Background: Arthroscopic rotator cuff repair (ARCR) is a useful surgical procedure for rotator cuff tears. However, clinical outcomes and shoulder muscle strength are impaired when retears occur after surgery. Recently, superior capsule reconstruction for reinforcement of arthroscopic rotator cuff repair (SCRR) has been introduced to prevent retear after ARCR for degenerated rotator cuff tears. However, it remains unclear how much shoulder muscle strength recover after SCRR. The objective of this study was to investigate the changes in shoulder muscle strength after SCRR in patients with reparable but degenerated rotator cuff tears.

Methods: We retrospectively studied twenty patients (mean age of 68.2 years) with degenerated rotator cuff tears (19 medium and one large tears, the Goutallier grade of the supraspinatus was 2–3) who underwent SCRR using an autograft of fascia lata. Shoulder muscle strength, Japanese Orthopaedic Association (JOA) score, and shoulder pain using Visual Analog Scale (VAS) were evaluated before and at the final follow-up (mean, 23.3 months; range, 12–62 months). Shoulder muscle strength in abduction (at full-can position) and at 90 degrees of shoulder abduction position), external and internal rotation at side were measured using digital handheld dynamometer (microFETII; Hoggan Scientific). Muscle strength in the affected shoulder was calculated as a percentage of that in the asymptomatic contralateral shoulder. The postoperative cuff integrity was evaluated by magnetic resonance imaging or ultrasound. Results: In this study, all 20 patients had no retear at the final follow-up. All shoulder muscle strengths significantly increased after SCRR (abduction strength at full-can position, 46% preoperatively to 87% postoperatively; at 90 degrees of shoulder abduction position, 31% to 88%; external rotation strength, 50% to 86%; and internal rotation, 85% to 105%, all P<0.0001). JOA score was significantly improved after SCRR (62.5±10.7 points preoperatively to 92.0±6.3 points postoperatively, P<0.0001). VAS score for shoulder pain was significantly decreased after SCRR (at rest: 15.5mm preoperatively to 0.2mm postoperatively, during motion: 58.5mm to 8.1mm, both P<0.0001). Conclusions: SCRR prevented postoperative retear of the repaired rotator cuff tendon even in cases with severely degeneration tendon. SCRR provided a significant pain relief and shoulder muscle strength returned to 86 to 105% of the uninjured contralateral side after SCRR.

Category: Shoulder - Rotator Cuff

Ultrasound Detects Increased Vascularity Following Rotator Cuff Tears Compared to Asymptomatic and Repaired Rotator Cuff Tendons

Abstract ID# 22835
All Authors:
Maria E Dey Hazra MD, Dr. med. GERMANY
Rony-Orijit Dey Hazra MD, Dr.med. UNITED STATES
Amelia R Kruse BS UNITED STATES
Lauren E Watkins PhD UNITED STATES
Peter J. Millett MD, MSc UNITED STATES

Summary:
Ultrasound examination provides a low-risk method of examining microvascular changes seen in tendons after injury and during recovery. This study investigates the potential for utilization in future treatment and recovery monitoring.

Data:
INTRODUCTION: Tears to the rotator cuff tendons are among the most common clinical tendon complications in the aging population [1]. Tendons are dense, highly organized, and relatively avascular tissues; however, tendon structural integrity and vascularity decrease with age and may be related to increased injury risk with age [1-3]. Further, tendon vascularity may change in the presence of tendon pathology consistent with acute inflammatory and healing processes such as in response to rotator cuff tears [4,5]. The aim of this study is to examine the microvascularature of the supraspinatus tendon (SSP) and long head of the biceps tendon (LHBT) using an ultrasound technique for superb microvascular imaging (SMI) in asymptomatic, torn, and repaired rotator cuff tendons. METHODS: This prospective study was approved by the institutional IRB and included 18 volunteers with asymptomatic shoulders (55 ± 18 y BMI 22.6± 3.0 kg/m2, 7 males), 6 with an unrepaired rotator cuff tear involving the SSP (64 ± 3 y, BMI 24.6 ± 4.1 kg/m2, 5 males, mean 28 months since tear), and 6 who had undergone a rotator cuff repair and biceps tenodesis surgery at least 4 months prior (57 ± 10 y, BMI 25.5± 1.5 kg/m2, 5 males, mean 7 months since repair). An ultrasound examination was performed using an Aploio i800 system and an 18LXLS linear array transducer (PLI-1205SBX/FS, Canon Medical Systems, Inc.). Two orthopedic surgeons with 6 years of experience with musculoskeletal ultrasonography measured microvasculature in the SSP and proximal LHBT with the SMI mode. The area of the vascular signal (cm2) within the tendons was recorded in both transverse and longitudinal orientations. Correlations between tendon vascular signal and age were assessed for asymptomatic subjects using a Pearson’s correlation coefficient. Differences between asymptomatic, tear, and repair cohorts and between readers were compared using a two-way ANOVA statistical test with a Tukey post-hoc analysis. RESULTS: There was significantly greater vascular signal in the longitudinal direction of torn supraspinatus (p=0.036, Figures 1 and 2) and biceps tendons (p=0.002, Figure 1) compared to asymptomatic and post-operative tendons. There were no differences between groups when vascularity was measured in the transverse direction (PSP=0.728, biceps p=0.264). Correlations could not be found between the age of asymptomatic participants and the vascular signal within the SSP (R = 0.1732, p = 0.5063) and LHBT (R = 0.3594, p = 0.1566) in the longitudinal direction, nor in the transverse direction for the SSP (R = -0.2903, p = 0.2583) or LHBT (R = 0.2498, p = 0.3335). DISCUSSION: There was minimal vascular signal within asymptomatic tendons. The vascularity signal increased in individuals with unrepaired SSP tears. Approximately 4-8 months following SSP repair and biceps tenodesis, tendon vascularity was not significantly different from asymptomatic tendons. Overall, results suggest that ultrasound techniques that evaluate tendon microvasculature in the absence of contrast agents may represent a low-risk and reliable method to monitor rotator cuff tendons following injury and during recovery. Further investigation will examine if the increased vascularity in the torn state could be a potential target for medication to increase healing rates. SIGNIFICANCE/ RELEVANCE: Ultrasound examination provides a low-risk method of examining microvascular changes seen in tendons after injury and during recovery. This study investigates the potential for utilization in future treatment and recovery monitoring.

Category: Shoulder - Rotator Cuff

Outcome Comparison Between Arthroscopic Repair Of Full-Thickness Rotator Cuff Tear In Workers’ Compensation And Non-Workers’ Compensation Patients: Special Counseling Is Required

Abstract ID# 23319
All Authors:
Mark David Haber MBBS, FRACS AUSTRALIA
Andres Eduardo Rodriguez Borgonovo MD AUSTRALIA

Summary:
WC patients are on average 8 years younger than non-WC patients but have lower clinical outcomes scores at week 26 compared with non-WC patients. Paradoxically however, WC patients have better healing with inferior retear rates and therefore, it is speculated, a better long-term prognosis. This result is helpful in the counselling of these patients and the formation of rehabilitation plans.

Data:
Introduction: Rotator cuff tears (RCTs) are significantly more common in manual workers referred to as workers’ compensation patients (WC), especially those involved in repetitive overarm lifting compared to the general population. RCTs are therefore a burden on the health care system as well as the manual workers, who are cared for under the WC insurance. The purpose of this study was to compare the functional outcome and retear rate of arthroscopic repair of full-thickness rotator cuff tear (FTRCT) in WC compared to non-WC patients. Methods: A total of 301 patients with FTRCT were included. 243 non-WC patients and 58 WC patients that required an arthroscopic rotator cuff repair between 2012 and 2020 with completed serial ultrasound examinations at weeks 6, 12, and 26 post-operatively were included. The time point for examination of cuff integrity was six months, based on the rotator cuff repair healing studies. Functional clinical scores were assessed by Constant score, Western Ontario Rotator Cuff Index (WORC), and Oxford score. Details were retrieved from the Socrates Orthopaedic Outcomes Software database. Surgical procedures were performed by the same experienced senior surgeon (MH). All patients had undergone an arthroscopic suture bridge repair technique. Results: Statistically, a significant difference was observed between the mean age of patients. 63 years ± 8.28 for the non-WC group and 55 years ± 7.52 for the WC group (p<0.001). No differences in the grade of tendinopathy were observed between both groups. Clinical outcomes were significantly improved at week 26 of all three scores (p<0.05) compared to preoperative scores in both groups. WC patients have statistically significant inferior Total Oxford Scores and WORC Total score preoperatively, at week 12 and at week 26 compared with non-WC patients (p<0.05). No differences between preoperatively Constant Scores were observed between both groups. Although subjective Constant score was statistically significantly lower in the WC group (15.69±7.5 vs 18.51±6.5 p<0.05). The Constant score at week 26 reflected statistically

All Authors:
significant differences with lower scores for the WC group (61.9 ± 18.5 vs 66.5 ± 16.3 p = 0.01). However, the WC group has a significantly inferior complete retear rate at week 12 (1.7% vs 5.8%) and at week 26 (1.7% vs 7.8%, p < 0.05). No differences in retear rate were found at week 6. Conclusion: These results demonstrate that WC patients are on average 8 years younger than non-WC patients, suggesting that manual labour is a substantial contributing factor to RCTs. WC patients have lower outcomes, at week 12 and at week 26 compared with non-WC patients. However, paradoxically, our study showed that WC patients have better healing with inferior retear rates and therefore, it is speculated, that a better long-term prognosis. Better healing may be in part because they are reluctant to push their rehabilitation due to greater pain, and their younger age. Short-term clinical outcomes of WC patients have worse results than those who don’t have a WC claim. This result is helpful in the counseling of these patients and the formation of rehabilitation plans.

Category: Shoulder - Rotator Cuff

Severe Attrition and Poor Satisfaction in Patients Undergoing Tele-Rehabilitation Versus Standard In-Office Rehabilitation After Arthroscopic Rotator Cuff Repair and ACL Reconstructions: Randomized Controlled Trials that Required Cessation

Abstract ID# 23428
All Authors:
Kinjal Vasavada BA UNITED STATES
Eric Jason Straus MD
Laith M. Jazrawi MD UNITED STATES
Kirk Anthony Campbell MD UNITED STATES
Dhruv S Shankar BS UNITED STATES
Amanda Avila MPH UNITED STATES
Edward Stephen Mojica BS UNITED STATES
Eoghan T. Hurley MB, BCH, MCh IRELAND
Kevin Lehane D.O. UNITED STATES
Spencer M. Stein MD UNITED STATES
Guillem Gonzalez-Lomas MD UNITED STATES
Michael J Ajala MD UNITED STATES

Summary:
Though overall satisfaction with both modalities was high, patients preferred in-person rehabilitation to telerehabilitation after undergoing ACLR and ARCR, as evidenced by nearly ubiquitous crossover from telerehabilitation to in-person rehabilitation in both studies.

Data:
BACKGROUND: The use of telerehabilitation after sports medicine procedures such as arthroscopic rotator cuff repair (ARCR) and anterior cruciate ligament reconstruction (ACLR) has rapidly increased in recent years; however, functional outcomes and patient satisfaction after telerehabilitation compared to in-person rehabilitation remain unclear. We hypothesized that functional outcomes and patient satisfaction would not differ significantly between the rehabilitation modalities.
METHODS: Two separate randomized-controlled trials were conducted involving patients scheduled to undergo ARCR or ACLR by one of six fellowship-trained sports medicine surgeons between October 2020 and November 2021. Initially 60 patients were included in each arm of the trial. Patients were randomized to receive telerehabilitation or in-person rehabilitation for their post-operative course. International Knee Documentation Committee Subjective Knee Form (IKDC) scores (for ACLR), the American Shoulder & Elbow Surgeons (ASES) score (for ARCR), and satisfaction metrics were collected at timepoints of baseline and at each post-operative visit. Baseline characteristics and outcomes between the in-person and telerehabilitation arms of each cohort were compared using Mann Whitney U-test for continuous variables and Fisher’s exact test for categorical variables. P-values less than 0.05 were considered significant.
RESULTS: In total, 16 ACLR patients were enrolled, of whom 10 (62.5%) were assigned to in-person rehabilitation and 6 (37.5%) to telerehabilitation. Additionally, 32 ARCR patients were enrolled of whom 20 (62.5%) were assigned to in-person rehabilitation and 12 (37.5%) were assigned to tele-rehabilitation. In both trials combined, of the 30 patients initially assigned to in-person rehabilitation, 24 (80%) completed the final follow-up survey and none reported crossover to telerehabilitation. Of the 18 patients initially assigned to telerehabilitation, 12 (67%) completed the final follow-up survey. Of these 12 patients, 11 (92%) reported crossover; 9 patients completed in-person rehabilitation and 2 patients completed hybrid in-person and tele-rehabilitation. CONCLUSIONS: Though overall satisfaction with both modalities was high, patients preferred in-person rehabilitation to telerehabilitation after undergoing ACLR and ARCR as evidenced by nearly ubiquitous crossover from telerehabilitation to in-person rehabilitation in both studies. However, a hybrid model combining in-person and tele-visits may be acceptable to most patients. This study provides evidence that patients exhibit a strong preference for in-person rehabilitation programs versus telerehabilitation programs after ACLR and ARCR procedures.

However, feedback from patients suggests that most would be amenable to a hybrid model combining both modalities, although further exploration is needed.

Category: Shoulder - Rotator Cuff

Improving Tendon-To-Bone Healing by Tendon Inversion: Using a Rat Biceps Tenodesis Model

Abstract ID# 23591
All Authors:
Dustin Craig Buller MD UNITED STATES
Ting Cong MD UNITED STATES
Varun Arvind BS UNITED STATES
Thomas Morgan Li BA UNITED STATES
Harrison Ferlauto MD UNITED STATES
Philip Nasser MSME, MSEI UNITED STATES
Paul J. Cagle MD UNITED STATES
Michael Hausman UNITED STATES

Summary:
This animal study observes the effect of “inverse tubularization” on tendon-to-bone healing in a rat biceps tenodesis model, demonstrating improved healing in the experimental group via 1) an increased pull-out strength with biomechanical testing and 2) increased direct fascicular healing to bone on histology.

Data:
Introduction: Tendon-to-bone repair (surgical tenodesis) is an imperfect science. Bone tunnel tenodesis is at risk for graft pull-out, re-repair, and tunnel widening. In this study, we hypothesized that inside-out tendon inversion, whereby the epitendon is longitudinally incised and inverted, may improve bone tunnel healing by obviating epitenon lubrication interference at the tendon-bone interface. Tendon inversion also permits exposure of intra-tendinous fascicles to the healing interface, which may improve healing strength by enabling direct fascicular healing against the bone tunnel walls. Methods: 40 adult Sprague-Dawley rats underwent supraperiosteal long head of biceps (LHB) tenodesis of the shoulder. 20 underwent tendon inversion (inversion group) and 20 did not (control group). The tendon is fixed by suspensory fixation in a bicortical bone tunnel using a 1.6mm microvascular clip. All animals were permitted ad lib cage activity until 8-week sacrifice. 14 animals from each group underwent biomechanical testing, and 6 underwent paraffin embedding for histology and immunohistochemistry. Biomechanics: All specimens were frozen in −80°C for one freeze-thaw cycle prior to specimen preparation for biomechanical testing. Musculature was removed from an otherwise intact humerus except for the tenodesed LHB. The humerus wasotted in 1 inch copper tubing with Bondo. Specimens were kept moist at all times using 1x phosphate buffered saline. The tendon was mounted in a 320-grit sandpaper sandwich with Krazy Glue. The specimens were mounted in an Instron 8872 materials testing system (Instron, Norwood, MA) with a 50N load cell for pull-to-failure testing. All specimens were preconditioned to 1N prior to initiation of testing. Peak failure forces are recorded and averaged. Failure mode was recorded. Results: All 40 animals successfully underwent surgery. There were no surgical complications. For biomechanical testing, it was apparent on specimen preparation that two tendon inversion specimens had an early tendon failure leading to a popye deformity. One control group specimen had uncharacteristic adhesion formation to the pectoralis insertion which interfered with failure testing. These three specimens were excluded from analysis. Biomechanics: The inversion group demonstrated a failure force of 10.97 ± 2.90 N, versus control at 8.61 ± 1.76N (p = 0.0247). Interestingly, by failure mode, there were 5 tendon pullouts in the inversion group, versus 2 tendon pullouts in the control group, as opposed to surface or midsubstance failures, though this difference was not statistically significant by Chi-square testing (p = 0.14). Histology and immunohistochemistry: H&E histology demonstrated evidence of direct intra-tendinous fascicular healing against the bone tunnel walls, with evidence of formation of Sharpey fibers, mechanically oriented fibril insertion into bone, and possible layered transitional tissues reminiscent of native entheses. Conclusions: Using a rat biceps tenodesis model, we have demonstrated that longitudinal, inside-out tendon inversion (inverse tubularization) may improve tendon-to-bone healing in a bone tunnel. This work may inform future improvements in surgical techniques for tendon-to-bone fixation.