Pathophysiology, Examination and Diagnosis
Martin J. Kelley, PT, DPT, OCS
University of Pennsylvania Health System

Rotator Cuff Tendons

What is a Massive Rotator Cuff Tear

- Massive refers to size not reparability
  - > 5 cm (Cofield)
  - Two Complete Tendons (Gerber)
    - Supraspinatus and infraspinatus
    - Supraspinatus and subscapularis
    - All three
  - Massive, irreparable
  - Irreparable, massive
• Attempted repair of retracted, stiff, functionally dead muscle is futile and potentially harmful

Pathogenesis-Contributing Factors
• Age related changes
• Intrinsic
• Extrinsic

Anatomic Investigations: Aging

Intrinsic Factors

Vascular Studies

Supraspinatus Tendon Study
• Nakajima et al. JSES, 1994
  – 30 cadavers
  – Split supraspinatus into bursal and articular sections
  – Histological and mechanical examination
• Results
  – BS tendon has strong longitudinal fibers, AS thin, disorganized
  – BS 2X as strong at failure
  – Reason for high incidence of AS tears

Rat Tendon Overuse Study-
Soslowsky et al., 2000
Rat Model
• Rats exposed to overuse protocol of treadmill running
  • 10° decline, 1 hr/day, 5 days/week at 17 m/min

Results - Geometry

Results - Mechanical Properties

Conclusion
• Overuse results in cuff tendon thickening BUT reduces tensile strength

Supraspinatus Tendon Strain Study
Bey et al., 2002

Create Partial Thickness Articular Side Tear

Results: Torn Specimen Strain

Results
• Intact rotator cuff
  – strain largely influenced by joint position
  – interaction of tendon and humeral head
  – failure strain: inferior region ~ 50% of superior region
  – inferior region may be susceptible to injury

• Torn rotator cuff
  – less tissue to support load → ↑strain
  – partial tears result in increased strains which could
Extrinsic Factors

Subacromial Impingement

Anatomy

Classification (Historical)
Subacromial Impingement
- Stage I: edema, inflammation, 30’s, rev.
- Stage II: scarring, fibrosis, 40’s, part. rev.
- Stage III: tendon failure, 50’s, irrev.

Pathogenesis
Rotator Cuff Tears
- Extrinsic factors - “Chicken or the Egg”
  - Subacromial impingement

Coracoacromial Arch Pressures
Internal Impingement
- Posterior glenoid rim

Abnormal Superior Glide
- Increased superior migration with impingement and full cuff tear
- Deutch et al., JSES, 1998
- Yamaguchi et al., JSES, 2000
- Paletta, JSES, 1997
- 100% of patients with a full rotator cuff tear had abnormal superior glide
• After rotator cuff repair only 14% Abnormal superior humeral head migration related to rotator cuff impingement or tear.

Yamaguchi et al.
• Humeral head superiorly migrate in some cuff tears and not in others. Superior migration does not always cause pain.
• Chronic/Degenerative- Patient with long standing full thickness retracted supraspinatus tear that may be asymptomatic or patient has adapted- “coper”

Rotator Cuff Impingement
• “Impingement”
  – Descriptive clinical sign
  – NOT a diagnosis
  – Mechanical irritation
  – Cuff tendons in the subacromial space

Tendonopathy Pathogenesis
• RE-Think – Reconsider Meaning of “IMPINGMENT”

Examination and Diagnosis
Classification of Rotator Cuff Tears
Type-
• Partial
  – Midsubstance
  – Articular
  – Bursal
• Full

Size-
Linear measurement
- Small < 2 cm
- Medium 2 – 5cm
- Large > 5cm
- Massive – 2 tendons

Square centimeter

Massive Tear Classification- Descriptors
- Acute- Healthy tissue tears due to high energy
- Acute on Chronic- “Acute extension”
  - Patient with chronic asymptomatic full thickness supraspinatus tear suffers an event causing an acute tear of the infraspinatus and/or subscapularis

Diagnostic Imaging
MRI
- Partial
- Full

History
- Age > 50
- Previous episodes
- Lateral-anterior shoulder pain
- Recent trauma
- Reports pain/weakness
- Significant difficulty elevating arm
- If younger – high energy trauma

Examination Findings
- Usually pain with AROM
- Passive and active motion probably limited (if reactive)
- Resisted abduction and ER more likely to be painful and weak (depends on time from injury)
- Significant spinati atrophy
- + impingement signs
- + pain/weakness with resisted Abd/IR (Jobe sign)
• + ER lag signs (supra/infra FRCT)
• + Belly press/lift off (subscapularis FRCT)
• + Biceps pain or long head rupture

External Rotation Lag Signs
Useful in determining the presence of:
• Full thickness rotator cuff tear (supraspinatus and/or infraspinatus)
• Post-op rotator cuff rupture/deficient cuff
• Significant suprascapular nerve entrapment
• Other neurologic involvement influencing the supraspinatus and infraspinatus, i.e., C6 nerve root compression, brachial plexopathy

Lag Signs

Jobe Sign

Internal Rotation Lag Signs
Useful in determining the presence of:
• Subscapularis rupture (pre-post op)
• Neurologic involvement causing weakness of the subscapularis i.e., C7 nerve compression, brachial plexopathy, subscapularis denervation.

Lift-Off Test
• Gerber and Krushell (JBJS, 1991 and 1996)
  – Developed to diagnose tears of the subscapularis
• Greis et al. (Am J Sports Med, 1996)
  – Subscapularis EMG activity is approximately 70% of the MVC
Belly-Press Test

  - Developed for individuals who could not perform the lift-off test due to decreased shoulder internal rotation passive range of motion
  - Patient places hand on belly and pushes in. A positive sign is inability to keep the elbow forward (moves in to body)
  - To further sensitize, attempt to pull the hand from the stomach

Lift-off, IR lag sign and Belly press

Summary

- Recognize factors involved in tendon failure
- Tendon strain may be major factor in cuff tear propagation
- Reconsider what “impingement” means
- Use the ER lag signs and belly press test to assist in clinical diagnosis of massive rotator cuff tear

References:


Bishop, J. (2004). Rotator cuff outcomes for arthroscopic versus open repairs. AAOS, New Orleans, LA.


Charles Getz, MD, Martin J. Kelley, DPT, OCS, Brian G. Leggin, MS, PT, OCS
APTA CSM 2006, San Diego, CA
Recent Advances in the Management and Rehabilitation of Massive Rotator Cuff Tears

NON-OPERATIVE REHABILITATION STRATEGIES FOR PATIENTS WITH MASSIVE ROTATOR CUFF TEARS

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CLINICAL SIGNS

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Recent Advances in the Management and Rehabilitation of Massive Rotator Cuff Tears
Clinical presentation of large and massive rotator cuff tears
- Pain (especially at night)
- Trauma/Chronic
- Atrophy
- PROM > AROM
- Impingement sign
- Weakness of FF & ER
- ER lag sign

Rotator Cuff Tears
Rehabilitation Principles

• Rehabilitation of large/massive cuff tears
  - Restore PROM
  - Initiate Cuff Strengthening (manual resistance)
  - Need to train remaining muscles to centralize humeral head to allow elevation
  - Emphasize subscapularis and deltoid

*Restore the balance point

Rotator Cuff Tears
Rehabilitation Principles

• supine active forward elevation
• gradually introduce gravity

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• add weighted ball and/or elastic resistance

SUPINE ELEVATION PROGRESSION
• Begin supine with elbow flexed to 90°
• Work up to 30 repetitions
• Once patient can perform 30 reps, extend elbow slightly
• Gradually introduce gravity by raising table or prop with pillows
• Add weights, weighted ball, elastic resistance as appropriate

STUDY
• Isbell, et al, presented at ASES Closed meeting, New York, NY
• 33 subjects:
  – 10 normals
  – 10 symptomatic 2 tendon cuff tears
  – 13 asymptomatic cuff tears
• EMG activity of 15 muscles during 10 functional tasks

STUDY
• All cuff tear patients had increased muscle activation during all tasks vs. normals
• Asymptomatic patients > subscapularis and deltoid activity
• Symptomatic patients = increased activity of torn rotator cuff and upper trapezius

STUDY
• Levy, et al, presented at ASES Closed meeting, New York, NY
• 17 patients with massive irreparable cuff tears
• All > 70 years-old
• Performed supine elevation progression

STUDY
• Exercise:
  – Supine AROM elevation 3x/day
  – Gradually incline head
  – 6 weeks – added 2kg weight
• Results:
  – 90% had significant improvement at 6 weeks

CASE STUDY
• 62 year-old cemetery worker
• Lifting a casket and felt a “pop” in right shoulder
• Immediate pain and inability to use right dominant arm

CASE STUDY
• MRI revealed complete chronic cuff tear with retraction of supraspinatus and infraspinatus
• Presents with G-H crepitus, + Hawkins, supraspinatus test, and ER lag signs at 20 & 90
• Atrophy of supra and infraspinatus fossae (bilaterally)

CASE STUDY
• PENN Shoulder Score = 46 / 100
• Pain = 11 / 30
• Satisfaction = 2 / 10
• Function = 33 / 60
  – No difficulty with toileting, opening a door, carrying at side
– Some difficulty sleeping, placing light objects on shelf at and above shoulder

CASE STUDY

• Treatment:
  – ROM exercises (extension with stick, cross body add., internal rotation)
  – Phase I strengthening (T-band ER, IR, extension)
  – Pulleys
  – Supine elevation progression
  – Manual resistance

OUTCOME

OUTCOME

• PENN Shoulder Score = 62 / 100
• Pain = 17 / 30
• Satisfaction = 7 / 10
• Function = 38 / 60

SUMMARY

• Restore PROM

• Improve strength of remaining cuff muscles

• Emphasize subscapularis and deltoid strengthening
Surgical Management: Debridement, Arthroscopic, Mini-open, and Open Repairs
Charles L. Getz, MD
Assistant Professor of Orthopaedic Surgery
University of Pennsylvania

Preview
When are cuff tears debrided vs. repaired?
What is done (what do I need to protect)?
Outcomes

“Failed Non-operative Treatment”
6 weeks of therapy minimum
3-4 months time period decide operative vs. non-operative

Repair vs. Debridement

Repair
- Good pain relief
- Improved function
- Long Rehab (6+ mos)
- Results Durable

Debridement
- Good pain relief
- Function unchanged
- Shorter rehab (3 mos)
- Results decline

How to tell if repairable?

Shoulder Factors
- Chronicity (>1 YR)
- Large lag sign
  - (>30 degrees)
- Significant atrophy on MRI

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Patient Factors

- Smoker
- Advanced age (>65)
- Smoker
- Multiple cortisone injections
- Prior failed surgery

Sonnabend JSES 2002

Debridement

What is done?
- Debride cuff to glenoid rim
- Release biceps tendon
- Smooth osteophytes (G.T. and acromion)

Debridement

What does a therapist have to protect?
If done open:
- deltoid repair

If done arthroscopically:
- nothing

Cuff Repair-Open

Technique
- Anterior deltoid head taken down
  (axillary nerve at risk)
- +/- acromioplasty
- Tendon mobilized
- Repair through bone tunnels
- CA ligament repaired

Cuff Repair-Open

What does the therapist have to protect?
- Deltoid repair
- Cuff repair
How long?
Probably 8-12 weeks

How long to protect cuff?
Traditionally 6 weeks-
Based on bone healing data

Presented/unpublished data
8-12 weeks before Sharpey’s fiber restored

Cuff Repair-Mini-Open

Technique
Arthroscopic Acromioplasty
Tendons mobilized arthroscopically
Deltoid split
Tendon repaired anchors or bone tunnels

Cuff Repair-Arthroscopic

Technique
Arthroscopic Acromioplasty
Arthroscopic cuff mobilization
Margin convergence
Repaired with anchors

Cuff Repair-Arthroscopic

What to protect?
Cuff Repair

How long?
8-12 weeks

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How long?
8-12 weeks

When cuff “retear”
Entire fixation may be lost
Traumatic event
Suture cuts through tendon

Partial healing of tendon
• Tear is smaller
• Fixation failed slowly enough to allow some healing

Complications

Open
• CA ligament incompetence
• Decompensation of function
  (attempting to repair irrepairable tears)
• Axillary nerve injury
• Deltoid dehiscence

Complications

Mini-open
• Deltoid pain
• Stiffness
• Deltoid dehiscence
• Unknown healing rates

Complications

Arthroscopic
• High rerupture rates (96%)
• Technically difficult

Results
Multiple studies 80-90% initial good pain relief that deteriorates with time

Time to this result
3 months

Results

Time frame for repair results
• 6 weeks-able to sleep in bed
• 6 weeks-off narcotic pain meds
• 3 months- PROM close to normal
• 4-5 months-patient able to lift arm
• 5-6 months-functional strength
• 1 year+-final result

Open
• High patient satisfaction (85%)
• Long-term follow-up (10 years)
• High non-healing rates (25-50%)
• Best functional results in patients with intact repairs

Open repair references
• Postacchini 2002 CORR
• Harryman 1991 JBJS
• Galatz JBJS 2001

Mini-open
High patient satisfaction
No anatomic data published

Severud Arthroscopy 2003
Results

Arthroscopic
High patient satisfaction in short term follow-up (1-2 years) 90%

Is this just from the acrmoioplasty?
Galatz JBJS 2004

Cuff Augmentation

Biologic
• Porcine Intestine
• No structural support
• Inflammatory reaction
• Trend to worse outcomes
Malcarney JSES 2005
Iannotti unpublished data

Structural
• Dermis
• Cross-linked Porcine
• No published data

Summary
• Non-operative treatment is the mainstay of treatment for massive cuff tears

• Repair is first option for surgical treatment

• Debridement can provide reliable pain relief, but does not improve strength

Summary
• Massive cuff repairs must be protected to allow them to heal

• Open repair has best published healing rates
• Arthroscopic repairs have high failure rate but low complication rate

Postoperative Rotator Cuff Rehabilitation: Massive Cuff Tears
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University of Pennsylvania Health System

Dangerous Territory

Philosophical Shift
• Immobilization - good- < 70’s

• Immobilization – bad- > 70’s- 2000

• Immobilization – good? Now

Nirvana
Bone-tendon healing

What Determines Outcome
• Tissue quality
• Tear size and shape
• Supraspinatus atrophy
• Patient age
• Patient compliance
• Surgeon expertise
• Rehabilitation
• Size/weight of the arm

Biomechanics of failure
• Zuckerman et al., JSES, 1991
  – Increased tension on cuff repair when arm is brought from 30 to 0 degrees
• Reilly et al., JSES, 2004
  – Repair tension was reduced from 34N to 0N when moving from 0 to 30 of abduction
  – A 9 mm gap formed in 24 hours after repair in cadavers when loading the cuff to 34N with arm at side
• Cummins et al., JSES, 2003
  – Failure occurs at suture-tendon interface

Rotator Cuff Repair
• Recognize the rotator cuff interval may need to be released- this effects rehab.

Fixation vs. Stress
• Mechanical fixation- suture/anchor holds tendon to bone
• Biologic Fixation- tendon/bone interface fuse
• Avoid cuff overload

Protect Against
• TENSION!!!!!!!!!!!
• TENSION!!!!!!!!!!

Rehabilitation

Phase I - Goals: Weeks 1-6
• Patient education- precautions/exercise
• Permit healing- Avoid cuff loading/limit ER-30°
• Control pain and inflammation- meds/therapy
• Achieve good passive ROM and prevent stiffness- initiate “passive” range of motion exercises.

Exercise Progression

• A continuum of exercise that:
  – Protects tissue integrity
  – Allows tissue healing
  – Prevents excessive tension loading
  – Prevents adhesions
  – Promotes return of functional strength

Core ROM and Strengthening Exercises

• Phase I ROM- Pendulum, ER, Elevation
• Phase II ROM- Extension, IR, Horizontal adduction

• Phase I Strengthening- ER, IR, Extension
• Phase II Strengthening- Flexion, Abduction, supported ER at @45 POS

Update

• Some surgeons are immobilizing for the first 3-6 weeks following cuff repairs.

• Why??????? ------→ Retear rate!!!!!!!
• Bone – tendon healing studies

Elevation ROM- Alternative
• Chair stretch- When they cannot relax cuff/deltoid
• Progress to supine forward elevation

Phase II 6 – 12 Weeks

Goals:
• Improve ROM-
  – Progress to Phase II ROM (IR, Ext., Hor. Add.) @ 8 weeks. Do not force functional IR (this is most lengthened position for cuff
• Improve neuromuscular control and strength
  – Use elevation progression
  – Progress to Phase I strengthening- meet criteria
    • Start with IR and extension first
  – Re-educate the dynamic stabilizers with submaximal manual -avoid cuff overload
• Emphasize normal scapulohumeral rhythm

What to Expect at @ 6 Weeks
• EXPECT AND RESPECT LIMITATIONS!!!
  – Especially if cuff was repaired under tension
  – Cuff tissue does not have normal length

Large and Massive Tears
• If repaired and place in abduction pillow or if known to be repaired “under tension”, expect limitations– RESPECT limitations.
• Hersche et al., JSES, 1998
  – Tears that retracted were under more tension when advanced and re-attached
• If the patient gains 20 degrees in between therapy sessions and presents with + ER lag signs –they have torn the repair!!!
EMG Activation During Elevation Progression. Gaunt, B and Uhl, T, ASSET, 2004

Elevation Progression (see back of outline)

Elevation Progression (continued)
Beware of the Evil Machine

ER Progression

Phase II- Update

• Progress to Phase I strengthening
Criteria
  – ER lag sign is negative
  – Minimal reactivity
  – No pain with submaximal resistance
  – Good passive elevation- > 140
• If criteria not satisfied then modify

Phase II- Update

• Phase I Strengthening- Do IR and Extension first
  – Move through pain free arcs and avoid repetitive “clicking and clunking”
  – Limit ER to @ 20 –30 degrees
  – Integrate medial scapular muscles by “setting”
  – 2 sets 10 → 3 sets 10 → 3 sets 15 → change color
Phase II

Submaximal Manual Resistance-Short-arc Less Stressful Than Isometric

Warning Signs

• Increased reactivity
• Excessive passive ER ROM with arm at side (occurs abruptly between sessions)
• Near normal functional IR
• Limited active elevation to less than 100 degrees beyond 8-10 weeks
• ER lag sign beyond 10 weeks (patient may continue to present with 10-15 lag)
• The weaker the patient the slower to progress
  – Use very light manual resistance

Phase III

12 -16 Weeks

Goals:

• Expected pain free ROM
  – some stiffness of ER at the side, elevation and in functional IR is acceptable and respected
• Optimize neuromuscular control
  – progress strengthening from non-provocative to provocative
• Improve endurance
• Initiate return to functional/work activities

Phase III

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Reality Check

- Many of the older, low demand patients require little beyond this.
- Functional strength and other compensation continues to occur
- Do not be tempted to progress to the point of

Phase III

- Progress to variable resistance machines if appropriate (after 12 weeks)
  - Curls
  - Triceps
  - Rows
  - Lat pull down in front
  - Work simulated activities-push/pull
- Lifting/carrying- boxes

Phase IV- 16 weeks  
6 months

- Return to recreational activities
  - Golf- begin swinging golf club \(\rightarrow\) tee up on fairways
  - Tennis- can swing racquet \(\rightarrow\) forehands \(\rightarrow\) two hand backhand \(\rightarrow\) easy serves
- Work
  - Patient to modified duty \(\rightarrow\) light lifting \(\rightarrow\) progress as tolerated
  - Some patients may begin work conditioning
  - Some patients should not go back to heavy repetitive lifting

Summary

- Know the size of tear and repair mechanics
• Respect healing- Tendon to bone
• Progress the patient based on THEIR shoulder
• Look out for the warning signs
• There is nothing wrong with being conservative even if you are a democrat!!!!
Indications and Surgical Considerations for Latissimus Dorsi Transfer and Reverse Prosthesis

Charles L. Getz, MD
Key points
Rotator cuff’s roll in shoulder function
   Humeral head depressor(fulcrum)
   Centers head on socket(stability)
   External rotation(Strength)

Key Points
Massive cuff tears can be
   • functional(balanced)
   • dysfunctional(unbalanced)

Arthritis can develop(10%)

So many choices
What are the patients complaints?
   • Pain,
   • Weakness,
   • Pain+Weakness
How functional is the patient?
Is the cuff repairable?
Is there significant arthritis?

What is best operation?
What is the complaint?
What can each surgical options do?
Will the patient be happy after the surgery?

Treatment options
Debridement
   • Pain Relief
Hemiarthroplasty
   • Pain Relief

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• Little functional improvement

Latissimus Transfer
• Functional improvement
• Little pain relief

Reverse Prosthesis
• Pain Relief and Function

Approaches to the shoulder

Deltopectoral
  Between anterior deltoid and pec major
  Subscapularis frequently divided and repaired

Need to protect
  Subscapularis repair

Approaches to the shoulder

Superior Approach
  Anterior head of deltoid taken down and repaired

Need to protect
  Deltoid repair

Hemiarthroplasty

Pros
• Pain relief consistent
• Easy Technically/low complication rate

Cons
• AROM before=AROM after(fulcrum not restored)
• Possible late glenoid based pain

Hemiarthroplasty

Technique
• Deltopectoral approach
• Subscap usually divided and repaired
Protect
• Subscapularis repair
Hemiarthroplasty

Results
• Difficult interpreting results—mixed patient population
• Pain relief predictable
• Function similar to pre-op

Latissimus Transfer

Pros
• Replaces posterior/Superior cuff
• Improves function
• Dynamic transfer?

Cons
• No pain relief
• Technically challenging
• Long Recovery

Lat Transfer

Technique
• Posterior approach to harvest Latissimus
• Superior approach to expose Humerus
• Tendon tunneled under deltoid
• Lat sewn into the greater tuberosity

Results
• High patient satisfaction (80%)
• Improves Active ROM (Ave 50 FF, 13 ER)
• Improves function for low weight
• Does not improve ability to hold 15 pound weight at shoulder height

Reverse prosthesis

Pros
• Fulcrum restored
• Pain relief
• Shoulder level function

Protect
• Implant
• Too much motion can cause dislocation

Cons
• Little ER strength
• Technically difficult
• Higher complication rate
• Longevity of implant

**Reverse Prosthesis**

Technique
• Deltopectoral approach or superior approach
• No cuff repair made
• Stability from deltoid tension/geometry of implant
• Function-remaining cuff/deltoid tension

**Reverse Prosthesis**

Results
• 92-98% satisfaction short term
• Pain relief near 100%
• Improved Outcomes scores
• High complication rates (33-50%)
  Dislocation
  Component loosening
  Infection

**Summary**

• Multiple surgical options available for the treatment of irreparable rotator cuff tears

Treatment is based on patient age, function, and expectation

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REHABILITATION FOLLOWING TENDON TRANSFERS for MASSIVE ROTATOR CUFF TEARS
Brian G. Leggin, MS, PT, OCS
Latissimus Dorsi Transfer Rehabilitation

• Same as for large / massive cuff repairs
• Except………

Latissimus Dorsi Transfer Rehabilitation

• Latissimus still fires when the arm is adducted and extended!!
• Must re-train the latissimus to act as an external rotator
• Emphasize internal rotation and deltoid strength

Latissimus Dorsi Transfer Rehabilitation

• Neuro-muscular re-education!!
• Stimulate latissimus with Adduction

STUDY

• PURPOSE:
  – To evaluate range of motion, strength, pain, satisfaction, and function of patients who have had latissimus dorsi transfer for irreparable posterosuperior rotator cuff tears.
METHODS

• Retrospective study of 14 patients who had lat transfer surgery

• All patients completed Penn Shoulder Score at initial office visit and most recent follow-up visit

• Pre and post-operative passive and active range of motion of both shoulders

METHODS

• Strength of ER, IR, and elevation in POS at 45°

• ER force while operative arm performed adduction

RESULTS

• 14 of 20 possible patients seen for follow-up
• Nine males, Five females
• Mean age = 54.8 (SD ± 7.4, range = 44 – 68)
• All gave informed consent

RESULTS ALL PATIENTS AROM

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<thead>
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<th></th>
<th>Pre</th>
<th>Post</th>
<th>p</th>
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<tbody>
<tr>
<td>FE</td>
<td>106°</td>
<td>118°</td>
<td>.56</td>
</tr>
<tr>
<td>ER @ 0</td>
<td>17°</td>
<td>26°</td>
<td>.30</td>
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<tr>
<td>ER @ 90</td>
<td>24°</td>
<td>50°</td>
<td>.05*</td>
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RESULTS POOR vs GOOD AROM
### RESULTS ALL PATIENTS

#### STRENGTH (kg)

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<th></th>
<th>Inv</th>
<th>Uninv</th>
<th>%</th>
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<tbody>
<tr>
<td>ER</td>
<td>2.8</td>
<td>7.7</td>
<td>34%</td>
</tr>
<tr>
<td>IR</td>
<td>14.0</td>
<td>14.6</td>
<td>98%</td>
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<tr>
<td>Elevation</td>
<td>7.7</td>
<td>12.7</td>
<td>63%</td>
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#### STRENGTH RESULTS POOR vs GOOD

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<th>Poor</th>
<th>Good</th>
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<tbody>
<tr>
<td>ER</td>
<td>1.38kg</td>
<td>3.6kg</td>
</tr>
<tr>
<td>IR</td>
<td>6.84kg</td>
<td>14.03kg</td>
</tr>
<tr>
<td>Elevation</td>
<td>3.5kg</td>
<td>7.73kg</td>
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</table>

### ER FORCE with ADDUCTION

#### PENN SHOULDER SCORE

#### GOOD vs POOR RESULTS FUNCTION

- 5 poor result patients could not:
  - Place hand behind head
  - gallon container on shelf at shoulder level
  - reach a shelf overhead
  - soup can a shelf overhead
  - gallon container on a shelf overhead
  - 4/5 could not place soup can a shelf at shoulder level
SUMMARY

- Latissimus dorsi transfer can be a successful procedure
- External rotation force increases when arm forcefully adducts
- Good subscap and deltoid function appears necessary for better outcome

FUTURE RESEARCH

- Doesn’t work – why?
- Works – why?
- Further analyze EMG data
- Randomized prospective study

REVERSE PROSTHESIS

REHABILITATION

- Early motion depends on surgeon preference and quality of glenoid fixation
- Some advocate no movement until 6 weeks post-op
- Some initiate no postoperative rehabilitation
- Others begin PROM first post-op day with limits of 90° FE and 0° ER
- Literature lacking in description of rehabilitation

Rittmeister and Kerschbaumer, JSES 2001

- Reported on 7 patients (8 shoulders) with RA and irreparable rotator cuff
- PROM on 1st post-op day
- Active flexion and abduction beyond 90° allowed after 6 weeks unless delayed union of acromion osteotomy

Rittmeister and Kerschbaumer
- Constant score improved from mean 17/100 to 63/100
• Postop active painfree shoulder range allowed use of hand at umbilicus in 2 patients, the head in 2, and above the head in 2 (one patient deceased & 1 implant removed)

Frankle, et al JBJS 2005
• 64 patients (66 shoulders) with cuff deficiency and arthritis (2-year follow-up)
• Rehab: Shoulder immobilizer for 4 weeks and PROM begun day 1 (limits of 90° FE and 0° ER
• 4-6 weeks: sling and AAROM
• 8-10 weeks: AROM
• Resistive exercise begun when subscap healed (usually 12 weeks)

Frankle, et al JBJS 2005

<table>
<thead>
<tr>
<th>Pre-op</th>
<th>Post-op</th>
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<tbody>
<tr>
<td>ASES score:</td>
<td>34.3</td>
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<tr>
<td>Pain:</td>
<td>6.3</td>
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<tr>
<td>ROM: FE</td>
<td>55°</td>
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<tr>
<td>ABD:</td>
<td>41.4°</td>
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<tr>
<td>ER:</td>
<td>12°</td>
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</tbody>
</table>

CURRENT PENN APPROACH
• Patients with a good deltoid allowed to use arm for waist level activities first 6 weeks. Then use arm unrestricted.

• Patients with post-op stiffness begun with PROM 7-10 days post-op with restrictions

• Patients with poor deltoid begun on strengthening and functional training at 6 weeks

SUMMARY
• Rehabilitation following reverse prosthesis is not standardized
• Preoperative deltoid function may play a role in postoperative shoulder function

• Rehab may vary depending on patients goals and abilities

LATISSIMUS DORSI TRANSFER REFERENCES:


REVERSE PROSTHESIS REFERENCES:

