Rehabilitation Following Rotator Cuff Repair

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REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

Introduction

Have different rehab programs for specific patients & surgeons

- “One size does not fit all”
- Rehab based on surgery & patient
- Size of the tear
- Tissue quality
- Type of repair
- Patient variables
- Multiple programs – several programs

Specific & Adjustable Rehab Programs
Return to Throwing after Rotator Cuff Repair Surgery

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

Introduction

- Same rehabilitation program for both patients
- Regarding rate of progression & activities

Rehabilitation Following Cuff Repair
Rehab Plan

Rotator Cuff Repairs in Overhead Throwers

Conway: Orthop No Am ’01
- 14 baseball players (13 pitchers)
- Intratendinous repair
- Average follow up 16 mos
- 8/9 (89%) followed for 1 yr or more returned to pre-injury level

Mazoue & Andrews: AJSM ’06
- 16 baseball players with mini open cuff repair
- 12 pitchers
- Mean follow –up 66 mos
- 1/12 pitchers returned to pre injury level
- 4/4 position players returned
- (2/4) surgery on ND shoulder
Rehab Post Rotator Cuff Repair Surgery

Points of Discussion

- Motion is Good for Joints!
- Is Motion Good for Soft Tissue Healing?
- Rehabilitation program is based on patient variables (tear size & tissue quality) & surgery variables
- Sharpey’s fibers sign. number not until 12 wks
  Sonnabend et al: JBJS ‘10
- 12-15 wks soft tissue healing
  Thomopoulos et al: J Biomech Eng ‘03

Rehab Following Rotator Cuff Repair Surgery

Points of Discussion

- Rehabilitation philosophy
- Early motion vs. delayed motion
- Individualize rehabilitation programs
- Muscle training & function

Do Not Want Early Strengthening - Rather Activation & GH Stability/Control

Rehabilitation Following Rotator Cuff Repair

Maximizing Tendon Healing

Biomechanical Factors

Biologic Factors

Patient Factors

Effect of Smoking on Rotator Cuff Repairs

Mallon et al. JSES 2004

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<th>Smokers</th>
<th>Non-smokers</th>
<th>Frequency (%)</th>
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84% vs 30%

Rehabilitation Following Rotator Cuff Repair

Introduction

What’s the concern about early motion?

Failure of the Repair!!!
Numerous studies have reported rates of recurrent cuff tears following rotator cuff repair surgery:

- **Boileau: JBJS '05** - 29% failure rate
  - 95% satisfied with the result at 2 yrs
- **Sugaya: Arthroscopy '05** - 40% in large to massive size tears (MRI)
  - Almost all have sign improvement in symptoms
- **Galatz: JBJS '04** - 94% large to massive tears
  - 16/18 (89%) had functional double
- **Harryman JBJS '91** - recurrent defect in 50% of 2 tendon tears
  - 87% good to excellent results at 5 yrs post-op

**Krishnan et al: Arthroscopy ‘08**

- Rotator cuff repairs in younger than 40 yrs of age patients
- 23 patients mean age 37 yrs
  - 90% returned to previous injury level
  - 100% diminished & increased function
  - ASES pre-op score 42, post-op 92 (100)
  - 95% would undergo procedure again

**Miller et al: AJSM ‘11**

- When do RTC repairs fail? Serial US exam after large RTC tears
- 22 patients with large or massive tears (>3 cm) standardized arthroscopic repair (mean age 62.7 yrs)
- Serial US performed at 2 days, 2 wks, 6 wks, 3 mos, 6 mos & 1 yr
- *4 weeks of immobilization, strengthening at 12 wks
  - 9 of 22 (41%) demonstrated recurrent tears
  - Pre-tears (66%) occurred within 60 days
  - 3 re-tears (33%) occurred after 178 days
  - 2/9 tears occurred during first 30 days (immob.) & 5 of 9 tears occurred within first 51 days

**Harryman et al, JBJS ‘91**

- Correlated functional ability with operative repairs of RTC
- Follow-up 5 years, ultrasound evaluation
- 80% repairs intact; if only supraspinatus
- 57% repairs intact; if two tendons repaired
- PROM – 8 wks, no strengthening 12 wks

**Rehabilitation Following Rotator Cuff Repair**

**Immobilization vs Immediate Motion**

- **Peltz et al: J Orthop Res ‘10**
  - ...after a short period of immobilization, increased activity is detrimental to both tendon mechanical properties and shoulder joint mechanics, presumably due to increased scar production
REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

Keys to Success

- Have different rehab programs for specific patients & surgeons
  - “One size does not fit all”
  - Rehab based on surgery & patient
  - Size of the tear
  - Tissue quality
  - Type of repair
  - Try to individualize
  - Multiple programs – 3 programs

Specific & Adjustable Rehab Programs

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

Three Distinct Programs

Arthroscopic Procedures

- Type I: small tears (1cm or<) (very good tissue quality)
  - Abduct sling 4 weeks, Full AROM 6-8 weeks

- Type II: medium - large tears (2-4 cm) (adequate tissue)
  - Abduct sling 4-6 weeks, Full AROM 8-12 weeks

- Type III: large - massive tear (4cm >)
  - (poor tissue, retracted tissue, tenuous repairs)
  - Abduct sling 4-6 wks, Full ROM 12-16 wks

Do we really want to go back to these days???

Rehab Following Rotator Cuff Repair

Motion

Some people say cuff repairs don’t get stiff

Rotator Cuff Repairs & Stiffness

8 weeks post-op massive cuff chronic repair
Rehab Following Rotator Cuff Repair

Motion

- Approximately 5-16% of all patients will develop stiffness after rotator cuff repair

Koo et al: Arthroscopy 2011
Huberty et al: Arthroscopy 2009
Chung et al: Arthroscopy 2013
Harris et al: Orthopedics 2013
Franceschi et al: Sports Med Arthroscopy ’11
Brislin et al: Arthroscopy 2007

Is this Acceptable to the Clinician?
**Management of Postoperative Shoulder Stiffness**

**Parsons, Gruson, Gladstone, Flatow: JSES ‘10**

- 43 patients retrospective study conservative rehab and outcomes at 6 mos & 1 yr
- Sling for 6 weeks (full time) no rehab
- Failures (MRI): Stiff group (N=10, 23%) 30% failure
  Non-stiff group (N=33, 77%) 64% failure
- What was stiff? (at 6-8 weeks)
  - 30 deg or < of ER
  - 100 deg or < of flexion
- No difference in ROM, pain & ASES scores at 1 year (stiff exhibited better)

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**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

**Introduction**

- Rehabilitation programs have changed:
  - Just Right Rehab
  - Healed Sufficient ROM
  - Has to be tailored:
    - Patients tissue quality
    - Specific surgical technique
    - Demanding of the patients
    - Surgeons philosophical approach
  - More aggressive rehab – improved function

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**Koo, Parsley, Burkhart, Schoolfield: Arthroscopy ‘11**

- Benefits of a modified rehabilitation program in reducing post-operative stiffness
- 152 patients underwent arthroscopic cuff repair
- 79 patients were identified as at least 1 risk factor for stiffness
- “Early overhead closed chain passive motion was added to a conservative rehab program ” (table slide)
- No patients developed post-op stiffness in modified grp
- Compared to historical control 13% stiffness
- Level IV Evidence
**Lastayo et al: JBJS ’98**

- Prospective randomized study (N=32)
- Randomly assigned to 2 groups:
  - A: CPM immediately (N=17)
  - B: manual PROM (N=15)
- Shoulder Pain & Disability Index
- Both groups resulted in extremely successful
  - 84% excellent results, 6% good results, fair 7% & poor results 3%
  - “no sign diff between groups...”motion yields favorable results...”

**Kim, Chung, Kim, et al: AJSM ’12**

- 105 consecutive patients undergoing arthroscopic repair of small & medium size tears
- Randomly assigned to one of two groups:
  - Early motion (3-4x day)
  - No passive motion for 4 wks small, 5 wks med.
- Assessed at pre-op, 3, 6 & 12 months (US, MRI, ROM, ASES, VAS for pain)
- No difference in ROM, early motion no negative effect on cuff repair healing

**Klintberg et al: Clin Rehabil ‘09**

- Prospective randomized study (N=14)
- Randomly assigned to 2 groups:
  - I: dynamic stabilization & PROM day 1
  - II: PROM immediately no cuff loading 6 wks
- Evaluated the patients at 3, 6, 12 & 24 mos.
- Pain, VAS, PROM, Strength, Funct Index
  - Early loading group better at 3 & 6 months (S) & slightly better for ROM, VAS, & strength at 24 mos (NS)

**Duzgun et al: Acta Orthop Traumatol Tur ‘11**

- Prospective randomized study (N=29)
- Randomly assigned to 2 groups:
  - A: Accelerated rehab (N=13)
  - B: slow protocol rehab (N=16)
- Evaluated pain, DASH & functional activity
  - No sign diff between groups pain
  - Accelerated group was superior to slower group regarding functional activities, DASH scores at 8, 12 & 16 weeks
No Significant Differences in Re-Tear Rates Between Early Passive ROM & Delayed Passive ROM

Size of the tear may influence re-tear rate

Early Active Motion was associated with increased risk of structural defect in rotator cuff repairs

Goals of Rehabilitation following rotator cuff repair:
- Protection of repair site
- Promote healing
- Restore ROM
- Restore strength
- Functional restoration
- Pain-free function
REHABILITATION FOLLOWING ROTATOR CUFF REPAIR
Keys to Success

1. Develop a Proper Treatment Plan
   - “Road map to treatment & success”
   - Operative report
   - Discussion of specifics with Surgeon
   - Communications is a key
   - Team approach

2. Know what you’re treating
   - “not all patients are the same”
   - Tissue quality
   - Size of the tear
   - Type of surgery(repair)
   - Concomitant surgeries
   - Patient variables (age, smokers)
   - Work activities & desired goals
   - Communication is key

Specific Rehabilitation Program

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR
Factors Influencing Rehabilitation

- Type of repair: open, mini-open or arthroscopic surgical technique
- Fixation method: single row, double row, suture bridge technique, augmentation
- Patient’s tissue quality: musculotendinous, osseous
- Size & Location of tear: absolute size, number of tendons
- Type of tear: Horizontal, vertical, combination

Rotator Cuff Repair

- Single Row Technique
- Double Row Sutures
- Suture Bridge Technique

Complex Suture Bridge Technique

Duquin, Buyea, Bisson: AJSM ‘10

- Which method of RTC repair leads to highest rate of structural healing? Review
- 1253 repairs from 23 studies
- Significantly lower retear rates in Double Row vs Single Row, Transosseous repair
- TO & SR retear rates 17% to 69% for tears less than 1cm to 5cm> respectfully
- DR retear rates: 1cm 7%, 41% for 5cm>
**Gartsman et al: JSES ’13**

- Ultrasound evaluation of rotator cuff repairs
- 90 consecutive cuff repairs
- Comparison suture bridge vs single row
  - 93% suture bridge healed at avg 10 mos
  - 75% single row healed at avg 10 mos
  - “significantly better tendon healing with arthroscopic suture bridge compared to single row…”

**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

- Chronicity of tear/repair: acute → chronic
- Surrounding tissue quality: subscapularis - posterior cuff
- anterior deltoid - posterior cuff
- Patient variables: Not age but activity level, motivation, general health, smokers, etc.
- Rehabilitation potential: independent/supervised
- Physician’s Guidance: post-surgery perception repair

**Factors Influencing Rehabilitation**

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**Rotator Cuff Repair**

*Adjust Rehab based on Tissue Quality*

**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

- Introduction – Failure Rates
  - Risk factors for recurrent tears:
    - Size of Tear
      - Ide: Arthroscopy ’05
      - Sugaya: JBJS ’97
      - Verma: Arthroscopy ’06
    - Age of Patient
      - Boileau: JBJS ’05
      - Boileau: JBJS ’05
      - Lichtenberg: Knee Surg Sports Med ’06
    - Occupation
      - Gazielly: Rev Chir Orthop Repar ’95
    - Tissue Quality & Early activities – aggressiveness, smokers

**Keys to Success**

- Have different rehab programs for specific patients & surgeons
  - “One size does not fit all”
- Rehab based on surgery & patient
- Size of the tear
- Tissue quality
- Type of repair
- Try to individualize
- Multiple programs

**Specific & Adjustable Rehab Programs**

**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

- Three Distinct Programs
  - Arthroscopic Procedures
  - Type I: small tears (1cm or<) (very good tissue quality)
    - Abduct sling 4 weeks, Full ROM 4-8 weeks
  - Type II: medium - large tears (2-4 cm) (adequate tissue)
    - Abduct sling 4-6 weeks, Full ROM 8-12 weeks
  - Type III: large - massive tear (>4cm >)
    - Poor tissue, retracted tears, tenuous repair
      - Abduct sling 4-6 wks., Full ROM 12-16wks
Rehab Following Cuff Repair

Overview Rehab Guidelines

Slow Rehab Approach  Faster Rehab Approach

Large-Massive tears  Poor tissue quality
Retracted tear, tension  Chronic tears
Smokers, health issue  Poor healing?
Single row fix – Lrg > Small – Medium tears

REHABILITATION FOLLOWING
ROTATOR CUFF REPAIR

Keys to Success

Individualize to the patient
“Make changes whenever possible”
“assess & adjust”
Not all cuff repairs are the same
Not all patients are the same
Not all surgeries are the same
Not everyone heals at same rate!!
7 different program

Team Approach to Treatment - Individualize

Different Protocols to Match Different Patients

Treatment Concept #1

Individualize  Classification Scheme

REHABILITATION FOLLOWING
ROTATOR CUFF REPAIR

Concomitant Procedures:
Cuff repair with SLAP
Cuff repair with stabilization
Cuff repair with Pect Repair

Factors Influencing Rehabilitation

Fatty Atrophy/Infiltrate

- Mild, Moderate, Severe
- Streaks of high signal on T1
- Loss of muscle bulk (Sagittal)
Rotator Cuff Tear
Classification (Prognosis) & Rehab

- **Tear**
  - Size: Number of Tendons vs Size of Tear (cm)
  - Thickness: Partial or Full
  - Timing: Acute or Chronic
  - Retraction: Amount

- **Muscle Quality – Goutallier Classification**
  - Stage 0 - Normal muscle
  - Stage 1 - Some fatty streaks
  - Stage 2 - More muscle than fat
  - Stage 3 - 50/50 fat and muscle
  - Stage 4 - More fat than muscle is present

Costouros... Warner: Arthroscopy ‘07

- 26 of 216 patients treated for RTC tear – identified as massive
- EMG & NCV performed pre & post-operatively
- 14 of 26 (54%) identified with peripheral nerve injury (7 suprascapular n, 4 axillary n, 2 upper trunk brachial plexus, 1 C spine)

Warner, ... Gerber, JBJS ‘92

- Anatomy & Relationships of the Suprascapular Nerve: Anatomical Constraints to Mobilization of the Supraspinatus & Infraspinatus Muscle in the Management of Massive RTC Tears
- 31 shoulders in 18 cadaver
- Relatively fixed on floor of fossa, 84% had no more than 2 motor branches, 84% exhibited first motor branch under transverse scapular ligament
- Lateral advancement of more than 3cm should not be performed because of effects on SS nerve

**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

**Keys to Success**

- Protection is important/imperative
  - *When in doubt go slow*
  - PROM places strain on cuff repair
  - Active muscle contraction places strain on cuff repair
  - Active functional motions - strain
  - Abduction braces/slings may help
  - Multiple programs

Team Approach to Treatment - Individualize

Arthroscopic Rotator Cuff Repair

Rehabilitation Program

- Post-Operative Braces/Slings
**Rehabilitation Following Cuff Repair**

*Shoulder Brace - Pillow*

- Hatakeyama: AJSM ’01
- Rotator cuff strain less at 30° & 45°
- Sign increase in strain from 30° to 15° & 15° to 0°

30 degree Pillow brace – decreases cuff strain

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**PROM Progression**

- PROM Progression Based on Progress & End Feel
- 30/45 deg abd ➔ 90 deg abd ➔ 0 deg

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**Park, Jun, El Attrache, Lee: AJSM ’07**

- Biomechanical effects of dynamic ER on rotator cuff repair
- 6 matched cadavers – single row fixation
- Cyclic loading with & without ER

- Anterior tendon gap formation was greater with end range ER (30° of ER)
- Strain on posterior tendon was less with ER

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**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

*Keys to Success*

- Controlled Stress can be Good !!!
  - “just be sure it’s controlled”
  - Be sure patient can tolerate it
  - Patient & Surgery variables
  - Light controlled motion assists in collagen synthesis & alignment
  - Immobilization – negative effects
  - Different rehab rates of progression

*Team Approach to Treatment - Individualize*

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**Increasing Concerns Regarding ROM (PROM & AROM)**

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**Which are safe exercises ??**
Dockery, Wright, LaStayo: Orthop ’98

- 10 healthy male volunteers
- Mean age 18 to 33 yrs of age
- Surface EMG applied to shldr
- 7 post-op rotator cuff exercises performed:
  - Pendulum
  - Pulley
  - Self assisted bar with opposite arm
  - Self-assisted ER/IR
  - PROM
  - PROM ER/IR
  - CPM device
- Only “passive” – CPM & PT PROM

Uhl et al: Phys Med & Rehab ‘10

- 12 different exercises:
  - Supine PROM opposite arm: 1% 4%
  - Table slide 5% 2%
  - Wash cloth press up (AA) 3% 7%
  - Table towel slide (AA) 7% 4%
  - Step up with ball (Active) 21% 18%
  - Standing press-up 29% 14%

Caution with long lever exercises & gravity

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

ROM Guidelines

AAROM & PROM Shoulder Flexion
REHABILITATION FOLLOWING ROTATOR CUFF REPAIR
Motion Guidelines

✓ Large & massive repairs – go slow
✓ Small to medium repairs – we can move
✓ When in doubt – don’t do it or go slow
✓ When unsure – try to find out 🌟
✓ Significant difference in PROM & AROM
✓ Excessive PROM (specific motions) can produce sign. strain onto repair site

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR
Keys to Success

 Restore Balance in The Shoulder
  “Balance is the key”
  “When in doubt go slow”
✓ Capsular balance – joint play
✓ Soft tissue balance
✓ ER/IR unilateral muscle ratios
✓ ER/Abd unilateral ratios
✓ Stable base – scapulae - Foundation

Team Approach to Treatment - Individualize

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR
Muscle Training Guidelines

Dynamic Stabilization Program

• Emphasize ER strength
• ER/IR ratio: 52% >
  ✓ This enables you to raise arm
• Rhythmic stabs
  ✓ ER/IR drills
  ✓ Flex/Ext drills
  ✓ Progress to sidelying Flex RS

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

DYSFUNCTIONAL ARC
Shoulder Shrug

• Rotator cuff dysfunction
• Inability to dynamically stabilize
• Arc of motion (0-30) (90-145)
  ✓ Dysfunctional arc ~30-90°
• Superior humeral head migration “shrug sign”
RHYTHMIC STABILIZATION
Rotator Cuff Dysfunction

- Supine → sidelying
- Isometric (RS) → isotonic
- Sidelying short arc isotonics 0-120/145°

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR
Muscle Training Guidelines

Progress resistance 1 lb. per week
Gradually load the repair site – stress/response
Electrical Stimulation- Shoulder
Reinold, Macrina, Wilk: AJSM ’08

• 39 RTC repair patients
  » Mean 10 ± 7 days s/p
  » Range 2-19 days
  » Mean age 54 (23-76 yrs)
• Peak force of ER
  • Significantly greater force w/ NMES
  » 3.27 kg with NMES
  » 2.49 kg without NMES
  ✓ > 22% increase
  ✓ No difference based on age, size of tear, days postop, or STIM intensity
**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

**Muscle Training Guidelines**

- "light" muscle re-education
- To prevent muscular inhibition
  - "muscle shutdown"
- Isometrics – subpainful & submax
- Electrical Muscle Stim
- Rhythmic stabs ER/IR & F/E
- Scapular strengthening wk 2
- Tubing ER/IR wk 4
- Side-lying flexion wk 6

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**Aquatic Rehabilitation - UE**

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**REHABILITATION FOLLOWING ROTATOR CUFF REPAIR**

**Keys to Success**

- Gradual return to function
  - "Sometimes slower is better"
- Depends on functional demands
- Depends on who they are
- Depends on unique surgery factors
- Depends on numerous factors
  - Life’s situation (care giver)
  - Patient’s with physical limitations

**Team Approach to Treatment - Individualize**

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**Boileau, Brassart, et al: JBJS ’05**

- Does the tendon really heal ??
- Arthroscopic repair of full thickness of supraspinatus
- 65 consecutive cuff arthroscopic repaired age 29 to 69 yrs of age (mean age ?)
- Avg. follow-up 29 mos. (arthrograms, MRI)
  - 71% completely healed & watertight
  - 3 partially healed
  - 16 patients not healed but size of tear reduced

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**Manaka, Ito, Matsumoto, et al: CORR ’11**

- Functional recovery following rotator cuff repair (Japanese Orthop Assoc scoring syst.
- 201 patients underwent arthroscopic repair
  - 31% took less than 3 months
  - 40% took between 3 & 6 months
  - 28% took more than 6 months
- Age, shoulder stiffness & cuff tear size influenced functional recovery time
Reflections – Outcome Data

“Nothing ruins a good outcome like long term follow-up studies”

- Bring people back and assess them
- Make changes based on your outcome data
- It’s all about function & pain & longevity with a rotator cuff repair

Evidence Based Treatment - Outcomes

Wilk : Tech Shoulder & Elbow Surg ’00

- 22 patients, mini-open repair
- Average follow-up 40 months: 4 yrs+
- Average age 64.7 years (range 40-76)
- Size of tear:
  - 1 small, 9 medium, 8 large, 4 massive
- 95% excellent/good results (ASES)
- Average score (ASES)
  - pre-op 30.7 vs. post-op 92
  - ADLs pre-op 3.25 vs. post-op 18.8
- 4 patients received MRI – 1 failure (excellent result)

Irreparable Rotator Cuff Tears

Rehab Guidelines

- Re-establish acceptable PROM – reduce capsular tightness (especially inferior)
- Reduce pain – muscle inhibition
- Activate rotator cuff muscles without pain
- Establish unilateral muscle balance
  - ER/IR ratio 55% ≥
  - ER/ABD ratio 53% ≥
  - Levy et al: Arthroscopy ’93,’96
- Posture & Scapular exercises
- Turn on & strengthen posterior cuff & scapular
  - RS, isometrics, EMS, pool exercises, gravity eliminated exercises, scapular drills, etc...
Rehabilitation Following Cuff Repair

“The Bottom Line”

- Rehab must match the surgery
- Rehab must match the patient
- Small tears – move them (but easy)
- Big tears, poor tissue, revisions – slow rehab down (don’t move them)
- PROM is ok for most repairs
- AROM & strengthening needs to be delayed
- When in doubt – communicate
  Team Approach!

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

Summary – Take Home Message

- All rotator cuff repairs are not the same
- Rehabilitation program must vary based on specific criteria:
  - Size of the tear
  - Retraction of the tear
  - Tissue quality
  - Chronicity of the tear
  - Patient variables
- Slower may be better in many cases

REHABILITATION FOLLOWING ROTATOR CUFF REPAIR

Summary - Key Points

- Must have different rehabilitation programs
- One program does not accurately fit all pts
- Individualize the program to a degree:
  - Single tendon repairs
  - Calcific tendonitis repair
  - Pre-existing adhesive capsulitis
  - PASTA repairs
  - Concomitant SLAP repairs
  - This patients may require more attention

Thank You!!!!