Thank You

- Thanks to APTA-SPTS and SPTS Shoulder-SIG for the kind invitation to present and share this information
- It is indeed an honor and privilege to be invited to participate and share information.

Rehabilitation Following Rotator Cuff Repair: Early vs Delayed Rehabilitation Protocols
(Accelerated vs Decelerated Rehab Programs: What is best and for Whom?)

APTA-CSM
San Antonio, TX.
February, 2017

Course Learning Objectives:
Upon completion of this educational session, learners should be able to:
1. Understand the importance of the surgical procedure, and the individual characteristics of the patient to customize the rehabilitation program to the patient
2. Synthesize the evidence supporting either the early (Accelerated) vs delayed (Decelerated) Programs
3. Apply the information to individual cases in their patient loads as to whether they should use the early (Accelerated) vs delayed (Decelerated) Programs
4. Analyze the success of their outcomes by synthesizing the information in this educational session into one's own clinical practice

Socratic Debate:
- Post-Operative Rehabilitation of Rotator Cuff Repairs
- KEW vs GJD

Disclosures:
The following companies have provided research equipment support to Biodynamics & Human Performance Center-AASU:
- Arthrometrics, Atlanta, GA
- Biodex, Shirley, N.Y.
- Boston Biomotion, N.Y.
- CDM Sport/Monitored Rehab Systems, Fort Worth, TX.
- DS2 Rehab Systems, Missouri City, TX.
- ERMI, Atlanta, GA.
- ExerTools, Petaluma, CA.
- Innovative Sports Inc, Chicago, IL.
- Performance Rehab Products, Kent, CT.
- Rehab Innovations, Inc., Omaha, NE.
- TheraBand, Akron, OH.

No Conflicts
The Shoulder, The Shoulder, 1934
E. A. Codman

ASES-Rehabilitation-RTC
- RTC tears affect ~30% of population > 60 yo
- RTC tears affect ~60% of population > 80 yo
- ~450,000 operations per year
- Direct medical costs - $7 billion/year
- Arthroscopic RTCR has increased 600% over past 10 years
- Arthroscopic repairs comprise greater than 95% of all RTCR in USA

We have all been Searching for the answers for a long time

Rehabilitation Following RTC Surgical Repairs
- Socratic Debate
- Accelerated Motion vs Delayed Motion:
- Effects on healing and RTC failures

Rehabilitation Following RTC Surgical Repairs
- Socratic Debate-Speed of Rehab:
  - Slowly:
  - Medium:
  - Fast:

Socratic Debate - RTC
- If it is appropriate for the right patient.......
- Whatever Kevin says I agree with him....
- If the patient meets the very precise criteria to begin an early motion rehabilitation program

Epidemiological factors influencing surgery and rehab of RTC repairs

Rotator Cuff Rehabilitation
- Several studies have noted that increasing age is a significant factor for diminished rotator cuff healing. Larger tears and fatty infiltration or atrophy also negatively affect rotator cuff healing.
- There is conflicting evidence to support postoperative rehabilitation protocols using early motion over immobilization following rotator cuff repair.

RTC Rehabilitation-Trends
- 12 Factors associated with successful recovery following RTC repair.
- 4 categories: demographic, clinical, RTC integrity, surgical procedure
- Demographic factors: age (older, less chance of tendon healing)
- <55 yo: 88-95% chance of tendon healing
- > 60 yo: 43-65% chance of tendon healing
- Implications: do not ignore S&S, because they will generally propagate

12 Factors associated with successful recovery following RTC repair
4 categories: demographic, clinical, RTC integrity, surgical procedure

Clinical Factors:
- BMD, diabetes, obesity
- Interesting factor: activity level prior to surgery
- More active: outcomes
- Best predictor of final strength was initial strength
- Pre-op stiffness: recovery time and RTA

RTC Integrity Factors:
- Tear size, number of RTC muscles involved, amount of tendon retraction, amount of fatty infiltration (tissue degeneration)
- More degenerated the tissue: outcomes
- Propagation injuries

Importance of PREHABILITATION

RTC Repair Rehabilitation
Is immediate motion or delayed motion appropriate?
- It depends on multiple factors including:
  - Patient characteristics, RTC tear type, physician surgical techniques, rehab procedures

RTC Early Motion vs Delayed Motion
- We want to initiate PROM/AROM/RROM early in the rehab program:
  - To prevent stiffness
  - Benefits articular cartilage
  - To facilitate tissue alignment
  - To increase morphological enhancement of the tissue healing response
  - To active the surrounding muscles
  - To prevent atrophy
  - To prevent reflex dissociation
  - To provide better outcomes
  - BUT, DOES EARLY MOTION REALLY DO ALL THAT???

Applications
- Immediate motion is relatively indicated for selected patients:
  - Younger patients
  - Athletic patients
  - Smaller/medium size tears
  - Surgical technique & expertise
  - Double row fixation
  - Suture bridge/Diamond Back techniques
  - If you pick your patients wisely, you can always be successful!!!

Applications
- Immediate motion is relatively contraindicated for selected patients:
  - Older patients
  - Inactive patients
  - Large/massive size tears
  - Poor quality tissue
  - Surgical technique & expertise
  - Single row fixation
  - Surgical procedure
**SOCRATIC DEBATE - RTC**

- Whatever Kevin says I agree with him....
- HOWEVER....
- It’s more about what he does not say that is more important!

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**Socratic Debate - RTC**

- It’s not just about:
  - The theoretical basis of the advantage of passive immediate motion is good for joints.
  - The theoretical basis of the advantage of soft tissue healing.
  - The theoretical advantages of stronger surgical procedures: double row, suture bridge, diamond back repairs based on biomechanical testing, fixation strength.
  - The theoretical basis of ideal rehab programs: PROM guidelines, what are safe exercises, etc.
  - The theoretical basis of ideal rehab programs: based on cadaveric model research, EMG studies, selected rehabilitation studies with methodological flaws.
  - ETC.

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**SOCRATIC DEBATE - RTC**

- All these theoretical reasons sound great as to why we should do
- “ACCELERATED REHABILITATION”,
- But what does the research really say???

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**Socratic Debate - RTC**

- We all have a tendency to CHERRY PICK the literature to support what we are presenting...
- Sometimes we can learn more from the literature that does not support our philosophy or position we strongly “BELIEVE IN”, than just the literature that does theoretically support our position...

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**RTC**

- “The postoperative rehabilitation program is critical for the successful arthroscopic treatment of RTC injury”


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**RTC Rehab**

- Post-operative rehab program is critical to the successful outcome following RTC surgical repairs

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**RTC**

- It is evident that a successful outcome after surgical RTC repair is as much dependent on surgical technique as it is on rehabilitation”


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**RTC Rehab**

- Post-operative rehab program is critical to the successful outcome following repairs of the RTC surgical repair
- However,
- What does the research really say?
**RTC**

- **LEVEL OF EVIDENCE - 1**
  - ASES scores - both improved, no SS differences
  - SST - both improved, no SS differences
  - Patient satisfaction - no SS differences
  - ROM - no SS differences
  - RTC healing - US at 12 months:
  - Early PROM group - 85% healing
  - Delayed PROM group - 91% healing


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**RTC**

- **LEVEL OF EVIDENCE - 1**
  - ASES scores - both improved, no SS differences
  - SST - both improved, no SS differences
  - Patient satisfaction - no SS differences
  - ROM - no SS differences
  - RTC healing - US at 12 months:
  - Early PROM group - 85% healing
  - Delayed PROM group - 91% healing


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**RTC**

- **LEVEL OF EVIDENCE - 1**
  - 68 patients (avg age 63.2 years)
  - Full-thickness crescent-shaped tear of supraspinatus
  - Repair-transosseous equivalent suture-bridge technique with SAD
  - Rehab: Early PROM group - postop PT - day 2
  - Rehab: Delayed PROM group - postop PT - 6 weeks
  - Same rehab protocols
  - RTC healing - 12 months - US imaging


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**Rotator Cuff Rehabilitation**

- Over a thirty-month period, 124 patients under the age of sixty-five years underwent arthroscopic repair of a full-thickness rotator cuff tear measuring <30 mm in width.
- Postoperatively, patients were randomized either to a traditional rehabilitation program with early range of motion or to an immobilization group with delayed range of motion for six weeks.


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**Rotator Cuff Rehabilitation**

- Arthroscopic repair of small and medium full-thickness rotator cuff tears results in reliable improvements in clinical outcome and a high rate of tendon integrity using a double-row repair technique in patients under the age of sixty-five years. There is no apparent advantage or disadvantage of early passive range of motion compared with immobilization with regard to healing or functional outcome.


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**Rotator Cuff Rehabilitation**

- **Systematic Review:** 3 RCT’s; 265 patients
  - Primary outcome: tendon healing in the repaired cuff
  - Results: Meta-analysis revealed no significant difference in tendon healing in the repaired cuff between early motion and immobilization groups. No differences in secondary outcome measures at 1 year.


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**Rotator Cuff Rehabilitation**

- Three level I and 1 level II randomized trials
  - No statistically significant differences in ASES scores between delayed vs early motion rehabilitation (mean difference [MD], 1.4°)
  - The risk of re-tears after surgery did not differ statistically between treatment groups


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**Rotator Cuff Rehabilitation**

- **CONCLUSIONS:**
  - The current meta-analysis did not identify any significant differences in functional outcomes and relative risks of recurrent tears between delayed and early motion in patients undergoing arthroscopic rotator cuff repairs.

Rotator Cuff Rehabilitation

- **CONCLUSIONS:**
  - A statistically significant difference in forward elevation range of motion was identified; however, this difference is likely clinically unimportant
  - (7° - MCLD with goniometry)


- **Rotator Cuff Rehabilitation**
  - Conclusion: Repair failure rates do not significantly differ between patients randomized to early and delayed motion protocols following arthroscopic single tendon rotator cuff repair.
  - Repair failure on MRI does not correlate with clinical outcome at 6 months or 1 year.
  - However, better subjective outcome scores at 6 weeks are associated with higher rates of repair failure at 6 months.


RTC Rehabilitation

- Prospective, randomized, investigator-blinded clinical trial
- The proportion of patients with tears at the 6-month post-op MRI’s were comparable
- (31% in delayed group; 34% in early group)
- Early motion was associated with lower WORC scores through post-op period
- Failure rates were different between the groups
- Sample size was too small to demonstrate the relation between tear morphology and rehab protocol

Arthroscopy, Jan;33(4):363-9, 2017

- **RTC Rehabilitation**
  - 10 systematic reviews
  - 11 RCT’s
  - Conflicting results and conclusions
  - This updated review showed no differences for function, pain, ROM, or re-tears ratio between early and conservative rehabilitation


Rotator Cuff Rehabilitation

- Purpose was to compare the benefits and harms of non-operative and operative interventions on clinically important outcomes in adults with rotator cuff tears
- **GRADE** (Grading of Recommendations Assessment, Development, and Evaluation) approach
- 137 studies met eligibility criteria. All trials had high risk for bias.


Biopsychosocial Reasons

- 169 patients with full-thickness RTC tears
- SF-36 mental component summary had the strongest association with shoulder pain and function and ASES and SST
- Psychosocial factors are associated with patient complaints in shoulder disorders

Wyllie, J.D., et al. Mental health has a stronger association with patient-reported shoulder pain and function than tear size in patients with full-thickness RTC tears.

- **RTC**
  - “There is little consensus as to the most effective treatment of full thickness tear of the RTC.”


- **Rotator Cuff Rehabilitation**
  - Biopsychosocial Reasons
    - 139 patients with shoulder pain
    - Patients with high pain catastrophizing
    - And low pain self-efficacy were
    - Associated with worse scores on the SPADI
    - Psychosocial factors are associated with patient complaints in shoulder disorders

Havel, M.E., et al. Psychological distress is associated with Greater perceived disability and pain in patients presenting to a shoulder clinic.

Biopsychosocial Reasons

- Elevated fear-avoidance beliefs were associated with poorer improvement in functional status from intake to discharge among people in the following 2 of the 8 shoulder disease categories:
  - 1) muscle, tendon, & soft-tissue disorders
  - 2) osteoarthropathies, chondropathies, & acquires musculoskeletal deformities


- No systematic reviews
- 1 RCT
- Conflicting results and conclusions
Rotator Cuff Rehabilitation

- CONCLUSION:
  - Evidence on the comparative effectiveness and harms of various operative and non-operative treatments for rotator cuff tears is limited and inconclusive.


RTC

- "Instead of being based on scientific rationale, traditionally most rehabilitation protocols are solely based on clinical experience and expert opinion."
  - (LEVEL V EVIDENCE)


RTC Rehabilitation

- Consensus statement to aid clinical decision making during the rehab of patients after arthroscopic RTC repairs.
  - Overarching philosophy of rehab is centered on the principle of the gradual application of controlled stresses to the healing RTC repair with consideration of RTC tear size, tissue quality, and patient variables.


RTC Factors-Trends

- 164 patients
  - Isometric strength: FF, IR, ER
  - Pre-op and post-op of 6, 12, 18, 24 months
  - Muscle strength had slowest recovery in pain relief and the restoration of shoulder function
  - Muscle strength in any direction did not correlate with post-op patient satisfaction
  - Muscle strength is highly correlated with pre-op quality of the muscle


RTC Fallacy 1:

- If we do not start early PROM, then the patient will develop stiffness following RTC repairs...

Rotator Cuff Rehabilitation

- Therefore, we conclude that 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.


RTC-Trends

- 489 arthroscopic RTC repairs
  - Only 5% developed postoperative stiffness

RTC Factors-Trends

- Conclusions:
  - Sling immobilization for 6 weeks after arthroscopic RTC repair does not result in increased stiffness
  - *** Slower rehab may improve the rate of tendon healing


- Systematic Review: Conclusions: 7 articles
  - Incidence of transient stiffness responsive to non-op rehab was 15%
  - Incidence of resistant stiffness that was permanent or required capsular release was 3.3%
  - Resistant postop stiffness was reported in 3.5% of patients with immediate PROM rehab
  - 4.5% of patients with 6-week sling immobilization
  - 0% of patients with a modified protocol


RTC Healing & Stiffness

- Retears are common outcomes of RTC repairs
- Stiffness is not an uncommon outcome of RTC repairs
- N=1533 arthroscopic RTC repair
- Single surgeon
- Likert scale to assess shoulder stiffness by patient
- 6 weeks: ROM
- 12 weeks: partial recovery
- 24 weeks: full recovery
- Shoulders that were stiff before surgery, were more likely to be stiff after surgery (PRE-HAB)


RTC Fallacy 2:

- Early Physical Therapy helps improve the RTC healing response and prevents re-tears...

RTC Factors 2:

- Conclusions: 7 articles
- Arthroscopic RTC repair postop stiffness resistant to non-op management is uncommon despite an initial immobilization period
- With resistant postop stiffness, arthroscopic capsular release can successfully restore ROM
- *** Arthroscopic RTC repair allows a delayed mobilization protocol that may be important in achieving RTC healing.


RTC

- "A large number of factors must be taken into account before implementing a rehabilitation protocol after RTC surgery"
- One of the most important factors a rehabilitation protocol should take into account is the timing of biological healing of bone to tendon or tendon to tendon interface, depending on the type of rupture and repair.


Rotator Cuff Rehabilitation

- "The threshold of fixation strength needed for early motion and RTC healing is unknown."


RTC Factors

- 2 tendon repairs - 40% failure
- Most fail in first 12 weeks
- SS force - 300 N
- IS force - 250 N
- RTC fails at 250 N
- 12 weeks: 25% of strength of tendon
- 26 weeks: 85% of strength of tendon

T. Romeo, ICCUS, Chicago, IL, July, 2014
**RTC**

- Imaging studies reveal defect recurrence in approximately one-third of the tears.
- **RTC** are known for their durability.

**RTC Factors-Trends**

- **LEVEL II RTC**
  - 64 patients with MRI (~8 months) evaluated after arthroscopic **RTC** repairs
  - Aggressive early passive rehab (manual therapy 2x/day & unlimited self-passive stretching exercise)
  - Limited early passive rehab (limited **CPM** exercise and limited self-passive exercise)


**RTC**

- **LEVEL OF EVIDENCE - 1***
  - Results: 3, 6, 12 month FU
  - No significant differences at all time points


**RTC Factors-Trends**

- Aggressive rehab group has 33% increases in ROM, ER, and **ADT** at 6 weeks
- **RTC** with early aggressive rehab: 9%
- **RTC** with early limited rehab: 23%
- **RTC** with early limited rehab: 23%


**RTC**

- **LEVEL OF EVIDENCE - 1***
  - “However, recent approaches show that longer immobilization may enhance tendon healing quality”


**RTC Factors-Trends**

- “A delayed gentle rehabilitation protocol with limits in ROM and exercise times after arthroscopic **RTC** repair would be better for tendon healing without taking any substantial risks”

After Rotator Cuff Repair: A Systematic Review and Meta-Analysis.

AJSM. 44(3): 785--791, 2016

Park, YB, et.al. Reversibility of supraspinatus muscle atrophy in tendon-bone healing after arthroscopic RTC repair. AJSM. 44(4):


Rotator Cuff Rehabilitation

- 28 studies (1,729 repairs)
- Re-tears
- Early rehab: 13.7%; delayed: 10.5% (p=.36)
- For >5 cm tears, the risk of re-tear was greater for early versus delayed PROM for double-row anchor (DA) repairs (56.4% vs 20%, P =.002)


RTC Rehabilitation

- 176 patients; age 56 yo
- Re-tears at 3 months: 9.1%
- Re-tears at 6 months: 3.4%
- Re-tears at 12 months: 2.8%
- Incidence of re-tears was associated with tear size and tendon degeneration
- The "critical period" for healing following RTC repair, during which risks of re-tears are high, extends to the first 6 months


RTC Surgery & Outcomes

- Tear size and thickness were not associated with pain and function
- Fatty infiltration, muscle atrophy, and tendon retraction were also not associated with pain and disability scores
- Factors unrelated to cuff anatomy such as mental health, comorbidities, age, and sex were associated with pain/function


RTC Fallacy 3:

- Early Physical Therapy obviously must be effective in rehabilitation programs...
**RTC**

**LEVEL OF EVIDENCE - 1**

- Conclusion: Early PROM after arthroscopic RTC repair

**DIR NOT guaranteed:**
- Early gain of ROM
- Pain Relief
- or enhance RTC healing and prevent re-tears


**RTC Fallacy 4:**

- Early Physical Therapy obviously must help improve patient outcomes...


**RTC**

- Dynamic joint function is not completely restored by RTC repair, thus compromising shoulder function and leading to long-term disability.
- Strength deficits persisted at 24 months for most patients
- GHJ mechanics and shoulder strength are not fully restored with current RTC repair techniques


**RTC Rehabilitation**

- To reach strength of the uninjured contralateral shoulder in all 3 planes of motion, recovery took:
  - 6 months in patients with small tears
  - 18 months in patients with medium tears
  - Patients with large-to-massive tears showed continuous improvement in strength up to 18 months, however they did not reach strength of the contralateral shoulder at 24 months
- Recommend patients continue rehab beyond one year


**RTC**

- Isokinetic peak torque pre-test values
- The greatest improvement in strength consistently occurred during the first 6 months after surgery
- By using isokinetic strength evaluation, we found that recovery of strength after RTC repair requires at least 1 year of rehabilitation


**RTC**

- Accelerated rehabilitation protocol after RTC repair has been proposed for patients at risk of postoperative stiffness
- MRI showed a significantly lower full-thickness re-tear rate for the DR group than the SR group


**RTC**

- At both 6-month and 2-year follow-up, there was no significant differences in terms of the rate of stiffness
- In selected patients at a high risk of shoulder stiffness and therefore necessitating accelerated postoperative rehabilitation, DR repair of the RTC could lower re-tear rates


**RTC Rehabilitation**

- LOE - 1
- MRA had a significantly lower full-thickness re-tear rate for the DR than for the SR group (8% vs 24%).
- In selected patients at a high risk of shoulder stiffness and necessitating accelerated post-op rehab, DR repair of the RTC could lower re-tear rates.


**RTC**

- 433 patients
- Patient expressions regarding physical therapy as the strongest predictor of surgery
- Patients decision to undergo surgery is influenced more by low expectations regarding the effectiveness of physical therapy than by patient symptoms or anatomic features of the RTC tear.


RTC

- Clinical Practice Guidelines by the AAOS, 12/4/10: 31 recommendations
- 19-inconclusive because of absence of definitive evidence
- 4 – moderate grade
- 6 – weak grade
- 2 – consensus statement of expert opinion (Level V)


RTC Rehab

- **Post-Operative Rehabilitation - Range of Motion Exercises**
  - 13. b. We cannot recommend for or against a specific time frame of shoulder immobilization without range of motion exercises after rotator cuff repair.
  - **Strength of Recommendation:** Inconclusive

RTC Rehab

- **Post-Operative Rehabilitation - Active Resistance Exercises**
  - 13. c. We cannot recommend for or against a specific time interval prior to initiation of active resistance exercises after rotator cuff repair.
  - **Strength of Recommendation:** Inconclusive

RTC Rehab

- The purpose of study was to determine common clinical practices among experts regarding RTC-R and to assist them in counseling patients.
- We surveyed 372 members of ASES and the Association of Clinical Elbow and Shoulder Surgeons (ACCESS)
- A consensus response (>50% agreement) was achieved on 49% (24 of 49) of the questions.
- Variability in responses likely reflects the fact that clinical practices have evolved over time based on clinical experience.


Rotator Cuff Rehabilitation

- SF-36 Mental Component Summary (SF-36 MCS)
- The SF-36 MCS had the strongest correlation with the analog scale for shoulder pain
- Patient mental health may play an influential role in patient-reported pain and function in patients with full-thickness RTC tears

Rotator Cuff Rehabilitation

- Perhaps we need to change the Rehabilitation program to alter the outcomes.

RTC Rehabilitation-Trends

- Past studies have shown ~75% of patients following a RTC repair will "technically fail" when defined as the RTC is not intact again after surgery.
- Despite these "failure rates", most research studies have shown that patient satisfaction after surgery is still very high.
- This means the rehabilitation process may be far more important than the actual surgery.

Summary And Conclusions

Congratulations And Thanks To SPTS

THANK YOU

Continue the87Discursive Debate.