Rehab Following Arthroscopic Cuff Repair

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Disclosures

- No Conflicts regarding content of this talk
Outline

- Biology of Healing
- Factors Affecting Healing
  - Surgical
  - Patient
- Early Accelerated Vs Delayed Rehabilitation
Biology of Healing

- Histology Native Tendon to Bone - 4-Zone Transition
  - Tendon
  - Fibrocartilage
  - Calcified Fibrocartilage
  - Bone

Rodeo SA. Biologic augmentation of rotator cuff tendon repair. JSES 2007
Biology of Healing

- Repair Tendon to Bone - 3-Zone Transition
  - Tendon
  - Fibrovascular Scar
  - Bone

Rodeo SA. Biologic augmentation of rotator cuff tendon repair. JSES 2007
Phases of Healing

- Inflammatory
- Proliferative
- Remodeling
Inflammatory Phase

- Up to approximately 10-14 days
  - Platelets form clot release cytokines, Macrophages phagocytize necrotic tissue and release cytokines
  - Lymphocytes, fibroblasts and other cells recruited
  - Ratio of Cells to tissue is high
  - Cytokines
    - TGF-β, ILs, BMPs, IGFs, VEGFs, PDGFs
    - Necessary to allow for organized collagen production
    - Augmentation (PRP, cytokine modulation, etc)
  - NSAIDS- inhibit healing
    - Rat Cuff Model Tendon-Bone Cohen et al. AJSM 2006
    - Human spinal fusion Glassman Spine 1998
Proliferative Phase

- Several weeks after repair
- Recruited cells
  - Fibroblasts and Tenocytes
  - Stimulation from cytokines begin to make Type III collagen
  - Change in proportion of cellular tissues to fibrous tissues (granulation tissue)
Remodeling Phase

- Months after repair
- Increased organization of fibrous tissue
- Reactive Scar
- Increased proportion of Type I collagen compared to Type III
Healing Time

- Most studies animal studies (sheep, goat, dog, rabbit)
  - Gerber C, JBJS-Am 1999 Sheep 6 wks-30%, 3 mon-52%, 6 mon-81%
  - St Pierre P, JBJS-Am Goat, Miyahara Dog, Uhtoff Rabbit
- Animals are not humans, different anatomy and physiology (rabbit study- spontaneous healing Hirose K, Arch Ortho Trauma Surg 2004 vs Yamaguchi US studies no spontaneous healing JSES 2001)
- Load to failure after repair (compared to normal tendon)
  - 6 weeks+ to 50% healing
  - 3-6 months 80% healing
Factors Affecting Healing

**Surgical**
- Identify Tear Type/Orientation
- Appropriate tension
- Knot vs Knotless
- Single vs Double Row Repair
  - Double Row biomechanically superior
    - Meier Arthroscopy 2006, Ma JBJS-Am 2006
  - Higher load to failure in double row rabbit model at 8 wks
    - Ozbaydar JBJS-Br 2008
  - Double row lower retear rate (14.2%/25.9%) but no difference in outcomes
    - Millet PJ, JSES 2014 (Meta-analysis of 7 RCTs)
Factors Affecting Healing

- **Patient Factors**
  - Age
  - Size of tear
  - Age of tear
  - Smoking
  - Diabetes
  - Bone quality
  - Tissue quality
  - Social factors
  - Medications
Principles of Postoperative Rehabilitation

- Control pain
- Protect repaired tissue
- Restore Function
  - Priority #1 - Motion
  - Priority #2 - Strength
The Goal of Rehabilitation

- Allow for healing while preventing stiffness
The Paradox

- Managing healing vs stiffness
- If immobilized too long - adhesive capsulitis
- If mobilized too early - failure of repair
Early mobilization

- Studies of other tissues show improved biomechanical and healing properties in tissues that are mobilized early with improved collagen orientation
  - Achilles (Palmes J Ortho Res 2002)
  - Flexor tendon repair
  - Bone

- Studies of the rotator cuff have not had similar findings...
Early vs Delayed Rehabilitation

Animal Studies (Rat Model)

- Improved collagen structure, viscoelastic prop with immobilization (Thomopolous J Biomech Eng 2003)
- Improved strength, collagen organization with 16 wks immobilization, 4 wks immobilization less collagen organization (Soslowksy J Biomech Eng 2007)
- No difference in ROM with 4 wks immobilization vs immediate ROM (Sarver JSES 2008)
Early vs Delayed Rehabilitation

- Human Studies
  - Commonly based on older repair techniques and implants
  - Commonly based on open or mini-open repair
  - Increase incidence of pain and stiffness
Early vs Delayed Rehabilitation

- **Postop ROM/Stiffness following arthroscopic RCR**
  - Systematic Review Denard, Burkhart Arthroscopy 2011
    - Adhesive capsulitis requiring Capsular release - 3%
      - With immediate PROM - 1.5%
      - With 6 wks immobilization - 4.5%
      - Capsular release effective treatment
  
- **Level 1 RCT Kim et al AJSM 2012**
  - 105 small/medium RCR Early PROM vs Abduction sling 4 wks
    - No difference in ROM, VAS, Functional outcomes
    - No difference in failure rates
Early vs Delayed Rehabilitation

- **Level 1 RCT Cuff DJ et al JSES 2012**
  - 68 pts full thickness supra tear with TOE repair, min 1 yr f/u
  - Immediate PROM vs 6 wks delayed ROM
  - No difference in pt satisfaction or ROM
  - Similar ASES and SST scores
  - Healing rates Immediate PROM – 85% vs Delayed – 91%

- **Level 2 RCT Lee BG Arthroscopy 2012**
  - Aggressive manual PTc PROM vs Self PROM program
  - ROM at 1 yr similar
  - Retear rate: Aggressive Manual PT – 23% vs Self PROM 8%
So should we change our practice?

- Well....maybe not just yet......
- Study limitations
  - Confounding Variables
    - Pre-operative ROM and medical comorbidities (ie. DM)
    - Tear size and classification
    - Repair type – SR vs. DR vs. TO vs. TOE
    - Associated procedures (ie. AC resection – open vs. scope, SAD, Biceps tenotomy vs. tenodesis)
    - Compliance with rehab protocol
Conclusions

- Currently we cannot force healing to occur faster either by surgeon/therapist technique or patient will power.
- Biology of healing limits our activity at all times in recovery.
- Better controlled trials are needed comparing both repair techniques and rehab protocols.
- All rehab should be individualized based on surgical findings/techniques and patient specific factors.
- When in doubt it appears by the current evidence that immobilization is safe.
My Protocol

- In continual evolution
- "Small" Tears
  - Sling 3 wks
  - ROM hand, wrist, elbow, immediate
  - Pendulums, PROM
- "Large" Tears
  - Sling 6 wks
  - ROM hand, wrist, elbow immediate
  - Pendulums, PROM 6 wks
  - AROM 8 wks
  - Resistance 12 wks
Thank you!