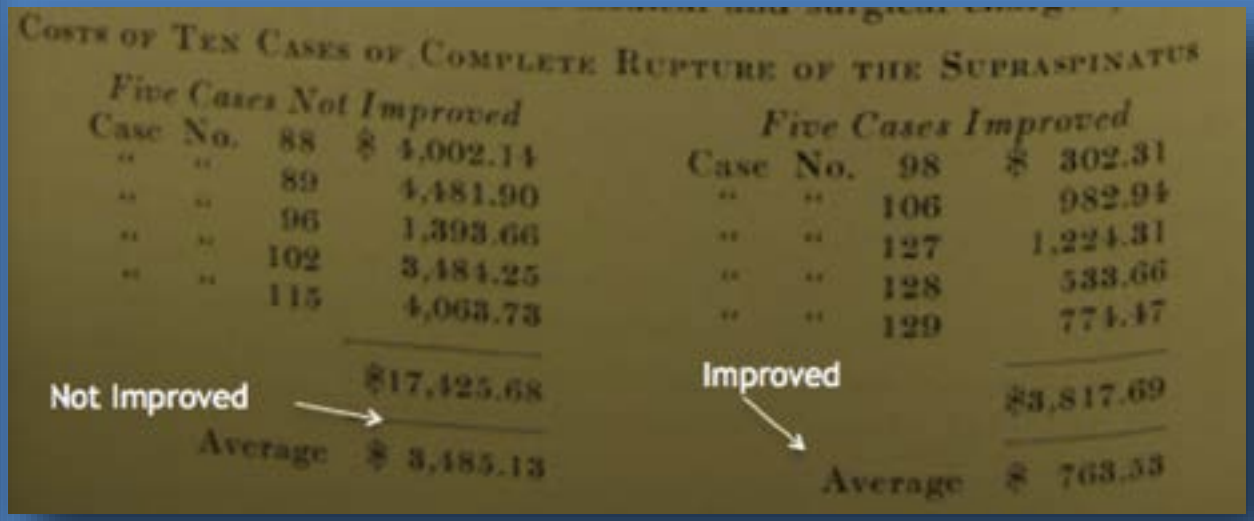


Fig 1. (A) E.A. Codman, the architect of the "end result" concept. (B) The cost of failure of rotator cuff repair as reported by Codman 100 years ago. From Codman EA. *The Shoulder* New York: Thomas Todd, 1934.[6]

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Background

Arthroscopic Treatment of Massive Posterosuperior Rotator Cuff Tears

A Critical Analysis Review

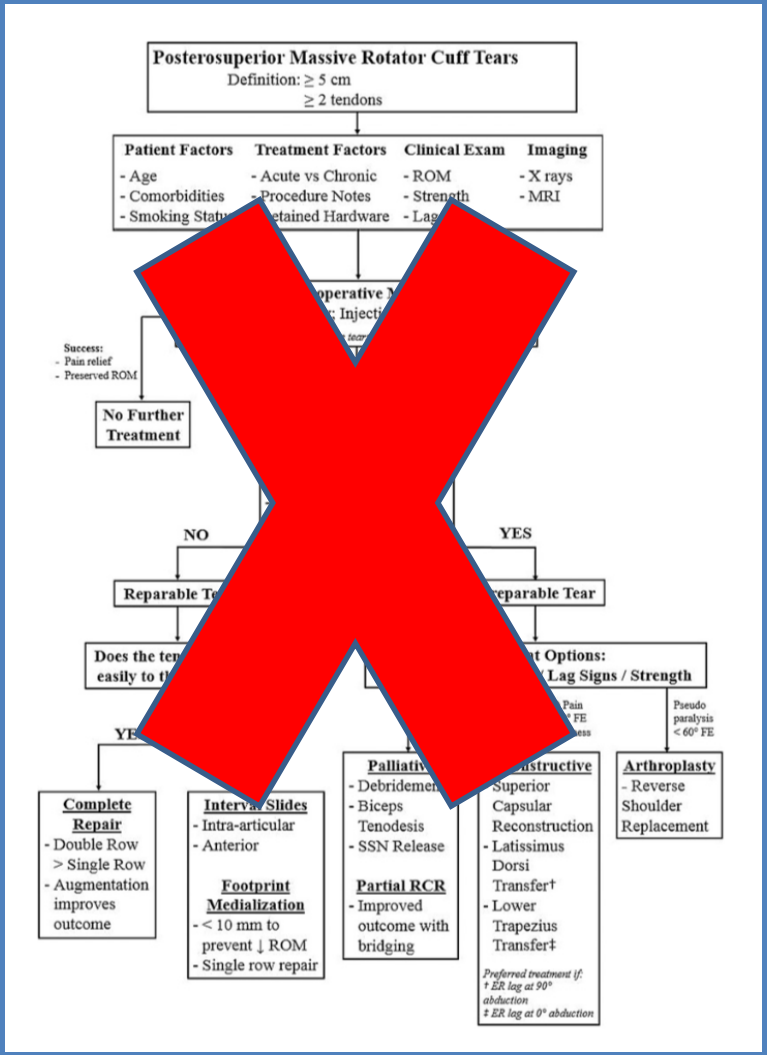
SUBSPECIALTY PROCEDURES

Novel Arthroscopic Tendon Transfers for Posterosuperior Rotator Cuff Tears

Latissimus Dorsi and Lower Trapezius Transfers

Eric R. Wagner, MD, Jarret M. Woodmass, MD, Kathryn M. Welp, MS, Michelle J. Chang, BS, Bassem T. Elhassan, MD, Laurence D. Higgins, MD, MBA, Jon J.P. Warner, MD

Treatment Algorithm



Woodmass et al. JBJS 2018;6(9),e3.

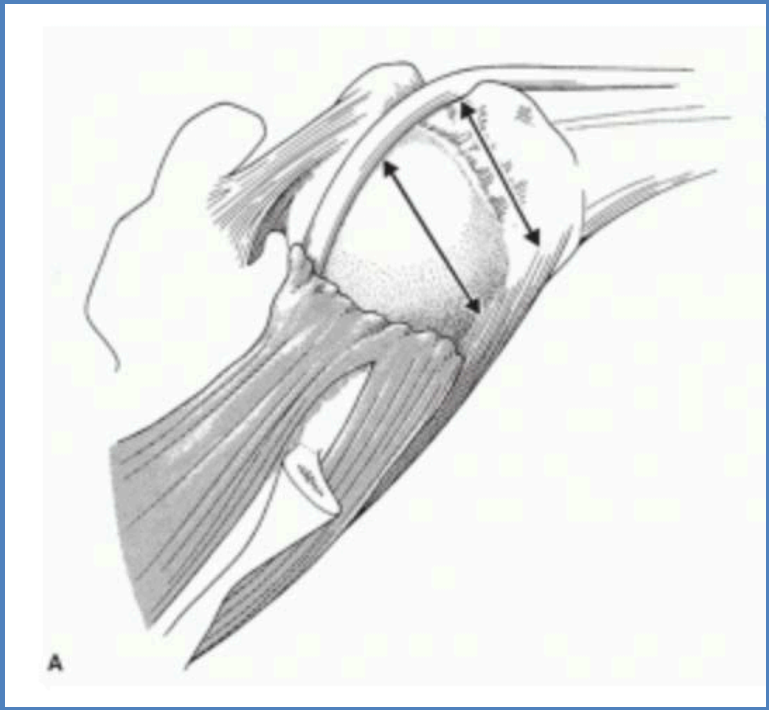
Massive Tears Made Easy

- Why are they different
- Timing
- Workup
- Treatment

Massive RCT: Definition

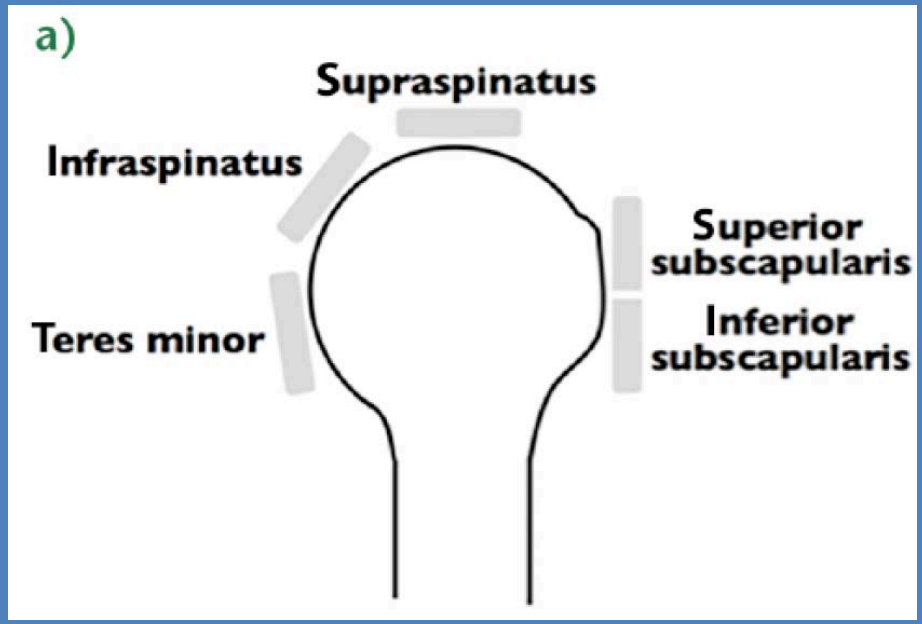
» **Cofield**:

- > 5cm tear



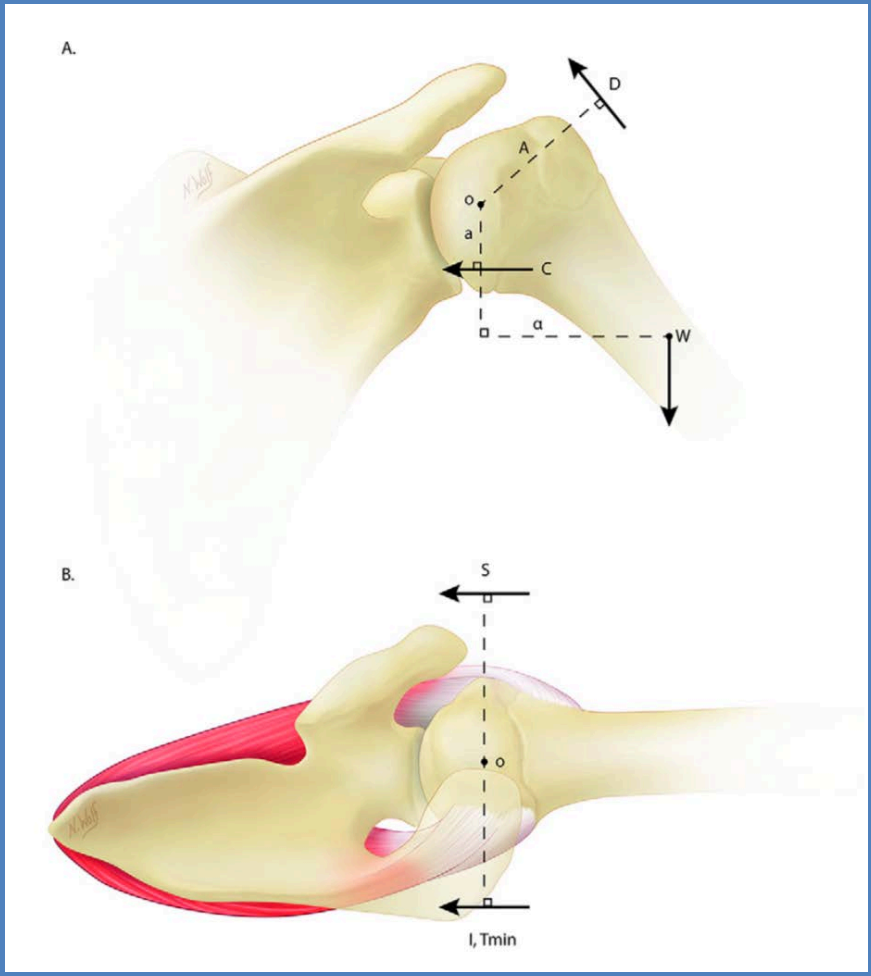
J Bone Joint Surg Am. 1984 Apr;66(4):563-7.

- **Gerber et al:**
  - > 2 Tendons



J Bone Joint Surg Am. 2000 Apr;82(4):505-15.

Anatomy and Biomechanics

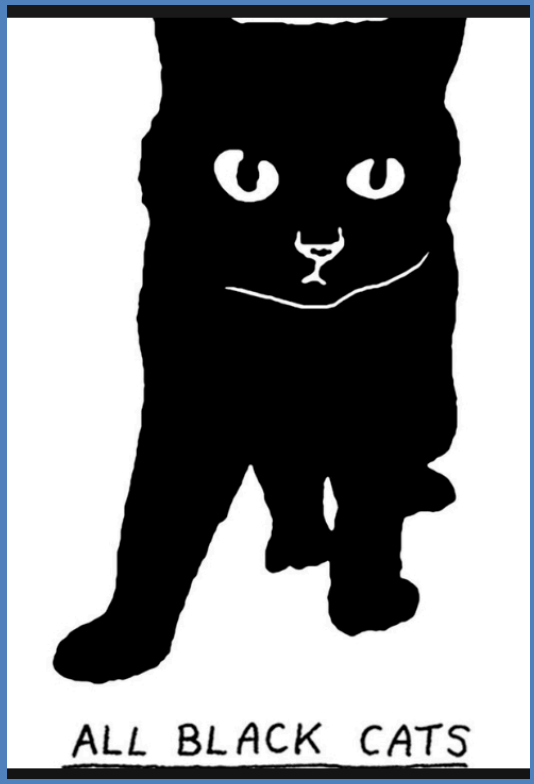


- Force Couples
  - » Disrupted
- Results:
  - » Weakness
  - » Proximal Migration
  - » ER lag signs
  - » Belly press / Lift off

Woodmass et al. JBJS 2018;6(9),e3.

Natural History of Massive Tears

- ALL RCTs are NOT the same
  - » Massive RCTs get….
    - Bigger
    - Weaker
    - Atrophic
    - Retracted
    - Contracted
    - Fatty Infiltrated



Massive Tears WILL become IRREPARABLE

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QUALITY = Cost / **Outcome**

- **Tear Chronicity of 6 months = Worse Outcome**

Surgery within 6 months of an acute rotator cuff tear significantly improves outcome

Nicholas S. Duncan, BMBS, BMedSci, MRCS(Ed), FRCS(Tr&Orth)*, Simon J. Booker, FRCS(Tr&Orth), Ben W.T. Gooding, FRCS(Tr&Orth), John Geoghegan, FRCS(Tr&Orth), William A. Wallace, FRCSEd(Orth), Paul A. Manning, FRCS(Tr&Orth)

Journal of Shoulder and Elbow Surgery

J Shoulder Elbow Surg (2015) 24, 1876-1880

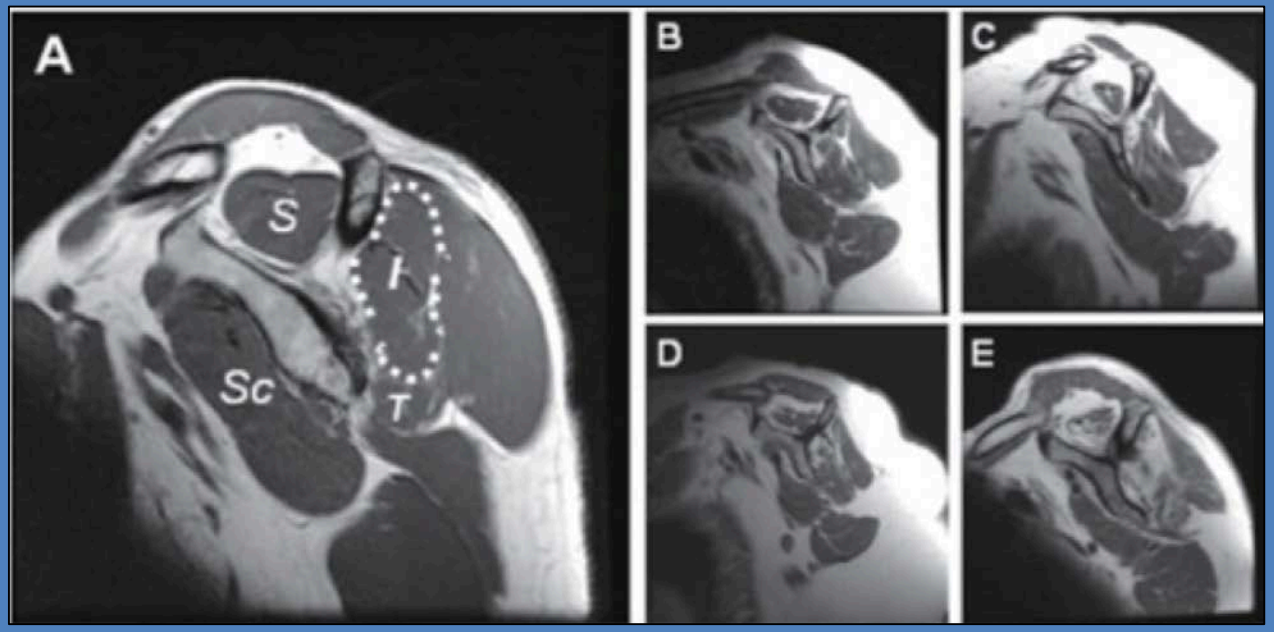
Comparison of outcomes with arthroscopic repair of acute-on-chronic within 6 months and chronic rotator cuff tears

Jeung Yeol Jeong, MD[a], Seung Yeop Song, MD[a], Jae Chul Yoo, MD[a,*], Keun Min Park, MD[a], Sang Min Lee, CES[b]

Journal of Shoulder and Elbow Surgery

J Shoulder Elbow Surg (2017) 26, 648–655

- **Fatty Infiltration: "Goutallier Classification"**

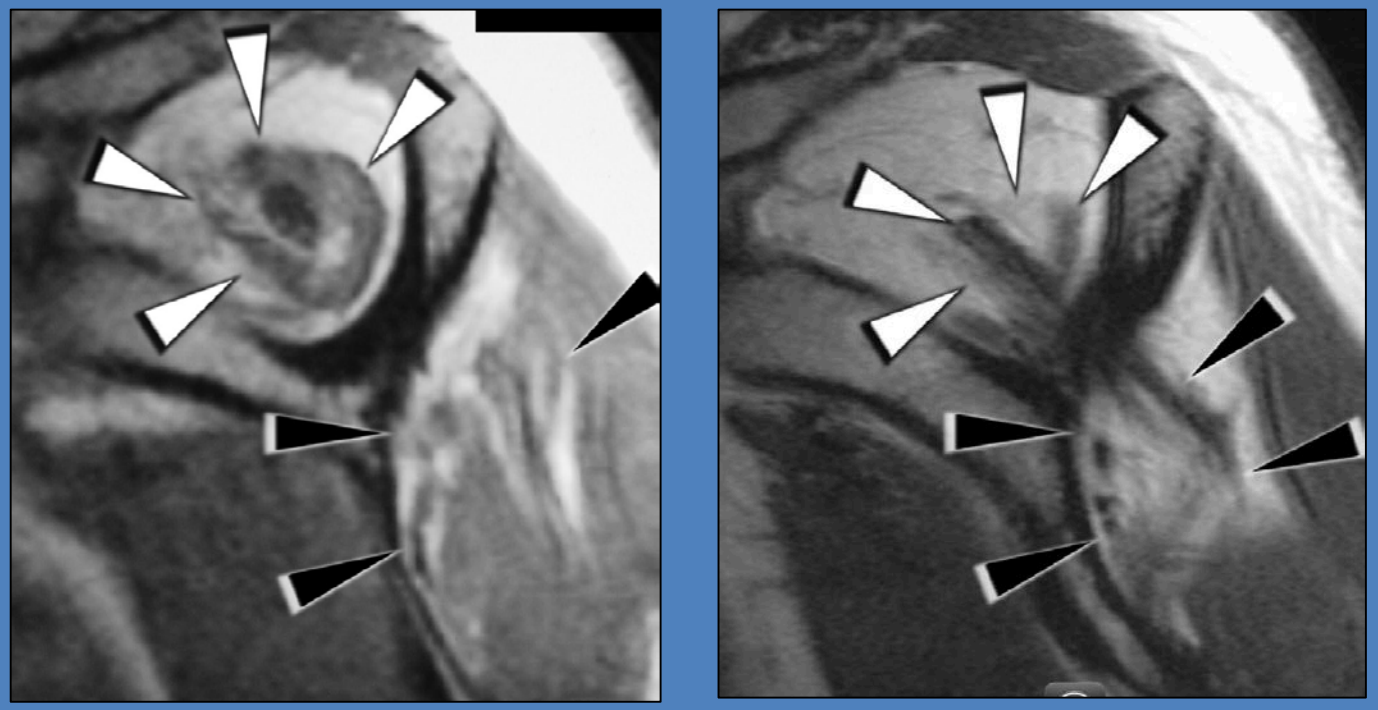


Grade 0	No fatty streaks
Grade 1	Some fatty streaks
Grade 2	More muscle than fat
Grade 3	As much muscle as fat
Grade 4	Less muscle than fat

J Shoulder Elbow Surg. 1999 Nov-Dec;8(6):599-605 Clin Orthop Relat Res. 1994 Jul(304):78-83

Effects of Delayed Treatment

- **Tear Chronicity: 6 months**



J Bone Joint Surg Am. 2007;89:1928-34

Effects of Delayed Treatment

Correlation of atrophy and fatty infiltration on strength and integrity of rotator cuff repairs: A study in thirteen patients

Christian Gerber, MD,[a] Alberto G. Schneeberger, MD,[b] Hans Hoppeler, MD,[c] and Dominik C. Meyer, MD,[a] *Zürich and Berne, Switzerland*

Fatty infiltration

- Progressive until repair

- Changes are irreversible

JSES 2007; 16:691-699.

Predicting the Irreparable Tear

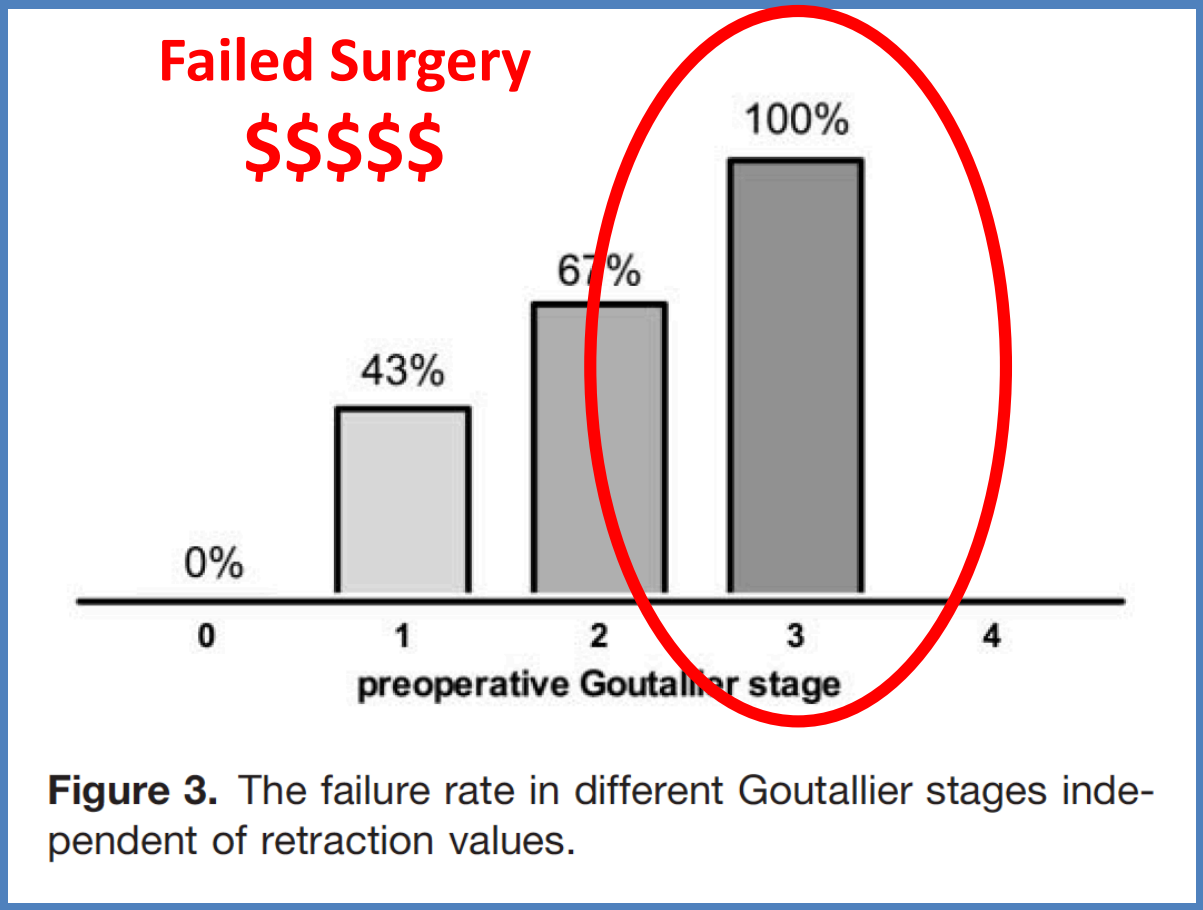


Figure 3. The failure rate in different Goutallier stages independent of retraction values.

The American Journal of Sports Medicine, Vol. 40, No. 10

Take Home Points

- 1. Massive Tears Require Urgent Evaluation
  - Have a high index of suspicion
  - Any weakness or lag signs on exam should be imaged
  - Treat like a quads or a patellar tendon rupture

Reparable or Irreparable

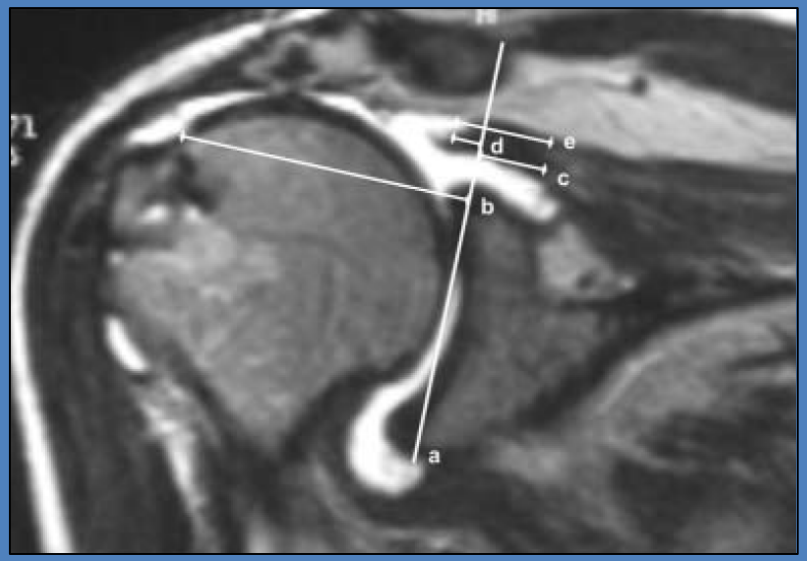
This is determined Pre-Operatively
NOT Intraoperatively

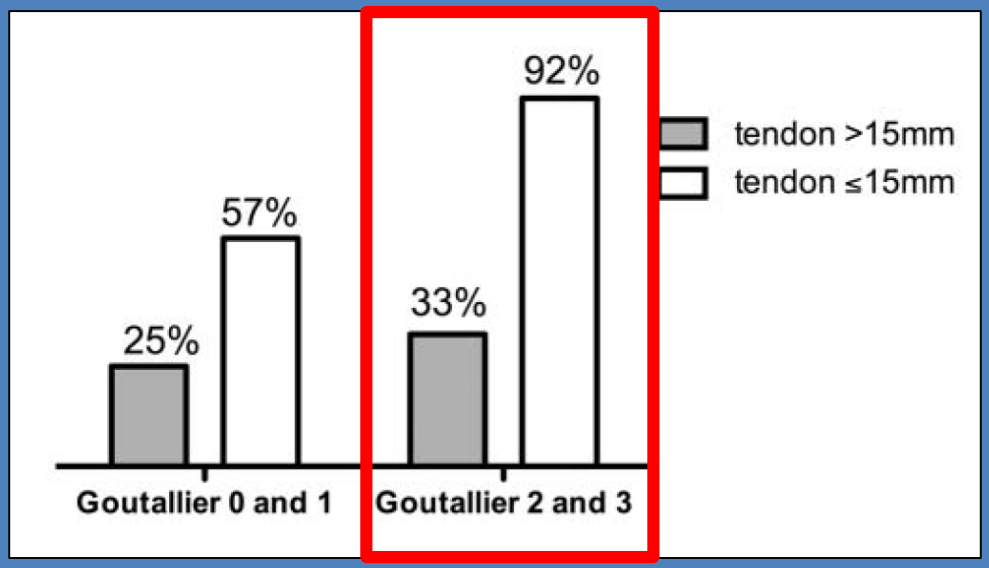
The American Journal of Sports Medicine, Vol. 40, No. 10

Predicting the Irreparable Tear

Retraction of Supraspinatus Muscle and Tendon as Predictors of Success of Rotator Cuff Repair

Dominik C. Meyer,* MD, Karl Wieser,*† MD, Mazda Farshad,* MD, MPH, and Christian Gerber,* MD, FRCS
Investigation performed at Balgrist University Hospital, Zurich, Switzerland





The American Journal of Sports Medicine, Vol. 40, No. 10

Re-tear rate = 92%

Predicting the Irreparable Tear

Can Preoperative Magnetic Resonance Imaging Predict the Reparability of Massive Rotator Cuff Tears?

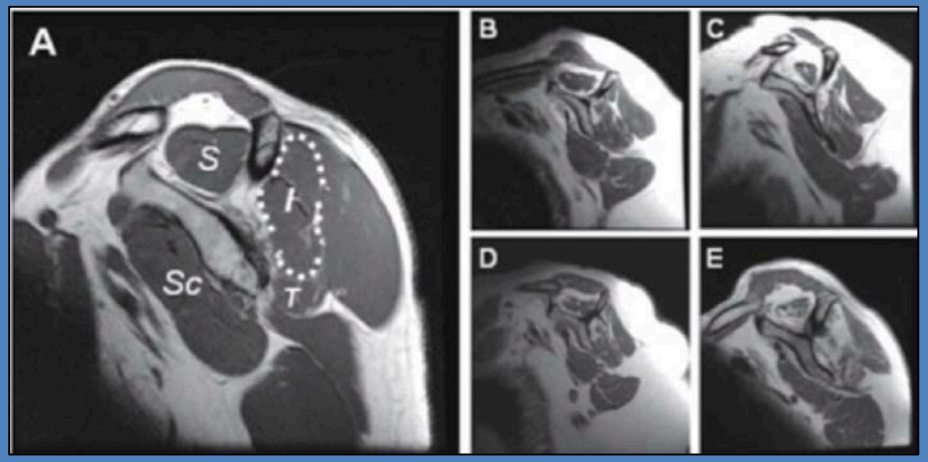
Jung Youn Kim,*† MD, Ji Seon Park,‡ MD, and Yong Girl Rhee,§‖ MD
Investigation performed at the Shoulder and Elbow Clinic, Department of Orthopaedic Surgery, College of Medicine, Kyung Hee University, Seoul, Republic of Korea

- Combinations:
  - Fatty Infiltration > 2
  - Patte Grade = 3

98% Specificity for an Irreparable Tear

JSES 2007; 16:691-699.

Predicting the Irreparable Tear



- Combinations:
  - » Fatty Infiltration > 2
  - » Patte Grade = 3

98% Specificity for an Irreparable Tear

  - » Fatty Infiltration ≥ 2
  - » Tendon length < 15 mm

Re-tear rate = 92%

Am J Sports Med. 2017 Jun;45(7):1654-63

Take Home Points

1. Massive Tears Require Urgent Evaluation

- Have a high index of suspicion
- Any weakness or lag signs on exam should be imaged
- Treat like a quads or a patellar tendon tear

2. Reparability is Determined Preoperatively

- Careful evaluation of MRI
  - Fatty Infiltration > 2
  - Tendon Length < 15mm
  - Retraction (Patte Grade)

The American Journal of Sports Medicine, Vol. 40, No. 10

How to Treat the Irreparable Tear?

Palliative

Superior Capsular Reconstruction

Tendon Transfers

Superior Capsular Reconstruction

What's all the hype about?

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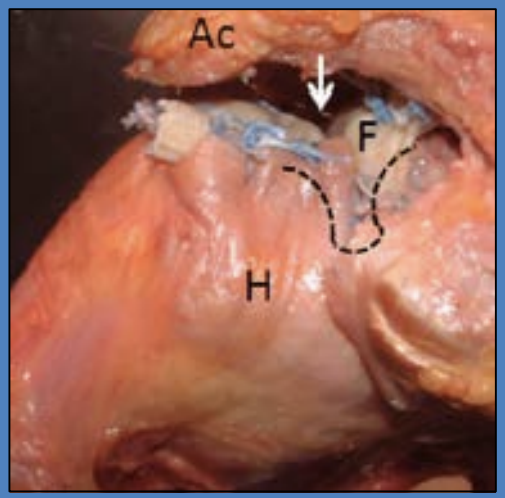
Clinical Results of Arthroscopic Superior Capsule Reconstruction for Irreparable Rotator Cuff Tears

Teruhisa Mihata, M.D., Ph.D., Thay Q. Lee, Ph.D., Chisato Watanabe, M.D., Ph.D., Kunimoto Fukunishi, M.D., Mutsumi Ohue, M.D., Tomoyuki Tsujimura, M.D., and Mitsuo Kinoshita, M.D., Ph.D.

ARTHROSCOPY
THE JOURNAL OF ARTHROSCOPIC AND RELATED SURGERY

- 24 shoulders (autograft fascia lata)
  - F/U 34 months (24-51)
- Improved (preop to postop):
  - Elevation (84 to 148)
  - ER (26 to 40)
  - ASES (23 to 93)



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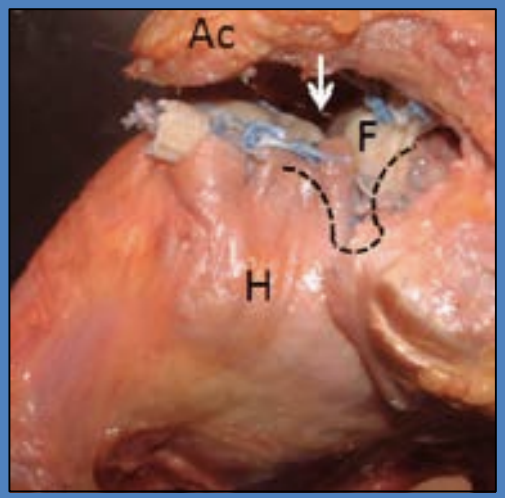

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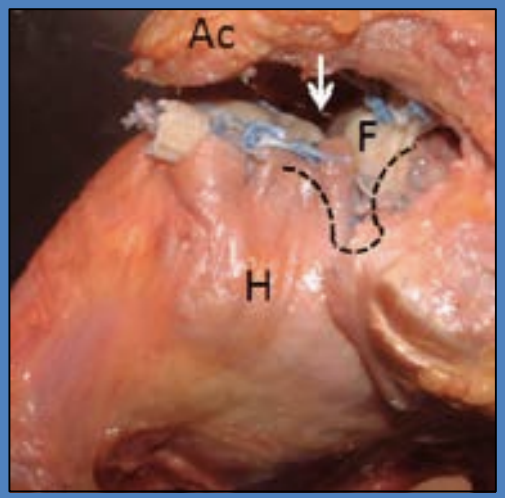
- Radiographic outcomes
  - AHI increased from 4.8 to 8.7
- No graft or tendon re-tears



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  - Primary setting, Follow-up 34 months (24-51)
- Radiographic outcomes
  - AHI increased from 4.8 to 8.7
- No graft or tendon re-tears

Exceptional clinical and radiographic outcomes with nearly 3 years f/u

Biomechanicall = EXCELLENT

Biomechanical Role of Cap r Continuity in Superior Caps Reconstruction for Irreparable Tears of the Supraspinatus Tendon

Teruhisa Mihata,*†‡ MD, PhD, Michelle H. McGarry,† MS, Timothy Kahn,† BA, Iliya Goldberg,† MS, Masashi Neo,‡ MD, PhD, and Thay Q. Lee,† PhD

The American Journal of Sports Medicine

Biomechanical Effect of Thickness and Tension of Fascia Lata Graft on Glenohumeral Stability for Su ior Capsule Reconstruction in Irreparable Supraspinatus Tears

Teruhisa ata, M.D., Ph.D., Michelle H. McGarry, M.S., Timothy Kahn, B.A., Iliya berg, M.S., Masashi Neo, M.D., Ph.D., and Thay Q. Lee, Ph.D.

ARTHROSCOPY
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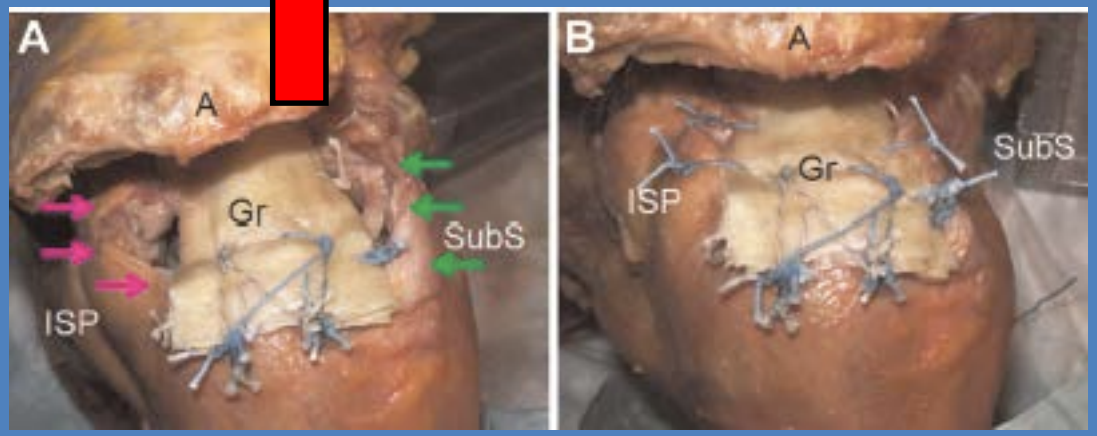

- Graft thickness
- of 8 mm >> 4 mm

Massive RCT: SCR

- How are we doing in North American???
  - Allograft versus Autograft
  - 3 mm versus 8 mm
  - Expanded indications to massive cuff

Arthroscopy Techniques, Vol 5, No 6 (December), 2016: pp e1407-e1418

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Superior Capsular Reconstruction

Arthroscopy Techniques, Vol 5, No 6 (December), 2016: pp e1407-e1418

Massive RCT: SCR

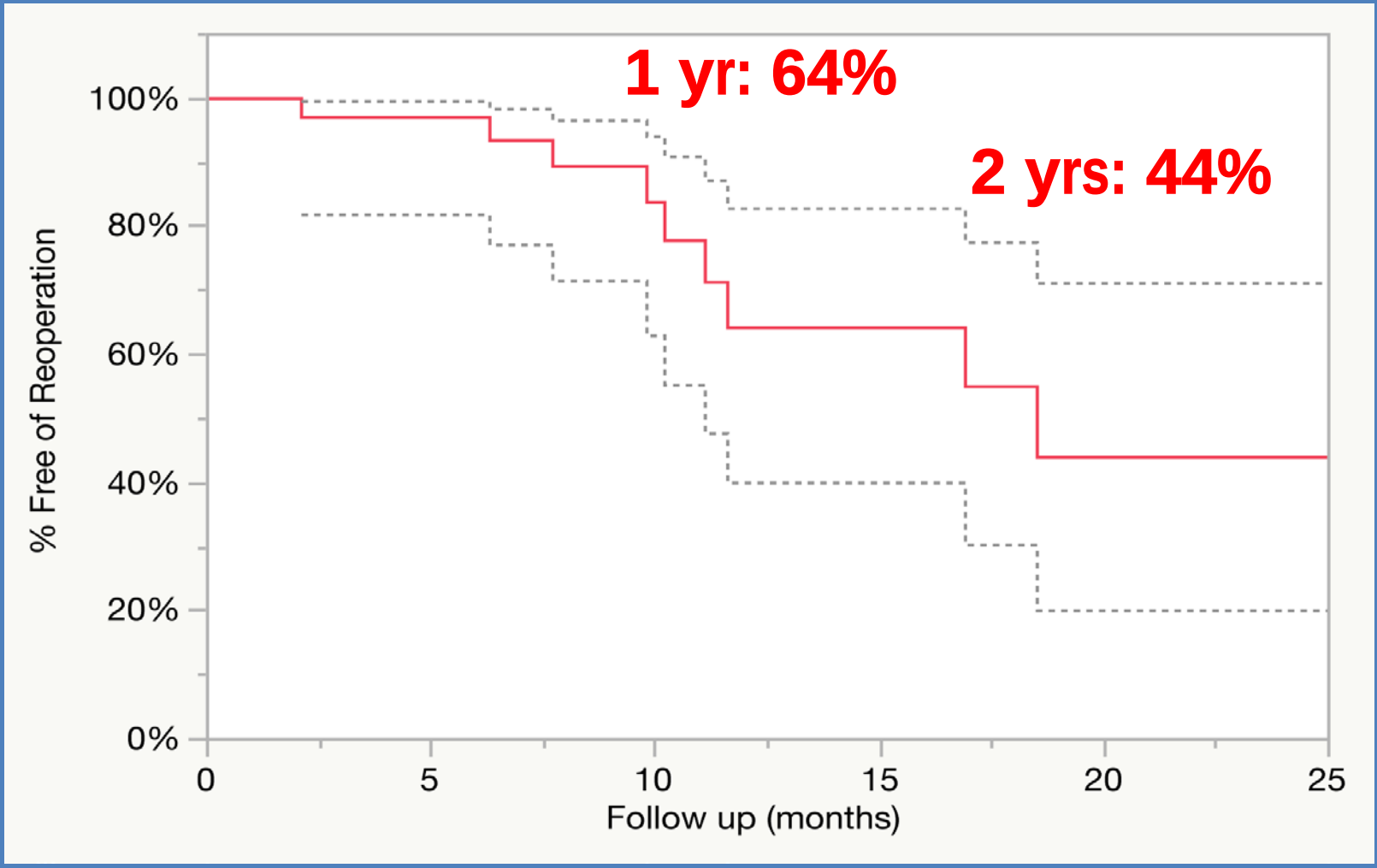
Clinical Outcomes (n=34)

MASSACHUSETTS GENERAL HOSPITAL

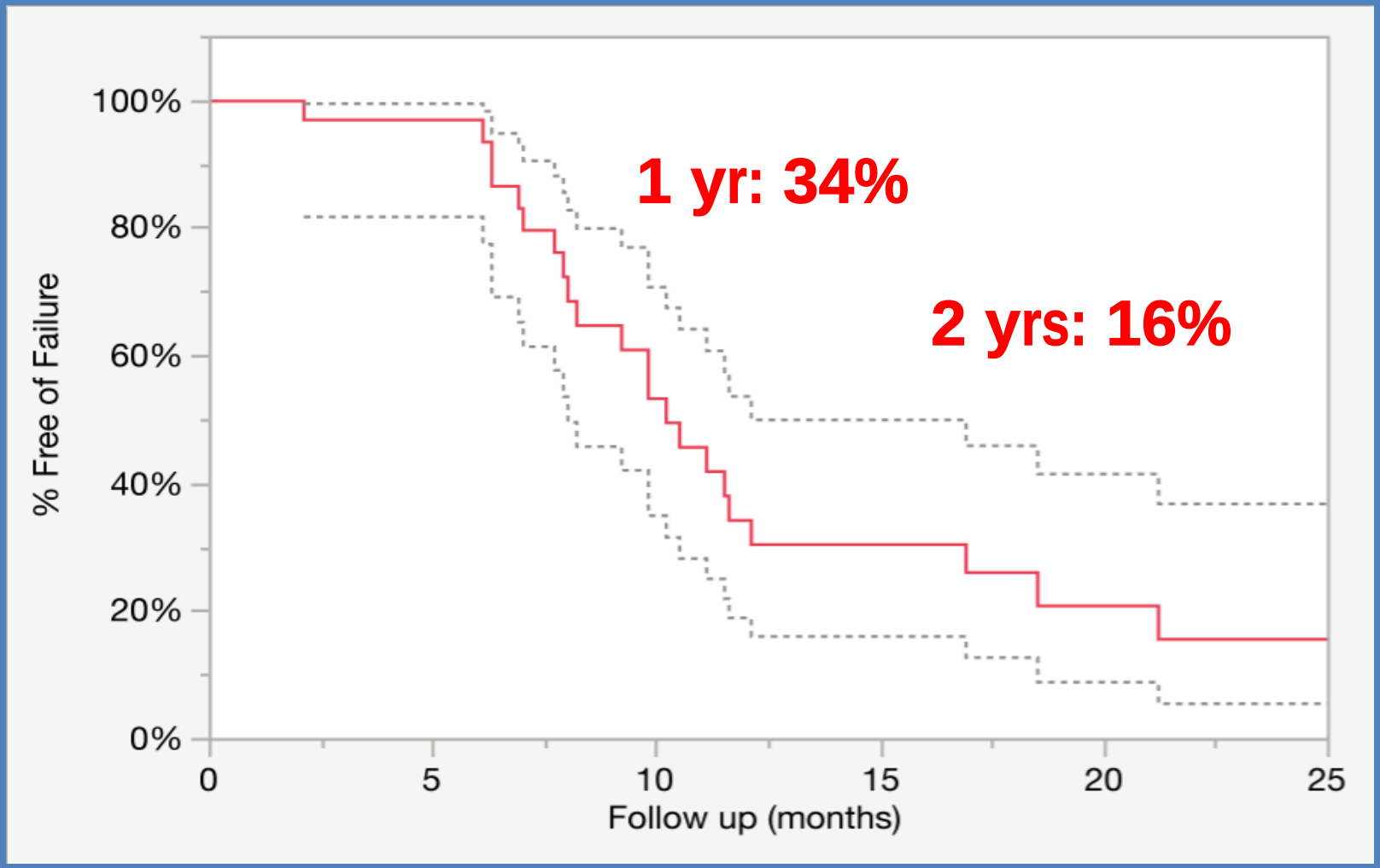
	Preop	Postop	p-value
Elevation	95º	105º	0.24
Ext Rot.	33º	36º	0.89
Abduction	72º	73º	0.91
VAS Pain	4.9	5.0	0.59
SSV (%)	27%	46%	0.27

Mean Follow-up: 12 months (6-23)

SCR Survival to Reoperation



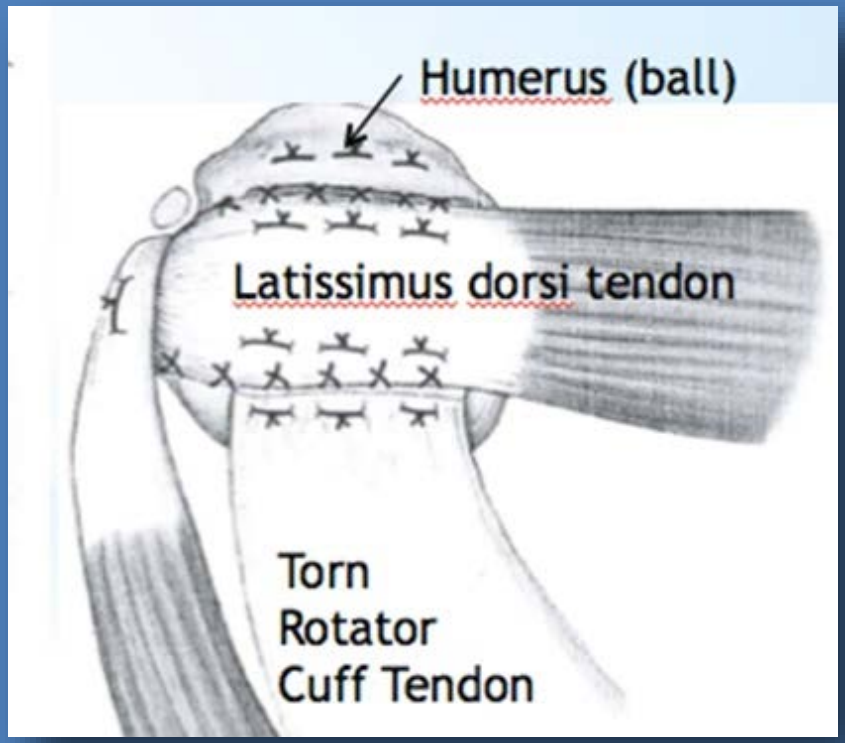
SCR Failure: Neer Criteria

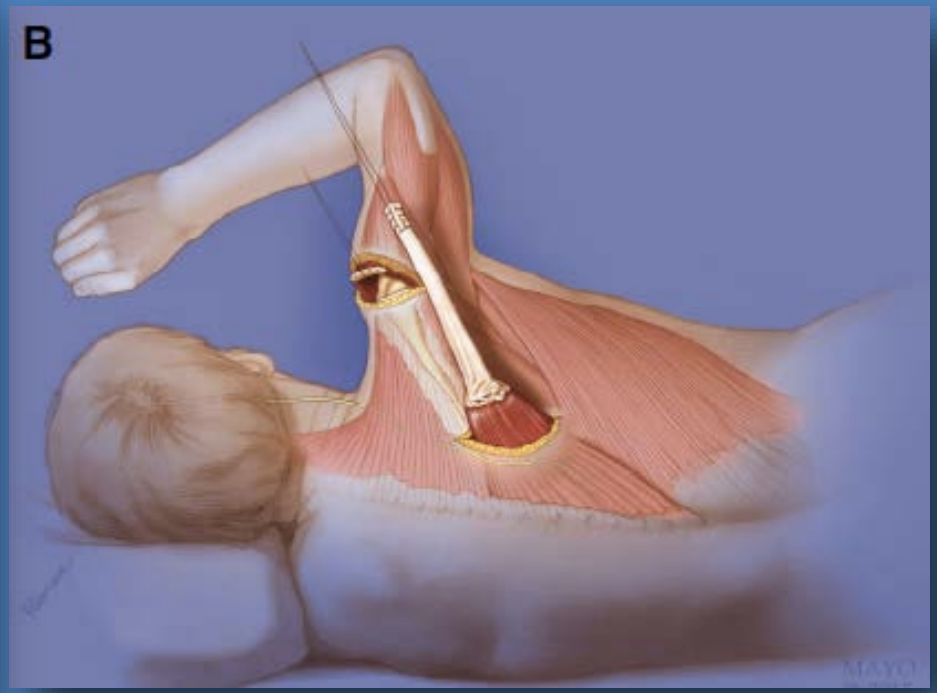


Massive RCT: SCR

- Further research to define graft choice and surgical indications

Massive RCT: Tendon Transfers





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Which one should is better?

Massive RCT: Tendon Transfers

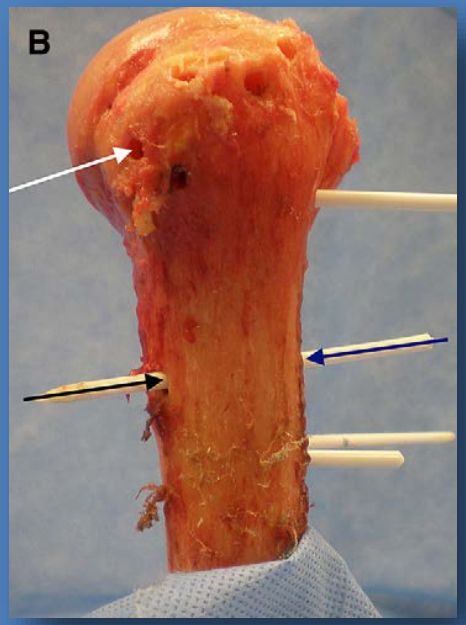
Biomechanical effectiveness of different types of tendon transfers to the shoulder for external rotation

Robert U. Hartzler, MD, Jonathan D. Barlow, MD, Kai-Nan An, PhD, Bassem T. Elhassan, MD*

Journal of Shoulder and Elbow Surgery

Comparison of LD, TM, and LT transfers

- External Rotation Moment Arms for 6 transfers in 6 fresh frozen cadavers
  - **LD** to superior or inferior
  - **TM** to superior or inferior
  - **LT** to superior or inferior



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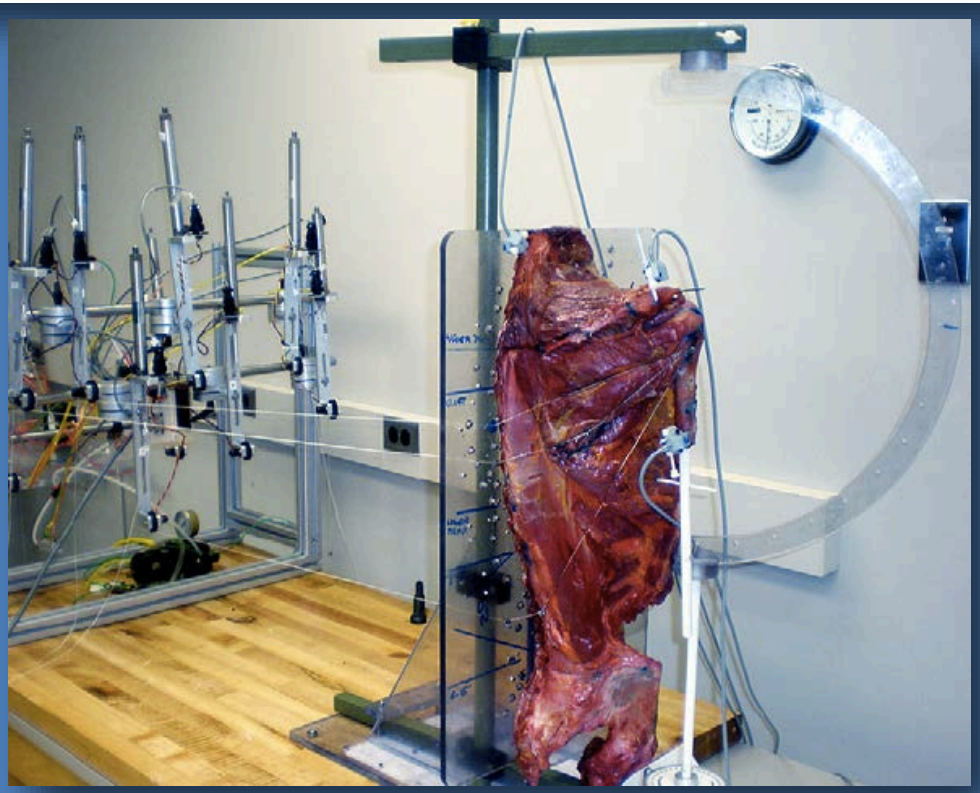
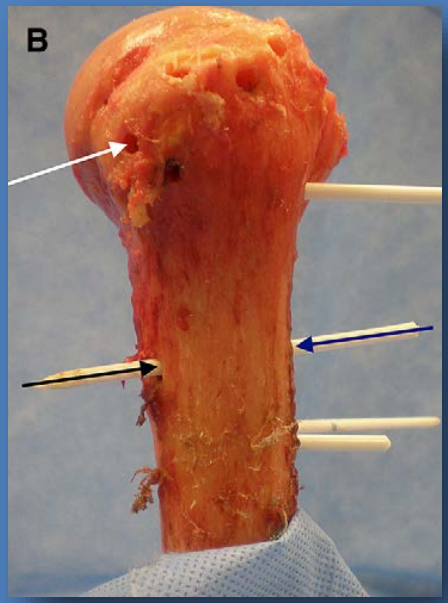




Massive RCT: Tendon Transfers

Optimal Transfers

- **Zero Degrees Abduction**
  - Lower Trapezius to infraspinatus (superior)
- **Ninety Degrees Abduction**
  - LD = TM = LT: to superolateral humeral head

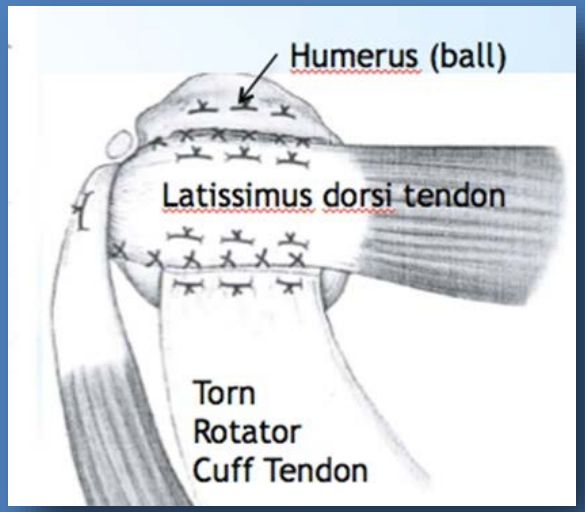
Massive RCT: Tendon Transfers

Latissimus Dorsi Transfer

Massive RCT: Tendon Transfers

Latissimus Dorsi Transfer

- Open or Arthroscopic Assisted
  - Most data is on the open procedure
- **70-90%** good results in most studies



Latissimus Dorsi Tendon Transfer for Treatment of Irreparable Posterosuperior Rotator Cuff Tears

Long-Term Results at a Minimum Follow-up of Ten Years

Christian Gerber, MD, FRCSEd(Hon), Stefan A. Rahm, MD, Sabrina Catanzaro, MD, Mazda Farshad, MD, MPH, and Beat K. Moor, MD

THE JOURNAL OF BONE & JOINT SURGERY
JBJS

- 46 LD transfers
- Follow-up 147 months

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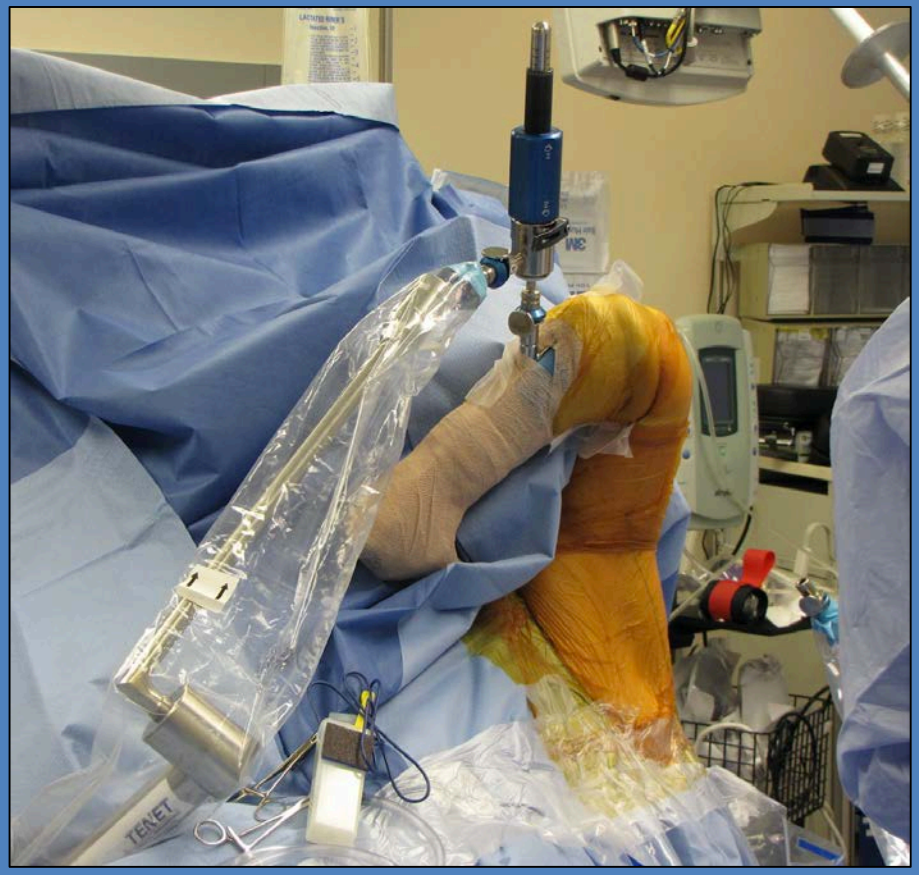
Long-Term Results at a Minimum Follow-up of Ten Years

Christian Gerber, MD, FRCSEd(Hon), Stefan A. Rahm, MD, Sabrina Catanzaro, MD, Mazda Farshad, MD, MPH, and Beat K. Moor, MD

- Results:
  - Improved preoperative to postoperative
    - SSV (29% to 70%)
    - Constant (56% to 80%)
    - Flexion (118 to 132)
    - ER (18 to 33)

Massive RCT: Latissimus Dorsi Transfer



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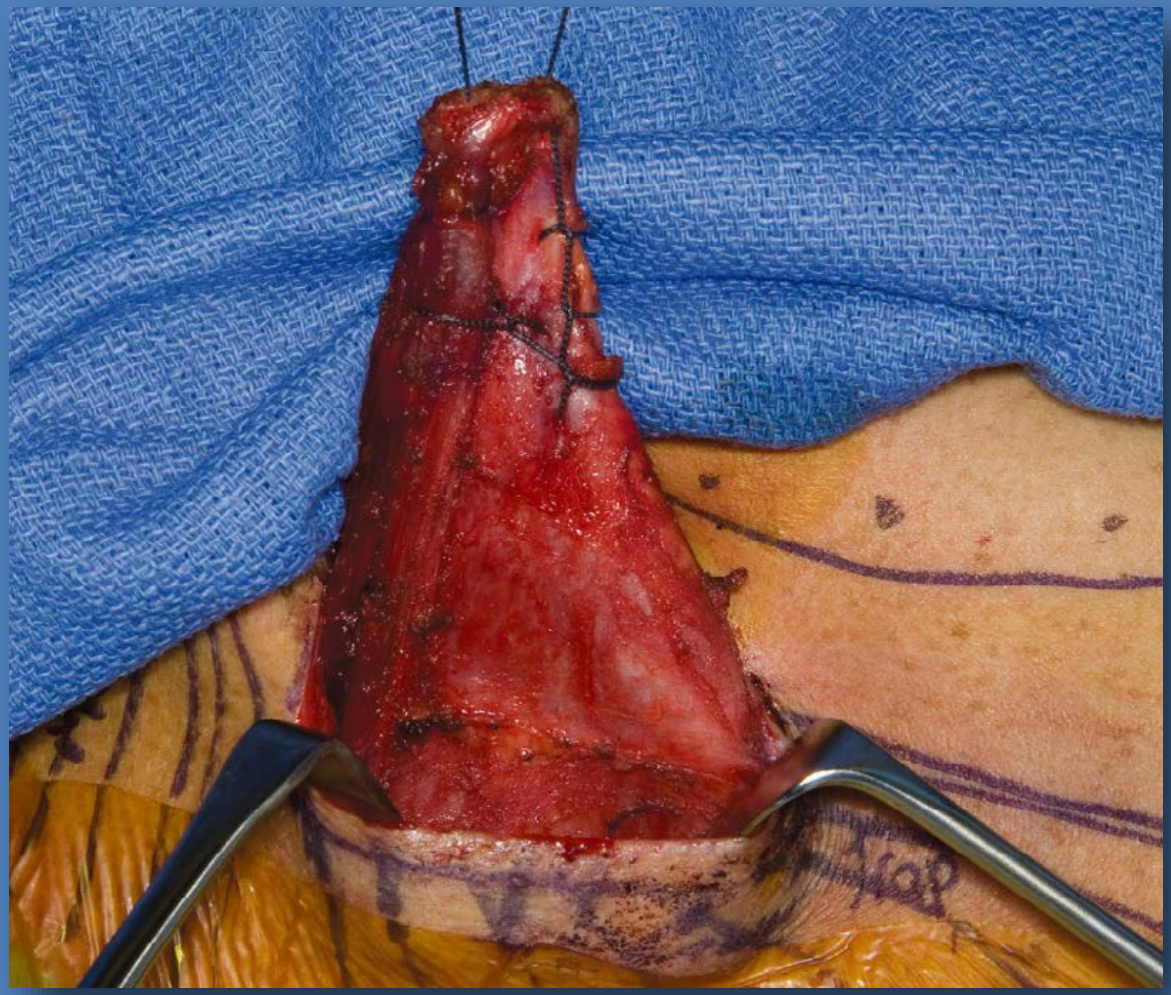
Massive RCT: Lower Trapezius Transfer



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Outcome of lower trapezius transfer to reconstruct massive irreparable posterior-superior rotator cuff tear

Bassem T. Elhassan, MD*, Eric R. Wagner, MD, Jean-David Werthel, MD

Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN, USA

Journal of Shoulder and Elbow Surgery

J Shoulder Elbow Surg (2016) 25, 1346–1353

- 33 patients with posterosuperior RC tears
  - Dx on MRI, confirmed during surgery
- Ipsilateral lower trapezius transfer + allograft
  - Follow-up 47 months

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Journal of Shoulder and Elbow Surgery

J Shoulder Elbow Surg (2016) 25, 1346–1353

- Improvements in pain, ROM ($p<0.01$)
  - Flexion 120º (from 70º)
  - Abduction 90º (from 40º)
  - ER 50º (from 10º)
  - SSV 78% (from 54%)
  - DASH 18 (from 52)

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Massive RCT: Tendon Transfers

Postoperative Protocol

0-6 Weeks: External Rotation Brace
6 Weeks: PROM + AROM
12 Weeks: Biofeedback Training
16 Weeks: Gentle Strengthening

Massive RCT: Tendon Transfers

Latissimus Dorsi Tendon Transfer for Irreparable Posterosuperior Rotator Cuff Tears

Factors Affecting Outcome

By Joseph P. Iannotti, MD, PhD, Shawn Hennigan, MD, Richard Herzog, MD, Sami Kella, MD, Martin Kelley, PT, Brian Leggin, PT, and Gerald R. Williams, MD

Investigation performed at the University of Pennsylvania School of Medicine, Presbyterian Hospital, Philadelphia, Pennsylvania

None of the patients with a poor outcome demonstrated electrical activity on EMG

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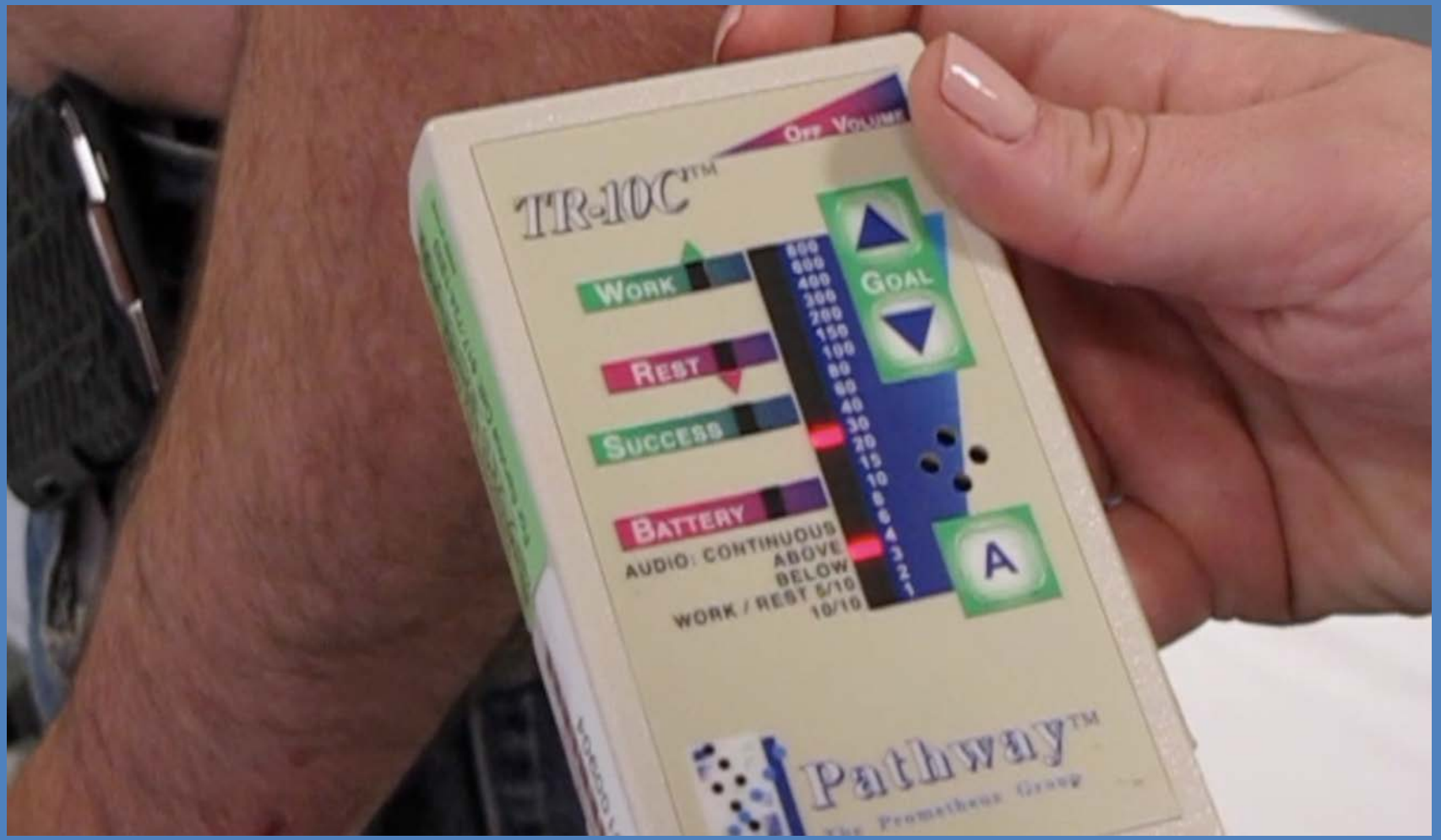
Latissimus Dorsi – Out of Phase (Biofeedback)

Latissimus Dorsi – Out of Phase (Biofeedback)



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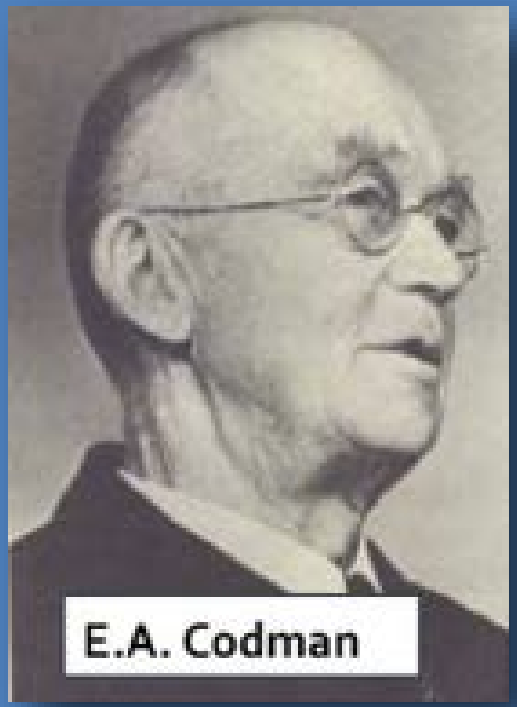
Preop

6 months Postop

Take Home Points

- 1. Massive Tears Require Urgent Evaluation
  - Have a high index of suspicion
  - Any weakness or lag signs on exam should be imaged
  - Treat like a quads or a patellar tendon tear
- 2. Reparability is Determined Preoperatively
  - Careful evaluation of MRI
    - Fatty Infiltration > 2
    - Tendon Length < 15mm
    - Retraction (Patte Grade)
- 3. Best Reconstruction Option
  - We don't know yet

Societal Impact



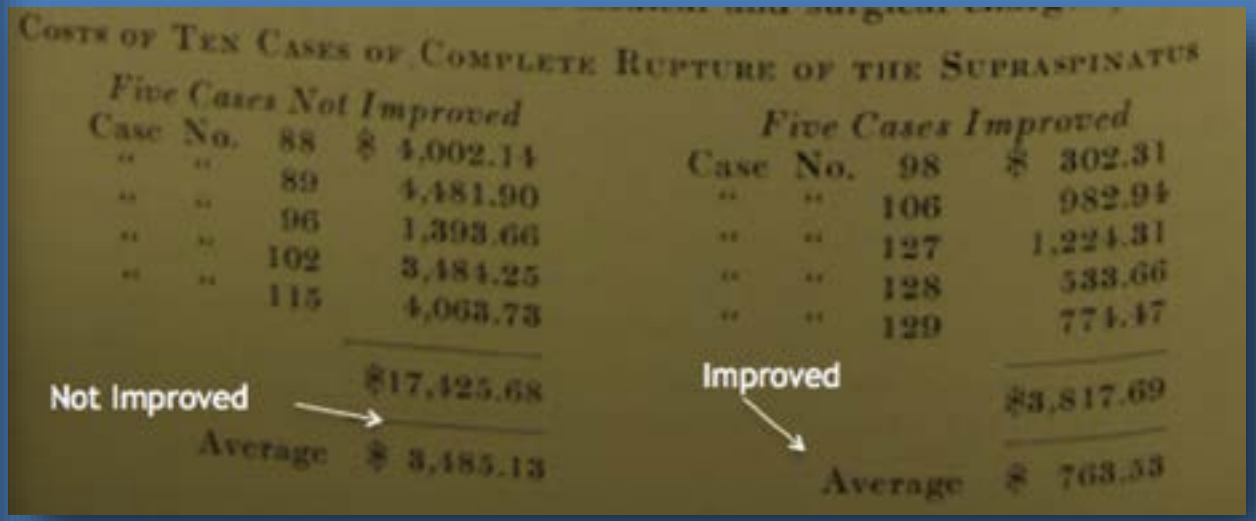


Fig 1. (A) E.A. Codman, the architect of the "end result" concept. (B) The cost of failure of rotator cuff repair as reported by Codman 100 years ago. From Codman EA. *The Shoulder* New York: Thomas Todd, 1934.[6]

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What's Next?

- Multi-center comparison of like tears
- Goal: Improve Quality
  - Decrease Cost
  - Improve Outcome

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Codman Shoulder Society

Goal: Improve Quality

- Decrease Cost
- Improve Outcome

EMORY

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Rochester, MN

HARVARD MEDICAL SCHOOL

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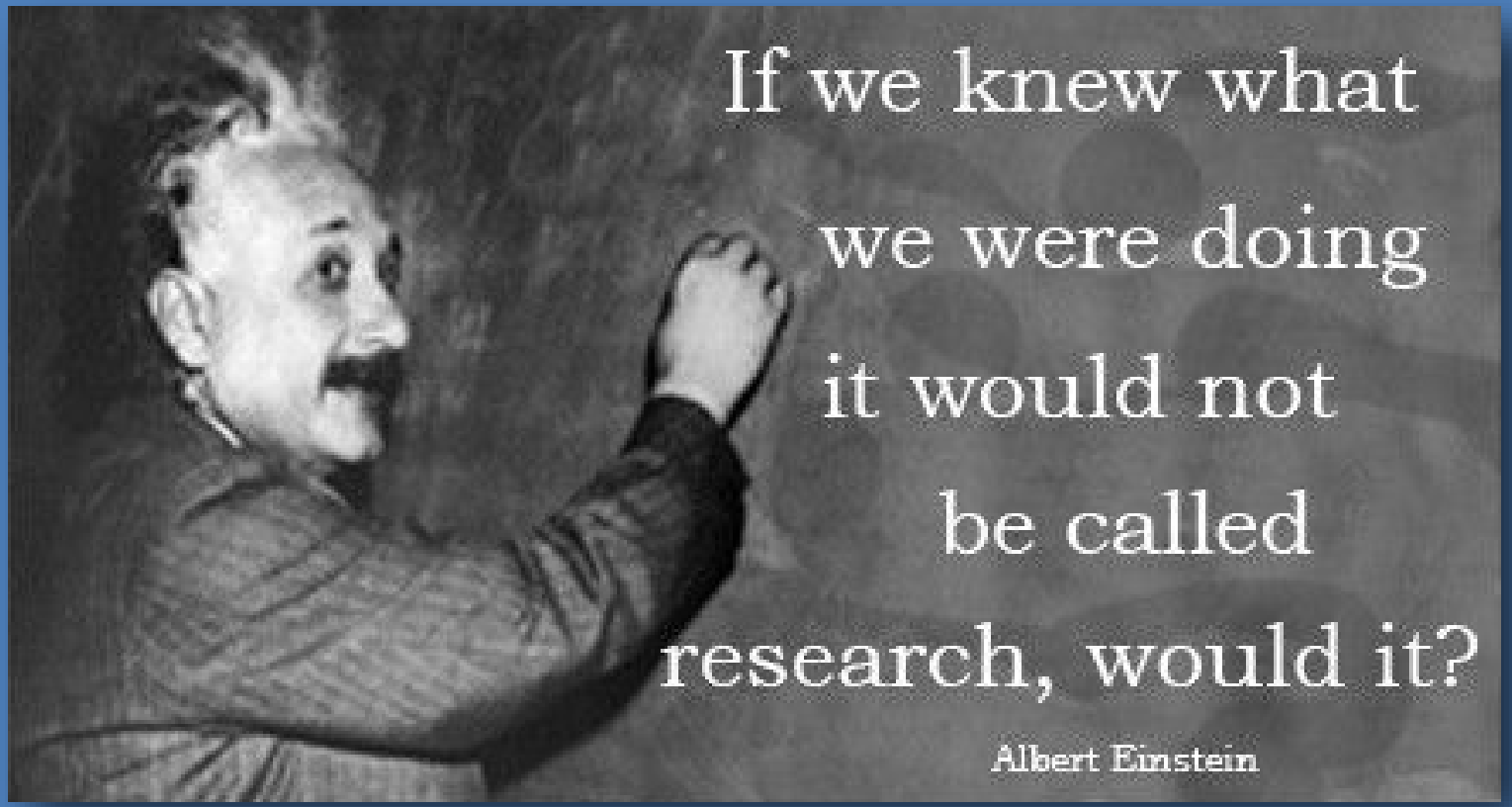
Thank you for your time!


If we knew what
we were doing
it would not
be called
research, would it?
Albert Einstein